EIGHTY-FIFTH

ANNUAL REPORT

OF THE

CHIEF ENGINEER

OF THE

Philadelphia Water Department

FOR THE YEAR

1886.

PHILADELPHIA:
DUNLAP & CLARKE, PRINTERS AND BINDERS, 819-21 FILBERT STREET.
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JOINT STANDING COMMITTEE ON WATER,

For the year commencing the First Monday in April, 1886.

Select Council.	Common Council.
THOMAS GREEN (*Chairman*),	E. A. ANDERSON,
J. B. ANDERSON,	JOHN L. BALDWIN,
ALBERT A. ARDIS, SR.,	JOHN BARDSLEY,
JAMES A. FREEMAN,	C. P. CARMANY,
JOHN H. GRAHAM,	W. R. CLARIDGE, JR.,
SAMUEL HART,	THOMAS FIRTH,
A. ELLWOOD JONES,	THOMAS L. HICKS,
HENRY JOHNSON,	WILLIAM HOLEMAN,
WILLIAM MOFFET,	J. FRED. LOEBLE,
THOMAS J. RYAN,	WILLIAM C. MACKIE,
WILLIAM THORNTON,	JAMES MORAN,
JOSEPH B. VAN DUSEN.	WILLIAM M. SMITH.

EX-OFFICIO.

JAMES R. GATES, *President of Select Council.*	CHARLES LAWRENCE, *President of Common Council.*

OFFICERS OF THE WATER DEPARTMENT.

CHIEF ENGINEER,

JOHN L. OGDEN.

Assistant Engineers.

ALLEN J. FULLER, WILLIAM WHITBY.

Draughtsmen,

John E. Codman, Arthur Marichal, James G. Davis.

Chief Clerk—JOB T. HICKMAN.
Assistant Clerks—J. G. Dixon, Kennedy McNeal.
Correspondence Clerk—P. de Haven.
Search Clerk—Thomas Spence.
Assistant Search Clerk—W. H. Poulson.
Assistant Clerk—H. J. Johnson.
Time Clerk—William J. Innes.
Pipe Inspector—Theo. S. S. Baker.
Messenger—Haines Lewis.

Telephone Operators.

Mattie Whittingham, Calvin Craner.

General Superintendent.

FRANK L. HAND.

Clerk to General Superintendent—John A. Hayes.
Assistant Clerk to General Superintendent—John B. Wright.

Engineers at Pumping Stations.

FAIRMOUNT—*First Engineer*, William H. Cubbler.
Second Engineer, John W. Bronson.

SPRING GARDEN—*Engineers*, David Pyke, H. A. Gideon, Abram Stott, John L. McGinnis.

Telephone Operator—Fannie Shields.

BELMONT—*Engineers*, William Kiner, Thomas Sedden.

ROXBOROUGH—*Engineers*, Joshua Bartley, Lewis Culp.

Mount Airy—*Engineers*, Archibald Weir, William Fletcher.

Chestnut Hill—*Engineer*, James McClenahan.

Frankford—*Engineer*, Chas. Douglass.

Kensington—*Oilers*, Peter J. Tuttle, William Maxwell.

Works General.

Foreman Carpenter—Henry Guest.
Foreman Bricklayer—Frank A. Mooney.
Foreman Stonemason—Crawford Lukens.
Foreman Rigger—James Forrest.
Foreman Painter—Charles Ravenor.
Foreman Laborer—Matthew J. Richmond.
General Storekeeper—S. C. Buchanan.

Superintendent of Shop—W. F. Courtney.
Clerk to Superintendent of Shop—John M. Curtis.

PURVEYORS.

First District, John H. Holmes.
Clerk, Wm. J. Mackey.
General Foreman, James Humes. *Foreman of Repairs*, W. W. Wellington.
Office, 1120 Wharton street.

Second District, David A. Craig.
General Foreman, Michael Young. *Foreman of Repairs*, Joseph Bryan.
Office, 918 Cherry street.

Third District, Charles J. Lowry.
Clerk, J. A. Spanagle.
General Foreman, Elias Abrams. *Foreman of Repairs*, Wm. Magee.
Office, 1420 Frankford avenue.

Fourth District, John Montgomery.
Clerk, Arthur B. Cook.
General Foremen, Geo. W. Showaker, James H. Forbes.
Foreman of Repairs, Jas. Hutchinson.
Office, Twenty-sixth and Master.

Fifth District, Henry Dawson.
Clerk, F. J. Cornman. *General Foreman*, Charles Frank.
Office, Lyceum Building, Roxborough.

Sixth District, David B. Morrell.
Clerk, Jonathan Bonsall. *General Foreman*, Edw. Homan.
Office, Town Hall, Germantown.

REGISTRAR'S OFFICE.

Registrar.

A. NEWLIN KEITHLER,

Registrar's Chief Clerk—E. S. Higbee.

Cashier—John F. Scheidt. *Permit Clerk*—Thos. Orr.

Assistant Permit Clerk—Chas. H. Russell.

Registering Clerk—A. Buckheister.

Assistant Registering Clerk—George B. Bunn.

Entry Clerks—Geo. S. Macauley, Chas. D. Birney.

Bill Clerk—William J. Halliday.

General Clerks.

John M. Stacker,	F. S. Harrison,	C. E. Anspach,
Henry R. Wildey,	John Caldwell,	J. L. Hamill.

Chief Inspector—William Hasson.

Inspectors.

Edward D. Thomas,	W. H. Thomas,	William Erwin,
James H. Graham,	William Rittenhouse,	Alex. McConnell,
Albert C. Weaver,	E. M. Rowe,	John Van Dusen,
James Buchanan,	William A. Agnew,	Louis Obermiller,
W. L. Kensil,	James Cameron,	John Simon,
Henry Homiller,	Thomas S. Flanagan,	Theo. Yeager,
	George Crooks,	

Messenger—Thomas J. Lister.

REPORT.

PHILADELPHIA WATER DEPARTMENT,

February 1, 1887.

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

GENTLEMEN:—The following Eighty-fifth Annual Report of this Department is respectfully presented for your consideration:

RECEIPTS.

Water Rents	$1,637,296 69
Fractional Rents	97,219 62
Delinquent Rents	15,049 50
Penalties	23,342 31
Water-pipe Frontage	122,743 91
Searches	2,960 00
Chief Engineer's Office	10,121 36
Total	$1,908,733 39

This is $101,562.58 above the revenue of last year. The principal increase has been in water rents—$70,264.75—and in the receipts from water-pipes—$30,561.73.

Of the water-pipe frontage claims referred to the City Solicitor for collection $24,594.95 have been received by him. If this amount be added to the receipts of the Registrar, the total for which this Department should receive credit would be $1,933,328.34.

The expenditures for the year 1886, excluding the special appropriation for extensions, were $565,423.39, and the revenue over expenditures would therefore be $1,367,904.95.

Eighty-five per cent. of the regular charges against charitable institutions are remitted by ordinance of Councils, and water is furnished free to buildings and grounds belonging to the city. At regular rates the assessments for water supplied for these purposes would amount to $56,236.69, as follows:

Fire Stations	$674 00
Police Stations	1,711 50
Public Schools	5,825 00
Public Buildings	7,515 00
Fairmount Park	18,104 24
Charitable Institutions (85 per cent.)	22,406 95

The delinquents amount to $188,509.15, of which $158,930.90 is uncollectible on account of the premises represented not being supplied with water.

An Ordinance provides that all dwellings in front of which water-pipes are laid shall be assessed at the same rate as is charged where water is introduced, provided that the owners cannot show that the said properties obtain water from other sources than the Water Department. The uncollectible delinquents are properties of this kind; they are supplied from pumps on the premises, in consequence of which the greater portion, if not all, of this amount will be taken off the books by affidavit when attachments are applied for.

The collectible delinquents, amounting to $29,578.25, are for properties having water attachments, but on account of being unoccupied, or for other causes, the shutting of the water therefrom has not compelled payment.

Of the above $18,887.25 only is for the year 1886, the balance being for previous years.

The water-rents collected for 1886 amount to	$1,637,296 69
Uncollected	18,887 25
Total	$1,656,183 94

Showing the delinquents for the current year to be but little more than one per cent. of the entire amount collectible.

In addition to the $122,743.91 received for pipe-frontage claims there still remain on file other claims for pipe laid amounting to $18,475.45, the time allowed for the payment thereof not having expired.

Unpaid claims amounting to $38,935.59 have been referred to the City Solicitor for collection.

For an itemized account of receipts see report of Registrar. (Appendix A.)

Revenues for ten years, 1877 to 1886, inclusive.

Year.	Delinquent Water Rents.	Delinquent Penalties.	Water Rents.	Penalties.	Fractional Rents.	Water-pipe.	Searches.	Chief Engineer's Office.	City Solicitor's Office.	Totals.
1877	$62,104 75	$7,957 45	$1,008,248 60	$16,309 65	$53,470 48	$73,253 88	....	$6,636 29	$56,233 57	$1,284,214 67
1878	136,123 93	19,759 24	1,085,838 41	25,915 19	49,391 90	55,631 89	....	3,871 49	40,113 80	1,416,645 85
1879	118,234 15	17,439 86	1,186,001 69	22,931 31	40,516 70	31,235 92	....	2,819 94	46,445 94	1,465,625 01
1880	112,728 37	16,783 11	1,218,925 66	19,002 35	48,038 07	26,077 90	....	4,786 07	38,015 53	1,484,357 06
1881	84,591 40	12,627 66	1,256,662 00	19,234 38	53,451 56	47,489 11	....	5,549 01	29,936 22	1,509,541 34
1882	78,543 01	11,479 18	1,295,419 87	18,016 23	49,529 90	34,979 52	....	7,515 88	21,421 05	1,516,904 64
1883	69,995 84	10,310 00	1,380,882 17	23,280 44	67,088 10	45,853 09	....	8,515 11	21,144 41	1,627,069 16
1884	19,837 72	2,492 97	1,566,027 57	22,797 76	77,557 40	71,542 00	$461 50	10,670 89	21,098 20	1,792,486 01
1885	11,267 25	1,561 03	1,567,031 94	22,298 78	101,643 88	92,182 18	1,988 75	9,197 00	18,993 23	1,826,164 04
1886	15,049 50	1,964 42	1,637,296 69	21,377 89	97,219 62	122,743 91	2,960 00	10,121 36	24,594 95	1,933,328 34

Appropriations and Expenditures.

Appropriation, December 30, 1885.		Amount appropria'd.	Amount expended.	Amount merging.	Amount not merging
Items.					
1. Salaries:					
Office Chief Engineer.........	$59,498	....	$57,527 71		
Office Registrar..................	37,160	....	36,900 26		
Fairmount pumping station	5,600	....	5,589 91		
Spring Garden pumping station..........................	23,860	....	23,154 20		
Belmont pumping station...	10,800	....	10,244 63		
Roxborough pumping station................................	8,320	....	7,320 00		
Mount Airy pumping station................................	2,970	....	2,970 00		
Chestnut Hill pumping station................................	1,410	....	1,410 00		
Frankford pumping station.	3,925	....	3,925 00		
Kensington pumping station.............................	1,620	....	1,431 00		
Works, general..................	19,295	....	19,295 00		
	$174,458				
Transfers:					
Twice-paid water rents............... $498 83					
Twice-paid water rents............... 2,608 39					
To Item 7.......... 1,000 00	$4,107 22	$170,350 78	$169,767 71	$583 07	
2. Regular supplies, including fuel, oil, and small stores....................		100,000 00	99,935 77	64 23	
3. Repairs to machinery and conveyance of workmen incident thereto: *Provided*, That the Controller countersign warrants on this item for bills for 1885..	$50,000 00				
Transfer to Item 4...........	5,000 00	45,000 00	44,927 00	73 00	
4. Maintenance and repairs to buildings, grounds, and reservoirs,	$35,000 00				
Transfer from Item 3......	5,000 00	40,000 00	39,962 05	37 95	
5. Maintenance and improvement of the distribution, including purchase of material and cost of labor connected therewith, which shall include paving over water-pipe..		135,000 00	134,989 95	10 05	
6. Supplies and labor at city repair shop...........................	$50,000 00				
Transfer to Item 7.........	1,000 00	49,000 00	48,855 68	144 32	
7. General, incidental, and contingent expenses, including $650 for keep of horse for Chief Engineer, and $750 for keep of horse for general superintendent and assistant engineer	$15,000 00				
Transfer from Item 1. ...	1,000 00				
Transfer from Item 6.....	1,000 00	17,000 00	16,986 13	13 87	

Appropriations and Expenditures—Continued.

Appropriation, December 30, 1885.	Amount appropria'd.	Amount expended.	Amount merging.	Amount not merging
Items.				
8. Surveys and expenses connected therewith for a future water supply	$10,000 00	$9,999 10	$0 90	
Totals, annual appropriation	$566,350 78	$565,423 39	$927 39	
Special appropriation	$496,000 00	$392,610 63	....	$103,389 37
Totals	1,062,350 78	$958,034 02	$927 39	$103,387 37

The special appropriation of $496,000 was for the further extension of the works. The Water Committee decided that it should be expended for the following purposes; the amounts being estimated and approximate only:

For one 20,000,000-gallon pumping engine, foundation, boilers, connections, etc., at the Spring Garden pumping station	$100,000
For two steel boilers at Roxborough Works, with grates, valves, foundations, flues and steam pipes	7,500
For a 48-inch pumping main, from Spring Garden engine house to Twenty-fourth and Parrish streets, 5,400 feet	72,000
For a 48-inch supply main from Twenty-fourth and Spring Garden streets to Twenty-first and Bainbridge streets, 8,800 feet	110,000
For a 36-inch main on Bainbridge street, from Twenty-first to Broad street, 3,300 feet	28,000
For a 30-inch supply main on Bainbridge street, from Twenty-first to Twenty-second street, 448 feet	3,500
For a 20-inch supply main on Broad street, from Snyder avenue to Wolfe street, 950 feet	3,500
For a 16-inch pumping main on Allen's Lane, from Germantown road south, 1,200 feet	2,000
For a 30-inch pumping main, from the southeast corner to the northeast corner of Roxborough reservoir, 510 feet	2,500
For relaying 16-inch supply mains on North College avenue, from Twenty-second street east, 1,200 feet	3,000
For a 36-inch supply main on Lehigh avenue, from American to Kensington avenue, 3,100 feet	26,000
For a 30-inch supply main on Lehigh avenue, from Kensington avenue to Cedar street, 3,600 feet	21,500

For a 20-inch main on Girard avenue, from Front to Otis street, 3,500 feet	12,000
For a 12-inch pipe on Girard avenue, from Front to Lawrence street, 2,200 feet	4,500
For replacing pipes, less than 6 inches in diameter, with larger pipes, in the old city and the districts of Southwark and Moyamensing, and for setting new fire hydrants in these districts..	60,000
For replacing old and small pipes in the Sixteenth, Seventeenth, Eighteenth, Nineteenth, Twenty-fifth, and Thirty-first Wards, with pipes suitable for the proper supply thereof, and for setting new fire hydrants in these wards	40,000

The expenditures are given in detail in the report of the Chief Clerk. (Appendix B.)

PUMPING STATIONS.

The following table shows the performance of the engines and turbines at the several stations:

Month.	Water Power.	Steam Power.	Totals.	Gallons per day Average.
January	930,543,755	1,182,070,368	2,062,614,128	66,535,939
February	770,912,773	1,078,689,808	1,849,602,581	66,057,235
March	814,240,702	1,271,222,147	2,085,462,849	67,272,995
April	632,326,877	1,400,319,992	2.032,646,869	67,754,895
May	533,953,884	1,832,152,943	2,366,106,827	76,326,026
June	517,519,741	1,985,507,763	2,503,027,504	83,434,250
July	587,476,588	2,240,035,666	2,827,512,254	91,210,072
August	521,375,692	2,291,989,907	2,813,365,599	90,753,729
September	335,332,571	2,398,709,803	2,734,042,374	91,134,745
October	279,500,442	2,472,020,410	2,751,520,852	88,758,737
November	457,355,151	1,874,299,844	2,331,654,995	77,721,833
December	902,015,619	1,399,394,123	2,301,409,742	74,239,023
	7,282,553,795	21,376,412,774	28,658,966,569	78,433,289

The above quantities are calculated from the registered strokes of the engines and the theoretical capacity of the pumps, with the usual allowance for imperfect packing or failure to make full stroke, as in the Worthington engines. The loss from these and other causes depends upon the condition of the machinery and the attention given by the engineers.

The pumps were generally in good order, and the men in charge more than usually careful, so that the percentage of loss was small.

The total amount pumped was 28,658,966,569 U. S. gallons, being 3,493,946,497 over that of the preceding year; a result due to increased facilities for distribution, especially in manufacturing districts.

This large increase in the pumpage was accomplished while the Department was deprived of the use of Fairmount reservoir, and of two of the turbines for several months by the building of the B. & O. tunnel, which necessitated the cutting of all supply mains from that basin.

The maximum pumpage for one day was in July, 102,202,-857, and the minimum, in February, 49,187,598. The daily average for the year was 78,433,289, about 80 gallons per capita, estimating the population at 975,000.

Occasionally during the summer every engine at the Spring Garden station was run to its full capacity, and any break would have seriously affected a large part of the city. Freedom from accident was due to the care and personal supervision of the General Superintendent and the faithfulness of the employes.

From the 7th of August until October 26th very little rain fell, and for sixteen weeks scarcely any water flowed over the dam, notwithstanding which there was no restriction in the use of the water.

Twenty-five billion nine hundred and eighty-four million eight hundred and twenty-seven thousand four hundred and forty-four (25,984,827,444) gallons were taken from the Schuylkill, 2,357,207,644 from the Delaware, and 81,556,446 from the springs of Chestnut Hill. Three hundred and sixteen million nine hundred and thirty-one thousand four hundred and eighty-one (316,931,481) gallons of Schuylkill water were pumped at auxiliary stations to higher elevations. Of the water obtained from the Delaware river, 883,140,241 gallons were pumped at Lardner's Point and principally consumed in Frankford and Bridesburg. One billion four hundred and seventy-four million sixty-seven thousand four hundred and three (1,474,067,403) gallons were pumped at Otis street wharf, being a decrease of 275,667,423 gallons from 1885. This water is drawn through a conduit reaching 200 feet beyond the wharf and 34 feet below low water. The engine at this, the Kensington station, is run only when actually necessary. The abandonment of these works can be accomplished only by providing additional mains for the supply of the Kensington district.

Twenty-five per cent. of the total pumpage was by water-power and the remainder by steam. The cost of the former, including all repairs, was $2.09 per million gallons raised 100 feet high, and the latter, $4.48. For the total amount pumped the cost was $4.13. This method of estimating the cost of pumping is for comparison only. The actual cost would be the running expenses of the stations divided by the number of million gallons raised into the reservoirs, which amounts to $6.66, or, including the total expenses of the Department, less the amount received for water-pipe frontage, the cost was $14.59 per million gallons pumped.

Including six per cent. interest on the estimated value of the water plant ($15,000,000), the cost per million gallons pumped would be $46. The revenue of the Department from rents during 1886 was $61.86 per million gallons. Taking into consideration these facts, the advisability of reducing the water rates, especially to manufacturers, is worthy of your attention. The cost of pumping has been somewhat reduced, as will be noticed by referring to the following table.

The consumption per capita has increased, and is now eighty gallons, due, in a great measure, to the laying of additional mains to sections of the city heretofore having an inadequate supply.

Pumpage Table for the Years 1877 to 1886, inclusive.

Year.	U. S. gallons pumped to reservoirs, etc.	No. of gallons pumped 100 feet high.	Cost per million gallons pumped 100 feet high.	Gallons per capita per day.	Estimated population.
1877	17,877,144,792	23,605,350,256	6.52	61	795,000
1878	19,101,664,332	27,668,619,658	6.56	64	813,000
1879	19,894,101,515	29,787,829,909	5.07	65	830,000
1880	21,120,792,386	31,686,275,272	5.51	68	847,000
1881	22,721,014,838	34,238,528,111	6.88	71	869,000
1882	24,691,440,430	37,873,302,258	6.66	76	890,000
1883	25,284,957,251	37,949,320,701	6.51	76	911,000
1884	25,495,179,353	39,001,865,294	5.54	74	932,000
1885	25,165,020,072	39,308,901,886	4.70	72	953,000
1886	28,658,966,569	46,255,361,203	4.13	80	975,000

Repairs to and Condition of Works.

The detailed statement of the General Superintendent of the work performed at each station and the repairs made under his supervision will be found in his report. (Appendix C.)

The machinery is in good order, with the exception of No. 2 engine at Belmont. One of its high pressure cylinders is cracked, but not sufficient to render it unserviceable. The old boilers at Belmont have been thoroughly examined and tested to 80 pounds without showing any indications of weakness, but as they are old, and only 45 pounds pressure allowed by the boiler inspectors, it will probably be advisable to replace them soon with a more economical type.

Some new floors are required at Fairmount works, and the reservoir wall on Twenty-fifth street needs pointing. The crib-work in front of the dam requires attention; many of the oak pieces on the deck have been torn off and must be replaced.

The grounds at the Spring Garden station should be graded in front of the old engine house, the roadway along the forebay paved and the river wall completed.

2

A fence is needed on the south side of Corinthian Avenue reservoir and entirely around the Spring Garden reservoir at Twenty-sixth and Master streets.

The pavement on the north side of Lehigh Avenue reservoir should be graded and a retaining wall built to protect the embankment. It also requires a new fence.

At Mount Airy station some grading should be done to improve the appearance of the place.

A new stack is needed for the old boilers at Roxborough.

At Frankford station the coal shed should be entirely covered in order to keep the coal dry. The pipe bridge across the Wissahickon creek should be painted.

It is desirable that some alterations be made in the turbines at Fairmount to prevent waste of water and to render them more economical in its use. This can be done by either closing one-half of the buckets or enlarging the pumps, the former being the more readily accomplished. If the head gates were arranged to be easily opened and shut much waste would be prevented. Power can be applied by either a separate wheel or by the use of one or more of those driving the pumps, by which the gates can be raised or lowered easily and quickly.

SUBMERGED MAIN.

This pipe is 36 inches in diameter and is laid upon the bed of the Schuylkill river below the Columbia bridge. The joints are Ward's patent, which permits the several sections to conform to the inequalities of the river bottom. The main was used for many years for the supply of the higher parts of the Fifteenth, Twenty-eighth and Twenty-ninth wards. In the latter part of 1882 it became unserviceable on account of a break at one joint in the deepest part of the river. The original break was mended, but between it and the eastern shore other breaks have since occurred, so that it is in a worse condition at present than before the repairs were begun. The present pipe should be put in good order, or a new one laid, so that the surplus power at Belmont works could be utilized, if needed, for the supply east of the river.

It would probably be cheaper to lay a new 30-inch pipe across the river upon the roadway of the Reading Railroad bridge if that company would give permission.

EAST PARK RESERVOIR.

This reservoir was begun in November, 1871, and continued partly by day's work and partly by contract until July, 1875, when the appropriation became exhausted. The banks were constructed to near the proposed height and the outlet chambers built.

When finished this basin will be in three unequal divisions. The following is a brief description:

Capacity southern section	62,740,931	gallons.
Eastern section	311,639,614	"
Western section	326,939,009	"
	701,319,554	"

The height of the top of the embankment is	138 feet C. D.
Water level	133 " "
Bottom of basin	108 " "
Depth of water	25 feet.
Slope of embankment 1½ to 1.	
Length of main embankment on centre line	7,537 "

Around the base of the embankment the distance is one and one-half mile.

Work should be resumed and the sections prepared for use as fast as appropriations can be made, beginning with the smallest or southern division, where the least work remains to be done. The bottom and inside slopes are to be trimmed to the proper lines, and covered with a coating of concrete or bricks. The area of the bottom is 32,364 square yards, and of the slopes 13,491 square yards.

Estimate for Completing Small Division.

EXCAVATION.	
14,000 cubic yards	$4,500
EMBANKMENT.	
5,100 cubic yards on sides and top	4,500
PUDDLING.	
6,000 cubic yards	6,000
CONCRETE.	
6,800 cubic yards	50,000
BRICK LINING AROUND UPPER PART OF SLOPES.	
400,000 bricks and laying thereof	10,000
Repairs to embankment	5,000
Incidentals and contingencies	20,000
Total	$100,000

CAMBRIA RESERVOIR.

This reservoir is to be located near Thirtieth and Cambria streets, and is intended for the supply of that part of the city now depending upon direct pumpage. The ground has been purchased and the construction of the basin will be begun as soon as an appropriation be made therefor; $206,512.50 have been paid for the grounds (about $45\frac{891}{1000}$ acres), and $42,377.33 for damages to surrounding properties on account of their proximity to the basin, and the blocking of streets. The interest paid upon the above, amounting to $46,100.07, makes the total cost $295,000.

AERATION.

The experiment of forcing air into the water under pressure has been continued during the year at the Belmont station. The water is charged with 20 per cent. of its volume of air, and the result appears to be the almost complete disappearance of free ammonia and the diminution of nearly 50 per cent. of albuminoid ammonia. There is another result, however, which causes considerable annoyance, and that is the difficulty in preventing the mains from leaking. Joints that are perfectly tight while pumping in the usual way will leak badly when the pipes are charged with air, and when the compressors are stopped the joints resume their former good condition. Professor Leeds, in a lecture before the Franklin Institute, December 23, 1886, stated that "this process had been applied at only one of our pumping stations, namely, Belmont, because at the others the mains are too leaky to permit of its use." This is not the reason, as the other pumping mains are all in good order. They are laid in such a manner, however, that no engineer would care to assume the risk of damage to engines and mains that would probably result from the use of this process.

DISTRIBUTION.

More pipes were laid in 1886 than during any previous year.

Water-pipes Laid from 1877 to 1886, inclusive.

Year.	Extensions.		Repairs & Relays.		Total Pipe Handled.		Stops.	Hydrants.	Service Attachments.
	Feet.	Pounds.	Feet.	Pounds.	Feet.	Pounds.			
1877....	83,799	6,231,645	12,430	431,373	96,229	6,663,018	257	126	4,208
1878....	61,650	4,100,860	6,965	423,727	68,615	4,524,587	234	77	3,516
1879....	41,613	4,553,381	6,150	255,085	47,763	4,808,466	183	49	2,929
1880....	23,085	844,946	9,557	262,826	32,642	1,107,772	138	70	2,943
1881....	56,616	2,832,623	3,832	199,649	60,448	3,032,272	249	144	3,483
1882....	56,860	5,396,165	7,740	484,092	64,600	5,880,257	312	120	3,484
1883....	63,215	3,048,645	12,605	675,420	75,880	3,724,065	281	130	4,877
1884....	83,862	7,135,948	18,079	1,380,271	101,941	8,516,219	324	147	5,945
1885....	137,967	12,234,074	93,783	3,265,537	231,850	15,499,611	539	307	7,286
1886....	136,831	18,238,457	121,210	4,883,826	258,041	23,122,283	786	295	8,009

Particular attention was given to the relief of districts suffering from a scarcity of water. That part of the city below South street, containing about one-fifth of the population of the city, has been depending for years on one 30-inch pipe, which was entirely inadequate. Many hydrants were without water during the day, and no part had a reasonable flow in the second-story of the houses.

A forty-eight inch main was laid from Fairmount reservoir to Twenty-first and Bainbridge streets, where it branched west by a 30-inch pipe to Twenty-second street, and east by a 36-inch pipe to Broad street, connecting on the latter streets with 30-inch pipes already in service.

The northern line of this district was changed from the lower to the upper side of South street, and the 16-inch main in that street, also connected with the large mains, has been used to increase the supply east of Broad street, where it was greatly needed. A large number of old pipes were relaid, using, wherever desirable, others of 10 and 12 inches in diameter. The rearrangement of this distribution resulted satisfactorily except in the vicinity of Tenth and Dickinson streets, where local causes still prevent a good supply.

The table on the following page shows the water pressures at the First District office, Wharton and Twelfth streets. These pressures were taken soon after the distribution was changed and can be considered as giving results under the most favorable conditions only:

The theoretical pressure is 31.22 pounds. This is reached during the night, showing that the pipes and fixtures are in good order, and that very little water is used. The greatest draught is between the hours of 9 and 12, when the gauge falls to 24 pounds. The uniformity of the pressures is very satisfactory, and shows that the supply main is of sufficient capacity to meet all the demands upon it. It is quite probable that during the summer these pressures will be lower.

Table showing Water Pressures at First District Office, for the week ending December 26, 1886.

Date.	Time. A. M. 1	2	3	4	5	6	7	8	9	10	11	12	P. M. 1	2	3	4	5	6	7	8	9	10	11	12
Monday, December 20	30	30	30	30	30	29	27	26	25	25	25	25	26	26	26	27	27	29	29	29	30	31	31	30
Tuesday, December 21	31	30	31	31	30	29	27	27	27	27	26	27	26	27	27	27	27	29	29	30	29	29	29	30
Wednesday, December 22	30	31	31	30	30	29	28	27	27	26	27	28	26	26	27	27	28	29	29	29	29	30	30	30
Thursday, December 23	31	30	30	30	30	28	28	27	27	25	21	27	27	27	27	27	27	29	29	29	30	29	30	30
Friday, December 24	30	31	30	29	29	29	27	26	25	24	24	25	25	24	24	25	26	28	28	29	29	29	30	30
Saturday, December 25	30	31	30	29	29	28	28	27	27	28	27	27	28	29	29	30	30	29	30	30	30	29	30	30
Sunday, December 26	31	30	30	29	29	29	28	28	28	29	29	29	28	29	30	30	30	30	30	30	30	30	29	30

Table showing Pressures with Supply from Fairmount Reservoir, for the week ending December 27, 1885.

DATE.	TIME.																							
	A. M.												P. M.											
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12
Monday, December 21	21	21	21	21	21	20	17	16	13	13	14	14	15	15	15	15	15	17	18	19	19	20	20	21
Tuesday, December 22	21	21	21	21	21	17	16	14	13	14	14	13	14	14	15	15	15	17	18	19	19	20	20	20
Wednesday, December 23	21	21	21	21	21	20	17	16	13	14	14	14	15	15	15	15	15	17	18	19	19	20	20	20
Thursday, December 24	21	21	21	21	21	20	17	15	14	14	14	14	14	14	14	15	18	19	19	20	20	20	20	21
Friday, December 25	21	21	21	21	21	21	20	19	18	18	18	18	19	19	19	19	20	20	20	20	21	21	21	21
Saturday, December 26	21	21	21	21	21	20	19	18	16	16	15	15	16	16	17	17	18	19	19	20	20	20	20	21
Sunday, December 27	21	21	21	21	21	21	21	20	19	19	19	19	19	19	20	20	20	20	20	20	20	21	21	21

NOTE.—Compare this table with table on page 18.

The Second district, lying between South and Vine streets, was supplied from Fairmount reservoir. On May 14th this district was placed on the Corinthian Avenue reservoir, which is twenty-five feet higher, and adds about ten pounds to the pressure. Upon the completion of the mains to the lower district, the thirty-inch main on Broad street—its former supply—was connected with the streets running east and west above South street, and is used as an additional main from Corinthian Avenue reservoir, for the old city. A number of old pipes were relaid, and this part of the city now has a fair supply, except where the old and small pipes are still in use or where improper plumbing arrangements exist.

The tables on the following pages show the pressures in this district as taken at 918 Cherry street, before and after the change of the source of supply.

The theoretical pressure for the latter table is 35 pounds. The result shows that considerable water is used during the night, or that there are some leaky pipes and fixtures in this section.

Special attention was given to the northeastern or Kensington district. In former years manufacturing establishments were frequently obliged to stop for want of water during the hot weather, and were always subject to great annoyance on account of the poor flow. The old 4-inch pipes were replaced by others of ten and twelve inches diameter and connected with the 36-inch pumping main on Otis street. All cross streets were connected with this main, which has been converted into a supply pipe. A 36-inch main was laid on Lehigh avenue, from American street to Kensington avenue, where it reduces to thirty inches, and thence continued to Gunner's Run. These alterations and additions resulted in a very satisfactory improvement in the pressure and in the delivery of water to the large consumers in this district.

Bridesburg, supplied only by a six-inch pipe in Richmond street, was greatly benefited by the laying of a twelve-inch pipe under Frankford creek, at Bridge street. It now has an abundant supply for fire and other purposes where formerly very little water could be obtained.

3

Table showing Pressures, with Supply from Corinthian Avenue Reservoir, for the week ending December 26, 1886.

Date.	Time																							
	A. M.												P. M											
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12
Monday December 20	25	25	26	26	26	26	27	25	17	17	18	19	20	20	21	22	23	24	26	27	28	28	28	29
Tuesday, December 21	30	30	30	30	29	28	23	22	21	20	20	22	23	23	23	23	24	25	26	26	26	27	28	29
Wednesday, December 22	29	29	29	29	29	24	23	22	21	21	22	22	23	23	22	23	25	27	28	28	29	29	29	30
Thursday, December 23	30	30	30	30	30	30	24	24	24	24	22	23	22	24	24	24	25	27	28	28	29	29	29	30
Friday, December 24	30	30	30	30	30	30	28	24	23	23	23	23	23	23	23	24	24	27	28	28	28	29	29	29
Saturday, December 25	30	30	30	30	30	29	29	28	28	27	27	27	28	29	29	29	29	30	30	30	30	31	31	31
Sunday, December 26	32	32	32	32	32	32	32	30	30	29	29	29	30	30	30	30	30	30	30	31	31	31	31	31

Table of Pressures at Third District Office, 1420 Frankford Avenue, for week ending December 27, 1885.

Date.	Time. A. M. 1	2	3	4	5	6	7	8	9	10	11	12	P. M. 1	2	3	4	5	6	7	8	9	10	11	12
Monday, December 21	......	......	......	......	......	......	26	18	16	16	17	21	19	17	19	18	22	25	29	31	32	34	35	36
Tuesday, December 22	37	37	37	37	35	33	26	18	18	16	17	17	18	16	17	18	22	23	29	33	34	34	35	36
Wednesday, December 23	37	37	37	37	35	34	26	20	18	16	17	19	19	17	17	16	18	23	27	32	32	33	34	35
Thursday, December 24	36	36	36	35	34	32	26	18	17	14	14	21	19	18	18	20	23	29	31	33	35	35	36	36
Friday, December 25	36	36	36	35	34	33	33	31	30	30	30	32	32	32	32	34	35	35	35	36	36	36	36	36
Saturday, December 26	37	37	37	37	36	34	30	30	30	29	30	32	31	30	31	31	31	33	34	35	35	36	36	36
Sunday, December 27	36	36	36	36	36	35	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......

For the week ending December 26, 1886.

Date.	Time.																							
	P. M.												A. M.											
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12
Monday, December 20	36	36	36	35	34	32	26	23	22	21	21	22	22	22	24	24	26	28	32	32	32	33	33	34
Tuesday, December 21	35	35	35	35	34	33	28	24	24	24	24	24	23	23	23	25	25	28	32	33	33	33	34	34
Wednesday, December 22	35	35	35	35	34	33	26	24	23	22	22	22	21	20	23	23	25	26	30	30	30	31	32	33
Thursday, December 23	34	34	34	33	32	25	25	23	21	21	21	23	21	21	21	21	25	27	31	32	33	33	33	35
Friday, December 24	34	35	35	35	34	32	25	23	23	18	18	19	20	19	22	22	27	31	32	32	33	33	33	35
Saturday, December 25	35	35	35	34	34	34	32	32	30	30	30	30	32	32	32	32	33	34	34	34	34	35	35	35
Sunday, December 26	35	35	35	35	35	35	34	32	32	32	32	33	33	34	34	34	35	34	35	35	35	35	35	36

No new mains were laid in the Fourth district for the purpose of improving the distribution. It receives a fair supply of water by direct pumpage, and few improvements can be made until the Cambria reservoir be completed.

In the Manayunk District a new 30-inch main was laid on the south side of Roxborough reservoir, by means of which the Twenty-first and Twenty-second wards can be supplied with water if it be found necessary at any time to empty the reservoir.

In the Germantown district a 16-inch pumping main was laid in Allen's lane, from the station to Germantown road. The object of this was two-fold: First, to relieve the pumps which formerly used one 10-inch pipe; and secondly, to increase the pressure and supply in the high service distribution.

For a complete account of the work in this branch of the Department, see report of A. J. Fuller, Assistant Engineer in Charge. (Appendix D.)

CHERRY STREET SHOP.

The following table will show the amount of work performed during the year, and a comparison thereof with other years:

Year.	Fire Hydrants.	Stop Valves.	Frames and Covers.	Ferrules.
1877	214	338	370	4,225
1878	332	281	393	3,425
1879	276	198	60	715
1880	314	149	212	3,649
1881	435	237	372	3,085
1882	596	336	596	3,506
1883	729	328	423	4,799
1884	198	367	588	4,966
1885	451	667	653	7,115
1886	526	953	927	8,480

The above are the principal articles manufactured by the Department. In addition, all appliances used in connection with pipe laying are made and repaired; and, so far as our tools will permit, the machinery of the several pumping stations is kept in order.

The Third Regiment Armory having been purchased by the city, a portion of it (the northern half) was set apart for the use of this Department as a machine shop. During the latter part of the year the work of fitting it up was begun, and progressed as fast as available funds and time permitted.

Two tubular boilers were taken from Kensington station, where they were no longer required, and set up in a room prepared for them at the new machine shop. A stack, seven feet eight inches square at the base and seventy-five feet high, was built outside of the house in rear of the boilers.

A fly-wheel engine that had been used at Chestnut Hill for driving a pump, was put in thorough repair, and also erected in the new shop to drive the machinery and blowers for the forges.

The blacksmith shop was placed in the annex, formerly used for company rooms, provision being made for four fires, with cast-iron forges and wrought-iron stacks and hoods. The steam-hammer will be set up in the same room. The offices and store-rooms are in the front of the building, and over them the pattern shop and pattern loft. More work was necessary than had been anticipated. The columns supporting the roof were so decayed that it was necessary to renew the lower portion and raise the roof, which had settled in consequence of the defective columns. The floor was entirely gone, as was suspected. The new floor of the machine shop was made higher and the joists set on brick foundations. Steam-pipes for heating the building were put in and drain and water connections laid. The machinery will be removed from the old shop at an early date.

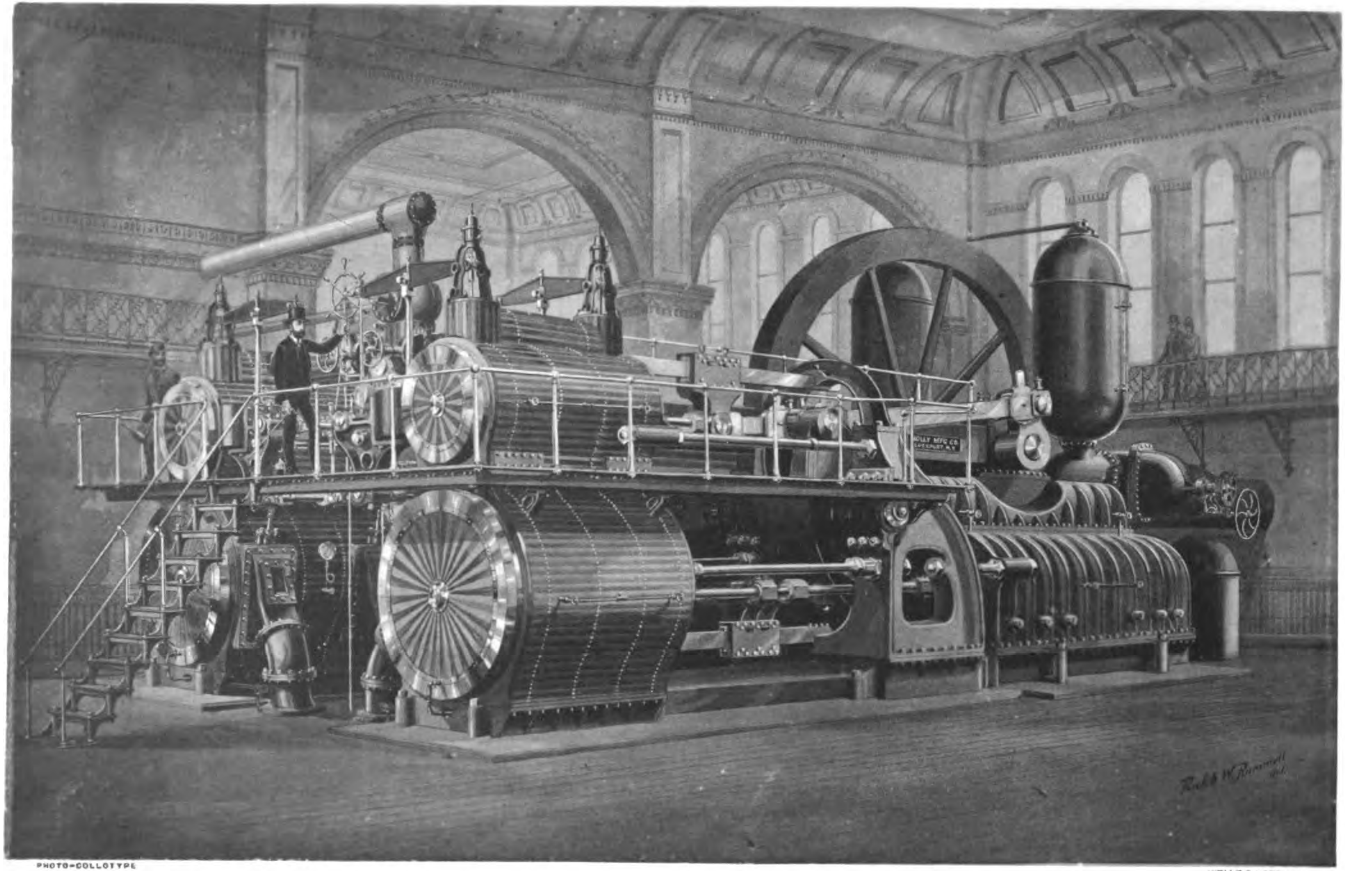

PHOTO-COLLOTYPE WELLS & HOPE CO.

GASKILL PUMPING ENGINE.

EXTENSIONS.

In addition to the extensions enumerated under the head of "Distribution," measures were taken to add to the pumping plant one engine, of twenty millions capacity, and seven boilers, rated at 560 nominal horse-power. Proposals were advertised for on June 4, and bids opened on June 15. The contract for the boilers was awarded to I. P. Morris & Co. for the sum of $26,965, and that for the engine to the Holly Manufacturing Company for $69,000. The specifications required the engine to be of the compound type, capable of delivering 20,000,000 gallons of water in twenty-four hours to a height of 165.5 feet, the duty to be not less than 100,000,000 of foot-pounds, on the basis of the evaporation of ten pounds of water per pound of coal. The engine accepted is known as the Gaskill Engine, and is guaranteed to give a duty of 110,000,000, and be ready for use by June 1, 1887.

Two of the boilers were set up at the Roxborough works on December 6, and, when tested, were found to be satisfactory—evaporating over eleven pounds of water from and at 212° F. per pound of combustible, and furnishing very dry steam. They developed 44 per cent. more horse-power than they were rated, and being entirely covered with a good non-conducting material there is no loss from radiation.

The five boilers intended for Spring Garden pumping station are well under way, and will be delivered early in 1887. All these boilers are of the kind known as Furnace Flue Tubular. They are internally fired, and are eight feet six inches in diameter and twenty feet long. The drawings were furnished by the Department. The following is a brief description taken from the specifications:

The five for Spring Garden works are intended to carry one hundred pounds of steam; the shell is five-eighths of an inch thick; the ends, tube-sheets, and spandrels nine-sixteenths of an inch thick; combustion chamber three-eighths of an inch thick; furnace ("Fox's Patent Corrugated Steel Furnace Flue") three-eighths of an inch thick; all plates to be of steel, of not more than sixty thousand nor loss than fifty thousand pounds per square inch tensile strength; the horizontal seams in the shell to be double riveted, double welted joints, all others double riveted; all edges of sheets to be planed, and all seams to be caulked on both sides throughout; they are to be capable of resisting a hydraulic pressure of two hundred pounds; each boiler to contain two furnace flues eight feet long and three feet seven inches in diameter, and ninety 4-inch lap-welded tubes, ten feet long; grate bars to be of the Tupper pattern; all necessary pop safety valves, stop valves, dampers, saddles, steam-feed and blow-off pipes, gauges, and check valves to be furnished by the contractor.

The two boilers for Roxborough are similar in design, but, being intended to carry only sixty pounds of steam, the metal is generally lighter.

During the year a number of boiler tests have been made, of which the following table shows the comparative results. For a detailed description of tests and results, see report of Mr. John E. Codman, Chief Draughtsman. (Appendix F.)

Number, Style, and Location of Boilers.	Quality of steam.	Coal burned per square foot of grate surface per hour.	Pounds of water evaporated per square foot of grate surface per hour, from 100° F. to steam, 70 pounds gauge pressure.	Pounds of water evaporated per square foot of heating surface per hour, from 100° F. to steam, 70 pounds gauge pressure.	Pounds of water evaporated from and at 212° F., per pound of combustible.	Per centage of heat lost by radiation, on basis of 14500 B. T. U., per pound of combustible.	Commercial horse-power.	Rated horse-power from heating surfaces.	Per centage above rated horse-power.	Per centage below rated horse-power.	Remarks.
5 Marine Boilers, Spring Garden........	.92250	11.700	80 02	2.160	9.080	30¼	520	565	....	8	Engine test.
3 Marine Boilers, Frankford........	.97875	8.800	59.41	1.600	9.550	36	242	339	....	28	Engine test.
3 Marine Boilers, Frankford........	.97875	7.230	55.41	1.500	10.835	28	233	339	....	30	Engine test.
2 Marine Boilers, Frankford........	1.00000	14.135	119.05	3.236	10.986	27	335	266	48	....	Bituminous { steam 212° F.
8 Cylinder Boilers, Belmont........	.95950	15.320	92.44	5.990	8.050	46	616	400	54	....	Boiler test.
4 Double-decked Tubular, Belmont........	.92630	16.700	116.80	2.700	9.380	38	492	360	36	....	Boiler test.
2 Plain Tubular, Mount Airy........	.99730	11.280	82.36	3.000	10.330	32	92	60	53	....	Boiler test.
2 Furnace-flue, Roxborough........	.98640	10.800	82.00	6.240	11.020	20	230	160	44	....	Boiler test.

HYDROGRAPHIC WORK.

Mr. Rudolph Hering, the Engineer in charge of Surveys, completed his work on June 30. Since then the hydrographic work, in connection with future sources of supply, has been continued under the supervision of Mr. Amasa Ely, whose report is attached. (Appendix G.)

REPORT OF INVESTIGATIONS OF SOURCES OF FUTURE WATER SUPPLY.

On September 8 the concluding report of Mr. Rudolph Hering, the Engineer in charge, was received. It is hereto attached. (Appendix H.) These investigations were begun in May, 1883, and continued during the years 1884, 1885, and until July, 1886. The amounts expended have been as follows:

During 1883	$20,500 20
During 1884	27,457 56
During 1885	22,399 10
During 1886	11,191 10
Total	$81,547 96

Annual reports of progress were made and included in the reports of the Chief Engineer. They form a valuable collection of data, which will assist in determining the question as to where the city must go for water when the present sources are no longer sufficient.

THE PRESENT WATER SUPPLY.

Quantity of Water Available.

The minimum flow of the Schuylkill, according to Mr. Edwin F. Smith, the best authority on the subject, is 245,000,000 gallons daily, which will be ample for the supply of the city thirty years hence. During eighty-one consecutive days of 1886 no water was wasted over Fairmount dam. The quantity pumped during that time was as follows:

	Gallons.
By steam, at Spring Garden, Belmont, and Roxborough......	6,144,511,149
By water, to Corinthian Avenue Reservoir.........................	904,533,931
Total..	7,049,045,080

To pump 904,533,931 gallons of water into Corinthian Avenue reservoir by the turbines requires the use of 13,568,008,965 gallons. This amount, added to the quantity pumped, gives the flow of the river, except the lockage.

Gallons pumped by water and steam........................	7,049,045,080
Gallons used by turbine wheels........................	13,568,008,965
Total flow of the river available........................	20,617,054,045

Average per day, 254,531,531 gallons.

By building inexpensive dams on the mountain streams, and by raising the existing dams, the minimum flow and the available storage could be increased. By building storage basins within the city limits part of the average flow could be stored to supplement the pumpage at low stages of the river. Should the entire minimum flow be pumped, the Navigation Company would be obliged to draw upon its storage reservoirs to meet the requirements of navigation.

The city, however, does not depend entirely upon the Schuylkill. At Lardner's Point, on the Delaware, where the water is said to be of good quality, two engines, each of ten millions of gallons capacity, are supplying Frankford, Bridesburg, and the upper part of the Twenty-fifth Ward. If necessary, this plant can be increased to make up for any possible deficiency in the flow of the Schuylkill.

Capacity of the Works.

STATIONS.	Theoretical.	Maximum, 1886.	Average, 1886.
Fairmount	34,000,000	36,000,000	20,000,000
*Spring Garden	90,000,000	63,700,000	40,000,000
Belmont	18,000,000	14,112,129	7,895,761
Roxborough	12,500,000	6,901,101	4,713,135
Lardner's Point	20,000,000	4,556,144	2,419,562
Kensington (Otis street)	6,000,000	8,000,000	4,713,135
Total	180,500,000	133,269,374	79,741,593

* Including the twenty million gallon engine now being constructed.

Pumping by water is much cheaper than by steam, and Fairmount can be depended upon for at least six months of the year, when the flow is at the average, for many years to come. It is only during the very warm weather, when the river is at its minimum, that the loss at Fairmount must be supplemented by the steam works. With additional mains and reservoirs the entire theoretical capacity of the engines will be available except when undergoing repairs.

STORAGE CAPACITY OF RESERVOIRS.

Fairmount. This reservoir supplies that part of the city below South street. The average daily consumption is 8,000,000 gallons, and the capacity of the reservoir 26,350,794 ; storage, about 3¼ days.

The portion of the city north of South street to Westmoreland, except that which is supplied by direct pumpage, receives water from the following named reservoirs :

Corinthian avenue, capacity	37,341,439
Spring Garden, "	12,009,581
Lehigh avenue, "	26,394,180
Total	75,745,200

The average daily consumption of this district is 30,000,000 gallons, and the storage for only $2\frac{1}{2}$ days.

West Philadelphia, with an average consumption of 8,000,000 gallons per day, has a reservoir (George's Hill) of about 40,000,000 capacity. The storage, therefore, is for 5 days, which allows the engines to be stopped when the river is turbid. By this arrangement that part of the city is very rarely troubled with muddy water.

Manayunk, or Twenty-first Ward, with an average daily consumption of 2,350,000 gallons is supplied from Roxborough reservoir, which has a capacity of 12,838,455 gallons, being sufficient for 5 days.

The Twenty-second and part of the Twenty-eighth wards, with an average consumption of 2,350,000 gallons per day, are supplied from Mount Airy reservoir, which has a capacity of but 4,545,917 gallons and storage for less than 2 days. To increase this storage it is proposed to enlarge the reservoir by building, on the north side, an addition to hold 55,286,000 gallons. This, with the present consumption, will provide a 25 days' supply. Suitable ground can probably be purchased for less money at another place, a larger reservoir built, and the present location abandoned.

Frankford and Bridesburg, with a consumption of 2,419,562 gallons, have a reservoir capacity for 8 days. If the reservoir (Wentz Farm) were in proper condition the storage would last 15 days, but owing to its defective construction it is impossible to raise the water above 14 feet. It should hold 36,046,097 gallons. If the Kensington station be abandoned and the area supplied from this basin be extended to the Kensington district the day's storage will be materially decreased.

A large part of the city, containing a population of 185,000, is supplied by direct pumpage. There is no opportunity for subsidence. The water is taken directly from the river, regardless of its condition, and the supply depends upon the continual action of the pumps.

With the completion of the East Park and Cambria reservoirs, all that part of the city which can be supplied therefrom, including that now under direct pumpage, will have from 15 to 20 days' storage, and during a minimum flow, if necessary, the supply to the city can be supplemented by drawing upon the storage.

Quality.

The Schuylkill river is a mountain stream, possessing in a remarkable degree the best means for self-purification. The action of the lime water of the lower tributaries upon the mine water is well understood. The main stream is broken by twenty-six dams and the small streams by at least an equal number. These greatly assist in the æration of the water. The stream is generally clear except after a rain, when it becomes turbid. The Delaware and other rivers are no exceptions to this general rule. This objection can be readily overcome by the completion of the East Park and the building of the Cambria and Mt. Airy reservoirs, which will permit the pumps to be stopped after a storm until the river becomes clear, and also allow the first surface washings of the streets and roads to pass over the dam. The city can then be supplied with water entirely satisfactory in appearance, and the pipes will not become choked with sediment as at present.

With regard to the wholesomeness of the water, there are but two ways by which it can be determined—experience and chemical analysis. If judged by the former, the general health of the city is sufficient evidence thereof. Twenty per cent. of the deaths are of persons over sixty years of age. If typhoid fever be caused by impure water the deaths would be evenly distributed over the entire city and average about the same each month. In the worst portions of the city and where the houses, as a rule, are not connected with the sewers, there are few cases. Along the Cohocksink sewer and its branches the disease appears to be most prevalent. Even Brooklyn, with one of the best water supplies, is not exempt, and during certain months the victims of this disease are quite numerous. Col. George E. Waring, in the Tenth United States Census Report (vol. 18, page 811), states that the mortality of Philadelphia is one less in each 1,000 persons than the city of London, two less than Paris and seven less than New York.

The other method generally adopted for ascertaining the purity of water is by chemical analysis, in regard to the value of which there are great doubts. Experts differ as to methods to be pursued, and the interpretation of the results obtained. In the majority of cases chemical examination cannot be relied upon as giving conclusive evidence of the suitability of a water for drinking and culinary purposes.

For a very able discussion of this subject see address by Charles W. Dulles, M. D. (Appendix I.)

To improve the quality of our water supply no expense should be spared, and all sewage should be excluded from the Schuylkill. The completion of the intercepting sewer will, to a very great extent, accomplish this within the city limits, and suitable legislation prevent its continuance beyond. The so-called intercepting sewer was projected for the purpose of preventing the pollution of the river by our own citizens, and when completed will undoubtedly accomplish its purpose for many years. When it has reached the limit of its capacity another, at a higher level and with greater fall, will be built. The present sewer is $4\frac{1}{2}$ feet in diameter, from Fairmount to Wissahickon creek, and from Wissahickon creek to Manayunk 4 feet, the first section having a uniform grade of 4 in 10,000 or $2\frac{11}{100}$ feet per mile, and the grade of the second or upper section $3\frac{7}{10}$ feet per mile. The total length is 39,000 feet, and it can be flushed from the canal at its upper end or Wissahickon creek midway. The sewer is smoothly plastered inside with Portland cement, and the grade is sufficient for a self-cleansing velocity of three feet, and a discharge of 48 cubic feet per second, or 1,250,000 gallons per hour. The water supply to Manayunk, Roxborough and Falls of Schuylkill does not exceed 3,000,000 of gallons, and the sewage is not much in excess of the same amount, so that the sewer is of ample size, not only for present requirements, but for fifteen or twenty years. The cost will be about $600,000, and it will be completed early in 1887.

RECOMMENDATIONS FOR IMPROVEMENT OF THE PRESENT SUPPLY.

The following items are respectfully presented. They represent the immediate requirements of the Department, and should be provided for as soon as possible. The estimated cost is given for each item, except for replacing small service pipes, for which some appropriation should be made each year until the work be completed.

Item 1. A 48-inch pumping main from the Spring Garden station to Thirtieth and Lehigh avenue; thence along Lehigh avenue to Ninth street, 20,000 feet; estimated cost		$300,000 00
Item 2. A 30-inch supply main from Wentz Farm reservoir to Sixth and Lehigh avenue, 26,000 feet		170,000 00
Item 3. Replacing old and small pipe with 6-inch and larger, as follows: Christian street, from Fifth to Eighth, 10-inch pipe, 1,400 feet	$2,500 00	
Christian street, from Tenth to Broad, 12-inch pipe, 2,000 feet	4,000 00	
Fortieth street, from Baltimore avenue to Woodland avenue, and in Woodland avenue, from Fortieth to Forty-ninth streets, 12-inch pipe, 4,300 feet	8,600 00	
Lehigh avenue, from Cedar to Richmond streets, 20-inch pipe, 2,200 feet	7,000 00	
Richmond street, from Lehigh avenue to Tioga street, 12-inch pipe, 2,400 feet	4,800 00	
Twenty-seventh street, from Thompson to Ridge avenue, 16-inch pipe, 3,300 feet	10,000 00	
Master street, from Taney to Twenty-second streets, 20-inch pipe, 2,100 feet	7,000 00	
Ridge avenue, from south of School lane to Hermit lane, 12-inch pipe, 7,000 feet	14,000 00	
		57,900 00

Item 4. For building Cambria reservoir (land damages not included)	500,000 00
Item 5. For completing East Park reservoir	700,000 00
The estimate for completing the small section is $100,000.	
Item 6. Pumping mains to, and supply mains from, East Park reservoir	90,000 00
Item 7. For enlarging Mt. Airy reservoir	225,000 00
Item 8. The adoption of some process for filtration.	
Item 9. The replacing of pipes less than 6 inches in diameter with larger sizes. This work should be continued until every such pipe be removed.	

FILTRATION.

The Schuylkill water even in its best condition has foreign matter like clay in suspension, which, when pumped into the reservoirs, settles on the bottom, materially diminishing the capacity thereof, and forming foundations for the growth of vegetation. It is therefore very desirable that clear water only be stored. If the water be clarified before going into the reservoirs the expense of cleaning would be avoided and the entire capacity of the mains and service-pipes, now partially obstructed with sediment, would be available.

One cause of the short supply of water in some parts of the city is undoubtedly due to the decreased area of the mains at low points by the accumulation of sediment. Besides the removal of all inorganic impurities in suspension, it is probable that a portion of the organic substances in solution may be precipitated by means of some harmless coagulant and retained by the filtering material. It has been found, also, that coke is highly efficient in removing organized matter from water under certain conditions and to occupy a high place as a biological filter. In England filtration works are considered necessities, and large sums of money have been expended in their erection and maintenance. Several persons have proposed to erect for trial, at one of our pumping stations, a filtering plant, at their own expense, with the understanding that if it should not prove satisfactory they will remove it without cost to the city. It is recommended

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that permission be granted to one or more of the parties in question to build an experimental plant at the Belmont station, or reservoir, and that it be given a thorough trial.

Future Supply.

The present sources can be depended upon for supplying the city until the year 1910 and possibly longer. Experience proves the water to be wholesome, but it can and will be improved both in appearance and quality. The investigation of the sources for future supply, now under examination, should be continued and our inquiry extended to other water-sheds. When the stream or streams to be utilized are determined upon, their entire collecting areas should be purchased and be either transformed into a park or allowed to return to their primitive condition as a forest. The water would then be entirely free from objectionable contamination and the best that could possibly be procured.

It will not be difficult to show that 230,000,000 gallons can be brought to the city daily by gravity from streams comparatively near, at an elevation sufficient to permit the water to flow into the Belmont reservoir and reduce to a minimum the quantity required to be raised for the use of Roxborough, Mount Airy, and Chestnut Hill.

In conclusion, I sincerely thank the Chairman and members of the Water Committee of Councils for their valuable assistance and advice, which greatly contributed towards the successful management of this Department, and for the very pleasant relations that existed between us during the past year.

Respectfully,

JOHN L. OGDEN,

Chief Engineer.

APPENDIX A.

REPORT OF THE REGISTRAR.

PHILADELPHIA WATER DEPARTMENT,
REGISTRAR'S OFFICE,
January 24, 1887.

JOHN L. OGDEN,
Chief Engineer.

SIR:—I respectfully submit the following Report of the Operations of this Office, for the year 1886:

The total receipts derived from all sources (paid daily as received into the office of the City Treasurer) were - - - - -	$1,933,328 34
This is an increase over the previous year of -	107,164 80
The collection of water rents and penalties for the year 1886, amounted to - - - -	1,658,674 58
An increase over the previous year of - -	69,343 86
The receipts from delinquent rents and penalties amounted to - - - - - -	17,013 92
An increase over the year 1885, of - -	4,185 64
The receipts from fractional rents and other sources amounted to - - - - - -	97,219 62
A decrease from 1885, of - - - -	4,424 26

The decrease in this item is caused by the large increase in number of new properties granted attachments without the payment of water rent, a bond being entered in the City Solicitor's Office to secure the Department from loss.

The receipts from water-pipe charges amounted to - - - - - - - - -	$122,743 91
An increase over the year 1885, of - -	30,561 73

The receipts from search fees amounted to -	2,960 00
An increase over the year 1885, of - -	971 25
Receipts through the Chief Engineer's Office for old material, fire connections, etc., amounted to . - - - - - -	10,121 36
An increase over the year 1885, of - -	924 36
The amount collected through the City Solicitor's Office for pipe frontage, and certified to this Department, amounted to - - -	24,594 95
An increase over the year 1885, of - -	5,601 72
Water-pipe bills to the amount of - - - were returned to the City Solicitor's Office for lien.	38,935 59
The receipts of the Department in full for the year 1886, as previously estimated by the Chief Engineer to the City Controller, were	1,900,000 00
Actual receipts for the year 1886 - - -	1,933,328 34
Increase over estimate of - - - - - -	33,328 34

The annexed itemized tables contain full information of the detailed work of this office.

Very respectfully,

A. N. KEITHLER,

Registrar.

Total Receipts of the Water Department for the Year 1886.

MONTHS.	Searches.	Delinquent Rents.	Penalties.	Rents for 1886.	Penalties.	Fractional Rents.	Water-pipe.	Chief Engineer's Office.	Totals.
January	$201 50	$779 50	$111 55	....	....	$6,587 24	$6,761 19	$1,401 21	$15,842 19
February	196 25	1,181 25	159 61	$204,209 09	....	6,088 48	7,337 67	1,777 11	220,949 46
March	259 75	1,921 50	136 24	330,105 98	....	7,830 96	10,382 19	....	350,636 62
April	280 75	3,041 00	376 28	897,717 14	....	9,143 11	13,215 97	33 08	923,807 33
May	277 25	1,053 50	158 06	37,496 60	$1,866 39	11,542 47	8,606 47	61 82	61,062 56
June	268 00	680 50	101 89	53,688 40	2,680 80	7,012 40	7,792 61	36 95	72,261 55
July	222 25	794 00	82 20	10,837 50	1,566 73	11,980 95	11,563 28	767 76	37,814 67
August	190 25	461 25	67 71	20,512 50	2,968 82	7,442 82	12,642 89	644 43	44,930 67
September	234 75	759 50	113 95	38,766 98	5,801 67	6,361 66	14,588 05	366 65	66,993 21
October	287 25	713 50	107 15	26,536 45	3,931 78	5,457 49	13,239 32	3,471 07	53,744 01
November	273 50	767 50	115 23	11,569 70	1,704 19	12,934 01	11,571 03	242 47	39,177 63
December	268 50	2,896 50	434 55	5,856 35	857 51	4,838 03	5,043 24	1,318 81	21,513 49
Totals	$2,960 00	$15,049 50	$1,964 42	$1,637,296 69	21,377 89	$97,219 62	$122,743 91	$10,121 36	$1,908,733 39

Total receipts through the office of the City Solicitor for the year 1886	24,594 95
Total receipts of the Water Department for the year 1886	$1,933,328 34
Receipts as previously estimated by the Chief Engineer	1,900,000 00

Items of Receipts under Head of "Fractional Rents."

YEARS.	Rents.	Ferrules.	Repairs.	Totals.
1886	$79,501 87	$16,624 00	$1,093 75	$97,219 62
1885	85,491 13	14,674 00	1,478 75	101,643 88
Increase	....	$1,950 00		
Decrease	$5,989 26	....	$385 00	$4,424 26

Receipts through the Chief Engineer's office for the year 1886.

January 12	G. W. Smith	Ashes, Mount Airy Station	$2 70
" 12	J. Scott	" " "	40
" 12	W. Dedeker	" " "	80
" 12	Miller & Yates	" " "	1 30
" 12	Brown & Goodnow	Use of roller	20 00
" 12	Morse, Williams & Co	Fire connection	65 30
" 12	John Gallaker	Stone	5 26
" 12	James Callahan	"	10 00
" 13	Butchers' Ice and Coal Co	Cutting ice	910 00
" 13	Pennsylvania Railroad Co	Repairing stop	5 57
" 14	Trustees First Reformed Church	Supply connection	68 31
" 18	N. C. Mitchell	Fire connection	72 80
" 19	Schofield, Mason & Co	" "	64 39
" 20	Butchers' Ice and Coal Co	Cutting ice	50 00
" 20	William M. Singerly	Fire connection	70 63
" 28	Philadelphia and Reading Railroad Co	Examining for leak	53 75
February 15	University of Pennsylvania	Repairing stop	1 50
" 15	Henry Snyder	Rent at Fairmount	450 00
" 20	M. Dolan & Bro	Old material	24 75
" 24	William H. Dawson	Stone	8 00
" 24	Bussenius, Cunliffe & Co	Old material	1,292 86
April 10	Good Intent Mills	Repairing stop	5 75
" 10	Henry C. Lea	Removing fire hydrant	21 43
" 17	West Spruce Street Presbyterian Church	Repairing pipe	5 90
May 3	James Parsons	New fire hydrant	11 44
" 6	Northminster Presbyterian Church	Repairing stop	5 90
" 6	H. H. Houston	Supply connection	44 48
June 8	Samuel Righter	Stone	5 00
" 8	F. Musky	"	10 00
" 8	Warrants	Overdrawn	7 55
" 9	Robert Shaw	Empty barrels	14 40
July 2	John Bromley & Sons	Fire connection	69 92
" 2	John Sullivan & Sons	" "	73 95

Receipts through the Chief Engineer's office for the year 1886—Continued.

July 3	F. S. & R. DeS. Bond	Fire connection	$68 48
" 19	Reeves & West	For penalty	50 00
" 21	Henry Snyder	Rent at Fairmount	450 00
" 29	Pennsylvania Railroad Co.	Supply connection	47 10
" 29	Blumenthal Bros. & Co.	Removing fire hydrant	8 31
August 2	F. Brecht.	" "	53 41
" 3	Street Sprinkling Company	Repairing fire hydrant	14 97
" 5	Pennsylvania Railroad Co.	New fire hydrant	40 56
" 6	Philadelphia Press Company (limited).	Supply connection	67 10
" 10	Joseph Ladley	Stone	83 60
" 16	Joseph Fling	Fire connection	65 29
" 21	Joseph McClure	Old material	250 00
" 21	Auction sale	Horse	69 50
September 1	John W. Bull	Old material	45 00
" 1	James Burke	" "	50 00
" 1	William C. Hamilton	" "	80 00
" 1	Warrants	Overdrawn	102 32
" 1	Rene Guillou	Removing fire hydrant	9 91
" 8	Warrant	Overdrawn	3 00
" 28	Baltimore and Ohio R. R. Co.	Supply connection	76 42
October 4	John A. Woodfall & Bro.	Old material	35 12
" 15	Thomas Young	Stone	5 00
" 18	Bussenius, Cunliffe & Co.	Old material	1,500 00
" 19	Summers & Co.	" "	50 00
" 19	A. Purvis & Son	" "	70 00
" 20	M. Dolan & Bro.	" "	200 00
" 27	" "	" "	100 00
" 27	Thompson C. Gill & Co.	" "	850 00
" 27	J. & P. Baltz	Repairing fire hydrant	4 95
" 27	J. A. Woodfall & Bro.	Old material	100 00
" 27	Summers & Co	" "	50 00
" 29	Girard Avenue Market Co.	Fire connection	6 00
" 29	Bussenius, Cunliffe & Co.	Old material	500 00
November 15	A. Purvis & Son	" "	34 78

Receipts through the Chief Engineer's office for the year 1886—Continued.

November 22.....	Summers & Co....................	Old material.........................	$33 69
" 22.....	Trustees Philadelphia Gas Works................................	Removing stop......................	43 92
" 26.....	John Bromley & Sons...........	Fire supply connection.........	65 58
" 26.....	" " "	" "	64 50
December 4......	Froelich Bros.......................	Removing fire hydrant.........	8 34
" 4......	Harry Rowland.....................	Stone....................................	2 00
" 4......	Fidelity Trust and Safe Deposit Company..................	Fire connection.....................	58 84
" 9......	Butchers' Ice and Coal Co.....	Cutting ice............................	325 00
" 14......	Stead & Miller.......................	Fire connection.....................	60 45
" 14......	George Strawbridge.......	Stone....................................	8 50
" 15......	John C. Hancock..................	Cutting ice............................	580 00
" 31......	John Williams & Sons..........	Fire connection.....................	71 69
" 31......	Bailey, Banks & Biddle.........	" "	77 81
" 31	Harry Rowland.....................	Stone....................................	1 00
" 31......	Michael Righter....................	"	2 00
" 31......	William P. Oglesby................	Repairing pipe......................	14 00
" 31......	Pennsylvania Railroad Co....	Supply connection................	31 86
" 31......	" "	Fire connection...................	77 07
" 31......	Warrant..............................	Overdrawn...........................	25
		Total.........................	$10,121 36

Comparative Statement of Receipts for the years 1885 and 1886.

YEARS.	Searches.	Delinquent Rents.	Delinquent Penalties.	Water Rents.	Penalties.	Fractional Rents.	Water-Pipe.	Chief Engineer's Office.	City Solicitor's Office.	Totals.
1886	$2,960 00	$15,049 50	$1,964 42	$1,637,296 69	$21,377 89	$97,219 62	$122,743 91	$10,121 36	$24,594 95	$1,933,328 34
1885	1,988 75	11,267 25	1,561 03	1,567,031 94	22,298 78	101,643 88	92,182 18	9,197 00	18,993 23	1,826,164 04
Increase....................	$971 25	$3,782 25	$403 39	$70,264 75	....	....	$30,561 73	$924 36	$5,601 72	$107,164 30
Decrease....................	....	....	....	....	$920 89	$4,424 26	....	....	....	....

Schedule of Charges against Fire Stations at the Regular Rates.

Wards.	Name.	Location.	Amount.
First	Fire station, No. 10	South side Morris street, west of Eighth	$28 00
Third	" " No. 3	117 and 119 Queen street	24 00
Fifth	" " No. 22	North side Evelina street, east of Third	26 00
"	Truck D Company	319 Union street	24 00
Sixth	" B "	321 and 323 Branch street	29 00
"	Fire station, No. 8	143 Race street	22 00
Seventh	" " No. 11	1035 Lombard street	24 00
"	" " No. 1	1837 and 1839 South street	30 00
Tenth	" " No. 17 and shops	1328 to 1334 Race street	138 00
Eleventh	" " No. 21	826 New Market street	30 00
Fourteenth	" " No. 26	1011 and 1013 Hamilton street	39 00
Fifteenth	" " No. 18	1903 Callowhill street	21 00
"	Truck A Company	2132 Fairmount avenue	18 00
Eighteenth	Fire station, No. 6	1118 East Montgomery avenue	64 00
Nineteenth	" " No. 15	Southeast corner Howard street and Columbia avenue	18 00
Twenty-first	" " No. 12	4541 to 4545 Main street	24 00
Twenty-third	" " No. 7	22 East Church street	20 00
"	" " No. 14	4612 Frankford avenue	26 00
Twenty-fifth	" " No. 28	West side Belgrade street, south of Clearfield street	24 00
Twenty-seventh	" " No. 5	Southeast corner Thirty-seventh and Ludlow streets	21 00
Twenty-ninth	" " No. 27	2202 and 2204 Columbia avenue	24 00
		Total	$674 00

Schedule of Charges against Police Station Houses at the Regular Rates.

Wards.	Names.	Locations.	Amount.
First	Seventeenth District Station House	South side Taylor street, east of Passyunk avenue	$65 00
"	Twenty-fifth " "	1507 and 1509 Moyamensing avenue	43 00
Third	Second " "	East side Second street, north of Christian street	92 00
Fifth	Central Station House	Southwest corner Fifth and Chestnut streets	96 00
"	Third District Station House	North side Union, east of Fourth street	63 00
Sixth	Fourth " "	219 and 221 North Fifth street	81 00
Seventh	Nineteenth District Station House	732 Lombard street	73 00
Eighth	Fifth " "	East side Fifteenth street, south of Walnut street	72 00
Ninth	Twentieth " "	1515 and 1517 Filbert street	57 00
Tenth	Sixth " "	235 North Eleventh street	71 00
Eleventh	Seventh " "	514 St. John street	35 00
Fourteenth	Eighth " "	1012 and 1014 Buttonwood street	64 00
Fifteenth	Ninth " "	Northwest corner Twenty-third and Brown streets	56 00
Seventeenth	Tenth " "	East side Front, north of Master street	64 00
Eighteenth	Eleventh " "	611 to 617 East Girard avenue	33 00
Twentieth	Twelfth " "	Northeast corner Tenth and Thompson streets	62 00
Twenty-first	Thirteenth " "	Station House alley, between Cotton and Mechanic streets	47 00
Twenty-second	Fourteenth District Station House	North side Lafayette, east of Adams street	60 00

Schedule of Charges against Police Station Houses at the Regular Rates—Continued.

Wards.	Names.	Locations.	Amount.
Twenty-second....	Sub-District Station House....................	Northwest corner of Twenty-seventh street and Highland avenue....................	23 00
Twenty-third.......	Fifteenth District Station House...........	Southwest corner Ruan and Paul streets..	64 00
Twenty-fourth.....	Sixteenth " "	Southwest corner Thirty-ninth and Spring Garden streets..............................	85 00
Twenty-fifth........	Twenty-fourth District Station House....	Southwest corner Belgrade and Clearfield streets..	28 00
"	Sub-District Station House....................	4746 Richmond street..	55 00
"	Nicetown Sub-District Station House......	3883 Germantown avenue..	33 00
Twenty-seventh...	Twenty-first District Station House.........	Southeast corner Spruce street and Woodland avenue.................................	72 50
Twenty-eighth.....	Twenty-second " "	Northwest corner Park and Lehigh avenues...	87 00
Twenty-ninth......	Twenty-third " "	Southwest corner Twentieth and Jefferson streets..	42 00
Thirtieth............	First " "	1923 to 1927 Fitzwater street..	37 00
Thirty-first..........	Eighteenth " "	2230 and 2232 Trenton avenue..	51 00
		Total........................	$1,711 50

Schedule of Charges against the Public Schools at the Regular Rates.

Wards.	Names.	Locations.	Amount.
First	Calhoun School	Tenth street and Snyder avenue	$58 00
"	Tasker "	Southeast corner Ninth and Tasker streets	20 00
"	Colored Consolidated School	South side Dickinson street, below Seventh street	15 00
"	Weccacoe "	Second and Reed streets	53 00
"	William Welsh "	Southeast corner Thirteenth and Jackson streets	36 00
"	Levin Handy Smith "	Fifth street and Snyder avenue	37 00
"	Henry Clay "	West side Lancaster street, above Reed street	18 00
"	Morris "	South side Morris street, east of Second street	16 00
"	First Ward Grammar "	Southeast corner Seventh and Dickinson streets	37 00
Second	George W. Nebinger "	North side Carpenter street, above Sixth street	22 00
"	Wharton "	Fifth street, below Washington avenue	106 00
"	Washington "	Carpenter street, above Ninth street	32 00
"	Watson "	Mary street, below Second street	20 00
"	John Hockdale "	Thirteenth and South Marshall street	62 00
Third	Mt. Vernon "	Catharine street, above Third street	39 00
"	Fletcher "	Christian street, above Front street	21 01
"	Thomas B. Florence "	Catharine street, below Eighth street	30 00
"	Lyons "	Southeast corner Catharine and Erie streets	8 00

Schedule of Charges against the Public Schools at the Regular Rates—Continued.

Wards.	Names.	Locations.	Amount.
Fourth	Ringgold School	Northeast corner Eighth and Fitzwater streets	$46 00
"	Fagen "	Twelfth street and Fitzwater street	23 00
"	William M. Meredith School	Fifth street, abŏve German street	47 00
"	Ralston "	Northeast corner Guilford and Bainbridge streets	18 00
"	Ronaldson "	605 Fitzwater street	8 00
Fifth	Horace Binney "	527 to 531 Spruce street	78 00
"	George W. Wharton "	Third street, above Lombard street	76 00
"	James Forten "	Southwest corner Sixth and Minster streets	42 00
Sixth	No. 1 Primary "	South side New street, below Second street	12 00
"	Northeast Boys' Grammar School	Northwest corner Crown and Race streets	32 00
"	Northeast Secondary School	222–224 Crown street	30 00
Seventh	U. S. Grant School	Northeast corner Seventeenth and Pine streets	35 00
"	Secondary No. 4, School	415 South Nineteenth street	22 00
"	O. V. Catto "	2028 Lombard street	20 00
"	Secondary No. 1, "	409 South Twenty-third street	14 00
"	Secondary No. 3, "	1119 Pine street, northeast corner Quince street	65 00
Eighth	Jemes A. Garfield "	Southwest corner Twenty-second and Locust streets	25 00
"	Hollingsworth "	South side Locust street, west of Broad street.	61 00

Schedule of Charges against the Public Schools at the Regular Rates—Continued.

Wards.	Names.	Locations.	Amount.
Eighth	Locust Street School	Northeast corner Twelfth and Locust streets	$33 00
Ninth	Filbert Street "	2015 Filbert street	21 00
"	Zane Street "	713 Filbert street	28 00
"	Keystone "	West side Nineteenth street, north of Chestnut street	45 00
Tenth	Sergeant Street School	920 Sergeant street	9 00
"	Northwest "	North side Race street, west of Broad street	32 00
"	Cherry Street "	1522 Cherry street	8 00
"	John Agnew "	1022 Cherry street	20 00
"	Edward Shippen "	North side Cherry street, west of Nineteenth street	24 00
Eleventh	Shunk Primary "	East side New Market, north of Brown street	16 00
"	Madison "	East side New Market, north of Noble street	22 00
"	Northern Liberties School	Third street, above Green street	22 00
"	Biedeman School	481 St. John street	20 00
Twelfth	Saunders "	Northwest corner Dillwyn and Callowhill streets	18 00
"	Rovoudt "	432-34-36 Maria street	16 00
"	E. M. Paxton School	Noble street, below Sixth street	30 00
"	Mifflin School	810 North Third street	22 00
Thirteenth	Adams "	Garden street, below Buttonwood street	37 00

Schedule of Charges against the Public Schools at the Regular Rates—Continued.

Wards.	Names.	Locations.	Amount.
Thirteenth..........	Warner School....................................	Perth street, above Parrish street..	$22 00
"	Wyoming School..................................	Northwest corner Sixth street and Fairmount avenue..	35 00
Fourteenth..........	Robert Vaux School...............................	North side Wood street, between Eleventh and Twelfth streets.........................	75 00
"	Monroe "	Wood street, east of Twelfth street..	72 00
"	Hancock "	Fairmount avenue, west of Twelfth street..	51 00
"	John M. Ogden School............................	Northeast corner Twelfth and Wistar streets..	69 00
"	Spring Garden "	Southeast corner Twelfth and Ogden streets...	64 00
"	Central High "	Southeast corner Broad and Green streets...	82 00
"	Robert T. Conrad "	South side Melon street, east of Twelfth street..	24 00
Fifteenth	Lincoln School....................................	Southeast corner Twentieth street and Fairmount avenue.................................	88 00
"	Practice "	Nos. 1619, 1621 Spring Garden street...	33 00
"	Girl's Normal School............................	Northeast corner Seventeenth and Spring Garden streets..................................	89 00
"	A. D. Bache "	Northeast corner Twenty-second and Brown streets...	74 00
"	Hoffman "	Northeast corner Seventeenth and Wood streets..	98 00
"	Thaddeus Stevens' School.......................	Northwest corner Seventeenth and Grayson streets..	116 00
"	Livingston "	Northeast corner Twenty-third and Shamokin streets.......................................	76 00
Sixteenth............	Wm. A. Lee "	Nos. 1111 to 1115 Howard street..	22 00
"	Landenberger "	Nos. 1113 to 1117 North Fourth street..	26 00

Schedule of Charges against the Public Schools at the Regular Rates—Continued.

Wards.	Names.	Locations.	Amount.
Sixteenth...........	Wolfe School..	Nos. 915 to 919 Charlotte street..	$25 00
"	Jefferson "	Nos. 912 to 916 North Fifth street..	28 00
Seventeenth.........	Webster "	Nos. 1231 to 1239 Hancock street..	16 00
"	Harrison "	Master street, above Second street..	22 00
"	James R. Ludlow School........................	Northeast corner Master and Lawrence streets................................	29 00
Eighteenth..........	Vaughan "	Nos. 1324 to 1326 Marlborough street..	48 00
"	Morris "	Nos. 1316 to 1322 Palmer street..	16 00
"	George Chandler "	Nos. 1020 to 1024 Montgomery avenue..	36 00
"	Douglass "	Southeast corner Edgemont and Huntingdon streets................................	16 00
"	T. K. Finletter "	Northeast corner Montgomery avenue and Gaul streets................................	29 00
"	Primaries, Nos. 7 and 8........................	Southwest corner Belgrade and Otis streets................................	16 00
Nineteenth..........	Wm. H. Hunter School........................	Southeast corner Dauphin and Mascher streets................................	37 00
"	Cohocksink "	Northwest corner Montgomery avenue and Fourth street................................	20 00
"	Cumberland "	Southwest corner Cumberland and Hancock streets................................	37 00
"	Wm. Anderson "	East side Fourth street, below Lehigh avenue................................	37 00
"	Price "	East side Howard street, north of Diamond street................................	27 00
"	Franklin "	East side American street, north of Columbia avenue................................	14 00
Twentieth...........	Penn "	Southeast corner Eighth and Thompson streets................................	63 00

Schedule of Charges against the Public Schools at the Regular Rates—Continued.

Wards.	Names.	Locations.	Amount.
Twentieth............	Rutledge School....................................	Northwest corner Seventh and Norris streets..	73 00
"	James Todd School..............................	Northwest corner Franklin and Norris streets...	66 00
"	James Lynd "	Twelfth street, above Columbia avenue..	54 00
"	Primary, No. 7 "	Nos. 1523 to 1531 Mervine street..	58 00
"	Daniel Webster "	Eleventh street, below Thompson street...	64 00
"	Park Avenue "	Park avenue, above Thompson street...	27 00
Twenty-first........	Levering "	West side Ridge avenue, north of Roxborough avenue....	22 00
"	Roxborough "	West side Ridge avenue, north of Cinnaminson street.....................................	7 00
"	Schuylkill Secondary School..................	East side Washington street, north of Hermitage street..................................	16 00
"	Fairview "	West side Manayunk avenue, north of Lyceum avenue....................................	45 00
"	Washington Primary "	East side Shur's lane, east of Cresson street..	23 00
"	Manayunk Grammar "	Nos. 175 to 187 Green lane..	20 00
Twenty-second....	Rittenhouse "	South side Rittenhouse street, east of Green street..	16 00
"	C. W. Scheaffer "	Germantown avenue and Wyoming street..	22 00
"	Bringhurst "	North side Bringhurst street, west of Wakefield street.....................................	16 00
"	Central Primary "	Nos. 128 to 136 Centre street...	16 00
"	Chestnut Hill "	South side Highland avenue, west of Twenty-ninth street................................	21 00
"	Germantown "	Northeast corner Adams and Lafayette streets...	102 00

Schedule of Charges against the Public Schools at the Regular Rates—Continued.

Wards.	Names.	Locations.	Amount.
Twenty-third	Henry Herbert School..........................	East side Frankford avenue, south of Foulkrod street..	37 00
"	Orchard Street "	Nos 4278 to 4282 Orchard street..	5 00
"	Marshall "	Northwest corner Sellers and Franklin streets..	19 00
"	Wilmot "	South side Meadow street, 86 feet west of Mulberry street................................	8 00
"	White Hall "	Southwest corner Pratt and Tacony streets...	24 00
Twenty-fourth.....	Norris J. Hoffman "	Northeast corner Fifty-fifth and Vine streets...........	31 00
"	Jesse George "	South side Hamilton street, west of Sixty-third street.......................................	28 00
"	Martha Washington School.....................	Northwest corner Forty-fourth and Aspen streets..	30 00
"	Belmont "	Southeast corner Forty-first and Oregon streets...	32 00
"	Warren "	East side Thirty-eighth street, below Warren street..	42 00
"	Mantua "	East side Thirty-eighth street, below Mt. Vernon street....................................	30 00
"	Haverford "	No. 3415 Haverford avenue..	28 00
Twenty-fifth........	Carroll "	No. 1528 Salmon street..	11 00
"	Henry W. Halliwell "	Northwest corner Frankford avenue and Clementine street................................	51 00
"	Sherman "	Northeast corner Frankford avenue and Somerset street....................................	23 00
"	George B. McClellan, No. 1, School.........	Northeast corner Edgemont and Neff streets..	16 00
"	George B. McClellan, No. 2, "	Northeast corner Thompson and Neff streets..	29 00
"	Boudinot School..................................	Southwest corner D street and Indiana avenue...	26 00

Schedule of Charges against the Public Schools at the Regular Rates—Continued.

Wards	Names.	Locations.	Amount.
Twenty-fifth........	Irving School..	North side Kirkbride street, northwest of Howell street................................	$16 00
"	Barton "	Southwest corner Frankford avenue and Buckius street................................	17 00
"	Asa Packer School................................	Southwest corner Broad and McFerron streets..	20 00
"	Bayard Taylor School............................	West side Turner street, north of Venango street..	26 00
Twenty-sixth.......	Jackson "	Southeast corner Twelfth and Federal streets..	151 00
"	James Alcorn "	Northeast corner Thirty-fourth and Wharton streets..	24 00
"	Landreth "	Southeast corner Twenty-third and Federal streets..	16 00
"	Girard "	Northwest side Passyunk avenue, west of Eighteenth street............................	8 00
"	Point Breeze "	Twenty-seventh street and Passyunk avenue..	16 00
"	Jeremiah Nichols School......................	Northeast corner Sixteenth and Wharton streets..	113 00
"	James Logan "	Northwest corner Nineteenth and Reed streets..	41 00
Twenty-seventh...	Newton Grammar "	Northwest corner Thirty-eighth street and Woodland avenue..........................	45 00
" ...	Newton Primary "	3459 Ludlow street...	24 00
" ...	Newton Secondary "	South side Chestnut street, east of Thirty-sixth street....................................	30 00
" ...	Greenway "	Fifty-second street and Woodland avenue..	10 00
" ...	Price "	Northwest corner Forty-seventh and Locust streets..	24 00
" ...	Paschallville "	Seventieth street and Woodland avenue..	13 00
" ...	West End "	Sixtieth and South streets..	10 00

Schedule of Charges against the Public Schools at the Regular Rates—Continued.

Wards.	Names.	Locations.	Amount.
Twenty-eighth.....	Oakdale School..........................	Northeast corner Eleventh and Huntingdon streets..........................	$34 00
"	Camac "	Southwest corner Thirteenth street and Susquehanna avenue..........................	64 00
"	James L. Claghorn School..........................	Southwest corner Seventeenth street and Susquehanna avenue..........................	36 00
"	T. H. Powers "	Southwest corner Susquehanna avenue and Woodstock street..........................	30 00
"	Bellevue "	Northwest corner Twenty-sixth and Cumberland streets..........................	32 00
"	Kenderton "	Northwest corner Fifteenth and Ontario streets..........................	34 00
"	Glenwood "	East side Ridge avenue, west of Thirty-second street..........................	16 00
"	Falls of Schuylkill "	South side Queen lane, west of Railroad..........................	5 00
Twenty-ninth......	Muhlenberg "	Southeast corner Seventeenth and Master streets..........................	20 00
"	Elisha Kent Kane "	Southeast corner Twenty-sixth and Jefferson streets..........................	71 00
"	Morris City "	Southeast corner Taney and Thompson streets..........................	16 00
"	Edward Gratz "	Southeast corner Twenty-third and Jefferson streets..........................	29 00
"	Reynolds "	Southwest corner Twentieth and Jefferson streets..........................	14 00
"	George G. Meade "	Northwest corner Eighteenth and Oxford streets..........................	61 00
Thirtieth.............	James Pollock "	Southeast corner Birch and Fitzwater streets..........................	16 00
"	Curtin "	Southwest corner Twentieth and Catharine streets..........................	16 00
"	Edwin M. Stanton "	Southeast corner Seventeenth and Christian streets..........................	77 00
"	William G. Pierce "	Southwest corner Twenty-fourth and Christian streets..........................	65 00

Schedule of Charges against the Public Schools at the Regular Rates—Continued.

Wards.	Names.	Locations.	Amount.
Thirty-first	Lucretia Mott School..............................	2206 to 2216 Huntingdon street..	43 00
"	Adams "	2030 to 2036 Adams street.......	24 00
"	John S. Hart "	2334 to 2348 York street..	41 00
		Total................................	$5,825 00

Schedule of Charges against Public Buildings at the Regular Rates.

Wards.	Names.	Locations.	Amount.
Fifth	Mayor's office	Square bounded by Fifth and Sixth and Chestnut and Walnut streets	$20 00
"	Telegraph Department		40 00
"	Office Clerks of Councils		21 00
"	Council Chambers		12 00
"	Court of Common Pleas, No. 1		32 00
"	" " No. 2		26 00
"	" " No. 3		18 00
"	" " No. 4		12 00
"	Sheriff's office		12 00
"	Independence Hall		52 00
"	Prothonotary's office		36 00
"	Old Court House		25 00
"	New "		84 00
"	Independence Square		47 00
Ninth	Basement	New City Hall, Broad and Market streets	662 00
"	West end, first floor		85 00
"	City Treasurer		18 00
"	City Controller		8 00

Schedule of Charges against Public Buildings at the Regular Rates—Continued.

Ward.	Names.	Locations.	Amount.
Ninth	City Commissioners	New City Hall, Broad and Filbert streets	$4 00
"	Southeast corner, first floor	"	48 00
"	Headquarters National Guards	"	4 00
"	Commissioner of City Property	"	6 00
"	Commissioners of Fairmount Park	"	8 00
"	Board of Revision of Taxes	"	4 00
"	Tax Assessors's office	"	2 00
"	Delinquent Tax office	"	4 00
"	Northeast corner, first floor	"	48 00
"	Receiver of Taxes	"	16 00
"	Northeast corner, second floor	"	48 00
"	Survey Department	"	13 00
"	Highway Department	"	6 00
"	Southeast corner, second floor	"	27 00
"	Architect's office	"	6 00
"	Supreme Court	"	33 00
"	Superintendent's office	"	10 00
"	Board of Guardians' office	42 North Seventh street	12 00

Schedule of Charges against Public Buildings at the Regular Rates—Continued.

Wards.	Names.	Locations.	Amount.
Tenth	Water Department shops	916 and 918 Cherry street	$53 00
"	State Fencibles armory	East side Broad, south of Race street	65 00
Eleventh	Morgue	Northwest corner Beach and Noble streets	14 00
Fourteenth	Spring Garden Hall	Northwest corner Thirteenth and Spring Garden streets	41 00
Seventeenth	Purveyor's office (Water Department)	Frankford avenue and Master street	5 00
Twenty-first	Engineer's houses (Water Department),	West side Pennsylvania and Norristown railroad, south of Shawmont	22 00
Twenty-second	Town Hall	Northeast corner Germantown avenue and Lafayette street	27 00
"	Fountain (Ellis Post)	East side Germantown avenue, north of Mill street	8 00
Twenty-third	Gas office	Southeast corner Frankford avenue and Ruan street	12 00
Twenty-sixth	Water Department	South side Wharton, east of Twelfth street	14 00
"	Highway Department	South side Wharton, east of Twelfth street	10 00
"	County Prison	West side Passyunk avenue, from Reed to Dickinson streets	2,376 00
Twenty-seventh	Philadelphia Almshouse	Thirty-fourth, south of Pine street	3,333 00
"	Highway Department	Southwest side Woodland avenue, west of Spruce street	7 00
Twenty-ninth	Water Department	Northeast corner Twenty-sixth and Master streets	19 00
		Total	$7,515 00

Schedule of Charges against Fairmount Park at the Regular Rates.

Names.	Locations.	Amount.
West Park	Belmont, including sprinklers for entire Park	$1,148 24
West Park	Belmont Mansion	83 00
West Park	British Building	18 00
West Park	Ohio Building	7 00
West Park	Memorial Hall	250 00
West Park	Horticultural Hall	98 00
West Park	Greenhouse adjoining Horticultural Hall	20 00
West Park	Outside grounds	128 00
West Park	Sweet Briar Mansion	15 00
West Park	Rhode Island Building	9 00
West Park, jet fountain	Lake west of Belmont avenue, north of Elm avenue	6,500 00
West Park, " "	Catholic Total Abstinence Society, north of Elm avenue	1,000 00
East Park, drinking fountain	North front Lemon Hill Mansion	168 00
East Park, " "	Northeast from Lemon Hill Mansion	112 00
East Park, " "	Northeast of Sedgley Guard-house	10 00
East Park, jet fountain	Northeast of Sedgley Guard-house	560 00
East Park, " "	East side forebay	560 00
East Park, " "	Green street entrance	756 00

Schedule of Charges against Fairmount Park at the Regular Rates—Continued.

Names.	Locations.	Amount.
East Park, jet fountain	On lawn east of steamboat landing	735 00
East Park, " "	On lawn northeast of steamboat landing	735 00
East Park, trefoil fountain	East of Lincoln Monument	2,205 00
East Park, fish pond	Main drive, near Brown street entrance	1,984 00
East Park, large fountain	West of Thirty-third street, south side Dauphin street	1,003 00
	Total	$18,1[illegible]4 24

List of Charitable Institutions

Which, under the provisions of the ordinance of June 21, 1878, and June 16, 1881, are charged 15 per cent. of the regular rates.

Wards.	Names.	Locations.	When placed on charity list.	Amount assessed.	Amount charged.
First	Sisters of St. Francis	505 Reed street	June 7, 1883	$22 00	$5 00
Second	St. Ann Widows' Asylum	906 Moyamensing avenue	June 21, 1878	24 00	5 00
"	Ridgway Library	Broad street, southeast corner Christian street	January 21, 1882	107 00	16 05
Third	Maternity Hospital	730–32–34 South Tenth street	December 21, 1883	12 00	5 00
"	Industrial Home	762 South Tenth street	June 21, 1878	50 00	7 50
"	Southern Home for Destitute Children	Southeast corner Fitzwater and Twelfth streets	June 21, 1878	154 00	23 10
"	Philadelphia Society for Employment and Instruction of the Poor	714–718 Catharine street—Special ordinance	March 23, 1878	76 75	5 00
Fourth	Institute for Colored Youth	915–919 Bainbridge street	April 17, 1883	28 00	5 00
"	Bedford Mission	619–621 Alaska street	June 2, 1879 June 11, 1879	121 00	18 15
Fifth	City Mission	411 Spruce street	April 10, 1883	16 00	5 00
"	Philadelphia Dispensary	127 South Fifth street	April 19, 1881	34 50	5 00
"	Newsboys' Aid Society	251 South Sixth street	September 20, 1881	62 90	9 43
Sixth	National Guard's Hall	518–520 Race street	April 26, 1884	54 00	8 10
"	Apprentices' Library	Arch street, southwest corner Fifth street	June 21, 1878	23 00	5 00
Seventh	Howard Hospital	1518–1520 Lombard street	April 10, 1883	22 50	5 00
"	Pennsylvania Hospital	Southwest corner Eighth and Spruce streets	June 21, 1878	520 50	78 18

List of Charitable Institutions—Continued.

Wards.	Names.	Locations.	When placed on charity list.	Amount. assessed.	Amount. charged.
Seventh	Western Soup Society	1613–1615 South street	June 21, 1878	$21 00	$5 00
"	Clinton street Boarding House	913–915 Clinton street	June 21, 1879 Sept. 30, 1879	80 00	12 00
"	Deaf and Dumb Asylum	1025 Clinton street	October 22, 1885	8 00	5 00
"	Deaf and Dumb Asylum	317 South Eleventh street	October 22, 1885	99 00	14 85
"	Deaf and Dumb Asylum	Broad street, northwest corner Pine street	June 21, 1878	698 00	104 70
"	Day Nursery	2218 Lombard street	October 3, 1882	12 00	5 00
"	Lincoln Institute	324 Eleventh street—Special Ordinance	March 23, 1873	106 00	5 00
Eighth	Midnight Mission	919 Locust street	December 21, 1883	23 00	5 00
"	Philadelphia Library	Northwest corner Juniper and Locust streets	January 31, 1882	66 00	9 90
"	Jefferson Hospital	Sansom street, south side, west of Tenth street	June 21, 1878	483 00	72 45
"	Union Benevolent Association	701 Sansom street	February 13, 1883	61 00	9 15
"	Jefferson College	Tenth street, west side, south of Sansom street	June 21, 1878	136 00	20 40
"	Children's Hospital	207 South Twenty-second street	June 21, 1878	103 00	15 45
"	St. James' School	151 South Twenty-fourth street	February 10, 1885	21 00	5 00
"	Historical Society	Southwest corner Thirteenth and Locust streets	February 28, 1884	20 00	5 00
Ninth	Women's Christian Association	1605 Filbert street	June 21, 1878	23 00	5 00
"	Homœopathic Hospital	1116–1118 Cuthbert street	June 13, 1881	29 00	5 00

List of Charitable Institutions—(Continued.)

Wards.	Names.	Locations.	When placed on charity list.	Amount assessed.	Amount charged.
Tenth	Central Soup Society	709–711 Cherry street	June 13, 1881	$103 00	$15 45
"	Indigent Widows' and Single Women's Society	North side Cherry street, east of Eighteenth st.	June 21, 1878 June 18, 1879	61 00	9 15
"	Catholic Home for Destitute Children & Orphan Girls	1718–1720 Race street	June 21, 1882	42 00	6 30
"	Wills' Eye Hospital	1810–1824 Race street	June 21, 1878	248 00	37 20
"	Academy of Natural Sciences	Race street, southwest corner Nineteenth street.	June 21, 1878	109 00	16 35
"	Presbyterian Historical Society	1227–1229 Race street	June 20, 1882	17 00	5 00
"	Pennsylvania Institute for the Instruction of the Blind	Northeast corner Race and Twentieth streets	June 21, 1882	451 00	67 45
"	Orthopædic Hospital	Summer st., northwest corner Seventeenth st	June 21, 1878	126 00	18 90
"	Academy of Fine Arts	Northwest corner Broad and Cherry streets	June 21, 1878	276 00	41 40
"	Magdalen Society of Philadelphia	Northeast corner Twenty-first and Race streets.	June 21, 1878	67 00	10 05
"	Hahnemann College	222–232 North Broad street	August 16, 1886	186 00	27 90
"	Friends' School	North side Cherry st., east of Seventeenth st.	April 16, 1886	71 00	10 65
Twelfth	Northern Soup Society	817 North Fourth street	June 21, 1878	40 50	6 07
"	Home Association	505 North Sixth street	June 21, 1878	18 00	5 00
Thirteenth	Northern Dispensary	606–610 Fairmount avenue	June 21, 1878	41 50	6 23
"	Sheltering Arms	717 Franklin street	September 16, 1885	29 00	5 00

List of Charitable Institutions—Continued.

Ward.	Names.	Locations.	When placed on charity list.	Amount assessed.	Amount charged.
Fourteenth..........	First Regiment Armory..........................	Southeast corner Broad and Callowhill streets...	March 19, 1884	$119 00	$17 85
"	Spring Garden Institute..........................	1349–53 Spring Garden street..........................	October 22, 1883	45 00	6 75
Fifteenth	Preston Retreat..	N. W. cor. Twentieth and Hamilton streets......	June 21, 1878	121 00	18 15
"	Home Infirmary..	2208 Brown street..	July 27, 1878	23 00	5 00
"	Northern Home for Friendless Children.	N. E. cor. Twenty-third and Brown streets.... ...	June 21, 1878	110 00	16 50
"	Soldiers' Orphans' Home..........................	N. E. cor. Twenty-third and Brown streets (rear)	June 21, 1879	85 00	12 75
"	House of Refuge..	N. W. cor. Twenty-second and Parrish streets...	March 18, 1879	1,050 42	157 57
"	" " (colored)	" " " " ..	March 18, 1879	400 00	60 00
"	Howard Institute..	1610 Poplar street..	June 7, 1883	13 00	5 00
"	" "	1612 " "	June 7, 1883	16 00	5 00
"	Jewish Foster Home..................................	S. W. cor. Twenty-fourth and Poplar streets.....	June 21, 1878	49 00	7 35
"	C. Morrison..	2426 Hare street..	June 24, 1879	5 00	
"	St. Vincent Home for Destitute Infants...	N. W. cor. Eighteenth and Wood streets............	June 21, 1878	109 00	16 58
"	Northern Home Infirmary..........................	826 North Twenty-third street..........................	November 16, 1880	11 00	5 00
"	Home for Aged Couples..............................	1721–23 Francis street..	December 5, 1883	14 00	5 00
"	Charity Hospital..	1832 Hamilton street..	February 5, 1885	17 00	5 00
"	Eastern Penitentiary..................................	N. E. cor. Twenty-second and Fairmount ave...	February 12, 1886	1,824 00	500 00

List of Charitable Institutions—Continued.

Ward.	Names.	Locations.	When placed on charity list.	Amount assessed.	Amount charged.
Sixteenth	Day Nursery	1008 North Fifth street	July 31, 1885	$29 00	$5 00
"	Wayfarers' Home	76–80 Laurel street	June 9, 1886	64 00	9 60
Eighteenth	St. Mary's Hospital	N. E. cor. Palmer street and Frankford avenue.	June 21, 1878	56 00	8 40
Nineteenth	Episcopal "	S. E. cor. Front street and Lehigh avenue	June 21, 1878	649 00	97 35
"	Northeastern Soup Society	1940 North Front street	June 21, 1878	8 00	5 00
"	St. Christopher's Hospital	N. W. cor. Lawrence and Huntingdon streets ...	September 2, 1884	82 00	12 30
Twenty-second	Women's Christian Association	4781 Germantown avenue	January 31, 1885	15 00	5 00
"	Young Men's Christian "	5019 " "	January 25, 1882	71 00	10 65
"	Lutheran Orphan's Home	5576 " "	June 21, 1878	67 00	10 05
"	" Asylum for Aged	5580 " "	June 21, 1878	84 00	12 60
"	Jewish Hospital	Cottage avenue	June 21, 1878	194 50	29 50
"	Germantown Hospital	East Penn street, west of Chew street	June 21, 1878	92 00	13 80
"	Pauline Home	" " east of Ross street	March 4, 1883	39 00	5 85
"	Litttle Sisters of the Poor	Mill street, fourth house east of Ross street	June 21, 1878	140 00	21 00
"	Jewish Foster Home	" first house west of Chew street	June 7, 1881	132 00	19 80
"	Germantown Poor House	Rittenhouse street	June 21, 1878	57 00	8 55
"	Home for Consumptives	East side county line, north of Evergreen ave	November 13, 1886	138 00	20 70

List of Charitable Institutions—Continued.

Ward.	Names.	Locations.	When placed on charity list.	Amount assessed.	Amount charged.
Twenty-fourth.....	Working Home for Blind Men................	3518 Lancaster avenue.....	June 21, 1878	$100 00	$15 00
"	Union Home for Old Ladies..........	N. W. cor. Lancaster and Girard avenues..........	June 21, 1878	15 00	5 00
"	Presbyterian Hospital...........................	S. W. cor. Powelton and Saunders avenues........	June 21, 1878	305 00	45 75
"	Pennnsylvania Home for Blind Women..	N. E. " " " "	June 18, 1881	73 00	10 95
"	Old Men's Home..................................	N. W. " " " "	June 18, 1881	170 00	25 50
"	Pennsylvania Hospital for Insane (female)	Haverford avenue, south side...........................	June 21, 1878; Feb. 17, 1879	880 00	132 00
"	" " " (male)..	S. E. cor. Haverford avenue and Fiftieth street.	June 21, 1878; Feb. 17, 1879	933 50	140 03
"	Colored Home..	S. W. cor. Forty-fourth street and Girard ave....	June 21, 1878	118 00	15 45
"	House of Good Shepherd.........................	" Thirty-fifth and Fairmount avenue...	June 21, 1878	516 00	77 40
"	Philadelphia Home for Infants...............	S. E. cor. Westminster avenue and Markoe st....	June 21, 1878	88 00	13 20
"	St. John's Orphans' Asylum.....................	Westminster avenue, north side.........................	June 21, 1878	105 00	15 75
"	Western Home for Poor Children...........	S. E. cor. Forty-first and Baring streets..............	April 18, 1882	44 00	6 60
"	Pennsylvania Homœopathic Hospital for Children...	S. W. cor. Forty-third and Brown streets...........	June 21, 1878	37 00	5 55
"	Colored Orphan's Home..........................	" Forty-fourth and Wallace streets (Special Ordinance)................................	March 23, 1878	74 50	11 17
"	Baptist Orphanage..........	" Forty-fifth and Fairmount avenue......	June 21, 1878	26 00	5 00
"	Zoological Garden..................................	" Thirty-fifth and Girard avenue	November 3, 1886	1,000 00	150 00

List of Charitable Institutions—Continued.

Ward.	Names.	Locations.	When placed on charity list.	Amount assessed.	Amount charged.
Twenty-fifth........	Old Ladies' Home..................................	Frankford avenue, north of cemetery...............	May 31, 1881	$11 00	$5 00
Twenty-seventh...	West Philadelphia Industrial School......	N. W. cor. Thirty-ninth and Pine streets..........	June 21, 1878	118 00	17 70
" ...	House of the Guardian Angel.........	N. E. cor. Seventieth and Woodland avenue......	April 16, 1886	97 00	14 55
" ...	University of Pennsylvania.....................	Northeast cor. Thirty-sixth and Spruce streets..	June 21, 1878	1,323 50	198 50
" ...	" " Veterinary Dep't	Southwest cor. Thirty-sixth and Pine streets....	June 21, 1878	127 00	19 05
" ...	" " Biological Dep't..	S. side Pine, bet. Thirty-seventh and Cleveland	June 21, 1878	95 00	14 25
" ...	" " Nurse Dep't.......	S. side Spruce street, west of Thirty-fourth street	June 21, 1878	47 00	7 05
" ...	Home for Colored Children.....................	Woodland ave., east of Forty-sixth street.........	April 15, 1885	32 00	5 00
" ...	Home for Incurables.............................	" " " Forty-eighth street........	January 1, 1883	129 00	19 35
" ...	Divinity School.....................................	" " southeast cor. Fiftieth street.....	April 16, 1883	200 00	30 00
" ...	Presbyterian Orphans' Home.................	" " west of Fifty-eighth street.......	July 18, 1878	128 00	19 20
" ...	Educational Home.................................	" " and Forty-ninth St. (sp. ord.)...	March 23, 1878	179 50	5 00
Twenty-eighth.....	Baptist Home..	Southeast cor. Seventeenth and Norris streets...	June 21, 1878	223 00	33 45
"	Odd Fellows' Home.....	Southeast cor. Seventeenth and Tioga streets.....	June 21, 1878	97 00	14 55
"	Methodist Episcopal Home.....................	Northeast cor. Thirteenth st. and Lehigh av......	June 21, 1878	178 00	26 70
"	Women's Homœopathic Hospital............	2135 and 2137 North Twentieth street...............	October 1, 1884	40 00	6 00
"	Masonic Home......................................	3333 North Broad street..................................	November 2, 1886	12 00	5 00

List of Charitable Institutions—Continued.

Ward.	Names.	Locations.	When placed on charity list.	Amount assessed.	Amount charged.
Twenty-eighth....	Masonic Home....................................	3337 North Broad street................................ ..	November 2, 1886	$14 00	$5 00
Twenty-ninth......	Homœopathic Hospital for Children.......	914 North Broad street...........................	December 21, 1883	61 00	9 15
"	School of Design for Women..................	1346 North Broad street..	June 21, 1878	129 00	19 35
"	Little Sisters of the Poor........................	East side Eighteenth street, north of Jefferson	June 21, 1878	192 00	28 80
"	German Hospital....................................	Southwest cor. Corinthian and Girard avenues..	June 21, 1878	743 00	111 45
"	House of Refuge....................................	Northwest cor. Twenty-second and Poplar sts...	June 21, 1878	439 00	65 85
"	St. Joseph's Hospital.............................	Southeast cor. Seventeenth st. and Girard av....	June 21, 1878	485 00	72 75
"	Women's Medical College.......................	Northwest cor. Twenty-first st. and N. Coll. av..	June 21, 1878	110 00	16 50
"	Women's Hospital.................................	Northeast cor. Twenty-second st. and N. Coll. av.	June 21, 1878	282 50	42 38
"	Girard College.................................... ...	South College avenue, north side......................	June 3, 1879	5,476 26	821 44
"	Union Temporary Home for Children.....	1525 Poplar street..	June 21, 1878	69 00	10 35
"	Northwest Soup Society.........................	1300 North Nineteenth street...........................	June 21, 1879	11 00	5 00
				$26,665 83	$4,258 88
		Loss of revenue to the city......	....	$22,406 95	

BY WARDS.

APPLI...	24	25	26	27	28	29	30	31	Total.
Aquaria	....	....	....	....	....	....	....	....	2
Bakeries	1	5	3	1	4	2	....	....	27
Barber shops	3	3	3	1	6	3	1	3	40
Bars	11	28	27	....	16	12	....	8	225
Basins and sink	164	43	21	173	545	188	18	10	1,989
Basins and sinks factories, hote	12	28	3	16	23	5	....	5	603
Baths in dwelli	506	674	745	227	811	353	29	114	5,196
Baths in public	....	....	....	....	....	....	....	....	25
Bidets	1	....	....	1	1	4	....	....	14
Bottling establi	....	1	....	....	....	....	....	....	6
Building purpo	89	173	89	47	132	47	5	14	1,063
Carriages and w	....	1	....	....	2	....	....	....	29
Cut-offs	19	13	62	7	29	33	44	57	896
Half dwellings	....	10	....	....	....	1	....	2	44
Drug stores	1	2	3	2	3	2	....	....	19
Ferrules, numb	594	1,088	865	210	948	392	68	240	7,380
Fountains, cou	....	2	2	2	2	....	....	2	32
Fountains, gard	....	1	....	....	4	....	....	....	9
Forges	....	....	....	2	....	....	....	....	4
Green-houses	3	16	....	....	1	1	....	....	39
Hydrants (new	549	1,050	793	191	892	334	21	166	6,021
Ice cream saloo	....	....	....	....	....	1	....	1	7
Lawn sprinkle	....	....	....	2	4	....	....	....	14
Laundries	....	....	1	....	1	4	....	....	29
Machines for sc bleaching, an	....	....	8	....	....	....	....	....	9
Milk houses	....	....	2	....	....	....	....	....	10

Ice crea		
Ice mach	....	1
Laborato	....	1
Laundri	3	4
Lawn sp	....	....
Machine	8	5

APPENDIX B.

REPORT OF THE CHIEF CLERK

OF THE DETAILED EXPENDITURE OF THE DEPARTMENT, DURING 1886.

PHILADELPHIA WATER DEPARTMENT.

February 1, 1887.

MR. JOHN L. OGDEN,
Chief Engineer.

SIR :—I have the honor to submit, herewith, a detailed statement of the expenditures of this Department for the year 1886; also a statement showing the total amounts available during the year, the sub-divisions of expenditures, and the balances remaining to the credit of the Department at the close of the year.

Respectfully,
J. T. HICKMAN,
Chief Clerk.

Detailed Expenditures of the Department for 1886.

General Appropriation.			Amount appropria'd.	Amount expended.	Balance merging.
An Ordinance to make an appropriation to the Water Department for the year 1886, approved December 30, 1885		$569,458 00			
Diminished by transfer to special appropriation for					
Refunds, March 1	$498 83				
Refunds July 17	2,608 39				
		3,107 22			
Net appropriation			$566,350 78		
Item 1. Salaries		$174,458 00			
Diminished by transfer to					
Refunds, March 1	$498 83				
Refunds July 17	2,608 39				
Item 7, October 11	1,000 00				
		4,107 22			
Net appropriation to Item 1			$170,350 78		
Salary of chief engineer			$7,000 00	$7,000 00	
" general superintendent			3,500 00	3,434 14	
" assistant engineers			4,700 00	3,505 96	
" draughtsmen			5,350 00	5,237 50	
" chief clerk			2,000 00	2,000 00	
" assistant clerks			1,980 00	1,980 00	
" janitor Spring Garden Hall			675 00	675 00	
" watchman Spring Garden Hall			675 00	675 00	
" lineman			720 00	720 00	
" telephone operators			840 00	840 00	
" foreman of laborers			675 00	675 00	
" watchmen (reservoirs)			6,750 00	6,750 00	
" policemen, with $40 each for uniforms			2,860 00	2,860 00	
" river watchmen			750 00	750 00	
" general storekeeper			800 00	800 00	
" correspondence clerk			1,000 00	1,000 00	
" clerk to general superintendent			900 00	900 00	
" assistant clerk to general superintendent			850 00	621 52	
" search clerk			1,100 00	1,100 00	
" assistant clerks			1,750 00	1,520 03	
" time clerk			900 00	900 00	
" messenger			600 00	600 00	
" pipe inspector			1,200 00	1,200 00	
" registrar			3,000 00	3,000 00	
" registrar chief clerk			1,350 00	1,350 00	
" cashier			1,300 00	1,300 00	
" permit clerk			1,080 00	1,080 00	
" assistant permit clerk			900 00	900 00	
" registering clerk			1,080 00	1,080 00	
" assistant registering clerk			900 00	900 00	
" entry clerks			2,000 00	2,000 00	
" bill clerk			1,300 00	1,300 00	
" general clerks			5,400 00	5,242 76	
" chief inspector			950 00	950 00	
" inspectors			17,100 00	16,997 50	
" messenger			800 00	800 00	
" purveyors			9,000 00	9,000 00	
" clerks to purveyors			3,600 00	3,540 00	
" general foremen			6,573 00	6,525 02	
" foremen of repairs			3,120 00	3,088 54	
" watchmen district yards			2,025 00	2,025 00	
" superintendent of shop			1,500 00	1,500 00	
" clerk of superintendent of shop			850 00	850 00	

Detailed Expenditures of the Department for 1886.

Salaries of Employes at Pumping Stations.	Engineer in charge.	First Engineer.	Second Engineer.	Assistant Engineers.	Oilers.	Firemen.	Coal Passers.	Watchmen.	Storekeepers.	Telegraph Operator.	Amount appropria'd.	Amount expended.	Balance merging.
Fairmount	....	1	1	....	4	....	....	....	1	....	$5,600 00	$5,589 91	
Spring Garden	1	....	....	4	6	14	4	....	1	1	23,860 00	23,154 20	
Belmont	1	....	....	2	2	4	4	....	1	....	10,800 00	10,244 63	
Roxborough	1	....	....	2	....	4	2	....	....	....	8,320 00	7,320 00	
Mt. Airy	....	....	....	2	....	....	2	....	....	....	2,970 00	2,970 00	
Chestnut Hill	....	....	....	1	....	....	1	....	....	....	1,410 00	1,410 00	
Frankford	1	....	....	....	1	2	....	1	....	....	3,925 00	3,925 00	
Kensington	....	....	....	....	2	....	....	....	....	....	1,620 00	1,431 00	
Salary of foreman carpenter											900 00	900 00	
" " bricklayer											950 00	950 00	
" " stonemason											900 00	900 00	
" " rigger											900 00	900 00	
" " painter											900 00	900 00	
Total												$169,767 71	$583 07

Detailed Expenditures of the Department for 1886.

General Appropriation.		Amount appropria'd.	Amount expended.	Balance merging.
Item 2. Regular supplies, including fuel, oil, gas, and small stores		$100,000 00		
Deficiencies of 1885:				
Bituminous coal	$46 45			
Pea coal, 754.09 tons at $2.58	1,946 54			
			$1,992 99	
Alcohol, 20 gals. at $2.40			48 00	
Bateaux, 5 at $56.00			280 00	
Brass fittings			473 09	
Babbitt metal			84 00	
Chandlery			2,914 21	
Forge			20 98	
Grease			6 50	
Gum valve-packing, etc			5,843 52	
Hardware			1,150 44	
Hemp packing			38 25	
Iron fittings			325 22	
Oil, black, 50 gals. at 9½ cts			4 75	
" castor, 98½ gal. at $1.25			123 13	
" cylinder, 1,442 gals. at 50 cts			703 00	
" " 1,974½ " " 55 "			1,085 99	
" electric, 51½ " " 60 "			30 90	
" " 51 " " 75 "			39 25	
" engine, 511½ " " 35 "			179 02	
" " 200½ " " 40 "			80 20	
" " 150½ " " 49 "			73 75	
" gasoline, 100½ " " 12 "			12 06	
" " 52½ " " 16 "			8 40	
" " 1,434½ " " 16½ "			218 63	
" headlight, 1,858½ " " 11¼ "			209 09	
" lard 1,057 " " 54 "			571 22	
" neatsfoot, 1 gal. with can			1 00	
Paints, paint oils, etc			1,247 25	
Tallow, 350 lbs., at 9 cts			31 50	
COAL FOR OFFICES AND SHOP.				
36 tons stove, at $5 25			188 95	
102 " nut, at $4.75			484 50	
71 " bituminous, at $4.75			337 25	
Wood, 24 cords, at $6.95			166 80	
" 22½ cords, at $7.45			167 63	
COAL FOR PUMPING STATIONS.				
Fairmount, 176 tons egg, at $4.50			792 00	
Spring Garden, 18,887.05 " pea, at 2.19			41,363 10	
Belmont, 6,647.18 " pea, at 2.10			13,960 61	
Roxborough, 26.14 " pea, at 2.78	$74 23			
Roxborough, 229.09 " pea, at 2.33	534 62			
Roxborough, 5,559.06 " pea, at 2.25	12,508 48			
			13,117 33	
Chestnut Hill, 1,216.18 " pea, at 2.63			3,200 53	
Frankford, 1,630.11 " pea, at 2.04			3,326 32	
Kensington, 2,467.17 " pea, at 2.04			5,034 44	
Totals			$99,935 77	$64 23

Detailed Expenditures of the Department for 1886.

General Appropriation.	Amount appropria'd.	Amount expended.	Balance merging.
Item 3. For repairs to machinery, and the conveyance of workmen incident thereto, $50,000 00			
Transferred to Item 4 .... 5,000 00			
Net appropriation to Item 3	$45,000 00		
Deficiency of 1885:			
Damper regulator	....	$300 00	
MATERIAL.			
Brass steam fittings	....	487 69	
Iron fittings	....	141 12	
Transportation	....	1,736 50	
Wages, carpenters, Second District $66 00			
" " Fourth " 214 50	....	280 50	
" painters, Second " $504 00			
" " Third " 138 00			
" " Fourth " 261 00	....	903 00	

Detailed Expenditures of the Department for 1886.

General Appropriation.									Amount appropria'd.	Amount expended.	Balance merging.
Item 3, continued.											
Material.	**Fairmount.**	**Spring Garden.**	**Belmont.**	**Roxborough.**	**Mt. Airy.**	**Chestnut Hill.**	**Frankford.**	**Kensington.**			
Brick, lime, and cement	$14 79	$668 18	$182 84			$12 38	$14 40			$892 59	
Covering steam-pipe		337 76		$201 67				$57 00		596 43	
Drip pans								8 00		8 00	
Fire-brick and clay		215 25	211 50	60 00	$4 50			84 00		575 25	
Gum valves and gasket		134 02						9 01		143 03	
Grate bars		371 01					371 00			742 01	
Lumber	24 00	42 20								66 20	
Piston castings			1 50							1 50	
Repairs to boilers	13 85	1,844 87	27 67	8 17		51 17	24 55	124 43		2,094 71	
Repairs to engines		12 49					112 44			124 93	
Repairs to pumps	1,811 00						4 50			1,815 50	
Totals	$1,863 64	$3,625 78	$423 51	$269 84	$4 50	$63 55	$526 89	$282 44		$7,060 15	

Detailed Expenditures of the Department for 1886.

General Appropriation.

Item 3, continued.

WAGES.	Fairmount.	Spring Garden.	Belmont.	Roxborough.	Mt. Airy.	Chestnut Hill.	Frankford.	Kensington.	Amount appropria'd.	Amount expended.	Balance merging.
Bricklayers	....	$1,430 50	1,864 12	$396 00	$432 25	$26 00	$171 50	$824 00		$5,144 37	
Carpenters	$2,047 00	1,399 50	358 00	277 50	....	....	196 00	....		4,278 00	
Horse, cart, and driver	....	....	....	12 00	....	....	....	....		12 00	
Laborers	340 50	3,088 51	519 63	236 00	....	....	173 75	293 13		4,651 52	
Machinists	2,786 81	3,856 24	2,397 19	2,270 86	256 12	215 87	2,368 93	1,312 13		15,464 15	
Painters	2,779 50	1,110 00	73 50	153 00	....	....	219 00	....		4,335 00	
Stonemasons	....	....	....	133 00	....	....	....	....		133 00	
Totals	$7,953 81	$10,684 75	$5,212 44	$3,478 36	$688 37	$241 87	$3,129 18	$2,429 26		$44,927 00	$73 00

Detailed Expenditures of the Department for 1886.

General Appropriation.		Amount appropria'd.	Amount expended.	Balance merging.
Item 4. Repairs to buildings, grounds, and reservoirs	$35,000 00			
By transfer from Item 3	5,000 00			
Net appropriation		$40,000 00		
Deficiency of 1885:				
Electric supplies			$21 50	
Brick, lime, and cement			1,188 59	
Chandlery			100 80	
Cleaning cess pool			30 50	
Electric supplies			868 30	
Forage			703 53	
Gum goods			43 20	
Harness			47 70	
Hardware			389 33	
Horse and harness			213 00	
Horses and carts			1,420 20	
Horse-shoeing			98 35	
Hauling ashes, Roxborough	$276 00			
" " Frankford	150 00			
" " Kensington	256 75			
			682 75	
Hauling coal			325 85	
Hire of engine			205 00	
Lumber			3,652 58	
Paints			823 43	
Repairs to heaters			65 95	
" roofs			580 45	
" scales			128 00	
" tools			3 51	
" tracks			396 27	
" wagons			96 95	
Roofing			310 50	
Scales			407 25	
Sodding			62 67	
Stone			289 51	
Tin plate			4 90	
Telephone calls			2 00	
" rental			612 50	
" supplies			18 03	
Piston rings			17 50	
Window curtains			20 75	
Wages, carpenters			3,520 50	
" drivers			322 00	
" foreman			171 00	
" helpers			3,921 75	
" laborers			14,425 95	
" lineman			10 00	
" painters			1,681 50	
" puddler			75 00	
" stableman			104 00	
" stonemasons			1,899 00	
Totals			$39,962 05	$37 95
Item 5. Maintenance and improvement of the distribution		$135,000 00		
Deficiency of 1885:				
Broken pipe	$100 49			
20-inch pipe	312 67			
Wharfage	100 34			
			$513 50	

Detailed Expenditures of the Department for 1886.

General Appropriation.	Amount appropria'd.	Amount expended.	Balance merging.
Item 5, continued.			
Brass castings		$1,124 17	
Bricks, lime, and cement		1,634 78	
Coke		367 35	
Chandlery		347 03	
Corporation cocks.—7,989— ½-inch, at $41		3,275 49	
" " — 358— ⅝-inch, at $51		182 58	
" " — 100— ¾-inch		67 00	
" " — 100—1-inch		90 00	
Desks		232 00	
Drain-pipe		104 62	
Diver		30 00	
Forge		29 89	
Freight		1 25	
Frost-valves		120 00	
Fire-clay		24 50	
Glazing		2 00	
Gum goods		1,023 39	
Hardware		1,911 00	
Hitching-post		24 00	
Hire of crab		21 00	
Horses and carts		245 70	
Hauling pipe		3,329 43	
Hay		1 98	
Inspecting pipe		784 10	
Iron fittings		237 16	
Iron specials, small, 87,333 lbs., at 02 1/10		1,833 99	
" " large, 8,315 lbs., at 02 2/10		182 93	
Lumber		5,968 94	
Lead, 100,060 lbs., at 4 89/100		4,892 93	
Measuring over pipe		2,150 39	
Oil, 103 gals. head-light, at 11¼ cents		11 59	
" 197½ gals. black, at 9½ cents,		18 78	
Paints		83 12	
Plumbing		122 46	
Powder		111 15	
Repairs to pavement		41 10	
" to gauge		37 30	
" to jacks		12 80	
" to meters		5 10	
" to pumps (ditch)		10 60	
" to tools		122 12	
" to tool houses		51 45	
Rent of shop and cellar		200 00	
Roofs		106 17	
Sawdust		20 00	
Spars		114 50	
Stone		16 20	
Tallow, 50 lbs., at 9 cents		4 50	
Tapping machines, three, at $125		375 00	
Use of dump		42 00	
Wheels and axles (for tool boxes)		171 63	
Window shades (Fourth District office)		7 00	
Wharfage		36 55	
Wages, improvement to distribution		9,278 39	
" First District		9,920 82	
" Second "		10,452 10	
" Third "		12,778 47	
" Fourth "		27,783 71	
" Fifth "		8,122 97	
" Sixth "		14,630 70	
" buildings, grounds, and reservoirs		9,548 62	
Totals		$134,989 95	$10 05

Detailed Expenditures of the Department for 1886.

General Appropriation.	Amount appropria'd.	Amount expended.	Balance merging.
Item 6. For supplies and labor at the city repair shop....$50,000 00			
Transferred to Item 7........ 1,000 00			
Net appropriation..........	$49,000 00		
Brass castings, 7,168 lbs., @ 10½ cts........ $752 60			
Brass castings, 14,430 lbs., @ 13½ cts...... 1,948 12			
$2,700 72			
CR.			
Brass scrap, 1,764 lbs., @ 7½ cts...$132 30			
Brass turnings, 2,100 lbs., @ 5½ cts 115 50			
$247 80	....	$2,452 92	
Brass fittings..........	....	142 60	
Bricks, lumber, and cement..........	....	742 35	
Chandlery..........	....	100 36	
Fire brick..........	....	51 60	
Fire clay..........	....	9 00	
Galvanizing..........	....	404 42	
Gas fixtures..........	....	39 00	
Green goods..........	....	666 40	
Hardware..........	....	1,737 35	
Iron fittings..........	....	133 09	
Iron and steel..........	....	2,651 03	
Lumber..........	....	1,200 37	
Machine work..........	....	3 50	
Oil, 48 gallons, headlight, @ 11¼ cts..........	....	5 40	
Paints..........	....	9 36	
Plug valves, 500 large, @ $5..........	....	2,500 00	
Plug valves, 100 small, @ $2.25..........	....	225 00	
Repairs to boilers..........	....	46 21	
Screw gear..........	....	2 55	
Shop castings, 291,082 lbs., at 1⅔..........	....	4,851 38	
Stone..........	....	67 50	
Tools..........	....	1,250 00	
Tallow, 100 lbs., @ 9 cts..........	....	9 00	
Wages..........	....	29,565 29	
Totals..........	....	$48,855 68	$144 32
Item 7. For general and incidental expenses, including keep of horses for Chief Engineer, Superintendent, and Assistant Engineer..........$15,000 00			
Increased by transfer:			
From Item 1.......... 1,000 00			
From Item 6.......... 1,000 00			
Net appropriation..........	$17,000 00		
Deficiency of 1885:			
Carriage hire..........$12 75			
Engineers' supplies.......... 60 62			
Ice.......... 13 76			
Stationery.......... 36 23			
Telephone calls.......... 9 85			
Wood.......... 8 75	....	$141 96	
Advertising..........	....	549 30	
Carpet..........	....	478 51	
Carriage hire..........	....	127 25	
Chandlery..........	....	78 38	
Desks and chairs..........	....	514 00	

Detailed Expenditures of the Department for 1886.

General Appropriation.	Amount appropria'd.	Amount expended.	Balance merging.
Item 7, continued.			
Engineers' supplies		$208 48	
Furnishing meals		315 95	
Ground rent		26 66	
Hardware		40 18	
Horses		482 50	
Incidentals		338 78	
Keep of horse (Chief Engineer)		650 00	
Keep of horse (Superintendent & Ass't Engineer)		716 93	
Maps		467 50	
Messenger service		35 93	
Morning papers		30 80	
Paper hanging		12 00	
Printing notice		71 38	
Services extra clerks, experts, gauge observers, &c		3,649 41	
Stationery		4,942 22	
Subscriptions to publications		37 00	
Text books and binding		67 99	
Transportation		2,117 15	
Travelling expenses (pipe inspectors)		209 12	
Telephone rental		585 00	
Washing towels		84 00	
Wood		7 75	
Totals		$16,986 13	$13 87
Item 8. For surveys and expenses connected therewith for a future water supply	$10,000 00		
Incidentals		$1,613 72	
Photo prints		242 40	
Services of surveying corps		8,142 98	
Totals		$9,999 10	90

Special Appropriations.		Amount appropria'd.	Amount expended.	Balance not merging
For the Extension of Works.				
Appropriation for surplus of Gas Loan No. 9, Ordinance May 18, 1886		$496,000 00		
Brass castings, 3,392 lbs., at $10\frac{1}{2}$ cents per pound	$356.21			
Brass castings, $11,414\frac{1}{2}$ lbs., at $13\frac{1}{2}$ cents per pound	1,540.92			
	1,897.13			
Credit—2,500 lbs. brass turnings, at 5 cents	125.00		$1,772 13	
Breeches pipes, 5 lengths, 13,478 lbs., at $3\frac{80}{100}$			512 16	
Bricks, lime and cement			988 88	
Freight			7 50	
Hauling pipe			8,477 33	
Hitching post			15 00	
Iron pipe:				
8,098 lengths 6″, 2,997,915 lbs., at $.01\frac{25}{100}$			37,474 02	
500 " 8″, 243,186 " $.01\frac{206}{1000}$			2,932 83	
500 " 10″, 334,926 " $.01\frac{206}{1000}$			4,039 82	
1,148 " 12″, 1,053,434 " $.01\frac{27}{100}$			13,378 62	
100 " 16″, 133,056 " $.01\frac{253}{1000}$			1,667 18	

Detailed Expenditures of the Department for 1886.

Special Appropriation.	Balance Jan. 1, 1886.	Amount expended.	Amount not merging
151 lengths 30″, 571,414 lbs. at .01 $\frac{20}{100}$		$6,856 96	
500 " 36″, 2,347,576 " .01 $\frac{20}{100}$		28,170 91	
1,180 " 48″, 9,123,532 " .01 $\frac{20}{100}$		109,481 54	
Iron specials:			
Small specials, 479,969 lbs., at .02 $\frac{1}{10}$		10,079 37	
Large specials, 247,018 " .02 $\frac{2}{10}$		5,434 42	
Lead, 533,098 lbs., at .04 $\frac{89}{100}$		26,068 45	
Lumber		506 94	
Plumbing		234 05	
Plug valves, 500, at $5.00		2,500 00	
" " 200, at $2.25		450 00	
Rebuilding stack Spring Garden station		1,237 50	
Services of diver		1,129 00	
" of expert		52 00	
Shop castings, 687,667 lbs., at. 01⅔		11,461 16	
Stop valves, 56, 3-way, at 23 $\frac{50}{100}$		1,316 00	
" 25, 4-way, at 70		1,750 00	
Testing boiler plate		101 10	
Wharfage		463 37	
Wages—First District		25,095 75	
" Second "		27,531 75	
" Third "		19,823 93	
" Fourth "		36,834 70	
" Fifth "		462 25	
" Sixth "		330 87	
Buildings, grounds and reservoirs		3,973 12	
Totals		$392,610 61	$103,389 39
For new mains, ordinance June 21, 1882, and March 24, 1883. Surplus 1880 and 1881	$2,738 12		
Iron pipe, 101 lengths (12-inch) 93,970 lbs. at .01 $\frac{27}{100}$		$1,193 42	
" specials		1,544 70	
For the extension of works, ordinance June 21, 1882. Surplus 1880 and 1881	70 64		
Iron specials		70 64	
For the extension of works, ordinance March 24, 1883. Surplus 1882	26 34		
Iron specials		26 34	
Item 19 of appropriation for 1883. For the purpose of pipes and special castings. Transferred from supplies 1882. Ordinance October 20, 1883	315 16		
Iron specials		315 16	
Twice paid and overpaid water rents:			
Ordinance December 31, 1880	155 57		$155 57
Ordinance June 16, 1881	502 25	25 00	477 25
Ordinance March 10, 1882	100 75		100 75
Ordinance December 11, 1882	202 65	11 50	191 15
Ordinance December 30, 1882	146 35		146 35
Ordinance November 12, 1883	394 95		394 95
Ordinance September 9, 1884	284 16	9 20	274 96
Ordinance October 4, 1884	476 75	16 60	460 15
Ordinance April 4, 1885	254 18	11 50	242 68
Ordinance June 22, 1885	565 03	138 00	427 03
	Amount appropria'd.		
Ordinance March 1, 1886. Transferred from Item 1	498 83	229 85	268 98
Ordinance July 17, 1886. Transferred from Item 1	2,608 39	1,774 16	834 23

Detailed Expenditures of the Department for 1886.

RECAPITULATION.			
Available for 1886.			
Balance January 1, 1886, from Annual Report of 1885	$6,232 90		
Transferred from annual to special appropriation:			
Refunds	3,107 22	$9,340 12	
Annual appropriation		566,350 78	
Special appropriation		496,000 00	$1,071,690 90
Expended from annual appropriation:			
For deficiencies	$2,969 95		
For surveys for a future water supply	9,999 10		
For maintenance	552,454 34	$565,423 39	
Expended from special appropriation:			
Refunds	$2,215 81		
New mains	395,760 87	397,976 68	
Total expenditure		$963,400 07	
Amount merging	$927 39		
Amount not merging	107,363 44	108,290 83	$1,071,690 90

APPENDIX C.

REPORT

OF THE

GENERAL SUPERINTENDENT

OF

WORK DONE DURING 1886 TO BUILDINGS, GROUNDS AND RESERVOIRS, AND BOILERS AND MACHINERY OF THE SEVERAL PUMPING STATIONS.

PHILADELPHIA WATER DEPARTMENT,
OFFICE OF THE GENERAL SUPERINTENDENT.

January 18, 1887.

JOHN L. OGDEN,
Chief Engineer:

SIR:—The following report of the work performed under my direction for the year 1886 is respectfully submitted:

On entering upon my duties as General Superintendent I found the machinery and boilers in fair condition, with the exception of engines Nos. 1 and 2 at Roxborough and No. 1 at Frankford, which necessitated considerable work during the year.

The reservoirs required immediate attention. The fences around them were mostly down, and, with the exception of those at the Corinthian avenue and Fairmount basins had to be rebuilt or extensively repaired. The banks of the East Park reservoir were badly damaged by wash-outs and in some places nearly cut through. These have been partially repaired, but much remains to be done.

There have been pumped during the year 28,658,966,569 gallons of water, an increase of 3,493,946,497 gallons over the pumpage of the year 1885. The cost of raising one million gallons 100 feet was $4.13, a decrease of 57 cents from the cost of the previous year.

The machinery and boilers of the several stations are now in good condition, and with the usual examinations and repairs incident to a year's running, will be in thorough condition for the heavy summer pumpage.

I take pleasure in stating that the employes of the several stations are well disciplined, capable and attentive to their duties.

Respectfully,

F. L. HAND,
General Superintendent.

FAIRMOUNT.

BUILDINGS.

In the old Mill house, bath-rooms for the use of the men were fitted up complete, plastered and wainscoted; woodwork and machinery painted; walls of the building whitewashed, and floors around wheels repaired. Closets were placed in the office and in the janitor's room.

In the new or mound dam Mill house, new platforms and steps were placed over the flumes; the gallery repaired its entire length and iron railings placed on each side. New doors were put in at the west end; all other doors repaired and all inside woodwork and machinery painted. The floors around the wheels were relaid.

GROUNDS.

The walls along the walk on the mound dam were repaired and pointed, and an ornamental fence built along the north side. The pavement around the marble fountain was renewed,

fountain reset and basin cleaned and reset; also, the masonry around the springs.

At the Callowhill street entrance a drain was built, and gates, pavement and railing along the river side repaired. Fish traps were placed in the pipes leading to fountains; new lamps placed in garden and along forebay; flagstone on the bridge reset, and pipes run along the forebay to facilitate the washing of the walks. Many dead trees were removed and the others trimmed. A coffer-dam was built in front of the bridge, the forebay drawn off and the racks in front of No. 3 wheel repaired; all others were examined and a foundation of stone built under the racks.

DAM.

A new pier of heavy yellow pine timber filled with stone and earth was built in front of the pavilion pier to protect it from ice. New flash-boards were placed on entire length of the dam.

RESERVOIRS.

During the summer the reservoirs were emptied. The old stop-valves were found to be useless and inoperative and new ones were put in. Two iron screens were placed over the outlet pipes and the old wooden ones repaired. The stone and brick walls and bottoms were renovated wherever required. Around Nos. 3 and 4 pumping mains the masonry was reset. A watch-house was built at the northwest corner; the old summer-houses (being old and unsafe) were removed and the banks sodded; the fence around the basin was repaired, all inclines graveled and rolled and the brick gutters renewed. Trees were trimmed and dead ones removed. A wire fence on cedar posts was put up along the walks and inclines and on the north side of the reservoir from the Green street entrance. A new boat was provided for use in the basin.

MACHINERY.

Turbine No. 1.—Painted with two coats of paint and varnished; step-bearings adjusted and lost-motion taken out of journals; new shoe placed in fly-wheel pit; pump-valves removed in order to empty the basin through pumping-main, afterward replaced, and screens to pump repaired.

Turbine No. 3.—Step-bearings adjusted; grating in front of head-gate repaired; wheels and pumps painted and varnished.

Turbine No. 4.—Step bearings adjusted; counter-balance weights hung with new chains; all journals examined; wheels and pumps painted and varnished.

Turbine No. 5.—Counter-balance weights hung with new chains; lost motion taken up in main shaft, connecting-rods and crossheads, bevel wheel moved up on upright shaft to make wheels gear better; wheels and pumps painted and varnished.

Turbine No. 7.—Main shaft jacked up and pedestals taken out; one entire new pedestal made and one refitted and bored out; shaft journals trued up and shaft and pedestals replaced and lined up; a five-inch wrought iron pipe put in to drain the pumping main; counterbalance weights rehung; step-bearing adjusted; pump-valves and plungers examined, and wheels and pumps painted and varnished.

Turbine No. 8.—Main journals examined and cleaned up; brass boxes put in cross-head; new plunger placed in left hand pump; all pump-valves examined; lost motion taken up in all journals; drain-pipe to draw water from main put in, and wheels and pumps painted and varnished.

Turbine No. 9.—Main shaft jacked up and both pedestals found to be broken, were replaced with new ones; journals of main shaft turned and trued up; new boxes and gibs put in cross-head; pumps and valves examined; a five-inch wrought-iron pipe put in to drain pumping main; counter-balance weights hung with new chains and wheels, and pumps painted and varnished.

The upright tubular boiler for heating wheel-houses was repaired; all heaters throughout the buildings were examined and repaired, and a new stove put in office.

SPRING GARDEN.

BUILDINGS AND GROUNDS.

Old Station.—Floors in No. 6 room repaired and steps changed from No. 7 to No. 6 room; all windows rehung with new sash-cords.

No. 7 Room.—The entire front of No. 7 engine-house and the old boiler-house cleaned and pointed; roofs of both No. 6 and No. 7 engine rooms repaired.

No. 8 Room.—All woodwork scraped, painted and varnished; closets built in.

New wagon-shed for carts and wagons built; stable repaired; fence put up back of shed for the storage of old material; closets built in storeroom; wash-room put in office; coal sheds repaired; heavier bumpers placed at end of coal shed tracks; new board-walk laid from steps to storehouse and between the railroad tracks; bridge over forebay replanked and rails refastened; drains and inlets laid for draining grounds around forebay; new walks around machine-shop and boiler-house paved over flue for the new boilers and the ground raised to properly drain it; grounds in front of and around new building and forebay graded and graveled; brick closets built on the hill back of coal sheds for use of the men and engineer of the new station. The telephone operator's room was removed from the old to the new station and closets built in room. A new float built in front of the conduit on the river for cleaning the screens; river wall in front of station partly built; new piers built for flower urns in front of the new engine-house and urns filled with flowers.

The fire-rooms of new station were whitewashed and cleaned; new wrought-iron doors were put in chutes in coal-sheds.

OLD SPRING GARDEN STATION.

Total capacity.—38,000,000 gallons per day.

No. 6.—Simpson Rotary Compound.—Capacity 8,000,000 gallons per day.
No. 7.—Marine Rotary Compound.—Capacity 20,000,000 gallons per day.
No. 8.—Worthington Duplex.—Capacity 10,000,000 gallons per day.

1886.	Running Time of each Engine in Hours.			Gallons Pumped by each Engine.			Total Pumpage of each Month.	Average Pumpage per Day	Coal.		Percentage of Ashes.	Oil. Cylinder.	Oil. Engine.	Mean Water Pressure and Mean Suction Lift in lbs. per sq. inch.			Gallons raised 100 feet per pound of coal.
	No. 6.	No. 7.	No. 8.	No. 6.	No. 7.	No. 8.	Gallons.	Gallons.	Tons.	Lbs.		Qts.	Qts.	No. 6.	No. 7.	No. 8.	
January	....	102½	277¾	....	72,473,670	91,379,040	163,852,710	5,285,571	360	224	20.0	106¼	31¾	......	53	84	325.0
February	7¼	125¼	296	2,928,500	92,597,290	98,708,960	194,234,750	6,936,955	350	677	20.4	119¾	30	50	53	84	396.0
March	30	223¼	284¼	11,404,200	147,909,340	97,112,960	256,426,500	8,271,822	418	1,864	20.0	143¾	58	50	51	85	437.3
April	....	69	402¼	....	158,404,240	145,512,220	303,916,460	10,130,548	495	1,439	19.9	123	64½	......	55	83	437.9
May	356	607½	261	136,642,000	428,166,220	103,041,230	667,849,450	21,543,530	831	160	20.0	249	79	53	54	83	574.0
June	267¼	478½	687	99,313,000	355,704,800	274,122,880	729,140,680	24,304,689	992	431	20.0	287¼	207¾	55	54	83	524.9
July	171	584¾	535¼	84,984,000	414,494,450	231,905,600	731,384,050	23,593,033	952	1,798	19.9	341½	211	56	54	74	548.2
August	859¾	622	543¾	138,201,000	455,636,550	235,194,800	829,032,350	26,742,979	984	433	23.0	380	230¼	53	53	70	601.6
September	555¼	643¼	654¾	214,230,200	524,944,210	299,703,920	1,038,878,330	34,629,277	1,187	1,705	20.2	480	275¼	54	55	69	624.7
October	181¼	702½	685	222,609,000	562,788,970	317,979,200	1,103,377,170	35,592,811	1,225	1,904	19.5	489½	250	55	55	69	612.8
November	2	500½	535¼	796,000	385,481,880	243,697,440	629,975,320	20,999,177	750	1,240	19.9	245	104¾	55	52	60	599.5
December	....	31¾	686¾	....	23,478,520	305,119,920	328,598,440	10,599,949	559	2,168	18.9	135½	35	......	52	72	419.1
Totals and averages.	1,929¾	4,690¾	5,849	911,107,900	3,622,080,140	2,443,498,170	6,976,666,210	19,114,154	9,109	603	20.1	3,100½	1,577½	53	53	76	542.1

Total capacity, 30,000,000 gallons per day.

NEW SPRING GARDEN PUMPING STATION.

No. 9, Worthington Duplex.—Capacity 15,000,000 gallons per day.
No. 10, Worthington Duplex.—Capacity 15,000,000 gallons per day.

1886.	Running Time of each Engine in Hours.		Gallons Pumped by each Engine.		Total Pumpage of each Month.	Average Pumpage per Day.	Coal.		Percentage of Ashes.	Oil.		Mean Water Pressure and Mean Suction Lift in lbs. per sq. inches.		Gallons raised 100 feet per pound of coal.
										Cylinder.	Engine.			
	No. 9.	No. 10.	No. 9.	No. 10.	Gallons.	Gallons.	Tons.	Lbs.		Quarts.	Quarts	No. 9.	No. 10.	
January	....	718	....	415,570,058	415,570,058	13,405,485	768	990	19.1	171½	74	....	78	386.2
February	274	416½	144,223,767	232,491,250	376,715,017	13,454,107	690	1,212	19.9	158	95	73	77	389.6
March	648½	196¾	331,627,022	94,555,316	426,182,338	13,747,817	796	626	20.1	220½	94	77	68	382.2
April	708	246¾	389,083,504	151,675,888	540,759,392	18,025,313	909	1,914	20.0	233¼	86	77	54	424.5
May	701	463½	373,323,949	282,047,770	655,371,719	21,141,023	1,216	1,701	19.2	278	99	81	72	384.7
June	716¾	419	400,121,621	248,619,892	648,741,513	21,624,717	1,183	1,067	19.1	312½	89½	83	73	391.1
July	744	712¾	392,655,217	361,868,117	754,523,334	24,339,462	1,360	822	17.7	343½	82	82	77	396.1
August	744	736½	367,394,004	364,223,064	731,617,068	23,600,550	1,352	752	20.0	441½	71	81	81	386.3
September	720	720	334,815,281	338,270,659	673,085,940	22,436,198	1,254	729	19.9	439	77½	83	83	383.2
October	727½	741¼	330,528,138	340,865,710	671,393,848	21,657,866	1,234	2,206	20.0	577¾	93	84	83	388.3
November	626¾	621¼	292,993,467	289,434,355	582,427,822	19,414,260	1,085	1,033	20.0	567	85¼	82	82	383.2
December	618	566½	300,054,552	265,360,730	565,415,282	18,239,202	1,108	2,202	19.7	465½	107	83	82	368.2
Totals and averages.	7,228½	6,558¾	3,656,820,522	3,384,982,809	7,041,803,331	19,292,611	12,961	1,814	19.5	4,211	1,053¼	80	75	389.0

SPRING GARDEN RESERVOIR.

An entire new fence was built around the basin and painted with two coats of paint; inside slope of south side of basin repaired; new watch-house and stop-house built and painted, and new platform placed over main in the basin.

CORINTHIAN RESERVOIR.

Inside slope of the basin repaired and cleaned; the outside bank repaired and sodded; the old wooden steps at the southeast and southwest corners removed and the banks rounded off and sodded; fence around basin coated with two coats of paint; all trees trimmed and dead ones cut down and removed.

ENGINES AND BOILERS (Old Station).

Engine No. 6.—Valves reset to regulate lead; lost motion taken up on main and all other journals; new joints made on steam-chest and steam-pipes; clamp of wrought-iron put around the bottom of high-pressure cylinder to make tight joint; the patent packing for the piston-rods taken out and replaced by the old stuffing-boxes; piston-packing in cylinders set out; iron rail put up on steps to the gallery around the beam; gates in conduit repaired and cleaned; wells pumped out and all lower pump-valves examined; wells cleaned and four-inch gas-pipe let into the wells to pump them out by the donkey-pumps; relief-valves on both ends repaired, guards to discharge valves refastened, and lower parts of the pump and foundation painted and whitewashed.

Engine No. 7.—Steam-chest bonnets removed and valves examined; piston-packing set out in both cylinders; beam-centre and fly-wheel journals on main shaft lined up; all journals examined and leads taken from them; steel bolts put in braces to steady the steam-cylinder; new joints made on steam-pipes; small air-compressors at Chestnut Hill station brought down and set up in the bottom of No. 7 engine-room, to increase the efficiency of air-chamber. All pump-valves examined and screens cleaned; patent packing for piston-rods taken out and replaced by the old stuffing-boxes.

Engine No. 8.—All pump valves examined, cylinder-heads removed and piston-packing set out; new joints made on steam-pipe; air-pumps overhauled and new valves and guards put in; lagging repaired and varnished, and pumps and pipes painted, striped and varnished.

Boilers No. 7 to 11, inclusive.—New bridge walls built in; furnaces relined; all boilers scaled and cleaned; blow-off valves ground in; water-columns cleaned and gauge-cocks ground; new joints made on safety-valves and valves overhauled; donkey-pump overhauled; attachments made for McGahan's steam tube-cleaner for the entire battery of boilers.

Boilers No. 12 to 21, inclusive.—Furnaces relined; all boilers scaled and cleaned; blow-off valves ground in; all water-columns and gauge-cocks frequently examined and kept tight and attachments made for McGahan's steam tube-cleaner for one battery.

Boilers No. 1 to 6, inclusive.—These boilers were taken down, cut up and removed, bricks cleaned and all rubbish removed; new foundations laid in cement for the new boilers: floors laid and flues built to stack; the old stack torn down and a new one built 150 feet in height (78 feet higher than the old one); foundation laid for hydraulic lift from the old to the new fire-room and the walls of this boiler-house run up with brick to the roof and cleaned for plastering.

The air-compressors were taken out of No. 7 engine-room room and stored in the cellar of storehouse. A coffer-dam was built across the conduit at the forebay and a centrifugal pump set up to empty the conduit and well.

The foundation and bottom of the old No. 4 pump was removed, and the well and conduit cleaned of all mud and debris.

The old feed-water heater was taken out of the cellar and foundation torn down.

The electric plant was removed from No. 6 room and set up next to the one at the new station.

ENGINES AND BOILERS (New Station).

Engine No. 9.—All valve-seats on discharge side refastened with iron keys and Babbitt metal; new studs put in pump-valves and all cast-iron valve-weights bushed with brass; stuffing-box glands refitted with four bolts in place of two; new joints made on steam-pipe; air-pumps examined and new springs put in where required; lagging around steam cylinders polished and varnished and nickel-plated bands placed around lagging.

Engine No. 10.—Stuffing box glands refitted with four bolts in place of two; air-pumps examined and one new strap put on air-pump rod connection; pump-valves examined and replaced where necessary; joints made on steam connections; lagging around steam cylinders polished and varnished; one new walnut head made for right-hand cylinder and nickel-plated band placed around lagging.

A gauge for indicating height of water in well was placed in engine-room; a new iron gate-rack put in Nos. 9 and 10 conduit at forebay and fitted down in cement; rack and screens in forebay cleaned.

BOILERS.

Marine Boilers Nos. 22 to 27 and 30 to 33, inclusive.—All boilers scaled and cleaned; new bridge walls built in; new grate bars fitted; new water-column pipes run on all the boilers. Boiler No. 27 was injured, necessitating the replacing of back connection-sheet and back tube-sheet. New tubes were put in; old tubes safe-ended and put into stock; new joints made on main steam-pipe; safety-valves ground in; new iron floor-plates laid between tracks in fire-room; floors under boilers cemented; boiler-covering on all the boilers repaired and whitewashed, all pipes painted; blow-off valves ground in; name-plates on fronts taken off and put on with studs; connections made to all boilers for McGahan's tube cleaner, and radiators put in the north and south ends of engine-room and in telephone operator's room.

BELMONT.

BUILDINGS AND GROUNDS.

New wagon-shed built, painted and tin-roofed; coal-shed repaired; and retaining wall built on north end; engine-room floors repaired; new cross-ties laid over bridge on siding; windows glazed; grounds cleaned and graded; new coal scales put in and track and turntable repaired; new float placed at river front of conduit.

RESERVOIR.

Fence around basin repaired; new posts put up and painted; inside slope repaired the entire length; stop gear and grating painted; flower urns in centre of basin painted and banks trimmed and cleaned.

ENGINES AND BOILERS.

Engine No. 1.—All steam and water-valves examined, air-pump heads removed and new valves put in; new joints made on high and low pressure cylinder heads; new joints made on steam pipe and all lost motion taken up.

Engine No. 2.—Overhauled and put in same condition as Engine No. 1. The right-hand high-pressure cylinder was found to have a crack in it about 18 inches long. The crack was dressed up, steam turned off from the jackets and engine worked successfully in that condition.

Engine No. 3.—Valves taken out and faced; valve-seats scraped; new valve-rods, new brasses for air-pump link; air-

Total Capacity—18,000,000 gallons per day.

BELMONT PUMPING STATION.

No. 1. Worthington Duplex—Capacity 5,000,000 gallons per day.
No. 2. Worthington Duplex—Capacity 5,000,000 gallons per day.
No. 3. Worthington Duplex—Capacity 8,000,000 gallons per day.

1886.	Running Time of each Engine in Hours.			Gallons Pumped by each Engine.			Total Pumpage of each Month.	Average Pumpage per Day.	Coal.		Percentage of Ash.	Oil. Cylinder.	Oil. Engine.	Mean Water Pressure and Mean Suction Lift in lbs. per sq. inch.			Gallons raised 100 ft. per pound of coal.
	No. 1.	No. 2.	No. 3.	No. 1.	No. 2.	No. 3.	Gallons.	Gallons.	Tons.	Lbs.		Qts.	Qts.	No. 1.	No. 2.	No. 3.	
January	136	176½	406½	35,110,500	43,171,440	144,711,875	222,993,815	7,193,348	522	40	19.9	83½	16	94	94	94	411.9
February	69½	191¾	368¼	16,359,600	47,590,296	132,227,975	196,177,871	7,006,352	455	1,198	17.4	59¾	13½	94	94	94	415.2
March	39	343	300½	9,246,900	83,823,648	142,056,390	235,126,938	7,584,739	547	1,789	15.8	66	17¾	94	94	94	413.8
April	217½	657	......	49,832,300	160,848,376	......	210,680,676	7,022,689	498	2,162	14.9	81¼	33¼	94	94	......	407.1
May	181½	127½	465	42,152,500	31,228,288	160,625,610	234,006,398	7,548,593	573	1,145	15.0	77	26¼	94	94	94	410.0
June	50	......	638½	14,232,600	......	225,533,247	239,765,847	7,992,194	549	1,430	15.9	72¼	31½	94	......	94	420.6
July	10	97	666½	2,211,200	23,489,202	243,636,422	269,336,824	8,688,284	629	1,438	15.0	99¼	36½	94	94	94	412.4
August	6	52	688½	1,424,800	13,180,120	256,283,550	270,888,470	8,738,337	605	2,207	15.1	82	34½	94	94	94	431.0
September	36	57½	638	8,688,600	18,136,812	243,814,410	270,639,822	9,021,327	630	873	14.8	81¼	28¼	94	94	94	413.9
October	27	88¾	618¼	6,041,000	25,441,848	235,967,625	267,449,873	8,627,415	614	2,115	15.2	83¾	33¼	94	94	94	419.3
November	127½	24	524	30,412,500	6,138,960	189,177,030	225,728,490	7,524,283	521	526	14.9	72¾	21¾	94	94	94	417.5
December	219	93	445	52,012,200	23,832,764	163,313,090	239,158,054	7,714,775	566	920	15.1	84½	34¼	94	94	94	407.1
Totals and averages	1,119	1,908	5,759	267,724,700	476,881,754	2,137,346,624	2,881,953,078	7,895,761	6,716	163	15.7	943¼	326¾	94	94	94	414.1

pumps examined and new valves and springs put in; water-valves examined and springs put on to reduce lift; four studs in place of two put in stuffing-boxes for steam and water piston-rods, drip-pipes altered and run into condensers.

Donkey-pumps repaired and an old Knowles' pump taken out and replaced by one repaired at shop; air-compressors supplied with new air piston-rings and new springs to air-valves.

BOILERS.

Cylinder Boilers No. 1 to 8, inclusive.—Boilers scaled and cleaned; brick work repaired; tanks and scales put up for making evaporation tests; connections made to feed pumps and boilers; new joints made on steam and blow-off pipes.

Tubular Boilers Nos. 9 to 14, inclusive.—Boilers entirely reset—new walls having been built; boilers scaled and cleaned and evaporation-test made. The purifiers were taken down and old feed-pipes put back; new joints made on steam and blow-off pipes; safety-valve ground in; water-columns and gauge-cocks repaired; tanks used for evaporation-test taken down when tests were finished and sent to Mt. Airy station.

ROXBOROUGH.

BUILDINGS AND GROUNDS.

The entire length of wharf in front of the engine and boiler-house and grounds was repaired with new cap-log and filled in with stone. Coal-shed repaired and covered with tarred paper and gravel; siding repaired; new cover for stops; wall of old engine-house repaired; retaining-wall pointed; engine-house roof repaired; air-pump pits enclosed and white-washed; wall torn out to put new boilers in boiler-house and closed when boilers had been put in position; fence around engineers' house repaired and grounds cleared up.

Total capacity, 14,750,000 gallons per day.

ROXBOROUGH PUMPING STATION.

No. 1.—Cornish Overhead Beam.—Capacity, 2,250,000 galls. per day.
No. 2.—Worthington Duplex.—Capacity, 5,000,000 galls. per day.
No. 3.—Worthington Duplex.—Capacity, 7,500,000 galls. per day.

1886.	Running Time of each Engine in Hours.		Gallons Pumped by each Engine.		Total Pumpage of each Month.	Average Pumpage per Day.	Coal.		Percentage of Ashes.	Oil.		Mean Water Pressure and Mean Suction Lift in lbs. per sq. inch.		Gallons raised 100 feet per pound of coal.
										Cylinder.	Engine.			
	No. 2.	No. 3.	No. 2.	No. 3.	Gallons.	Gallons.	Tons.	Lbs.		Quarts.	Quarts.	No. 2.	No. 3.	
January	....	485½	....	124,892,214	124,892,214	4,028,781	422	2,024	24.0	113	51½	....	157	487.8
February	....	482	....	121,634,628	121,634,628	4,344,093	407	1,722	24.9	116¾	41	....	157	492.7
March	....	505	....	126,005,202	126,005,202	4,064,683	421	45	25.2	140	51¾	....	157	494.3
April	193½	296½	45,482,870	74,262,102	119,744,972	3,991,499	375	2,233	17.9	147½	57¼	157	157	405.0
May	528	....	129,137,135	....	129,137,185	4,165,714	430	987	21.6	158	69¾	157	....	495.0
June	509½	....	129,186,400	....	129,186,400	4,306,213	427	292	22.9	138	56¾	157	....	499.5
July	187	454	47,026,245	114,252,657	161,278,902	5,202,545	516	2,087	10.3	223½	74¼	157	157	493.3
August	23	676½	5,394,960	169,161,435	174,556,395	5,630,851	603	1,796	19.2	258½	58	167	164	477.5
September	....	670	....	171,816,826	171,816,826	5,727,227	609	646	19.5	233½	62	....	165	465.7
October	....	622	....	170,638,158	170,638,158	5,504,456	623	743	27.8	137	55¾	....	166	452.2
November	140	387	35,745,445	108,631,821	144,377,266	4,812,575	574	691	17.7	204½	54½	164	166	415.2
December	255½	292	65,476,135	81,550,345	147,026,480	4,742,789	576	105	21.2	218	51¾	165	166	421.6
Totals and averages.	1,836½	4,870½	457,449,190	1,262,845,388	1,720,294,578	4,713,135	5,988	2,171	21.0	2,088¼	684¼	160	161	475.0

Total Capacity.—785,000 gallons per day.

ROXBOROUGH AUXILIARY STATION.

No. 1.—Knowles.—Capacity 500,000 gallons per day.
No. 2.—Knowles.—Capacity 285,000 gallons per day.

1886.	Running Time of each Engine in Hours.		Gallons Pumped by each Engine.		Total Pumpage of each Month.	Average Pumpage per Day.	Coal.		Percentage of Ashes.	Oil. Cylinder.	Mean Water Pressure.	
	No. 1.	No. 2.	No. 1.	No. 2.	Gallons.	Gallons.	Tons.	Lbs.		Quarts.	No. 1.	No. 2.
January	17	16	357,000	190,080	547,080	17,647	8	2,195	19.1	3½	36	36
February	....	44½	....	603,119	603,119	21,539	7	1,495	20.2	9¾	....	37
March	21½	21½	451,500	267,300	718,800	23,187	8	515	18.9	5½	36	36
April	14	41	294,000	532,884	826,884	27,562	7	1,535	19.3	6½	36	36
May	19½	50	408,100	543,444	951,544	30,964	8	483	20.9	6½	36	36
June	16	49	336,000	565,356	901,356	30,045	7	1,311	18.2	6½	36	36
July	51	120	1,965,000	2,133,659	4,098,659	132,214	8	1,497	21.1	12	36	36
August	16	50	480,000	560,791	1,040,791	33,573	5	801	19.1	8	36	36
September	24	49	583,900	544,654	1,128,554	37,618	5	66	24.9	6½	36	36
October	32	37	693,900	409,640	1,103,540	36,784	4	1,832	21.5	6½	36	36
November	25	42	468,750	489,786	958,536	31,951	5	1,273	19.6	6	36	36
December	18	47	479,100	563,530	1,042,630	33,633	5	756	18.0	6½	36	36
Totals and averages	254	567	6,517,250	7,404,243	13,921,493	38,141	83	319	20.0	83¾	36	36

RESERVOIR AND AUXILIARY STATION.

Engine and boiler-house whitewashed and painted; new floor put in coal-house; fence on reservoir repaired and painted; stop-covers renewed and painted; stand-pipe in basin taken down, sides of bank cleaned and repaired; old float taken out of the basin and replaced by a new boat.

The tanks on Ridge avenue, supplying the high levels, were caulked, hoops driven, and painted with two coats of paint.

ENGINES AND BOILERS.

Engine No. 2.—High and low-pressure cylinders bored out, both fitted with Flanders' patent piston-packing and an entire new set of rings for both cylinders; air-pumps taken out, rebored and put back; new valves, studs and spring fitted to air-pumps; valves faced and seats scraped; valve-stems turned and trued up; extra foundation-bolts put on air-pumps; rock-shaft turned and pedestal-bearings made wider and Babitted; new brass boxes fitted in bell-crank and connecting rods; pins turned up; piston-rods dressed; new joints made on steam and exhaust pipes; pump-valves all renewed and new studs put in; a $1\frac{1}{2}$-inch charge-pipe was put in to charge pumps; new steel key placed in plunger; diaphragms fastened with through-bolts and new joints made on air-pump heads.

Cylinders, steam-chests and pipes covered with Hanmore's patent covering, and the walnut lagging replaced.

Engine No. 3.—Cylinder-heads removed and piston-packing set out. An entire new set of studs for the pump-valves were put in and spiral springs put on valves in place of cast-iron weights; new guards and guard-plates; diaphragms taken out and refastened with through-bolts; new joints made on air-pump heads; new joint made on steam-chest; additional bolts put in stuffing-box glands; steam-chests and steam-pipes covered and walnut lagging replaced; air-pumps examined and all joints made tight and pumps and discharge-pipes painted.

Donkey-pumps repaired; new copper bend put in steam-pipe in fire-room; new heaters put in engine-room and old ones repaired.

BOILERS.

Boilers Nos. 1 to 3, inclusive.—Boilers scaled and cleaned; furnaces relined and new bridge walls built in; new blow-off pipe put in, also new joints in safety and check-valves.

Marine Boilers Nos. 4 to 7, inclusive.—Boilers scaled and cleaned; new dampers put in, and new joints made on water-columns.

NEW BOILERS.

Two steel furnace-flue tubular boilers were built during the year by the I. P. Morris Company of Philadelphia, and have been placed in the west side of fire-rooms. They are now being connected up and will be ready for steaming at an early date.

The boilers are eight feet six inches in diameter and twenty feet long. They are built throughout of steel, designed to carry sixty pounds steam-pressure, are fitted with Fox's Patent Corrugated Furnaces, and were built in accordance with designs and specifications furnished by the Department.

MOUNT AIRY STATION.

The fence around the reservoir has been almost entirely rebuilt, banks cleaned and slopes repaired; division wall cut down, relaid and concreted; grounds cleared of all old rubbish and graded; new wire fence with cedar posts put up around the lot from the engine-house to the reservoir wall; new walk laid in front of engine-house and stop-houses covered.

ENGINES.

Two new check-valves were put on air-pump; lost motion taken out of Nos. 1 and 2 journals and new key fitted in fly-wheel of No. 2 engine.

Total Capacity.—2,000,000 gallons per day.

MOUNT AIRY PUMPING STATION.

No. 1.—Davidson, Rotary.—Capacity, 1,000,000 gallons per day.
No. 2.—Davidson, Rotary.—Capacity, 1,000,000 gallons per day.

1886.	Running Time of each Engine in Hours.		Gallons Pumped by each Engine.		Total Pumpage of each Month.	Average Pumpage per Day.	Coal.		Percentage of Ashes.	Oil.		Mean Water Pressure and Mean Suction Lift in lbs. per sq. inch.		Gallons raised 100 ft. per pound of coal.
										Cylinder.	Engine.			
	No. 1.	No. 2.	No. 1.	No. 2.	Gallons.	Gallons.	Tons.	Lbs.		Quarts.	Quarts.	No. 1.	No. 2.	
January	2	742	73,500	26,652,750	26,726,250	862,137	66	1,076	19.4	62	15¾	60	60	238.6
February	11	561	396,000	23,526,000	23,922,000	845,357	58	1,495	18.7	56	14	60	60	242.4
March	3	741	108,000	22,756,240	22,864,240	737,556	57	1,618	20.1	49¼	16	60	58	235.1
April	43	677	1,113,740	18,238,510	19,352,250	645,075	55	641	20.4	59¾	15	57	57	207.9
May	84	660	2,286,250	18,837,000	21,123,250	681,395	60	1,408	18.4	62	17	57	58	206.8
June	5	715	161,250	22,210,000	22,371,250	745,708	57	1,019	19.9	48½	15	62	61	231.1
July	....	741	....	23,926,873	23,926,873	771,834	62	1,940	19.7	54¼	15¾	....	60	225.9
August	79	643	3,031,500	26,403,375	29,434,875	949,512	70	92	19.4	47¼	15½	59	58	249.5
September	1	719	45,000	29,871,500	29,916,500	997,216	66	1,564	19.1	38	15	60	59	266.3
October	1	744	49,500	31,184,000	31,233,500	1,007,532	67	331	20.2	32	15½	60	59	271.1
November	....	720	....	27,256,000	27,256,000	908,533	60	667	19.3	30	15	....	58	268.8
December	51	693	1,624,500	23,258,500	24,883,000	802,679	62	1,208	19.1	33	15¾	57	57	236.2
Totals and averages.	280	8,356	8,889,240	294.120,748	303,009,988	830,164	745	1,859	19.5	572	185¼	59	58	241.3

BOILERS.

Furnaces of boilers were relined; boilers scaled and cleaned; tanks sent from Belmont station for making evaporation tests put up; tests made and tanks removed to Roxborough station.

CHESTNUT HILL.

BUILDINGS AND GROUNDS.

New coal-shed for 300 tons of coal built, with drive-way on upper and cart-way on lower floors; closets put in for workmen; new floors laid in engineers' house; floors in engine-room where No. 1 engine formerly stood renewed and walls of dam repaired.

ENGINES AND BOILERS.

Engine No. 1 and the Wilbraham rotary pump taken out and sent to new machine shop, where they were set up; air-compressors taken down and put up at Spring Garden station for the use of No. 7 engine.

Engine No. 2.—Front steam cylinder-head bushed to suit piston-rod; piston overhauled; valve faced and new joints made; pump taken down and pump cylinder bushed with brass.

No. 3 pump overhauled and new gum joints put in; new joints made on main steam-pipe.

A new Worthington donkey feed-pump, new injector and a new copper feed-water heater were put in for supplying and heating feed-water for boilers.

BOILERS.

Boilers scaled and cleaned; patch put on cylinder boiler No. 2 and all new joints made.

Total capacity—1,500,000 gallons per day.

CHESTNUT HILL PUMPING STATION.

No. 1.—Wilbraham Rotary.—Capacity 750,000 gallons per day. (Has been removed to new shop, Twelfth and Wharton streets.)
No. 2.—Knowles.—Capacity 250,000 gallons per day.
No. 3.—Worthington Duplex.—Capacity 500,000 gallons per day.

1886.	Running Time of each Engine in Hours.		Gallons Pumped by each Engine.		Total Pumpage of each Month.	Average Pumpage per Day.	Coal.		Percentage of Ashes.	Oil.		Mean Water Pressure and Mean Suction Lift in lbs. per sq. inch.		Gallons raised 100 feet per pound of coal.
										Cylinder.	Engine.			
	No. 1.	No. 3.	No. 1.	No. 3.	Gallons.	Gallons.	Tons.	Lbs.		Quarts.	Quarts.	No. 1.	No. 3.	
January	360	384	3,735,900	2,442,060	6,177,960	199,289	25	952	18.3	23	23	53	53	145.1
February	336	336	3,772,800	2,148,120	5,920,920	211,461	23	1,134	17.4	21	21	53	53	139.4
March	48	696	516,005	10,819,675	11,335,680	365,667	31	1,764	17.8	17¾	17¾	53	54	197.4
April	....	720	....	11,378,930	11,378,930	379,297	34	67	16.9	15	15	....	53	189.6
May	....	744	....	11,823,890	11,823,890	381,415	34	477	16.2	15½	15½	....	54	191.3
June	....	720	....	11,672,232	11,672,232	389,074	23	147	17.4	15½	15½	....	54	195.6
July	....	657	....	10,530,104	10,530,104	339,680	29	1,523	19.5	13¾	13¾	....	54	197.9
August	....	28	....	527,280	527,280	17,009	7	783	19.7	1	....	....	53	39.7
September	....	26¾	....	417,690	417,690	13,923	7	1,468	20.5	1½	1½	....	53	30.2
October	....	19	....	343,200	343,200	11,070	9	1,322	20.3	1¼	1¼	....	53	198.1
November	....	199	....	2,784,600	2,784,600	92,820	14	1,778	19.0	4¼	4¼	....	53	104.1
December	....	744	....	8,643,960	8,643,960	278,837	27	985	17.7	15½	15½	....	55	174.3
Totals and averages,	744	5,273¾	8,024,705	73,531,741	81,556,446	223,442	278	1,200	18.4	145	144	53	54	161.7

FRANKFORD.

BUILDINGS AND GROUNDS.

Grounds cleaned; new cement pavement made in front of steps on the south and east sides of building; fire-room whitewashed, windows glazed and water-closets plastered; new derrick put up for hoisting coal. The entire trestle-work carrying the pumping main and the trestle-work at Shallcross' farm have been painted with two coats of paint and new stone piers built thereunder.

A new fence put up around the entire top of reservoir, banks cleaned, stops and stop-houses painted; watch-house painted with two coats of paint; iron railing around stop-houses painted; fence along lane repaired and steps at fountain entirely reset.

ENGINES AND BOILERS.

Engine No. 1.—Engine almost entirely taken down; cylinder-heads taken off; pistons taken out; pistons and followers faced up; cylinders examined and found in good condition; main and cut-off valves planed off and faces scraped; valve-stems turned and trued up; new brass nuts put on cut-off valve-stem; new rock-shaft for main valve; new nut on high-pressure piston-rod; extra bearing put on rock-shaft; all valves ground in; new joints made under cylinder-heads; throttle and tail-valves ground in and fitted with new studs; all connecting-rod brasses and brasses for links bored out and the journals filed and trued up; beam-bearings taken out, rebored and journals dressed; bearings in cross-head and rock-shaft filed, air-pumps examined and new valves put in; new iron shoe placed in fly-wheel pit; screw-jacks put up to hold wheel while men are in pumps; pump-valves examined and valves and studs renewed where necessary; air-chamber put on suction-pipes and fitted with water-glasses, and relief-valves repaired.

Engine No. 2.—New pedestal for main shaft; new cut-off gear put on engine; new section of main steam-pipe; new joints

Total capacity 20,000,000 gallons per day.

FRANKFORD PUMPING STATION.

No. 1.—Marine Compound Rotary.—Capacity 10,000,000 galls. per day.
No. 2.—Corliss Compound Rotary.—Capacity 10,000,000 galls per day.

1886.	Pumping Time of each Engine in Hours.		Gallons Pumped by each Engine.		Total Pumpage of each Month.	Average Pumpage per Day.	Coal.		Percentage of Ashes.	Oil. Cylinder.	Oil. Engine.	Mean Water Pressure and Mean Suction Lift in lbs. per sq. inch.		Gallons raised 100 feet per pound of coal.
	No. 1.	No. 2.	No. 1.	No. 2.	Gallons.	Gallons.	Tons.	Lbs.		Quarts.	Quarts.	No. 1.	No. 2.	
January	....	205½	....	67,432,206	67,432,206	2,175,232	95	1,158	19.2	37½	13	....	77	574.2
February	....	183	....	60,582,150	60,582,150	2,163,648	59	1,381	19.8	33	11	....	78	472.6
March	....	228½	....	75,941,990	75,941,990	2,449,741	116	1,104	20.1	43	19	....	77	530.2
April	27½	189½	15,765,797	53,782,353	69,548,150	2,318,271	63	1,140	20.0	48	24	77	78	523.0
May	....	203¾	....	71,844,153	71,844,153	2,317,553	112	2,124	19.7	48	24	....	77	517.4
June	....	225½	....	79,551,747	79,551,747	2,651,724	113	1,998	19.4	50	25	....	80	568.1
July	27¾	194½	9,081,117	66,838,787	75,919,854	2,449,027	117	1,166	18.7	62	34	80	79	525.4
August	38½	186¼	12,304,031	66,178,832	78,482,863	2,531,705	112	2,102	20.2	58	26	80	84	565.2
September	76	148½	27,142,962	52,234,788	79,377,750	2,645,925	116	1,178	21.3	63½	44	82	82	554.1
October	222½	....	79,974,410	....	79,974,410	2,579,819	133	1,800	20.8	52½	51	82	....	486.1
November	37½	159	13,572,163	55,274,717	68,846,880	2,294,896	111	2,210	19.8	46	23	82	82	500.0
December	189½	26½	67,155,140	8,482,948	75,638,088	2,439,938	123	10	20.3	50	27	82	80	500.1
Totals and averages.	619¼	1,945½	224,995,620	658,144,621	883,140,241	2,419,562	1,277	1,691	20.0	591½	321	80	79	563.0

made; pumps lined up, new studs put in valve-seats, and brass hand-rail put up around engine.

BOILERS.

New socket-bolts put in back connection of No. 2 boiler; blow-off valves altered; safety-valves ground in; new joints made on steam-pipe; new studs put in boiler-fronts for holding fire-doors; new Tupper grate-bars fitted in boilers; bridge wall-plates reset and new dampers put in flues.

Heater put in engine-room and heater in cellar repaired.

KENSINGTON.

BUILDINGS AND GROUNDS.

The foundations of old Nos. 1 and 2 engines were torn down to below floor-line and new floor laid; engine-room wainscoted, painted and grained; new closets painted and glazed and fitted up in wash and bath-rooms; walls and ceilings in engine and fire-rooms cleaned and whitewashed; doors in front of engine-house repaired; roofs repaired over engine and fire-rooms and new rain-conductors put up; sky-lights repaired in fire-room, gas fixtures replaced, steps taken down from outside and placed inside of store-room to bath-rooms; cellar cleaned of all rubbish; drains run into a well dug for the purpose and connected with pipes to the donkey-pump for pumping it out; cellar walls whitewashed and steps repaired; fire-room repaved where old boilers Nos. 6 and 7 formerly stood; shed over fire-room doors built and covered with tar-paper and graveled; coal-shed repaired and roof covered with tar-paper; seats put up along shed; gas-pipe run to end of coal-shed, and a lamp with reflector placed on shed to light end of wharf; wharf repaired and derrick rebuilt.

RESERVOIR.

The large section of the basin was emptied and 2600 loads of mud removed from it; bottom repaired and stand-pipe of

KENSINGTON PUMPING STATION.

No. 3.—Worthington Duplex.—Capacity 6,000,000 gals. per day.

1886.	Running Time in hours.	Gallons. Pumped.	Average Pumpage per Day.	Coal.		Percentage of Ashes.	Oil.		Mean Water Pressure and Mean Suction Lift in lbs. per square inch.	Gallons raised 100 ft. per pound of coal.
							Cylinder.	Engine.		
	No. 3.	No. 3.	Gallons.	Tons.	Lbs.		Quarts.	Quarts.	No. 3.	
January	350	103,878,075	3,350,905	150	1,703	25.2	31½	16	58	392.0
February	346½	98,899,353	3,532,119	145	510	24.7	28½	13½	58	391.6
March	403	116,620,459	3,761,950	183	1,134	24.6	43¼	18½	58	365.4
April	424	124,112,278	4,137,075	178	437	25.1	48½	16¼	58	400.4
May	143	40,045,404	1,291,787	71	824	24.6	16½	25¾	58	322.6
June	401	124,176,738	4,139,224	155	1,350	25.3	36½	27½	56	458.8
July	685	2 9,037,066	6,743,131	258	2,192	25.2	60	28	56	464.1
August	568	176,409,815	5,690,639	218	602	24.9	58½	28¼	54	464.7
September	458½	133,448,383	4,448,279	182	1,004	25.3	40	21	55	420.5
October	485	146,506,711	4,726,022	191	575	24.9	42	22	55	440.4
November	623	19 ,944,930	6,398,164	225	139	25.3	57½	27½	56	490.3
December	30	8,988,189	289,941	39	2,231	25.2	6	3	56	129.2
Totals and averages	4 917	1,474,067,403	4,038,540	2,0 0	1,501	25.0	463¾	247¼	56	428.7

pumping-main taken down in order to convert it into a distributing as well as a pumping-main; screen built over it and all other screens repaired; entire slopes of all the sections repaired and cleaned; new watch-house built at the centre of the division walls; coal and wood-houses built for same and all painted and glazed; pavement laid around house; fence and steps repaired and incline graveled; water-conductors laid; wall built around stops and covered with iron grating and pavement relaid.

ENGINES AND BOILERS.

Engine No. 3.—High and low-pressure cylinder-heads taken off and the piston-rings set out; new joints made under cylinder-heads; steam-chests taken off and new joints made; steam-traps overhauled; donkey-exhaust turned into the condenser; new joints made on steam-pipe; air-pumps examined and packed; pumps examined and new valves put in where needed; cylinders and steam-chests covered with Hanmore's covering and painted; drip-pans made for pumps and stuffing boxes; the old Knowles' donkey-pump taken down and replaced.

BOILERS.

Boilers Nos. 1 to 5, inclusive.—Boilers scaled and cleaned; furnaces relined and bridge-walls rebuilt; a number of the tubes taken out of each boiler to clean the shells; tubes safe-ended and replaced; twelve tubes replaced by new ones; water-columns taken down and pipes cleaned out; all safety-blow and check-valves examined and put in order; top of boiler-setting repaired and whitewashed.

Boilers Nos. 6 and 7.—After these boilers had been cleaned and put in first-class condition and the furnaces relined, they were taken down and sent to the new machine-shop and set up there; old heaters and steam-pipes taken out and sold.

EAST PARK RESERVOIR.

All trees cut down from the inside banks and cuts in bank filled in with clay and gravel, using about 1500 loads.

SECOND DISTRICT.

New fence built for enclosing the grounds at west end of South street bridge for use as a storage yard; new office built and fence and office painted with two coats of paint.

THIRD DISTRICT.

Office painted and glazed; drawers put up in office for purveyor's use.

FOURTH DISTRICT.

The entire square at Twenty-sixth and Master streets enclosed with a high fence; new office for purveyor built, with storehouses, men's quarters, lead-room, wagon-shed and out-house all painted, glazed and finished complete; wagon-shed covered with tin roof, and rain-conductors put up; tool-wagon repaired, crabs for hoisting heavy pipes made.

OFFICE.

Large set of drawers made, put up and painted for permit-clerk; new racks made for printing-frame for drawing-room; partition taken down in superintendent's office; rack made for Chief Clerk's office. The telephone connections between the offices and the different stations of the Department have been frequently repaired and are kept in good condition.

At Spring Garden station the old burnt-out electric-light wires were removed from the front of the new building and new ones put up. Wires were also run along the forebay for lighting it.

Two new horses were purchased during the year for the use of the Department, and one horse that was useless was sold.

Height of Stack (feet).	Section of Stack (square feet).
95	25
....	25
100	49
100	25
100	25
100	$20\frac{1}{4}$
100	
100	25
50	$7\frac{9}{16}$
100	33
....	9

APPENDIX D.

REPORT

ON THE

OPERATIONS IN CONNECTION WITH THE

DISTRIBUTION SYSTEM

DURING 1886.

MR. JOHN L. OGDEN,
Chief Engineer:

SIR:—I have the honor to submit the following report for the year 1886, showing the alterations and additions to the Distribution System, and an account of the work performed under my direction.

Of the main pipes projected during the year the following have been finished:

Allen's Lane, from Germantown ave. to Mt. Airy Station.	16-in.,	1,019 ft.
Amber street, from Norris street to Lehigh avenue..........	10-in.,	3,834 ft.
Bainbridge street, from Broad to Twenty-first streets	36-in.,	3,290 ft.
Bainbridge street, from Twenty-first to Twenty-second streets..........	30-in.,	444 ft.
Broad street, from Snyder avenue south..........	20-in.,	336 ft.
Emerald street, from Otis to Lehigh avenue..........	12-in.,	3,128 ft.
Gaul street, from Otis to Huntington streets..........	10-in.,	2,449 ft.
Hare street, from Twenty-second to Twenty-fourth streets.	48-in.,	807 ft.
Lehigh avenue, from Cedar street, to Kensington avenue...	30-in.,	3,566 ft.
Lehigh avenue, from Kensington ave. to American street...	36-in.,	3,208 ft.
Spring Garden st., from Twenty-first to Twenty-fifth streets.	48-ni.,	1,704 ft.

Twenty-first st., from Bainbridge to Spring Garden streets.	48-in.,	7,302 ft.
Twenty-second street, from Hare to Poplar streets,............	48-in.,	1,240 ft.
Twenty-fourth street, from Callowhill to Hamilton streets	20-in.,	380 ft.
Twenty-fourth st., from Hamilton to Spring Garden streets.	36-in.,	501 ft.
Twenty-fourth street, from Spring Garden to Hare streets.	48-in.,	1,590 ft.
Tulip street, from Otis street to Lehigh avenue...............	12-in.,	3,214 ft.
Connections..	20-in.,	629 ft.
"	30-in.,	613 ft.
"	36-in.,	299 ft.
"	48-in.,	62 ft.
Making a total of.................		38,596 ft.

The 48-inch pumping main, from Spring Garden station to Twenty-fourth and Parrish streets has been partially laid, and all of the materials for its completion are on hand. The 20-inch main on Broad street, from Snyder avenue to Wolf street, has been laid about half way, and the remaining pipes are on the ground. Nearly all of the pipes for the 20-inch main, on Girard Avenue, from Front to Otis streets, have been received, ready for work to commence next year, as soon as the weather will permit. The relaying of the 16-inch mains, on North College avenue, has not been commenced. There are several reasons for these delays. The contractors for 20-inch pipe were unable to fill orders for some time on account of their men being on a strike, and the Department could not purchase from any other manufacturer. In the early part of the year materials on hand were used for the benefit of the Schuylkill River East Side Railroad Company, with the understanding that they would return them in kind within a reasonable time; but, although a list was furnished them in May, the pipes and special castings were not received by us until November and December.

The laying of large mains in the older portions of the city is each year becoming a more difficult task, The streets are usually twenty-six feet in width, from curb to curb, and beneath the surface are found sewers, drains, gas and water-pipes, traction and electric conduits, etc., the altering of which adds greatly to the expense.

The cost of laying the new 48-inch main on Twenty-first street, which was the most suitable that could be selected, was 19 per cent. greater per foot for labor than for a similar main on Poplar, Twenty-sixth and on Parrish streets, where the obstructions were few in comparison.

MAINS.

The following quantities of new pipe have been laid:

¾-inch,	130 feet,
1¼-inch,	114 feet,
3-inch,	27 feet,
4-inch,	677 feet,
6-inch,	88,185 feet,
8-inch,	1,698 feet,
10-inch,	8,798 feet,
12-inch,	6,899 feet,
16-inch,	1,111 feet.
20-inch,	1,345 feet,
30-inch,	4,650 feet,
36-inch,	7,298 feet,
48-inch,	15,899 feet.

A total of 136,831 feet, or twenty-five miles and 4,831 feet, added to the distribution system, making a total of 852 miles and 5,084 feet now in use.

Fifty-three thousand five hundred and sixty-two feet of pipe have been used for relaying and repairing mains and connections, of which amount 45,308 were for replacing 18,629 feet of 3-inch, 23,202 feet of 4-inch, and 3,477 feet of old 6-inch pipe, that had become useless from corrosion, etc.

Twenty thousand six hundred and fifty-four feet of pipe, of various sizes, have been used for repairs, lowered, raised, etc., making the total pipe of all sizes handled 258,041 feet, or 23,122,283 pounds, which is 50 per cent. more pounds handled than during any previous year.

FIRE-HYDRANTS.

Nine old-style and 423 new-style fire-hydrants have been set in new locations, and 169 of the old have been replaced by

15

others of the improved design, making the total number of the latter put in during the year, 502.

The total number of fire-hydrants now in use is 6,490, of which 966 are of the latest pattern.

Drills.

Eight thousand and nine attachments have been made, as follows: 7,482 $\frac{1}{2}$-inch, 258 $\frac{5}{8}$-inch, 104 $\frac{3}{4}$-inch, 133 1-inch, 32 2-inch, 1 3-inch, 7 4-inch, and 2 6-inch. The combined openings of these attachments are 1,948 square inches, or greater than the area of a 48-inch pipe.

Meters.

Six meters have been set in new locations. Twenty-two have been renewed and twenty-seven discontinued. Total in use December 31, 1886, 284.

Seven hundred and fifty-eight service-pipes, 28 drains, and 13 inlets were altered and repaired by the men employed at meter shop, costing, for material, $752.51, and for labor, $1,011.34.

Mains Laid and Altered for the Baltimore and Ohio Railroad Company.

The entrance of the Baltimore and Ohio Railroad Company into the City necessitated the alteration and laying of numerous service, supply and pumping mains, particularly in the vicinity of Fairmount, where all the pipes from the reservoir and works crossed the line of the proposed tunnel on Twenty-fifth street and Pennylvania avenue. As these mains were the only means for supplying that part of the city between Vine and South streets, it was impossible to dispense with their use until provision had been made for placing this district on another service during the time required for the construction of the tunnel. This was accomplished by laying a new main east of the tunnel on Twenty-fourth street, consisting of a 20-inch pipe, from Callowhill to Hamilton streets; a 36-inch pipe from Hamilton to Spring Garden streets, and a 48-inch from Spring Garden street to the pumping mains on Fairmount avenue, and connecting them with the old mains supplying the district. By this arrangement the old City was furnished with water, partly from Corinthian avenue reservoir, and partly by direct pumpage.

The pumping mains from Fairmount reservoir crossing the tunnel at Fairmount avenue, were not disturbed until the construction of the tunnel was completed at Spring Garden street and the mains re-connected with Fairmount reservoir. This was eventually done by laying a 48-inch main on the north side of Spring Garden street, between Twenty-fourth and Twenty-fifth streets, connecting the new 48-inch main on Twenty-fourth street with the several outlets from Fairmount reservoir at Twenty-fifth street.

The grades of Callowhill and of Hamilton streets were raised east and west of Twenty-fifth street, to obtain headway room for the construction of the tunnel. On the former street a 10-inch pipe was laid from Twenty-fourth to Hamilton streets, and the old 6-inch pipe was cut off and abandoned. On Hamilton street the 6-inch pipe was raised from Callowhill street east 114 feet, and from Callowhill street west 125 feet, to correspond with the change.

The grade at Sixtieth and Woodland avenue was also raised to obtain headway for the Baltimore and Ohio Railroad. A skew-iron girder-bridge was constructed by them at this point, and the 12-inch pipe on Woodland avenue was raised to conform to the new level. At the bridge the pipe descends behind the abutments and crosses the railroad beneath the tracks.

At Callowhill, Hamilton and Biddle streets, the service-pipes crossing the tunnel were laid on iron bars, resting on the lower flanges of the "covered-way" girders, and at Wharton street bridge the pipe was suspended in triangular iron brackets, fastened to the side of the bridge girders.

At Gray's Ferry road, Spring Garden street and Fairmount avenue the mains rest on top of the tunnel, with the exception of the 48-inch main at the latter place, which, on account of the shallow covering, is laid between two iron girders, 36 feet long and 5 feet in depth, the main resting on a floor of iron and cement, supported by the lower flanges of the girders.

Distribution and Mains.

At the beginning of the present year, the First Dirtrict, or that part of the City below South street, and between the Delaware and Schuylkill rivers, obtained its entire water supply from the Corinthian reservoir, through a 30-inch main, 14,000 feet in length. The supply of this District has been changed. A stop was placed on the 30-inch main on Broad street above South, to prevent the Corinthian water from going below this point, and the District is now supplied from Fairmount reservoir through the new 48-inch main down Twenty-first street to Bainbridge, then east through a new 36-inch main on Bainbridge street to the old 30-inch main on Broad street, and west from Twenty-first street, through a new 30-inch main on Bainbridge street to Twenty-second, where it connects with the 30-inch main.

The stops on the south side of South street were raised, and those on the north side closed, so as to give this District the benefit of the trunk main on South street for circulation and distribution. The 20 and 30-inch dead ends, at Twenty-second and South streets, have also been connected for the same purpose.

A 10-inch pipe has been laid on Twentieth street, to connect the old 10-inch pipe south of Pemberton street, to the new 36-inch on Bainbridge street.

The old 6-inch pipe on Reed street, betwen Tenth and Eleventh street has been relaid with 10-inch pipe; also, the old 4-inch on the east side of Eleventh street, to north of Wharton street with 10-inch pipe; north of Wharton street to Washington avenue, with 12-inch pipe, and from Washington avenue to Carpenter street, on the west side of Eleventh street, from Carpenter to Thurlow, and from Carpenter to Fitzwater street, with 8-inch pipe.

A 10-inch pipe was also laid on the south side of Washington avenue, from Moyamensing avenue to Second street, on the north side of Washington avenue, in place of the old 3-inch, from Second to Front streets.

It was intended to extend the 20-inch main on Broad street, from Snyder avenue to Wolf street. Only 336 feet were laid—the balance, 542 feet, was delayed for want of material, which was received too late to complete the work this year.

Altogether, there have been 4,699 feet of supply-mains and connections laid in this district, all of which connect with the mains at the cross streets.

The old 30-inch main on Broad street, between Washington avenue and South street, was also connected in the same manner.

The capacity of the new 48-inch main, which now supplies this district from Fairmount, is twenty-five million gallons per diem—fully three times that of the old 30-inch, from Corinthian reservoir.

The Second District, or that part of it which lies between South and Vine streets and the Delaware and Schuylkill rivers, is now supplied from Corinthian reservoir, by means of the new 48-inch main on Twenty-fourth street, and the 30-inch main down Broad street, from Corinthian reservoir, which formerly supplied the First Dictrict. The cross-mains at Lombard, Pine, Spruce, Locust, Race and Vine streets, have been connected with the latter main.

The stops on the north side of South and Vine streets are down.

The West Philadelphia supply remains substantially the same as last year.

In the Third District, north of Vine street, between Sixth street and Germantown avenue and the Delaware river, and below Lehigh and Kensington avenues, the following mains were laid:

A 36-inch on Lehigh avenue, from American street to Kensington avenue, where it reduces to 30-inches, and continues southeast to Cedar street. This main is connected at all the cross streets, and can be supplied from the old 36-inch main at American street and Lehigh avenue, from either Kensington works or Fairhill reservoir. All the cross-mains on Otis street between Beach and Front streets, and on Susquehanna avenue from Front to Second streets, have been connected with the 36-inch main. A 10-inch supply-main was laid on Gaul street, from Otis to Huntingdon streets, connecting with the 36-inch main on Otis and at all the intermediate streets. A similar main was laid on Amber street, from Norris street to Lehigh avenue, connecting to the 18-inch main on Norris street, and to the new 30-inch on Lehigh avenue. A 12-inch main was laid on Tulip and on Emerald streets, from Otis to Lehigh avenue, connecting with the 36-inch main on Otis street, and with the 30-inch on Lehigh avenue, and at all intermediate streets.

On the south side of Girard avenue the old 4-inch pipe was relaid with 12-inch, from Front to Third streets, where it reduces to a 10-inch, and continues to Lawrence street. A 12-inch pipe was also laid, to replace the old 6-inch on Richmond street, from Wheatsheaf lane to south of Tioga street. At Bridesburg a 12-inch submerged main was laid across Frankford creek, southwest of Bridge street, and continued with 10-inch pipe on Bridge street, northwest to Tacony road, and southeast to Washington avenue and on Washington avenue to Church street. The submerged section was made of 12-inch pipe and special castings, with lead joints. It was partly put together on the bank, then placed in position above the water, suspended from the bridge and from a derrick on the diver's boat. The several sections were then connected and lowered to the bottom of the creek, where it rests on a bed prepared by a diver. Bags of concrete were placed alongside and under it, and the joints were fastened together with two bolts at each joint, passing from an iron band back of the bell to one in front of it. The length of the submerged section is 108 feet. Work was begun July 22d and finished August 4th; the water was let into it on August 14th.

The Twenty-third Ward and part of the Twenty-fifth are supplied from Frankford reservoir, as far south as Indiana avenue, on the northwest side of Kensington avenue, and down Wheatsheaf lane to Richmond street; also, along Tacony road to Bridge street, and down Bridge street through the submerged main to Bridesburg; below Bridesburg, down Richmond street until the pressure of the water from this source is balanced by that of Fairhill reservoir.

Fairhill reservoir supplies east of the west side of American street, from Huntingdon street north; south of Huntingdon, from American to Sixth street, and east of Sixth street; the southern boundary being the Corinthian and direct pumpage pressure from the 30-inch main on Ninth street; the 10-inch on Girard avenue and the 10-inch and 16-inch on Poplar street.

That part of the District which is east of Germantown avenue, between Dauphin and Westmoreland avenue, north of Cumberland and west of Sixth street and American street, is supplied by direct pumpage from Spring Garden works.

Numerous complaints of a short supply were received from these last two sections previous to making the connections to the 36-inch main on Otis street and laying the mains above mentioned.

To improve the section depending upon direct pumpage, that portion between Front and American north of Huntingdon street was taken from the direct pumpage system and added to the District supplied from Fairhill reservoir, and the 18-inch main on Sixth street, between Lehigh avenue and Cumberland street, was added to the direct pumpage system; also, Third, Fourth, Lawrence and Fifth streets, were laid across Lehigh avenue from the south to the north side, to give a better circulation from below to north of Lehigh avenue. This change resulted in an increase of seven pounds pressure at the highest point.

The Fourth District, which is north of Vine street, west of Sixth and Germantown avenue to the Schuylkill river, and south of Westmoreland avenue, is supplied partly from Corinthian reservoir and partly by direct pumpage in the same manner as last year.

Several complaints of a short supply were received from the neighborhood of Huntingdon street and Ridge avenue, and examination showed pressures as low as two and three pounds. To remedy this, the water was brought from Germantown through the 6-inch pipe on the west side of Broad street to York avenue, and along York avenue and Dauphin street to Ridge avenue, the result being twenty-one pounds pressure. It was found that this pressure was often considerably lowered whenever the 4-inch supply connection at Dobson's Mills was used. This connection was from the 6-inch pipe supplying the locality from which the complaints came, and was transferred to the 12-inch main supplied by direct pumpage, since doing which no complaints have been received.

At Fairhill reservoir the 36-inch stand-pipe which extended above the surface of the water in the west section, was removed so as to make a distributing as well as a receiving main between this and Corinthian reservoir.

In addition to the work done for the Baltimore and Ohio Railroad Company, the following mains were laid in this District:

A 48-inch main on Twenty-fourth street, from north of Fairmount avenue to Hare street, on Hare street to Twenty-second, and on Twenty-second to Poplar street.

At the west end of Corinthian reservoir the old 30-inch connection was changed so as to be used either with the old 30-inch or the new 48-inch main.

At Twenty-second and Poplar streets the 30-inch connection between the 30-inch main on Poplar street and the 30-inch main on Twenty-second street, was disconnected from the latter and connected to the new 48-inch main. Also, a connection was made between the 30 and 48-inch mains on

Twenty-second street below Poplar, and a 30-inch connection was laid from the new 48-inch main near Poplar street, to the old 30-inch outlet from the north side of Corinthian reservoir. By means of this main and its several connections the 48-inch main on Twenty-fourth street, supplying the Second District, can be filled from either Corinthian reservoir or by direct pumpage.

An extension of the 48-inch main on the north side of Spring Garden street, between Twenty-fourth and Twenty-fifth streets, which, as previously described, connects with Fairmount reservoir, was laid on Spring Garden street, from Twenty-fourth to Twenty-first streets, and on the latter street to Vine street, being part of the main for supplying the First District.

Three thousand one hundred and ninety-four feet of the new 48-inch pumping-main between the Spring Garden works, and the 48-inch pumping-main from Fairmount at Twenty-fourth and Parrish streets, have been laid on Poplar, Twenty-sixth and Parrish streets.

In the Manayunk District no new supply-mains were laid.

On the night of the 17th of July a 30-inch stop was put on the overflow, at the north corner of the Roxborough reservoir, and a 20-inch stop on the cross connection, between the pumping and Mt. Airy supply mains; also, a 20x20-inch breeches pipe and a 20-inch stop on Manayunk supply-main. The 20-inch main on the southwest side of Roxborough reservoir, was relaid with 30-inch pipe. The work was begun on Friday, July 23d, by men from the Fourth and Fifth Districts. The excavation was finished Saturday afternoon, and at 4 o'clock the mains were emptied and cut. Five hundred and four feet of 20-inch pipe were taken up and replaced with 30-inch, and sixty-five feet of 20-inch pipe were laid, in place of a portion of the old main, which was abandoned. The work was finished and water let into the mains at 8 P, M., Sunday, July 25th, making twenty-eight hours between the time of shutting off the water and turning it on again. The height of the water in the Roxborough basin at the time of shutting off the pumping-main was 19 feet 1 inch. It had fallen to 15 feet 11 inches when the work was finished and pumping resumed.

The height of the water in the Mt. Airy basin was respectively 11 feet 4 inches and 3 feet. On Monday morning it was 7 feet 2 inches.

In the Germantown District a 16-inch main was laid on Allen's lane, from Mt. Airy pumping station to Germantown avenue, for the increase of the supply of the high pressure district formerly depending upon a 10-inch pipe. This main was finished and water let into it July 31st.

The new West Philadelphia storage yard, at South street and Meadland avenue, will add greatly to the facilities for doing work in this section. It has been graded and fenced in and provided with a watch-house.

The removal of the City Repair shop from No. 918 Cherry street, will give increased storage-room for this district in this most important locality.

A new office for the Fourth District has been built, and the yard fenced in a substantial manner. A similar yard and office should be provided for the Third District, which, though the largest, is almost entirely without storage-room.

The tools and appliances for laying pipe are complete and in good condition, except that a small steam-boiler and rotary-pump, for the purpose of draining ditches, is much needed. This is especially required when a main bursts. Such an accident should be repaired promptly, and yet it is often delayed for hours, and even days, by the difficulty in getting rid of the water.

A hoisting-engine is also frequently required, and a saving to the City would result by purchasing, instead of hiring one, as has heretofore been the case.

Respectfully,

ALLEN J. FULLER,

Assistant Engineer in Charge of Distribution.

IRON SERVICE AND SUPPLY MAINS LAID IN 1886.

First District,

Comprising the First, Second, Third, Fourth, Twenty-sixth, and Thirtieth Wards.

Street. Location.	Size in inches.	Distance in feet.
Service Mains.		
Bancroft street, from 6 feet south of south house line of Moore, to north house line of Tasker	6	903
Chadwick street, from 4 feet south of north house line of Moore, to 6 feet south of north house line of Morris	6	453
Dorrance street, from Federal to Ellsworth	6	318
Dudley street, from 365 feet west of Ninth, to Tenth	6	112
Eleventh street, from south house line of Moore, to south house line of Pierce	6	158
Ellsworth street, from Passyunk avenue, west	6	6
Ernest street, from dead end, 137 feet 8 inches west of west house line of Twenty-eighth, west	6	95
Fernon street, from 19 feet east of centre, to 25 feet west of centre of Twenty-first	6	44
Fernon street, from centre of Seventeenth, west	6	25
Front street, from 83 feet south of south line of Reed, north	8	219
Hicks street, from dead end, 159 feet 3 inches south of south house line of Dickinson, south	6	182
Jackson street, from Eighth to 386 feet west of Ninth	6	831
Jarden street, from Reed to Wharton	6	449
Keefe street, from Front, west	6	34
Lambert street, from Reed to Long lane	6	358
Latona street, from Twenty-second, west	6	370
Manton street, from Twenty-first, west	6	193
Mole street, from dead end, 159 feet south of south house line of Dickinson, south	6	182
Moore street, from centre of Eleventh, west	6	25
Morris street, from 85 feet east of centre of Nineteenth, to 25 feet west of centre of Twenty-first	6	1,107
Mountain street, from centre of Nineteenth, west	6	19
Mountain street, from 19 feet east of centre, to 25 feet west of centre of Twenty-first	6	44
Nineteenth street, from Morris, to 10 feet south of south house line of Fernon	12	268
Oakford street, from Long lane, west	6	276
Oakford street, from Twenty-first, west	6	193
Oakford street, from dead end, 271 feet west of west house line of Twenty-second, west	6	144
Park street, from Shunk, north	6	232
Passyunk avenue, east side, from Washington avenue to Ellsworth	8	429
Passyunk avenue, west side, from Carpenter to Washington avenue	8	450
Reed street, south side, east and west of centre of Front	6	44

Street. Location.	Size in inches.	Distance in feet.
Service Mains—Continued.		
Reed street, north side, east and west of centre of Front...	6	47
Reed street, from Long lane, west...	6	153
River road, from 1,096 feet south of Passyunk avenue, to Passyunk avenue...	6	1,096
Seventeenth street, from 6 feet south of north house line of Morris, to Tasker...	6	431
Shunk street, from Twenty-eighth to Park...	6	144
Tasker street, from Twentieth to Long lane...	6	1,072
Twentieth street, from Pemberton to 8 feet south of north curb line of Bainbridge...	10	199
Twentieth street, from 7 feet 6 inches south of north curb line of Watkins, to north curb line of Morris...	6	171
Twenty-first street, from Oakford to Federal...	6	324
Twenty-first street, from Watkins to Tasker...	6	601
Twenty-second street, from Pemberton, south...	6	20
Twenty-eighth street, from Shunk, north...	6	25
Thirty-fifth street, from Gray's Ferry road, north...	8	506
Washington avenue, south side, from Front, west...	10	31
Washington avenue, from 14 feet east of east house line of Second, to Moyamensing avenue...	10	260
Woodstock street, from Tasker, north...	6	12
Total...	...	13,267
Supply Mains.		
Bainbridge street, from 16 feet 9 inches west of east house line of Broad, to Twenty-first...	36	3,290
Bainbridge street, from Twenty-first to Twenty-second...	30	444
Broad street, from south house line of Snyder avenue, south...	20	336
South street, from 16 feet 9 inches west of east curb line of Broad, west...	16	46
Twenty-first street, from Bainbridge to South...	48	336
Total...	...	4,452
Supply Connections.		
Bainbridge street, from 36-inch main on Bainbridge, to 6-inch main on Fifteenth...	10	16
Bainbridge street, from 36-inch main on Bainbridge, to 6-inch main on Sixteenth...	10	16
Bainbridge street, from 36-inch main on Bainbridge, to 6-inch main on Seventeenth...	10	16
Bainbridge street, from 36-inch main on Bainbridge, to 6-inch main on Eighteenth...	10	17

Street. Location.	Size in inches.	Distance in feet.
Supply Connections—Continued.		
Bainbridge street, from 36-inch main on Bainbridge, to 6-inch main on Nineteenth	10	18
Bainbridge street, from 30-inch main to 6-inch main on Bainbridge, to west side of Twenty-first	6	6
Bainbridge street, south side, from 30-inch main on Broad, to 6-inch main on east side Broad	10	10
Broad street, east side, from 30-inch main on Broad, to 16-inch main on South	16	28
Broad street, east side, from 30-inch main on Broad, to 6-inch main on Fitzwater	10	10
Broad street, east side, from 30-inch main on Broad, to 6-inch main on Catharine	10	12
Broad street, east side, from 30-inch main on Broad, to 6-inch main on Carpenter	10	10
Twenty-second and South streets, 20-inch and 30-inch dead ends connected	20 30	35 20
Washington avenue, 14 feet east of east house line of Second, from 10-inch pipe on south side of Washington avenue, to 10-inch on north side	10	33
Total		247
Fire-hydrant Connections	6	1,094
Fire Connections (*private*).		
Twelfth street, west side, 56 feet 7 inches south of south house line of Carpenter For J. Williams & Son.	4	18
Supply connections (*private*).		
Mifflin street, south side, 88 feet 8 inches west of west house line of Broad, for St. Agnes' Hospital	4	19
Twelfth street, east side, 128 feet north of north house line of Washington avenue, for Campbell & Elliott	3	18
Twelfth street, east side. 144 feet north of north house line of Reed, for new machine shop	6	200
Total		237

Street. Location.	Size in inches.	Distance in feet.
Repairs, general	6	414
" "	8	23
" "	10	25
" "	30	12
Total		474
Repairs, new stops put in	6	63
" " "	20	6
" " "	30	9
Total		78

Pipe taken up.

Alaska street, from Seventh to Eighth	3	421
Almond street, from Swanson to Second	4	768
Anita street, from Tenth to 330 feet west of Twelfth	3	1,227
Austin street, from Reed to Federal	3	832
Bohemia street, from Fourth east	3	225
Campbell street, from Fitzwater to Sixth	4	448
Carpenter street, from 10 feet 6 inches west of east curb line of Eleventh, west	6	54
Dudley street, from 87 feet east of east house line of Tenth, east	4	38
Eleventh street, west side, from Catharine to Fitzwater	4	370
" " from Carpenter to 11 feet north of Thurlow	4	522
" " east side, from Reed to Carpenter	4	1,961
Harmony street, from Fourth to Fifth	3	450
Lafayette street, from Ninth to Tenth	3	446
League street, from Nineteenth west	4	372
Manilla street, from Ninth to Tenth	3	446
Marriott street, from Seventh to Ninth	3	900
Marion street, from Front, west	3	32
Milton street, from 11 feet 6 inches east of west curb line of Eleventh, west	3	29
Naylor street, from Austin to Eleventh	3	270
Newton street, from Washington to Carpenter	3	435
Passyunk avenue, connections between 6-inch pipe on Eighth, 13 feet 6 inches north of north house line of Plover and 8-inch on Passyunk avenue	4	9
Pemberton street, from Eighteenth to Twenty-third	4	2,411
Prime street, from Front, west	3	33
Reed street, north side, from centre of Front, east	3	9
" " " " " west	4	12
" south side, " " " east	4	11
" " " " " west	4	12
" from Tenth to Eleventh	6	494
Sidney street, from Federal to Ellsworth	3	333
Stewart street, from Manilla to Catharine	3	490

Street. Location.	Size in inches.	Distance in feet.
Pipe taken up—Continued.		
Sutherland street, from Christion to Queen	3	369
Thurlow street, from 10 feet east of west house line of Eleventh, west	4	28
Washington avenue, north side, from Swanson to Otsego	4	301
" " south side, " " " "	4	330
" " north side, from Front to Second	3	418
	6	34
" " south side, from Front, west	3	34
" " north side, from Moyamensing avenue to Third	4	298
" " south side, from Moyamensing avenue to Third	4	300
Repairs taken up	4	41
" "	6	174
" "	30	6
Total		16,393
Fire-hydrant connections taken up	3	4
" " "	4	63
" " "	6	20
Total		87
Relaid.		
Alaska street, from Seventh to Eighth	6	446
Almond street, from Swanson to Second	6	779
Anita street, from Tenth to 330 feet west of Twelfth	6	1,227
Austin street, from Reed to Federal	6	775
Bohemia street, from Fourth, east	6	209
Broad street, east side, from 9 feet south of south house line of South to 67 feet south of Rodman	30	116
Campbell street, from Fitzwater to Sixth	6	420
Carpenter street, from 10 feet 6 inches west of east curb line of Eleventh, west	10	54
Dudley street, from 327 feet west of Ninth, west	6	38
Eleventh street, east side, from Reed to 96 feet north of north house line of Wharton	10	283
Eleventh street, east side, from 96 feet north of north house line of Wharton to Washington avenue	12	1,250
Eleventh st., east side, from Washington av. to Carpenter	8	448
Eleventh street, west side, from Carpenter to 11 feet north of Thurlow	8	522
Eleventh street, west side, from Catharine to Fitzwater	8	376
Harmony street, from Fourth to Fifth	6	450
Lafayette street, from Ninth to Tenth	6	447

Street.	Location.	Size in inches.	Distance in feet.
	Relaid—Continued.		
League street, from Nineteenth, west		6	372
Manilla street, from Ninth to Tenth		6	448
Marriott street, from Seventh to Ninth		6	900
Marion street, from Front, west		6	32
Milton street, from 11 feet 6 inches east of west curb line of Eleventh, west		6	29
Naylor street, from Austin to Eleventh		6	278
Newton street, from Washington avenue to Carpenter		6	449
Passyunk avenue, from Marriott to Carpenter		6	276
"	connection (13 feet north of north house line of Plover) between 6-inch on Eighth, and 8-inch on Passyunk avenue	6	11
Passyunk avenue, from Federal to Ellsworth		6	344
Pemberton street, from Eighteenth to Twenty-third		6	2,369
Prime street, from Front, west		6	33
Reed street, from Tenth to Eleventh		10	494
Reed street, north side, from Front, east and west		6	21
Reed street, south side, from Front, east and west		6	23
Sidney street, from Federal to Ellsworth		6	336
Stewart, from Manilla to Catharine		6	515
Sutherland, from Christian to Queen		6	369
Thurlow street, from 10 feet east of west curb line of Eleventh, west		6	28
Washington avenue, north side, from 7 feet east of west curb line of Swanson, west		6	91
Washington avenue, north side, from 157 feet east of west curb line of Swanson to Otsego		6	211
Washington avenue, south side, from Swanson to Otsego		6	359
"	north side, from Front to Second	10	452
"	south side, from Front, west	6	34
"	north side, from Moyamensing avenue to Third	6	298
"	south side, from Moyamensing avenue to Third	6	300
Wharton street, from Eleventh, east and west		6	13
Total			16,925
Relaid fire-hydrant connections		6	485
	Lowered.		
Twenty-ninth street, from east house line of Hummell, west		4	152

Street. Location.	Size in inches.	Distance in feet.
Raised.		
Broad street, from 153 feet south of south house line of South, north	30	144
Federal street, from centre of Twenty-first, east and west	6	57
Gray's Ferry road and Thirty-fourth to cross B. & O. tunnel	20	184
Total	....	385
Cut off and abandoned.		
Broad street, east side, from 9 feet south of south house line of South to 67 feet south of south house line of Rodman	30	116
Eleventh street, east side, from 3 feet north of south curb line of Washington avenue, north	12	14
Front street, from 83 feet south of south house of Reed to 86 feet north of north house line of Reed	4	219
Passyunk avenue, from centre of Carpenter, north	3	267
Passyunk avenue, from Federal to Ellsworth	4	338
Reed street, south side, from intersection of Front, east	4	23
" " " " " west	4	21
" north side, " " " east	3	25
" " " " " west	4	22
Washington avenue, south side, from centre of Swanson, west	4	29
Total	....	1,074

Recapitulation of First District.

	Purposes for which used.	Size—Inches. 3	4	6	8	10	12	16	20	30	36	48	Totals in feet and pounds.
New pipe, or feet added.	Service mains			10,905	1,604	490	268						13,267
	Supply mains							46	336	444	3,290	336	4,452
	Supply main connections			6		158		28	35	20			247
	Fire hydrant connections			1,094									1,094
	Fire connections (private)		18										18
	Supply connections (private)	18	19	200									237
	Total { feet	18	37	12,205	1,604	648	268	74	371	464	3,290	336	19,315
	Total { pounds	270	703	402,765	67,368	35,640	19,296	8,140	58,989	154,048	1,388,380	196,560	2,332,159
Pipe used, but adding nothing to feet in the ground.	Repairs, general			414	23	25				12			474
	" new stops put in			63					6	9			78
	Pipe taken up	7,403	8,295	776						6			16,480
	" relaid			12,930	1,346	1,283	1,250			116			16,925
	Fire hydrant connections relaid			485									485
	Pipe lowered		152										152
	" raised			57					184	144			385
	" cut off and abandoned	292	652				14			116			1,074
	Total { feet	7,695	9,099	14,725	1,369	1,308	1,264		190	408			36,053
	Total { pounds	115,425	172,881	485,925	57,498	71,940	91,008		30,210	133,796			1,158,683
	Total handled { feet	7,713	9,136	26,930	2,973	1,956	1,532	74	561	867	3,290	336	55,368
	Total handled { pounds	115,695	173,584	888,690	124,866	107,580	110,304	8,140	89,199	287,844	1,388,380	196,560	3,490,842

Second District.

Comprising the Fifth, Sixth, Seventh, Eighth, Ninth, Tenth, Twenty-fourth, and Twenty-seventh Wards.

Street. Location.	Size in inches.	Distance in feet.
Service Mains.		
Allman (or Regent) from Forty-second to east house line of Forty-third	6	488
Arch street, south side, from 31 feet east of west house line of Broad, west to dead end	6	46
Aspen street, from DeKalb to Thirty-eighth	6	211
Benkert street, from Warren, southwest	6	134
Bingham court, from 263 feet north of north house line of Spruce, north	6	181
Brown street, from Thirty six-and-a-half to Thirty-seventh	6	202
Cherry street, from 4-inch main east side of Broad, to 5 feet 6 inches west of 30-inch main	6	19
DeKalb street, from Aspen, south	6	14
Evans street, from north house line of summer, south	6	11
Fairmount avenue, from 2 feet west of centre of Orion, west	6	90
Fairmount avenue, from Forty-seventh to Forty-eighth	6	347
Forty-fifth, from 9 feet north of centre of Merion avenue, to 26 feet north of south house line of Wyalusing	6	349
Forty-seven-and-one-half (or Moss) street, from 351 feet south of Fairmount avenue, to Fairmount avenue	6	351
Forty-ninth street, from 400 feet northwest of Chester to Springfield avenue	6	58
Forty-ninth street, from P. W. & B. R. R. to 44 feet 2 inches northwest of centre of Paschall	6	244
Fifty-fifth street, north and south of centre of Melrose	6	24
Haverford avenue, from 4 feet west of west house line of Mantua avenue, east	6	32
Inglis street, from dead end 351 feet east of centre of Second, east	6	25
Juniper street, from Spruce to South	6	133
Linwood street, from 5 feet west of centre of Thirty-eighth to Thirty-ninth	6	628
Mantua avenue, from Haverford avenue to 341 feet 11 inches west of centre of Thirty-second	6	1,021
Melrose (or Downing), from dead end, 276 feet west of west house line of Fifty-fourth, to 12 feet west of centre of Fifty-fifth	6	261
Mt. Vernon, from Mantua avenue to 3 feet east of centre of Thirty-third	6	650
Naudain street, from Twenty-first, west	6	13
Orion street, from dead end, 178 feet 6 inches north of north house line of Fairmount avenue, north	6	100
Paschall avenue, from Forty-ninth to east curb line of Fiftieth	6	458

Street. Location.	Size in inches.	Distance in feet.
Service Mains—Continued.		
Race street, from Twenty-third to St. David (B. & O.).....	6	259
Reno street, from Holly to Forty-second street...............	6	290
Sansom street, from 5 feet west of east curb line of Broad, west..	6	20
Springfield avenue, from 12 feet east of west house line of Forty-eighth to Forty-ninth..................................	6	451
St. Bernard place, from Forty-ninth to 30 feet southeast of southeast house line of Springfield avenue..............	6	577
Struthers street, from Twelfth to Thirteenth.................	6	446
Twenty-first, east and west of centre of Granville...........	6	9
Thirty-second street, from Haverford to Mantua............	6	660
Thirty-sixth-and-one-half street, from Aspen to Brown...	6	413
Thirty-seventh street, from dead end, 20 feet south of Brown, north..	6	21
Wallace street, from Thirty-second to 3 feet east of centre of Thirty-third..	6	406
Walnut street, from Twenty-fourth, west (B. & O.)..........	6	417
Wiota street, from Spring Garden, south.......................	6	124
Total..	....	10,183
Supply Mains.		
Twenty-first street, from 17 feet north of centre of South, to 40 feet south of centre of Vine..........................	48	5,268
Supply Main Connections.		
Broad and Vine streets, between 30-inch main on Broad and 12-inch on Vine...	12	23
Broad and Race streets, between 30-inch main on Broad, and 8-inch on Race..	6 8	21 8
Broad and Locust streets, between 30-inch main on Broad, and 6-inch on Locust street................................	6	42
Broad and Spruce streets, between 30-inch main on Broad, and 12-inch on Spruce..	12	45
Broad and Pine streets, between 30-inch main on Broad, and 6-inch on Pine..	6	33
Broad and Lombard streets, between 30-inch main on Broad, and 6-inch on Lombard...............................	6 10	30 5
Total..	....	207
Fire-hydrant connections..	6	1,172

Street. Location.	Size in inches.	Distance in feet.
Fire connections (private).		
Hudson street, west side, 187 feet north of north house line of Chestnut, for Fidelity Trust Company..........	6	10
Market street, north side, 165 feet east of east house line of Thirty second, for Penna. R. R. Co.....	4 6	12 9
Sansom street, south side, 83 feet west of west house line of Twelfth, for Bailey, Banks & Biddle.................	4	22
Total	....	53
Motor Connections (private).		
Seventh street, west side, 22 feet south of south house line of Chestnut, for Press Co. (Limited)......................	4	11
Supply connections (private).		
Bingham's court, west side, 100 feet south of south house line of Willing's alley, for Penna. R. R. Co...........	4	7
Market street, south side, 168 feet west of west house line of Eleventh, for Girard Estate................	6	74
Walnut street, north side, 357 feet west of west house line of Twenty-fourth..	4	21
Woodland avenue, southeast side, 127 feet west of curb line of Fifty-ninth, for B. & O. R. R. Co................	8	53
Total...	....	155
Drains.		
Broad street, east side, from 10 feet north of north house line of Arch, south..	6	11
Fifty-second street, west side, 15 feet north of centre of Lancaster avenue..	6	11
Market street, north side, 17 feet west of west house line of Fourth..	6	12
Market street, north side, 14 feet west of west house line of Eleventh..	6	7
Twenty-first street, centre of Arch..............................	10	10
Total..	....	51
Repairs, general	4	7
" "	6	748
" "	8	24
" "	10	48

Street. Location.	Size in inches.	Distance in feet.
Repairs, general—Continued	12	45
" "	16	17
" "	20	6
" "	36	12
Total	....	907
Repairs, new stops put in	4	5
" " "	6	94
" " "	8	6
" " "	12	8
" " "	20	3
Total	....	116
Pipe taken up.		
Bedell place, from Cherry to Bissell	3	136
Bingham's court, from Spruce, north	3	268
Bissell street, from Bedell, west	3	41
Carter street, from Second to Exchange place	3	336
Chester street, from Race to Vine	4	657
Clover street, from Eleventh to Thirteenth	4	890
Duponceau street, from Locust to Walnut	3	405
Exchange place, from Dock to Carter	3	244
Filbert street, from Seventh to Eighth	4	396
Graff street, from Eleventh to Twelfth	3	446
Gatzmer street, from Front to Second	3	396
Girard street, from Eleventh, west	4	99
Griscom street, from 168 feet north of north house line of Pine, north	3	72
Inglis street, from Second, east	3	296
Jayne street, from Seventh to Eighth	3	437
Juniper street, from South to Budd	3	1,169
Juniper street, from Spruce to Chestnut	3	1,370
Juniper street, from Arch to Vine	3	1,356
Lancaster avenue, from 24 feet west of centre of Fifty-second, west	6	38
Lee street, from Eighteenth, west	3	285
Moravian street, from Sixteenth to Seventeenth	4	446
Morgan street, from Ninth to Eleventh	3	842
Schell street, from Vine to Maple	3	557
Sergeant street, from Ninth to Eleventh	3	792
Woodland avenue, from 508 feet west of Fifty-ninth, west	12	228
Total	....	12,202
Taken up repairs	3	99
" "	4	10
" "	6	383
" "	8	15

Street.	Location.	Size in inches.	Distance in feet.
Taken up repairs—Continued		10	15
" "		12	16
" "		16	6
" "		20	14
Total			558
Fire-hydrant connections taken up		3	60
" " "		4	398
" " "		6	27
Total			485
Relaid.			
Bedell street, from Cherry to Bissell place		6	136
Bissell street, from Bedell, west		6	41
Bingham's court, from Spruce, north		6	298
Carter street, from Second, to 3 feet 6 inches west of centre of Exchange place		6	336
Chester street, from Race to 8 feet north of centre of Vine		6	691
Clover street, from Eleventh to Thirteenth		6	890
Duponceau street, from 18 feet north of centre of Locust to 13 feet south of centre of Walnut		6	405
Exchange place, from 23 feet north of centre of Dock to Carter		6	247
Filbert street, from Seventh to 7 feet east of centre of Eighth		6	445
Gatzmer street, from Front to Second		6	455
Girard street, from Eleventh, west		6	99
Graff street, from Eleventh to Twelfth		6	444
Griscom street, from 168 feet north of north house line of Pine, north		4	72
Inglis street, from Second, east		6	352
Jayne street, from Seventh to Eighth		6	442
Juniper street, from South to Budd		6	1,022
Juniper street, from Spruce to 14 feet south of centre of Chestnut		6	1,492
Juniper street, from 12 feet north of centre of Arch to Vine		6	1,345
Lancaster avenue, from 24 feet west of centre of Fifty-second, west		6	40
Lee street, from Eighteenth, west		6	315
Moravian street, from Sixteenth to Seventeenth		6	446
Morgan street, from Ninth to Eleventh		6	891
Sergeant street, from Ninth to Eleventh		6	891
Schell street, from Vine to 4 feet 6 inches north of centre of Maple		6	558
Woodland avenue, from 508 feet west of Fifty-ninth, west (B. & O. R. R.)		12	242
Total			12,595

Street. Location.	Size in inches.	Distance in feet.
Relaid repairs	4	6
" "	6	230
Total	....	236
Relaid fire-hydrant connections	6	493
Lowered.		
Arch street, east and west of centre of Twenty-first	30	158
Franklin street, from 275 feet east of east house line of Fifty-second, to Pear	6	270
Franklin street, southeast side, southwest of Pear, fire-hydrant connection	6	10
Pine street, intersection of Broad	6	8
Arch street, from 33 feet east of centre of Twenty-first, west (gas main)	16	74
Total	....	520
Raised.		
Broad street, from 56 feet 8 inches north of north house line of South, north	30	72
Woodland avenue, from 60 feet east of Fifty-ninth, west	12	564
Woodland avenue, from 37 feet west of Sixty-first, east (B. & O. R. R)	12	408
Total	....	1,044
Shifted.		
Twenty-first street, from 12 feet north of north house line of South, to 3 feet south of south house line of Lombard	6	263
Twenty-first street, from 18 feet south of north house line Lombard to 23 feet south of south house line of Pine	6	261
Twenty-first street, from Granville to south curb line of Spruce	6	169
Twenty-first street, from 16 feet north of north house line of Spruce to south curb line of Locust	6	374
Total	....	1,067
Cut off and abandoned.		
Fire hydrant connections	3	88
" "	4	263
" "	6	13
Total	....	364

Recapitulation of Second District.

	Purposes for which used.	Size—Inches: 3	4	6	8	10	12	16	20	30	36	48	Totals in feet and pounds.
New pipe, or feet added.	Service mains			10,183									10,183
	Supply mains											5,268	5,268
	Supply main connections			126	8	5	68						207
	Fire hydrant connections			1,172									1,172
	Fire connections (private)		34	19									53
	Motor connections (private)		11										11
	Supply connections (private)		28	74	53								155
	Drains			41		10							51
	Total feet		73	11,615	61	15	68					5,268	17,100
	Total pounds		1,387	383,295	2,562	825	4,896					3,081,780	3,474,745
Pipe used, but adding nothing to feet in the ground.	Repairs, general		7	748	24	48	45	17	6		12		907
	" new stops put in		5	94	6		8		3				116
	Pipe taken up	9,607	2,896	448	15	15	244	6	14				13,245
	" relaid		78	12,511			242						12,831
	Fire hydrant connections relaid			493									493
	Pipe lowered			288				74		158			520
	" raised						972			72			1,044
	" shifted			1,067									1,067
	" cut off and abandoned	88	263	13									364
	Total feet	9,695	3,249	15,662	45	63	1,511	97	23	230	12		30,587
	Total pounds	145,425	61,731	516,846	1,890	3,465	108,792	10,670	3,657	76,360	5,064		933,900
	Total handled feet	9,695	3,322	27,277	106	78	1,579	97	23	230	12	5,268	47,687
	Total handled pounds	145,425	63,118	900,141	4,452	4,290	113,688	10,670	3,657	76,360	5,064	3,081,780	4,408,645

Third District.

Comprising the Eleventh, Twelfth, Sixteenth, Seventeenth, Eighteenth, Nineteenth, Twenty-third, Thirty-first, and part of the Twenty-fifth Wards.

Street. Location.	Size in inches.	Distance in feet.
Service Mains.		
Almond street, from 6-inch main on southwest side of York, to 6-inch main on northeast side	6	57
Amber street, from Tioga s reet, south	6	188
Aramingo street, from Almond to Commerce	6	446
Berks street, south side, from Fourth to Manor	6	302
Berks street, north side, from Orianna to Fourth	6	143
Blair street, from Norris to Bowers	6	175
Bley street, from Hull, northeast	6	205
Bowers street, from Blair to 8 feet northwest of the southeast house line of Trenton avenue	6	299
Bridge street, from 74 feet northwest of Young, northwest.	10	71
Bridge street, across Frankford Creek	12	164
Bridge street, from 12-inch, dead end, to Tacony road	10	1,200
Cambria street, from Sixth, west	6	145
Cedar street, from 4-inch main on southwest side, to 6-inch main on northeast side of York street	6	54
Church street, from Garden to southeast house line of George	6	1,897
Cope street, from Amber, east	6	294
Collins street, northeast and southwest of 30-inch main on Lehigh avenue	6	8
Edmund street, from Orthodox to 5 feet north of the south house line of Margaretta	6	578
Elizabeth street, from Jasper to Kensington avenue	6	459
Emerald street, from 30-inch to 6-inch main on northeast side of Lehigh avenue	10	13
Emery street, from Ash to Buckius	6	557
Fifth street, from south to north side of Lehigh avenue	6	68
Filmore street, from 27 feet north of south house line of Lehigh avenue, north	6	63
Fourth street, from 28 feet north of south house line of Lehigh avenue, north	6	68
Garden street, from Jenks to Bridge	6	1,123
Gaul street, from 4-inch main on southwest side of York to 6-inch main on northeast side of York	6	54
Green, from Paul to Orchard	6	241
Hancock street, from 3 feet south of 36-inch main on Lehigh avenue to 6 feet north	6	9
Hazzard street, from 87 feet east of centre of Jasper to Emerald	6	342
Hedge street, from centre of Meadow, southwest	6	29
Hope street, from north curb line of Lehigh avenue, south	6	22
Howard street, from 3 feet south of 36-inch main on Lehigh avenue to 6-inch main, north side	6	12

Street. Location.	Size in inches.	Distance in feet.
Service Mains—Continued.		
Huntingdon street, from Ninth to Germantown avenue...	6	532
Hutchinson street, from Tyson to Lehigh avenue............	6	858
Hutchinson street, from 121 feet south of centre of Silver to Somerset..........................	6	342
Indiana street, from 527 feet east of Fourth to Fourth.....	6	527
James street, from Orthodox, northeast.........................	6	327
James street, from Pratt to Taylor............................	6	954
Jasper street, from 80 feet southwest of the northeast house line of Lehigh avenue, northeast..........................	10	69
Jasper street, from Madison avenue to Wellington...........	6	41
Jenks street, from Garden to Richmond.......................	6	424
Kipp street, from Tusculum to Cambria......................	6	327
Lawrence street, from Twenty-five feet north of south house line of Lehigh avenue, north.......................	6	68
Lawrence street, from dead end, 145 feet north of north house line of Indiana to 12 fe t north of south house line of Clearfield...	6	367
Leamy street, from 27 feet north of south house line of Lehigh avenue, north...	6	63
Leithgow street, from south side of Manor to Berks.........	6	406
Leithgow street, from Cambria to Indiana.....................	6	554
Madison avenue, from dead end, 325 feet west of Emerald to Jasper..	6	110
Martha street, from 6 feet southwest of 30-inch main on Lehigh avenue, northeast......................................	6	12
Meadow street, from southeast curb line of Cherry to Hedge.........	6	391
Melrose, from centre of bridge, southwest............	6	22
Memphis street, from 4-inch main on southwest to 6-inch main on northeast side of York.............................	6	54
Memphis street, from 3 feet northeast of the southwest curb line of Lehigh avenue, northeast...........	6	15
Mintzer street, from 189 feet south of Brown to Brown....	6	189
Orchard street, from Richmond to Meadow.....................	6	518
Orianna street, Somerset north to 69 feet south of south house line of Cambria..................................	6	458
Orianna street, from Indiana, south..............................	6	16
Orkney street, from Lehigh avenue to Somerset.............	6	555
Palethorp street, from 3 feet south of 36-inch main on Lehigh avenue to 6 feet north..............................	6	9
Reynolds street, from Garden to Richmond....................	6	398
Russell street, from Kensington avenue, east...................	6	324
Salmon street, from Ash to Buckius.........	6	546
Sepviva street, from 6-inch main on southwest side of York to 6-inch main on northeast side.........	6	57
Sepviva street, from 12 feet northeast of southwest curb line of Lehigh avenue, northeast to 30-inch main.....	6	6
Sepviva street, from 17 feet northeast of southwest house line of Tioga, northeast..	6	26
Silver street, from Hutchinson to Germantown avenue.....	6	274

Street. Location.	Size in inches.	Distance in feet.
Service Mains—Continued.		
Third, from 25 feet north of south house line of Lehigh avenue, north	6	70
Thompson street, from 6 inch main, southwest side, to 6-inch main on northeast side of York	6	54
Thompson street, from Buckius to Ash	6	507
Tioga street, southwest side, from Agate to Sepviva	6	772
Tioga street, from Sepviva to Waterloo	6	372
Trenton avenue, northwest side, from 6 feet 6 inches northeast of southwest curb of Lehigh avenue, northeast	6	28
Tulip street, from 9 feet north of south curb line of Lehigh avenue, northeast	6	10
Tyson street, from Eighth to 5 feet east of east house line of Ninth	6	316
Washington street, from Bridge to Church	10	284
Wellington street, from Jasper to Kensington avenue	6	582
Wensley street, from Kensington avenue, southeast	6	537
William street, from Ash to Church	6	487
Willow street, from Harrison to 254 feet northeast of northeast house line of Wakeling	6	803
Total	....	23,947

* NOTE.—12-inch main (submerged) across Frankford creek, parallel with Bridge street, on northwest side.

Street. Location.	Size in inches.	Distance in feet.
Supply Mains.		
Amber street, from Morris to Lehigh avenue	10	3,834
Cedar street, southeast side, from 6 feet northeast of the southwest curb line of Lehigh avenue, northeast	10	28
Emerald street, from Otis to Lehigh avenue	12	3,128
Gaul street, from Otis to Huntingdon	10	2,449
Lehigh avenue, south side, from fifty-one feet east of centre of Cedar, to Frankford avenue	30	2,284
Lehigh avenue, north side, from Frankford avenue to 24 feet east of east house line of Kensington avenue	30	1,282
Lehigh avenue, north side, from 24 feet east of east house line of Kensington avenue, to 28 feet west of west house line of American	36	3,208
Tulip street, from Otis to Lehigh avenue	12	3,214
Total	....	19,427
Supply main connections.		
Huntingdon street, east and west of 18-inch main on Sixth	6 10	70 17

Street. Location.	Size in inches.	Distance in feet.
Supply main connections—Continued.		
Otis street, northwest side of Girard avenue, between 36-inch main on Otis and 4-inch on Girard avenue	6 10	3 8
Otis street, southeast side of Girard avenue, between 36-inch main on Otis and 4-inch on Girard avenue	6 20	2 50
Otis and Thompson streets, between 36-inch main on Otis and 6-inch on Thompson	6 10	3 15
Otis street and southwest side of Moyer, between 36-inch main on Otis and 4-inch main on Moyer	6 10	4 15
Otis street and southwest side of Belgrade, between 36-inch main on Otis and 6-inch main on Belgrade	10	9
Otis street and southwest side of Cedar, between 36-inch main on Otis and 6-inch main on Cedar	6	12
Otis and Memphis streets, between 36-inch main on Otis and 6-inch main on Memphis	10	3
Otis and Tulip streets, between 36-inch main on Otis and 6-inch main on Tulip	6	9
Otis and Sepviva streets, east side, between 36-inch main on Otis and 6-inch main on Sepviva	6	17
Otis and Sepviva streets, west side, between 36-inch main on Otis and 6-inch main on Sepviva	6	14
Otis and Frankford avenue, between 36-inch main on Otis and 10-inch on Frankford avenue	10	16
Otis and Blair streets, between 36-inch main on Otis and 6-inch main on Blair	6 10	3 8
Otis street and northwest side of Trenton avenue, between 36-inch main on Otis and 4-inch main on Trenton av.	6	7
Otis and Holman streets, between 36-inch main on Otis and 6-inch main on Holman	6	20
Otis street and southwest side of Amber, between 36-inch main on Otis and 6-inch main on Amber	6 10	10 13
Otis and Coral streets, between 36-inch main on Otis and 6-inch main on Coral	6	11
Otis and Emerald streets, between 36-inch main on Otis and 6-inch main on Emerald	6	32
Susquehanna avenue and Howard street, between 36-inch main on Susquehanna av. and 6-inch main on Howard	6 10	2 15
Susquehanna avenue and Hancock street, between 36-inch main on Susquehanna av. and 6-inch main on Hancock	6 10	3 14
Total		405
Fire hydrant connections	6	1,542
Fire connections (private).		
Emerald street, west side, 52 feet south of south house line of Adams, for Firth, Foster & Co	4	31

Street. Location.	Size in inches.	Distance in feet.
Fire connections (private)—Continued.		
Fillmore street, east side, 199 feet north of north house line of Lehigh avenue	4	18
Front street, east side, 194 feet north of northwest house line of Jasper	4	20
Lehigh avenue, north side, 80 feet east of east house line of Fillmore, for John Bromley & Son	4	14
Leithgow street, east side, 170 feet north of north house line of Cambria, for Stead & Miller	4	10
Paul street, east side, 25 feet 6 inches north of north house line of Meadow, for Charles Shaw	4	22
Somerset street, north side, 82 feet west of west house line of Seventh, for John Blood & Co	4	19
Total	....	134
Supply connections (private).		
Delaware avenue, east side, 367 feet south of south house line of Laurel, for Baltimore and Ohio Railroad Co.	4	39
	6	12
Total	....	51
Drains.		
Lehigh avenue, south side, 12 feet southeast of southeast curb line of Cedar	6	18
Repairs, general	6	316
" "	10	23
" "	20	5
Total	....	344
Repairs, new stops put in	6	280
Pipe taken up.		
American street, east side, from Jefferson, south	4	107
" " west side, from Jefferson to Master	4	453
Belrose street, from centre of Noble, south	4	25
Bodine street, from Oxford to Columbia avenue	4	531
Bridge street, from Washington to 74 feet west of Young	6	252
Girard avenue, south side, between Front and Lawrence	4	985

Street. Location.	Size in inches.	Distance in feet.
Pipe taken up—Continued.		
Hazzard street, from Jasper, east	4	87
Trenton avenue, southeast side, from 16 feet northeast of southwest curb line of Lehigh avenue, northeast	6	15
Total	....	2,455
Fire-hydrant Connections	4	445
" "	6	38
Total	....	483
Pipe Relaid.		
American street, east side, from Jefferson to Master	6	453
" " west " " " "	6	453
Belrose street, from Noble, south	6	17
Bodine street, from Oxford to Columbeia avenue	6	531
Bridge street, from northwest curb line of Washington to 144 feet west of west house line of Young	10	252
Girard avenue, south side, from Front to Third	12	1,381
" " south side, from Third to Lawrence	10	721
Hazzard street, from centre of Jasper, east	6	87
Richmond street, from 33 feet southwest of southwest house line of Tioga to 5 feet north of centre of Wheat Sheaf lane	12	3,168
Trenton avenue, southeast side, from 16 feet northeast of of southwest curb line of Lehigh avenue, northeast	6	15
Total	....	7,078
Relaid Fire-hydrant Connections.	6	4 40
Cut off and Abandoned.		
American street, east side, from 106 feet 9 inches south of south house line of Jefferson to Master	4	350
Girard avenue, south side, between Front and Lawrence	4	1,115
Fire-hydrant Connections Cut and Abandoned.	4	85
Total	....	1,465

Recapitulation of Third District.

	Purposes for which used.	Size—Inches. 4	6	10	12	20	30	36	Totals in feet and pounds.
New pipe, or feet added.	Service mains		22,146	1,637	164				23,947
	Supply mains			6,311	6,342		3,566	3,208	19,127
	Supply main connections		222	133		50			405
	Fire hydrant connections		1,542						1,542
	Fire connections (private)	134							134
	Supply connections (private)	39	12						51
	Drains		18						18
	Total — feet	173	23,940	8,081	6,506	50	3,566	3,208	45,524
	Total — pounds	3,287	790,020	444,455	468,432	7,950	1,183,912	1,353,776	4,251,832
Pipe used, but adding nothing to feet in the ground.	Repairs, general		316	23		5			344
	" new stops put in		280						280
	Pipe taken up	2,633	305						2,938
	" relaid		1,556	973	4,549				7,078
	Fire hydrant connections relaid		440						440
	Pipe cut off and abandoned	1,465							1,465
	Total — feet	4,098	2,897	996	4,549	5			12,545
	Total — pounds	77,862	95,601	54,780	327,528	795			556,566
	Total handled — feet	4,271	26,837	9,077	11,055	55	3,566	3,208	58,069
	Total handled — pounds	81,149	885,621	499,235	795,960	8,745	1,183,912	1,353,776	4,808,398

Fourth District,

Comprising the Thirteenth, Fourteenth, Fifteenth, Twentieth, part of Twenty-eighth, and part of Twenty-ninth Wards.

Street. Location.	Size in inches.	Distance in feet.
Service Mains.		
Arizona street, from Twenty-seventh east	6	226
Bertha street, from Carlisle to Fifteenth	6	209
Bouvier street, from Montgomery avenue north	6	325
Burns street, from Brown to Parrish	6	357
Caroline street, from dead end 20 feet 6 inches south of Centre of Herman north	6	21
Clarence street, from Twenty-sixth to Twenty-seventh	6	452
Corinthian avenue, from South College avenue south	6	54
Diamond street, south side, from Seventeenth to Eighteenth	6	443
Diamond street, from 23 feet east of east house line of Uber to Twentieth	6	262
Diamond street, from Crosky to Twenty-third	6	221
Dover street, from York to Herman	6	276
Eighteenth street, from dead end 50 feet south of south house line of Diamond north	6	60
Fifteenth street, from Dauphin to Cumberland	6	1,122
Fontaine street, from west house line of Nineteenth to Twentieth	6	435
Girard avenue, from Thirty-first west	10	27
Gratz street, from Berks to Norris	6	553
Herman street, from Twenty-sixth to Twenty-seventh	6	450
Herman street, from Twenty-ninth to Thirty-first	6	914
Kay street, from Carlisle to Fifteenth	6	209
Keith street, from Columbia avenue to Montgomery avenue	6	564
North College avenue, from Twenty-first east	6	102
Page street, from 6 feet east of east house line of Nineteenth to Twentieth	6	437
Page street, from Twenty-ninth west	6	173
Park avenue, from Cumberland south	6	141
Perot street, from Twenty-fifth to Twenty-sixth	6	464
Philadelphia street, from Dauphin north	6	414
Poplar street, from 148 feet west of west house line of Thirtieth west	6	24
Richfield street, from Twelfth to Thirteenth	6	454
Ringgold street, from Berks to Taylor	6	276
South College avenue, from Twentieth to Corinthian avenue	6	457
Stillman street, from Columbia avenue to Montgomery avenue	6	567
Taylor street, from Brown to Parrish	6	390
Taylor street, from Berks north, then east to Twenty-fourth	6	535
Thirtieth street, from dead end 24 feet 6 inches south of centre of Herman north	12	25

Street. Location.	Size in inches.	Distance in feet.
Service Mains—Continued.		
Thirty-first street, from 12-inch stop northeast side of Ridge avenue to Dauphin	6	736
Thirty-first street, from Dakota to Herman	6	160
Thirty-second street, from 12-inch stop northeast side of Ridge avenue to Dauphin	6	325
Thomas avenue, from York north	6	192
Twenty-eighth street, from Master south	6	132
Twenty-first street, from North College avenue north	6	44
Twenty-sixth street, from Sedgely to York	6	1,057
Twenty-sixth street, from Biddle to Callowhill	6	146
Walter street, from Twenty-ninth to Thirtieth	6	454
Warnock street, from Diamond north	6	174
Wilt street, from Nineteenth to Uber	6	228
York street, from Sedgely to Twenty-fourth	6	283
Total	......	15,570
Supply Mains.		
Twenty-second street, from 25 feet south of south house line of Poplar to Hare	48	1,240
Hare street, from Twenty-second to Twenty-fourth	48	807
Twenty-fourth street, from Hare to 98 feet north of north house line of Fairmount avenue	48	354
Twenty-fourth street, from 98 feet north of north house line of Fairmount avenue to Spring Garden (B. & O.)	48	1,236
Twenty-fourth street, from Spring Garden to Hamilton (B. & O.)	36	501
Twenty-fourth street, from Hamilton to Callowhill (B. & O.)	20	380
Twenty-first street, from 25 feet south of south house line of Vine to Spring Garden	48	1,698
Spring Garden street, from Twenty-first to Twenty-fourth	48	1,306
Spring Garden street, from Twenty-fourth to Twenty-fifth (B. & O.)	48	398
Twenty-fifth street, east side, from 48 feet south of north house line of Spring Garden north (B. & O.)	30	27
Total	....	7,947
Pumping Mains.		
Parrish street, from 8 feet 10 inches west of west house line of Twenty-fourth to 11 feet 6 inches west of east house line of Twenty-sixth	48	856
Twenty-sixth street, from Parrish to Poplar	48	446
Poplar street, from Twenty-sixth to 108 feet west of west house line of Thirtieth	48	1,892
Total	....	3,194

Street. Location.	Size in inches.	Distance in feet.
Supply Main Connections.		
Corinthian Reservoir, Twenty-second street, from 48-inch main 162 feet north of north house line of Parrish east to Reservoir	30	20
Corinthian Reservoir, Poplar street, from 48-inch main on Twenty-second east to Reservoir	30	327
Fairmount Reservoir, Spring Garden street, from 48-inch main east of Twenty-fifth west (B. & O.)	36	261
	20	384
Fairmount Reservoir, Spring Garden street, from 36-inch main southeast corner of Reservoir (B & O.)	30	30
Spring Garden and Twenty-fifth streets, east side, connecting 20-inch with 48-inch main (B. & O.)	20	54
Spring Garden and Twenty-fourth streets, west side, connecting 48-inch with 48-inch main (B. & O.)	36	6
	48	54
Spring Garden and Twenty-fourth streets, east side, connecting 20-inch with 48-inch main (B. & O.)	20	74
Spring Garden street, south side, from 22-inch main of Pennsylvania avenue to 6-inch main of Twenty-third	6	33
Twenty-fourth and Hamilton streets, connecting 30-inch with 36-inch main on Twenty-fourth	30	43
Twenty-fourth street and Pennsylvania avenue, connecting 22-inch with 48-inch main on Twenty-fourth	48	8
	20	32
Twenty-fourth street and Fairmount avenue, connecting 48-inch main on Twenty-fourth	36	32
Twenty-fourth street, east side, from Fairmount avenue south, connecting 48-inch with 48-inch main on Twenty-fourth	30	112
Twenty-second street, east-side, 140 feet north of north curb line of Parrish, connecting 30-inch main with 30-inch reservoir connection	30	23
Twenty-second street, 47 feet 4 inches south of south house line of Poplar, connecting 48-inch main with 30-inch main on Twenty-second	30	14
Twenty-second street, 37 feet 9 inches south of south house line of Poplar, connecting 48-inch main with 48-inch main on Poplar street	30	24
Total	....	1,531
Fire hydrant connections	6	1,594
Fire connections (private).		
Callowhill street, southwest side, 207 feet northwest of Twenty-fifth, for Beswick & Kay	4	13
Girard avenue, north side, 61 feet east of east house line of Hutchinson, for Girard Avenue Market Company	4	2
	6	3

Street. Location.	Size in inches.	Distance in feet.
Fire connections (private)—Continued.		
Hamilton street, north side, 182 feet east of east house line of Nineteenth, for John C. Graham	4	14
Montgomery avenue, south side, 84 feet west of west house line of Ninth, for Sullivan & Son	4	13
Total	....	45
Supply connections (private).		
Fairmount Park, southwest of B. and O. tunnel, from 30-inch main to Fairmount avenue	6	211
Fairmount Park, west of Fairmount avenue entrance	4	12
Twenty-seventh street, east side, 10 feet south of south house line of Master to supply hydrant, for Public Bath	4	16
Total	....	239
Drains.		
Fairmount Reservoir	6 8 12	28 33 20
Girard avenue, 18 feet east of west house line of Franklin, from 12-inch main	6	8
Master street, northeast corner of Twenty-sixth, from Fourth District Office	4	24
Twenty-first street, northwest corner of Vine, from fire hydrant	6	14
Twenty-first and Callowhill streets	4 6	2 8
Twenty-second street, southeast corner of Brown, from Water Department property	4	46
Twenty-fourth street, 22 feet north of north house line of Callowhill, from 20-inch main	12	12
Thirty-third street, south of Master	6	81
Spring Garden street, east house line of Twenty-fifth, from 20-inch main	6	18
Total	....	294
Repairs, general	4	102
" "	6	509
" "	10	75
" "	12	30
" "	20	22
" "	22	33
" "	30	21
Total	....	792

Street. Location.	Size in inches.	Distance in feet.
Repairs, new stops put in	6	4
" " "	10	3
" " "	12	9
" " "	20	3
" " "	30	1
Total	....	20
Pipe taken up.		
Biddle street, from Twenty-third to east house line of Twenty-fifth (B. and O.)	4	852
Biddle street, from east to west side of Twenty-fifth (B. and O.)	4	67
Brandywine street, from Taylor to Twenty-fifth (B. and O.)	4	180
Callowhill street, from east to west side of Twenty-fifth (B. and O.)	6 20	65 45
Fairmount avenue, from east and west of Pennsylvania avenue (B. and O.)	6 48	90 230
Garden street, from Vine to Buttonwood (B. and O.)	3	1,308
Green street, from east to west side of Twenty-fifth (B. and O.)	22	75
Hamilton street, from east to west side of Twenty-fifth (B. and O.)	6	64
Hare street, from Twenty-second to Twenty-third	4	334
Hare street, from Twenty-third to Twenty-fourth	6	454
Hare street, from Twenty-fourth to Twenty-fifth	4	441
Linn street, from Twenty-second to Twenty-fourth	4	907
Ringgold street, from Hare to Brown	4	454
Shamokin street, from Twenty-third east	4	300
Spring Garden street north side, from Twenty-third to Twenty-fifth	4	936
Spring Garden street, south side, from Twenty-third to Twenty-fifth	4	937
Spring Garden street, intersection of Pennsylvania ave	22	33
Spring Garden Pumping Station	36 48	5 9
Taylor street, from Hare to Brown	4	490
Thirty-third street, intersection of Thompson	30	8
Thirty-third street, intersection of Master	30	17
Twenty-fifth street, from Hamilton to Fairmount Reservoir	30	350
Twenty-fifth street, from Callowhill to Pennsylvania ave	6	1,275
Twenty-sixth street, from Callowhill to Biddle	20	110
Wood street, from Ridge avenue to Tenth	3	. 216
Wood street, from Eleventh to 18 feet west of east house line of Broad	4	1,463
Total	....	11,715
Pipe taken up on fire hydrant connections	4	67

Street. Location.	Size in inches	Distance in feet.
Pipe relaid.		
Biddle street, from Twenty-third to east house line of Twenty-fifth	6	852
Biddle street, from east to west house line of Twenty-fifth, (B. & O)	6	49
Callowhill street, from Twenty-fourth to Hamilton, (B. & O.)	10	742
Callowhill street, intersection of Hamilton (B. & O.)	6	12
Fairmount avenue, from 162 feet west of west house line of Twenty-fifth, west (B. &. O.)	48	276
Garden street, from Vine to Buttonwood	6	1,352
Girard avenue, south side, from Eighth to ten feet west of east house line of Ninth	6	198
Girard avenue, south side, from Tenth to Broad	6	1,946
Girard avenue, north side, 18 feet east of east house line of Eighth to Tenth	6	778
Hamilton street, from east to west house line of Twenty-fifth (B. &. O.)	6	81
Hare street, from Twenty-second to Twenty-fourth	8	790
Hare street, from Twenty-fourth to Twenty-fifth	6	455
Linn street, from Twenty-second to Twenty-fourth	6	907
Ringgold street, from Hare to Brown	6	454
Shamokin street, 127 feet west of Twenty-second to Twenty-third	6	327
Spring Garden street, north side, intersection of Pennsylvania avenue	20	33
Spring Garden street, from east to west side of Twenty-fifth (B. & O.)	20	110
Spring Garden street, from east to west side of Twenty-fifth (B. & O.)	30	74
Spring Garden street, north side, from west side of Twenty-third to Twenty-fifth street	6	780
Spring Garden street, south side, from Twenty-third to 11 feet west of east house line of Twenty-fifth	6	786
Taylor street, from Hare to Brown	6	451
Twenty-second street, from Brown, south	6	98
Twenty-fifth street, from Callowhill, north	6	9
Twenty-fifth street, west side, from Hamilton to Biddle	6	243
Wood street, from Ridge avenue to Tenth	6	244
Wood street, from 3 feet east of west house line of Eleventh, to Broad	6	1,441
Total.	....	13,488
Relaid fire hydrant connections	....	195

Street. Location.	Size in inches.	Distance in feet.
Pipe lowered.		
Biddle street, from Twenty-fifth, west	6	417
Spring Garden street, from Taylor, east	20	111
Spring Garden street, intersection of Pennsylvania avenue	22	33
Twenty-first street, from Callowhill, north	20	107
Total	....	668
Pipe raised.		
Callowhill street, from Twenty-second, east (gas-pipe)	12	124
Hamilton street, from Twenty fifth, east (B. & O.)	6	114
Hamilton street, from Twenty-fifth, west (B. & O.)	6	125
Poplar street, intersection of Twenty-seventh (gas-pipe)	4	25
Poplar street, intersection of Twenty-seventh (gas-pipe)	8	140
Twenty-second street, from 167 feet north of Parrish, north	30	94
Total	....	622
Pipe shifted.		
Twenty-second street, from Brown, north (gas-pipe)	3	325
Pipe cut off and abandoned.		
Callowhill street, from Twenty-fourth to Twenty-fifth	6	425
Callowhill street, from Twenty-fifth, west	6	144
Callowhill street, from Twenty-fourth to Twenty-fifth	20	435
Callowhill street, from Twenty-fifth, west	20	550
Girard avenue, south side, from Tenth to Broad	4	1,946
Girard avenue, south side, from Eighth to Ninth	4	198
Girard avenue, north side, 18 feet east of east house line of Eighth, to Tenth	4	778
Hamilton street, from Twenty-fourth to Twenty-fifth	30	425
Total	....	4,901
Cut and abandoned on fire hydrant connections	3	16
" " " " "	4	392
" " " " "	6	14
Total	....	422

Recapitulation of Fourth District.

Purposes for which used.		Size—Inches. 3	4	6	8	10	12	20	22	30	36	48	Totals in feet and pounds.
New pipe, or feet added.	Service mains			15,518		27	25						15,570
	Supply mains							380		27	501	7,039	7,947
	Pumping mains											3,194	3,194
	Supply main connections			33				544		593	299	62	1,531
	Fire hydrant connections			1,594									1,594
	Fire connections (private)		42	3									45
	Supply connections (private)		28	211									239
	Drains		72	157	33		32						294
	Total { feet		142	17,516	33	27	57	924		620	800	10,295	30,414
	Total { pounds		2,698	578,028	1,386	1,485	4,104	146,916		205,840	337,600	6,022,575	7,300,632
Pipe used, but adding nothing to feet in the ground.	Repairs, general		102	509		75	30	22	33	21			792
	Repairs, new stops put in			4		3	9	3		1			20
	Pipe taken up	1,524	7,428	1,948				155	108	375	5	239	11,782
	Pipe relaid			11,463	790	742		143		74		276	13,488
	Fire hydrant connections relaid			195									195
	Pipe lowered			417				218	33				668
	Pipe raised		25	239	140		124			94			622
	Pipe shifted	325											325
	Pipe cut off and abandoned	16	3,314	583				985		425			5,323
	Total { feet	1,865	10,869	15,358	930	820	163	1,526	174	990	5	515	33,215
	Total { pounds	27,975	206,511	506,814	39,060	45,100	11,736	242,634	43,500	328,680	2,110	301,275	1,755,395
Total handled { feet		1,865	11,011	32,874	963	847	220	2,450	174	1,610	805	10,810	63,629
Total handled { pounds		27,975	209,209	1,084,842	40,446	46,585	15,840	389,550	43,500	534,520	339,710	6,323,850	9,056,027

MANAYUNK DISTRICT,

Comprising the Twenty-first and part of the Twenty-eighth Wards.

Street. Location.	Size in inches.	Distance in feet.
Service Mains.		
Abbotsford avenue, from Queen lane, northeast	6	24
Centre street, from northeast curb line of Clay to Webster	6	275
Chestnut street, from Leverington to Ripka	6	312
Conarroe street, from northeast house line of Manayunk avenue, northeast	6	314
Cotton street, from Main, southwest	6	96
Cresson street, from Queen, southeast	6	18
Cresson street, northeast side, from Penn to Cedar	6	349
Cresson street, northeast side, from Adams, southeast	6	277
Division street, from Jefferson to Mt. Vernon	6	312
Fleeson street, from Ridge avenue, southwest	6	392
Harrison street, from Oak to Gay	6	195
Jackson street, from Main to Baker	6	366
Leverington avenue, from Mansion avenue to 12 feet southwest of centre of Chestnut	6	452
Markle street, from dead end 55 feet northeast of northeast house line of Terrace, northeast	6	67
Markle street, from 223 feet southeast of other Markle street, southeast, then northeast to southwest house line of Manayunk avenue	6	177
Mt. Vernon street, from Division, northeast	6	201
Ogle street, from dead end 241 feet 6 inches northwest of northwest house line of Fountain, northwest	6	265
Queen lane, from dead end 401 feet 3 inches northeast of Thirty-fifth to northeast house line of Thirty-fourth	6	341
Queen street, from 7 feet southwest of southwest house line of Cresson, northeast	6	208
Ripka avenue, from Mansion avenue to 12 feet northeast of southwest house line of Hamilton	6	220
Rochelle street, from dead end 549 feet 6 inches northeast of Manayunk avenue, northeast	6	96
Smick street, from Leverington to Ripka	6	309
Sumac street, from dead end 267 feet northeast of Righter to southwest house line of Wetherill	6	184
Sunnyside street, from Thirty-fifth, northeast	6	522
Thompson street, from Oak to Gay	6	195
Thirty-fifth street, from Fairview, northwest	6	154
Thirty-fifth street, from Queen lane, southeast	6	205
Webster street, from Green lane to Centre	6	300
Total		6,826

NOTE.—Omitted in Annual Report for 1884:

Mitchell street, from Leverington to Roxborough	6	589

Street. Location.	Size in inches.	Distance in feet.
Fire-hydrant Connections..	6	160
Fire Connections (private).		
Cotton street, east side, 76 feet southwest of southwest house line of Main, for Sevill Schofield, Son & Co....	6	12
River road, northeast side, 296 feet southwest of southwest house line of Washington, for F. S. and Rosalie Des Bond..	4	22
Total..	....	34
Supply Connections (private).		
Ridge avenue, northeast side, 450 feet northwest of northwest house line of Scott's lane, for John & James Dobson..	4	36
Drains.		
Abbotsford avenue and Philadelphia, Germantown and Chestnut Hill Railroad bridge..................................	¾ 1¼	130 114
Total..	....	244
Repairs, general..	6	44
" "	10	5
" "	12	6
Total..	....	55
Repairs, new stops put in..	6	8
" " "	20	5
Total..	....	13
Pipe taken up at Roxborough Reservoir.		
Williams avenue, from Ann street, southwest..................	20	504
Fire-hydrant Connections taken up..................................	4	92

Street. Location.	Size in inches.	Distance in feet.
Relaid at Roxborough Reservoir.		
Ann street, from Williams avenue north	20	65
Williams avenue, northeast corner of Ann	20	20
Williams avenue, from Ann southwest	30	504
Total	....	589
Relaid Fire Hydrant Connections	6	85
Lowered.		
Baldwin street, from 216 feet northeast of northeast house line of Hamilton northeast	6	79
Baldwin street, northwest side, 255 feet northeast of northeast house line of Hamilton	4	12
Fowler street, from Jefferson northwest	6	61
Jefferson street,. from southwest house line of Fowler northeast	6	54
Jefferson street, from 30 feet northeast of northeast house line of Linden northeast	6	108
Mansion avenue, from 43 feet southeast of southeast house line of Ripka southeast	6	150
Mansion avenue, southwest side, 118 feet southeast of southeast house line of Ripka	4	14
Queen Lane, from 52 feet southwest of southwest house line of Scott's Lane to 48 feet northeast of northeast house line of Cresson	6	581
Queen Lane, southeast side, 412 feet northeast of Thirty-fifth	4	14
Thirty-fifth, from Queen Lane northwest	6	85
Total	....	1,158
Raised.		
Baker street, from northwest curb line of Green Lane northwest	6	50
Shifted.		
Ann street, from 64 feet northwest of Williams avenue northwest	20	18
Cut off and Abandoned.		
Ann street, from Williams avenue northwest	20	64

Recapitulation of Manayunk District.

	Purposes for which used.	Size—Inches.								Totals in feet and pounds.
		¾	1¼	4	6	10	12	20	30	
New pipe or feet added.	Service mains				6,826					6,826
	Fire hydrant connections				160					160
	Fire connections (private)			22	12					34
	Supply connections (private)			36						36
	*Drains	130	114							244
	Total { feet	130	114	58	6,998					7,300
	Total { pounds	156	258	1,102	230,934					232,450
Pipe used, but adding nothing to feet in the ground.	Repairs, general				44	5	6			55
	Repairs, new stops put in				8			5		13
	Pipe taken up			92				504		596
	Pipe relaid							85	504	589
	Relaid fire hydrant connections				85					85
	Lowered			40	1,118					1,158
	Raised				50					50
	Shifted							18		18
	Cut off and abandoned							64		64
	Total { feet			132	1,305	5	6	676	504	2,628
	Total { pounds			2,508	43,065	275	432	107,484	167,328	321,092
	Total handled { feet	130	114	190	8,303	5	6	676	504	9,928
	Total handled { pounds	156	258	3,610	273,999	275	432	107,484	167,328	553,542

* Wrought iron pipe used.

Germantown District.

Comprising the Twenty-second and parts of the Twenty-fifth and Twenty-eighth Wards.

Street. Location.	Size in inches.	Distance in feet.
Service Mains.		
Bass street, from 11 feet southeast of northwest curb line of Church northwest	6	15
Baynton avenue, from 768 feet 6 inches southeast of Wistar to Wisteria	6	68
Carpenter street, from 511 feet southwest of centre of Green northeast to southwest house line of Emlen	6	2,523
Carpenter street, from 356 feet northeast of southwest house line of Emlen northeast	6	84
Clapier street, from northeast house line of Fern to McKean	6	725
Corr street, from Smedley to east house line of Seventeenth	6	192
Crowson street, from 11 feet southeast of northwest curb line of Church northwest	6	15
Cumberland street, from southeast house line of Mill southeast	6	300
Duglass street, from Hancock southwest	6	279
Fifteenth street, from Lowe north	6	15
Green street from Frank to Carpenter	6	366
Green street, from Upsal southeast	6	317
Hancock street, from Price to Centre	6	326
Hancock street, from southeast house line of Duglass to Walnut lane	6	182
Jefferson street, from southeast to northwest house line of Duval	6	40
Jefferson street, from dead end 489 feet northeast of northeast house line of Mercer northeast	6	90
Knox street, from Chelten avenue to Lehman	6	529
Knox street, from Seymore to Manheim	6	548
Lehman street, from Morris southwest	6	677
Lowe street, from Fifteenth west	6	228
Lowe street, from Sixteenth east	6	110
Mt. Airy avenue, from northeast house line of Sullivan to Anderson	6	589
McKean street, from Clapier northwest	6	25
Mather street, from Tioga to 15 feet north of south house line of Venango	6	539
Mechlin street, from Baynton avenue southwest	6	217
Mercer street, from Ashmead southeast	6	221
Mercer Place, from Mercer northeast	6	209
Morris street, from Chelten avenue to Lehman	6	493
Morris street, from Hansbury to Queen	6	521
Morton street, from north house line of Washington to Upsal	6	1,660
Musgrove street, from southeast to northwest house line of Church	6	35

Street. Location.	Size in Inches.	Distance in feet.
Service Mains—Continued.		
Ontario street, from Twenty-first to Twenty-second	6	448
Patton avenue, from Penn to Coulter	6	333
Philellena street, from northeast house line of Sherman to Green	6	589
Sedgwick street, from Germantown avenue northeast	6	449
Sedgwick street, from 12 feet 6 inches northeast of southwest house line of McCallum to northeast house line of Green	6	641
Sixteenth street, from dead end 320 feet north of north house line of Bristol to St. Mark's square	6	42
St. Luke's Square, from Sixteenth west	6	48
St. Mark's Square, from Sixteenth west	6	288
St. Paul's Square, from Sixteenth west	6	244
Sprague street, from 416 feet southeast of southeast house line of Mt. Airy avenue southeast	6	89
Thirty-first street, from Willow Grove avenue southeast	6	15
Upsal street, from 14 feet northeast of southwest house line of Green northeast	10	27
Wisteria street, from Baynton avenue northeast	6	25
Total	....	15,376
Pumping Main.		
Allen's Lane, from 25 feet northeast of northeast property line of Mt. Airy Pumping Station to Germantown avenue	16	1,019
Service Main Connections.		
Clapier street and McKean avenue	3	6
McKean avenue 28 feet west of centre of Clapier	3	3
Total	....	9
Supply Main Connections.		
Gorgas street and Germantown avenue	6	24
Pumping Main Connections.		
Allen's lane and Germantown avenue	16	18
Fire Hydrant Connections	6	538

Street. Location.	Size in inches.	Distance in feet.
Fire Connections (private).		
Bristol street, north side, 248 feet 11 inches east of east house line of Wayne, for Bradbury Brothers...........	2	....
Stenton avenue, northwest side, 47 feet 6 inches northeast of northeast house line of Armstrong, for Joseph Fling..	4	10
Supply Connections (private)....................................	....	10
Thirty-first street, 13 feet 6 inches southeast of centre of Willow Grove, for H. H. Houston..........................	4	4
Connections at Pumping Stations.		
Chestnut Hill, blow-off..	4	26
Drains.		
Franklin street, from 255 feet southwest of southwest house line of Germantown avenue, southwest...........	4	154
Repairs, general..	3	18
" "	4	14
" "	6	24
" "	8	2
" "	10	7
" "	16	8
Total..	....	73
Repairs, new stops put in....................................	3	2
" " "	4	11
" " "	6	3
" " "	10	3
" " "	20	4
Total..	....	23
Repairs, new check-valve put in.		
Mt. Airy Pumping Station, on 20-inch supply main, 50 feet northwest of northwest curb line of Allens lane..	20	11

Street. Location.	Size in inches.	Distance in feet.
Taken up.		
Franklin street, from 176 feet southwest of southwest house line of Germantown avenue, southwest	3	79
Highland avenue, from 405 feet northeast of Twenty-seventh to 117 feet northeast of Twenty-ninth	4	1,666
Fire hydrant connections taken up	3	16
" " "	4	192
Total		1,953
Relaid.		
Franklin street, from 176 feet southwest of southwest house line of Germantown avenue, southwest	4	79
Highland avenue, from Germantown avenue to 117 feet northeast of Twenty-ninth	6	1,816
Johnson street, from Adams to Green	6	737
Johnson street, from centre of Morton, northeast and southwest	4	19
Total		2,651
Relaid fire hydrant connections	6	223
Lowered.		
High street, from 502 feet northeast of northeast house line of Morton, northeast	6	8
Cut off and abandoned.		
Germantown avenue, intersection of Allens lane	4 10	60 38
Highland avenue, from Germantown avenue to 405 feet northeast of Twenty-seventh	4	200
Johnson street, from Adams to Green	3	737
Fire hydrant connections	3	17
" "	4	188
Total		1,240

Recapitulation of Germantown District.

	Purposes for which used.	Size—Inches. 3	4	6	8	10	16	20	Totals in feet and pounds.
New pipe, or feet added.	Service mains			15,349		27			15,376
	Pumping mains						1,019		1,019
	Service main connections	9							9
	Supply main connections			24					24
	Pumping main connect'ns						18		18
	Fire hydrant connections			538					538
	Fire connections (private)		10						10
	Supply connect'ns (private)		4						4
	Connections at Works		26						26
	Drains		154						154
	Total... feet	9	194	15,911		27	1,037		17,178
	Total... pounds	135	3,686	527,263		1,485	114,070		646,639
Pipe used, but adding nothing to feet in the ground.	Repairs, general	18	14	24	2	7	8		73
	Repairs, new stops put in	2	11	3		3		4	23
	Repairs, new check valve put in							11	11
	Pipe taken up	95	1,858						1,953
	Pipe relaid		98	2,553					2,651
	Fire hydrant connections relaid			223					223
	Pipe lowered			8					8
	Pipe cut off and abandoned	754	448			38			1,240
	Total... feet	869	2,429	2,811	2	48	8	15	6,182
	Total... pounds	13,035	46,151	92,763	336	2,640	880	2,385	158,190
Total handled	feet	878	2,623	18,722	2	75	1,045	15	23,360
	pounds	13,170	49,837	620,026	336	4,125	114,950	2,385	804,829

RECAPITULATION OF WORK ON THE WATER PIPES.

	Purposes for which used.	Size—Inches. 3/4	1 1/4	3	4	6	8	10	12	16	20	22	30	36	48	Totals in feet and pounds.
New pipe, or feet added.	Service mains					80,927	1,604	2,181	457							85,169
	Supply mains							6,311	6,342	46	716		4,037	6,999	12,643	37,094
	Pumping mains									1,019					3,194	4,213
	Service main connections			9												9
	Supply main connections					411	8	296	68	28	629		613	299	62	2,414
	Pumping main connections									18						18
	Fire hydrant connections					6,100										6,100
	Fire connections (private)				260	34										294
	Motor connections (private)				11											11
	Supply connections (private)			18	154	497	53									722
	Connections at Works				26											26
	Drains	130	114		226	216	33	10	32							761
	Total feet	130	114	27	677	88,185	1,698	8,798	6,899	1,111	1,345		4,650	7,298	15,899	136,831
	Total pounds	156	258	405	12,863	2,912,305	71,316	483,890	496,728	122,210	213,855		1,543,800	3,079,756	9,300,915	18,238,457
Pipe used, but adding nothing to feet in the ground.	Repairs, general			18	123	2,055	49	183	81	25	33	33	33	12		2,645
	Repairs, new stops put in			2	16	452	6	6	17		21		10			530
	Repairs, new check valve put in										11					11
	Pipe taken up			18,629	23,202	3,477	15	15	244	6	673	108	381	5	239	46,994
	Pipe relaid				176	41,013	2,136	2,998	6,041		228		694		276	53,562
	Fire hydrant connections relaid					1,921										1,921
	Pipe lowered				192	1,831				74	218	33	158			2,506
	Pipe raised				25	346	140		1,096		184		310			2,101
	Pipe shifted			325		1,067					18					1,410
	Pipe cut off and abandoned			1,150	6,142	596		38	14		1,049		541			9,530
	Total feet			20,124	29,876	52,758	2,346	3,240	7,493	105	2,435	174	2,127	17	515	121,210
	Total pounds			301,860	567,644	1,741,014	98,784	178,200	539,496	11,550	387,165	43,500	706,164	7,174	301,275	4,883,826
Total handled	feet	130	114	20,151	30,553	140,943	4,044	12,038	14,392	1,216	3,780	174	6,777	7,315	16,414	258,041
	pounds	156	258	302,265	580,507	4,653,319	170,100	662,090	1,036,224	133,760	601,020	42,500	2,249,964	3,086,930	9,602,190	23,122,283

RECAPITULATION BY DISTRICTS.

Districts.		Sizes—Inches.														Totals.	
		¾	1¼	3	4	6	8	10	12	16	20	22	30	36	48	Feet.	Pounds.
New pipe or feet added.	First			18	37	12,205	1,604	648	268	74	371		464	3,290	336	19,315	2,333,159
	Second				73	11,615	61	15	68						5,268	17,100	3,474,745
	Third				173	23,940		8,081	6,506		56		3,566	3,208		45,524	4,251,832
	Fourth				142	17,516	33	27	57		924		620	800	10,295	30,414	7,300,632
	Germantown			9	194	15,911		27		1,037						17,178	646,639
	Manayunk	130	114		58	6,998										7,30[illegible]	23[illegible],036
	Total.. feet	130	114	27	677	88,185	1,698	8,798	6,899	1,111	1,345		4,650	7,298	15,899	136,831	
	Total.. pounds	156	258	405	12,863	2,912,305	71,316	483,890	496,728	122,210	213,855		1,543,800	3,079,756	9,300,915		18,238,457
Pipe used, but adding nothing to feet in the ground.	First			7,695	9,099	14,725	1,369	1,308	1,264		190		403			36,053	1,158,683
	Second			9,695	3,249	15,662	45	63	1,511	97	23		230	12		30,587	933,900
	Third				4,098	2,897		996	4,549		5					12,545	556,566
	Fourth			1,865	10,869	15,358	930	820	163		1,526	174	990	5	515	33,215	1,755,395
	Germantown			869	2,429	2,811	2	48		8	15					6,182	158,190
	Manayunk				132	1,305		5	6		676		504			2,628	321,092
	Total.. feet			20,124	29,876	52,758	2,346	3,240	7,493	105	2,435	174	2,127	17	515	121,210	
	Total.. pounds			301,860	567,644	1,741,014	98,784	178,200	539,496	11,550	387,165	43,500	706,164	7,174	301,275		4,883,826
Total handled	feet	130	114	20,151	30,553	140,943	4,044	12,038	14,392	1,216	3,780	174	6,777	7,315	16,414	258,041	
	pounds	156	258	302,265	580,507	4,653,319	170,100	662,090	1,036,224	133,760	601,020	43,500	2,249,964	3,086,930	9,602,190		23,122,283

NEW FIRE HYDRANTS.

FIRST DISTRICT.

Street. Location.	Ward.	Size of Main in inches.	Connection.		Style.			
			4 in.	6 in.	Old.	New, No. 1.	New, No. 2.	New, No. 3.
Alaska street, south side, 58 feet east of east house line of Eighth	4	6	....	9 ft.	....	....	1	
Almond street, north side, 15 feet east of east house line of Second	4	6	....	13 ft. 4 in.	....	....	1	
Anita street, north east corner of Eleventh	26	6	....	14 ft.	....	....	....	1
Anita street, south side, 1 foot west of west house line of Eleventh	26	6	....	9 ft.	....	....	1	
Austin street, east side, 88 feet north of north house line of Reed	26	6	....	6 ft. 6 in.	....	....	1	
Bainbridge street, southeast corner of Broad	4	30	....	17 ft.	....	....	1	
Bainbridge street, northwest corner of Fifteenth	30	36	....	10 ft. 9 in.	....	....	....	1
Bainbridge street, north side, west house line of Sixteenth	30	36	....	9 ft.	....	....	1	
Bainbridge street, southwest corner of Seventeenth	30	36	....	22 ft.	....	....	....	1
Bainbridge street, southeast corner of Eighteenth	30	36	....	23 ft.	....	....	....	1
Bainbridge street, northwest corner of Nineteenth	30	36	....	24 ft. 6 in.	....	....	1	
Bainbridge street, south side, east house line of Twenty-first	30	36	....	20 ft. 2 in.	....	....	1	
Bancroft street, southwest corner of Morris	26	6	....	10 ft. 6 in.	....	....	1	
City Repair Shop Yard, Twelfth, below Wharton	1	6	....	....	....	1		
Dorrance street, east side, 62 feet south of south house line of Ellsworth	26	6	....	7 ft.	....	1		

New Fire Hydrants—First District—*Continued.*

Street. Location.	Ward.	Size of Main in inches.	Connection. 4 in.	Connection. 6 in.	Style. Old.	Style. New, No. 1.	Style. New, No. 2.	Style. New, No. 3.
Eleventh street, southwest corner of Moore	1	6		20 ft. 8 in.			1	
Eleventh street, southwest corner of Peirce	1	6		13 ft.				1
Eleventh street, east side, 9 feet south of south house line of Federal	26	12		13 ft. 6 in.			1	
Eleventh street, northeast corner of Ellsworth	26	12		13 ft. 2 in.				1
Eleventh street, east side, south house line of Washington avenue	26	12		10 ft.			1	
Eleventh street, east side, 4 feet north of north house line of Washington avenue	2	8		8 ft. 2 in.			1	
Eleventh street, east side, south house line of Carpenter	2	8		10 ft. 2 in.			1	
Eleventh street, west side, 2 feet 6 inches north of north house line of Carpenter	2	8		10 ft. 6 in.			1	
Eleventh street, southwest corner of Christian	3	8		12 ft. 10 in.				1
Eleventh street, west side, south house line of Catharine	3	8		11 ft.			1	
Eleventh street, west side, south house line of Thurlow	3	8		10 ft.			1	
Eleventh street, west side, south house line of Fitzwater	3	8		11 ft.			1	
Flora street, northwest corner of Scott	1	6		6 ft. 6 in.				1
Federal street, north side, 1 foot east of east house line of Twentieth	26	6		14 ft.			1	
Fifth street, southwest corner of Emily	1	6		13 ft. 10 in.				1
Fifteenth street, east side, 3 feet south of south house line of Reed	26	6		13 ft. 6 in.			1	

New Fire Hydrants—First District—*Continued.*

Street. Location.	Ward.	Size of Main in inches.	Connection. 4 in.	Connection. 6 in.	Style. Old.	Style. New, No. 1.	Style. New, No. 2.	Style. New, No. 3.
Fourth street, east side, 47 feet south of south house line of Mifflin	1	6		13 ft.			1	
Harmony street, north side, 12 feet east of east house line of Fifth	3	6		3 ft. 6 in.			1	
Jackson street, north side, 158 feet west of west house line of Eighth	1	6		13 ft.			1	
Jackson street, north side, 295 feet west of west house line of Ninth	1	6		13 ft.			1	
Juniper street, west side, 62 feet south of south house line of Fitzwater	3	4		9 ft.			1	
Lafayette street, south side, east house line of Tenth	26	6		5 ft. 6 in.			1	
Latona street, north side, 338 feet west of west house line of Twenty-second	26	6		7 ft.			1	
League street, north side, 65 feet east of east house line of Twentieth	30	4		6 ft. 8 in.		1		
Manilla street, southeast corner of Tenth	2	6		11 ft.				1
Marriott street, north side, 113 feet east of east house line of Eighth	2	6		10 ft.			1	
Moore street, south side, 176 feet east of east house line of Eighth	1	6		16 ft. 6 in.			1	
Morris street, south side, west house line of Eleventh	1	6		12 ft. 7 in.			1	
Morris street, northwest corner of Nineteenth	26	12		14 ft. 6 in.			1	
Milton street, north side, west house line of Eleventh	2	6		9 ft.			1	
Ninth street, west side, northwest corner of Jackson	1	6		13 ft.				1
Park avenue, east side, 207 feet north of north house line of Shunk	26	6		7 ft.	1			

New Fire Hydrants—First District—*Continued.*

Street. Location.	Ward.	Size of Main in inches.	Connection. 4 in.	Connection. 6 in.	Style. Old.	Style. New, No. 1.	Style. New, No. 1.	Style. New, No. 1.
Passyunk avenue, southeast side, 100 feet northeast of Twenty-third	26	10	....	4 ft. 10 in.	....	....	1	
Passyunk avenue, northwest side, 185 feet southwest of south house line of Carpenter	2	8	....	8 ft. 10 in.	....	....	1	
Pemberton street, northeast corner of Nineteenth	30	6	....	8 ft. 8 in.	....	....	1	
Pemberton street, northwest corner of Twenty-second	30	6	....	9 ft. 10 in.	....	....	1	
Pemberton street, northeast corner of Twenty-third	30	6	....	9 ft. 10 in.	....	....	1	
Reed street, southwest corner of Long lane	26	6	....	24 ft.	....	....	1	
River road, northeast side, 473 feet southeast of Passyunk avenue	26	6	....	27 ft.	....	....	1	
River road, northeast side, 936 feet southeast of Passyunk avenue	26	6	....	30 ft.	....	....	1	
River road, northeast side, 1,095 feet southeast of Passyunk avenue	26	6	....	28 ft.	....	....	1	
Seventeenth street, southeast corner of Tasker	26	6	....	13 ft.	....	....	1	
Shunk street, north side east house line of Park	26	6	....	13 ft.	....	....	....	1
Sidney street, west side, 57 feet south of south house line of Ellsworth	26	6	....	2 ft. 9 in.	....	1		
Sixth street, southeast corner of Cantrell	1	6	....	8 ft.	....	....	....	1
Sixth street, southwest corner of Cantrell	1	6	....	8 ft.	....	....	....	1
Sixth street, southeast corner of Dudley	1	6	....	14 ft.	....	....	1	
Sixth street, northeast corner of Moyamensing avenue	1	6	....	17 ft. 3 in.	....	....	....	1

New Fire Hydrants—First Diserict—*Continued.*

Street. Location.	Ward.	Size of Main in inches.	Connection. 4 in.	Connection. 6 in.	Style. Old.	Style. New, No. 1.	Style. New, No. 2.	Style. New, No. 3.
Sixteenth street, east side, 72 feet south of south house line of Dickinson	26	6		15 ft. 6 in.			1	
Snyder street, south side, 70 feet west of west house line of Fifth	1	6		7 ft. 5 in.			1	
Snyder street, southeast corner of Tenth	1	6		5 ft. 6 in.				1
Snyder street, north side east house line of Eleventh	1	6		9 ft.			1	
Stewart street, northeast corner of Christian	3	6		6 ft. 10 in.			1	
Tasker street, northwest corner of Woodstock	26	6		13 ft.			1	
Tasker street, northeast corner of Second	1	6		17 ft.			1	
Thirteenth street, northeast corner of Lentz	26	6		13 ft. 6 in.				1
Thirty-fifth street, west side, 194 feet north of north house line of Gray's Ferry road	26	8		22 ft.			1	
Thirty-fifth street, east side, 252 feet north of north house line of Gray's Ferry road	26	8		23 ft.			1	
Thirty-fifth street, west side, 467 feet north of north house line of Gray's Ferry road	26	8		22 ft. 8 in.			1	
Titan street, north side, 68 feet east of east house line of Twentieth	26	4		10 ft. 6 in.			1	
Twentieth street, west side north house line of Bainbridge	30	36		28 ft. 6 in.			1	
Twentieth street, southeast corner of Morris	26	6		14 ft.			1	
Twenty-first street, northeast corner of Mountain	26	6		14 ft.			1	
Twenty-first street, southeast corner of Tasker	26	6		24 ft. 8 in.			1	

New Fire Hydrants—First District—*Continued.*

Street. Location.	Ward.	Size of Main in inches.	Connection. 4 in.	Connection. 6 in.	Style. Old.	Style. New, No. 1.	Style. New, No. 2.	Style. New, No. 3.
Washington avenue, south side east house line of Otsego	2	6	....	8 ft.	....	....	1	
Washington avenue, north side, 2 feet east of east house line of Otsego	2	6	....	6 ft. 4 in.	....	....	1	
Washington avenue, south side east house line of Moyamensing avenue	2	10	....	17 ft. 6 in.	....	....	1	
Washington avenue, north side, 1 foot west of west house line of Moyamensing avenue	2	6	....	8 ft. 6 in.	....	....	1	
Washington avenue, south side, 88 feet west of west house line of Moyamensing avenue	2	6	....	10 ft. 2 in.	....	....	1	
Washington avenue, north side, 2 feet east of east house line of Third	2	6	....	8 ft. 6 in.	....	....	1	
Winton street, northwest corner of Tenth	1	6	....	9 ft.	....	....	....	1
Totals	......	....	....	1,094	1	4	63	18

New Fire Hydrants Set in 1886—Continued.

SECOND DISTRICT.

Street.	Location.	Ward.	Size of Main in inches.	Connection. 4 in.	Connection. 6 in.	Style. Old.	Style. New, No. 1.	Style. New, No. 2.	Style. New, No. 3.	Style. New, No. 5.
Allman street,	south side, 10 feet east of east house line of Forty-third	27	6		5 ft. 4 in.			1		
Arch street,	northeast corner of Fifteenth	10	30		10 ft.					1
Benkert street,	109 feet south of south house line of Warren	24	6		6 ft. 8 in.	1				
Brown street,	southeast corner of Thirty-seventh	24	6		21 ft.			1		
Clover street,	southeast corner of Thirteenth	9	6		8 ft. 3 in.			1		
Chestnut street,	north side, 133 feet west of west house line of Seventh	9	10		7 ft. 7 in.			1		
Chestnut street,	northeast corner of Thirty-seventh	27	8		25 ft. 5 in.				1	
Duponceau street,	northwest corner of Locust	8	6		6 ft. 10 in.			1		
Eighth street,	northeast corner of Cherry	10	10		15 ft. 2 in.				1	
Evans street,	northeast corner of Summer	10	6		4 ft. 11 in.		1			
Fifth street,	southwest corner of Cherry	6	10		15 ft. 5 in.				1	
Fortieth street,	northwest corner of Baring	24	12		20 ft. 3 in.				1	
Forty-fifth street,	southeast corner of Wyalusing avenue	24	6		8 ft. 4 in.		1			
Forty-second street,	2 feet 6 inches south of south house line of Market	27	6		12 ft. 3 in.			1		
Forty-seven and One-half st.,	west side, 316 ft. south of south house line of Fairmount av.	24	6		8 ft. 8 in.		1			

New Fire Hydrants—Second District—*Continued.*

Street. Location.	Ward.	Size of Main in inches.	Connection. 4 in.	Connection. 6 in.	Style Old.	Style New, No. 1.	Style New, No. 2.	Style New, No. 3.	Style New, No. 5.
Forty-ninth street, west side, 17 feet 2 inches northwest of P., W. & B. R. R.	27	6	....	21 ft. 7 in.	....	1			
Forty-ninth street, east side, 15 feet north of north house line of Trinity Place	27	6	....	21 ft. 5 in.	....	....	1		
Gatzmer street, southwest corner of Front	5	6	....	5 ft. 8 in.	....	....	....	1	
Inglis street, north side, 173 feet west of West house line of Front	5	6	....	3 ft. 6 in.	1	....			
Juniper street, northeast corner of South	7	6	....	10 ft. 5 in.	....	....	1		
Juniper street, northwest corner of Lombard	7	6	....	7 ft. 11 in.	....	....	1		
Juniper street, northeast corner of Pine	7	6	....	7 ft. 10 in.	....	....	1		
Juniper street, southeast corner of Spruce	7	6	....	10 ft. 4 in.	....	....	....	1	
Juniper street, northeast corner of Locust	8	6	....	10 ft. 5 in.	....	....	1		
Juniper street, southeast corner of Walnut	8	6	....	11 ft.	....	....	....	1	
Juniper street, northeast corner of Sansom	8	6	....	14 ft.	....	....	1		
Juniper street, southeast corner of Chestnut	8	6	....	12 ft.	....	....	....	1	
Juniper street, west side, 323 feet 6 inches south of south house line of Vine	10	6	....	6 ft. 10 in.	....	....	1		
Linwood street, southeast corner of Thirty-ninth	24	6	....	11 ft. 4 in.	....	....	1		
Ludlow street, south side, 61 feet east of east house line of Thirty-first	27	6	....	12 ft. 3 in.	....	1			
Locust street, southwest corner of Seventh	8	6	....	16 ft.	....	....	....	1	

New Fire Hydrants—Second District—*Continued.*

Street. Location.	Ward.	Size of Main in inches.	Connection.		Style.				
			4 in.	6 in.	Old.	New, No. 1.	New, No. 2.	New, No. 3.	New, No. 5.
Locust street, northwest corner of Twenty-third	8	6	....	15 ft.	....	....	1		
Lombard street, north side, 2 feet west of west house line of Seventh	7	6	....	13 ft. 11 in.	....	....	1		
Mantua avenue, northeast side, 49 feet west of east house line of Thirty-second	24	6	....	14 ft. 9 in.	....	....	1		
Mantua avenue, northeast side, 344 feet west of centre of Thirty-second	24	6	....	15 ft. 2 in.	....	....	1		
Market street, southwest corner of Bank	6	6	....	9 ft.	....	....	....	1	
Market street, north side, 6 feet west of west house line of Third	6	6	....	8 ft. 6 in.	....	....	1		
Market street, south side, 13 feet east of east house line of Fourth	6	6	....	6 ft.	....	....	1		
Market street, north side, 19 feet west of west house line of Fourth	6	20	....	13 ft. 10 in.	....	....	1		
Market street, north side, 16 feet west of west house line of Eleventh	9	20	....	20 ft. 4 in.	....	....	1		
Market street, northeast corner Thirty-seventh	24	10	....	44 ft. 3 in.	....	....	....	....	1
Mt. Vernon street, northwest corner of Mantua avenue	24	6	....	9 ft. 4 in.	....	....	1		
Mt. Vernon street, southeast corner of Thirty-third	24	6	....	8 ft. 8 in.	....	....	1		
Morgan street, north side, 145 feet east of east house line of Eleventh	10	6	....	9 ft. 6 in.	....	1			
Paschall avenue, southeast corner of Fiftieth	27	6	....	23 ft. 4 in.	....	....	1		
Seneca street, northeast corner of Forty-eighth and One-half	24	6	....	14 ft.	....	....	1		
Sergeant street, northeast corner of Tenth	10	6	....	14 ft. 9 in.	....	....	1		

New Fire Hydrants—Second District—*Continued.*

Street. Location.	Ward.	Size of Main in inches.	Connection. 4 in.	Connection. 6 in.	Style. Old.	Style. New, No. 1.	Style. New, No. 2.	Style. New, No. 3.	Style. New, No. 5.
Sergeant street, north side, 183 feet east of east house line of Eleventh	10	6	....	10 ft. 3 in.	....	1			
Sergeant street, northeast corner of Eleventh	10	6	....	12 ft. 2 in.	....	....	1		
Seventh street, northwest corner of Cherry	10	6	....	22 ft. 9 in.	....	....	1		
Seventh street, southwest corner of Barclay	7	6	....	13 ft. 3 in.	....	....	1		
Seventeenth street, southwest corner of Moravian	8	6	....	5 ft.	....	....			
Sixth street, southeast corner of Lombard	5	6	....	17 ft.	....	....	1		
Sixth street, northeast corner of Buckley	5	6	....	14 ft. 6 in.	....	....	1		
Sixth street, southeast corner of Adelphia	5	6	....	15 ft. 6 in.	....	....	1		
Sixth street, west side, 1 foot north of north house line of Cherry	6	6	....	13 ft.	....	....	1		
South street, north side, 4 feet 6 inches east of east house line of Sixth	5	12	....	10 ft. 7 in.	....	....	1		
South street, northeast corner Seventh	5	12	....	15 ft. 5 in.	....	....	....	1	
South street, north side, 57 feet east of east house line of Nineteenth	7	12	....	14 ft. 2 in.	....	1			
South Penn square, south side, 115 feet east of east house line of Fifteenth	9	10	....	14 ft.	....	....	1		
Springfield street, north side, 13 feet west of west house line of Forty-eighth	27	6	....	23 ft. 11 in.	....	1			
St. Bernard street, north side, 185 feet southwest of southwest house line of Forty-ninth	27	6	....	14 ft. 9 in.	....	....	1		
Struthers street, north side, 168 feet east of east house line of Thirteenth	10	6	....	3 ft. 10 in.	....	1			

NEW FIRE HYDRANTS—SECOND DISTRICT—*Continued.*

Street. Location.	Ward.	Size of Main in inches.	Connection. 4 in.	Connection. 6 in.	Style. Old.	Style. New, No. 1.	Style. New, No. 2.	Style. New, No. 3.	Style. New, No. 5.
Third street, west side, opposite Elbow lane	6	6	....	13 ft. 10 in.	....	....	1		
Thirtieth street, southeast corner Locust	27	6	....	18 ft. 5 in.	....	....	1		
Thirty-first street, southwest corner Chestnut	27	6	....	24 ft. 6 in.	....	....	1		
Thirty-ninth street, northeast corner Brown	24	6	....	24 ft. 2 in.	....	....	1		
Thirty-second street, northeast corner Mount Vernon	24	6	....	20 ft. 7 in.	....	....	1		
Trinity place, northeast corner Twenty-third	7	6	....	15 ft.	....	....	1		
Twelfth street, east side, 8 feet 6 inches north of north house line of Clover	9	6	....	13 ft. 9 in.	....	....	1		
Twentieth street, northwest corner Summer	10	6	....	18 ft. 7 in.	....	....	1		
Twenty-first street, southeast corner Lombard	7	48	....	5 ft.	....	....	....	1	
Twenty-first street, southwest corner Naudain	7	48	....	6 ft. 4 in.	....	....	1		
Twenty-first street, southwest corner Delancey place	7	48	....	16 ft. 11 in.	....	....	....	1	
Twenty-first street, west side, 23 feet 4 inches south of centre of Pine	7	6	....	16 ft. 5 in.	....	....	1		
Twenty-first street, southwest corner Spruce	7	20	....	8 ft.	....	....	....	1	
Twenty-first street, southeast corner Rittenhouse	8	48	....	12 ft. 4 in.	....	....	....	1	
Twenty-first street, east side, 8 feet north of north house line of Heberton	8	48	....	7 ft. 11 in.	....	....	....	1	
Twenty-first street, east side, 5 feet north of north house line of Chestnut	9	48	....	11 ft.	....	....	....	1	

NEW FIRE HYDRANTS—SECOND DISTRICT—*Continued.*

Street. Location.	Ward.	Size of Main in inches.	CONNECTION. 4 in.	CONNECTION. 6 in.	STYLE. Old.	STYLE. New, No. 1.	STYLE. New, No. 2.	STYLE. New, No. 3.	STYLE. New, No. 5.
Twenty-first street, east side, 5 feet north of north house line of Filbert	9	48	....	10 ft. 1 in.	....	....	....	1	
Twenty-first street, southwest corner Arch	9	20	....	7 ft. 5 in.	....	....	....	1	
Twenty-first street, 10 feet north of north house line of Race	10	48	....	5 ft.	....	....	....	1	
Wallace street, south side, east of east house line of Thirty-third	24	6	....	12 ft. 8 in.	....	....	1		
Walnut street, north side, 416 feet west of centre of Twenty-fourth	8	6	....	17 ft. 10 in.	....	1			
Walnut street, northwest corner Twenty-fourth	8	6	....	18 ft. 4 in.	....	....	1		
Vine street, northwest corner Dillwyn	12	10	....	12 ft. 2 in.	....	....	....	1	
Race street, northwest corner Twenty-third	10	6	....	20 ft. 9 in.	....	....	....	1	
Race street, south side, east of house line of St. David	10	6	....	14 ft. 3 in.	....	....	1		
Woodland avenue, 740 feet west of centre of Fifty-ninth	27	12	....	2 ft.	....	1			
Total	....	....	....	1,172 ft.	3	11	50	22	2

New Fire Hydrants—Continued.

Third District.

Street. Location.	Ward.	Size of Main in inches.	Connection.		Style.			
			4 in.	6 in.	Old.	New, No. 1.	New, No. 2.	New, No. 3.
Amber street, northeast side, northeast house line of Dauphin	31	10	....	6 ft.	....	....	1	
Amber street, east corner of Cumberland	31	10	....	8 ft. 6 in.	....	....	1	
Amber street, south corner of Huntingdon	31	10	....	8 ft. 6 in.	....	....	....	1
Amber street, south corner of Lehigh avenue	31	10	....	8 ft. 6 in.	....	....	....	1
American street, west side, south house line of Jefferson	17	6	....	8 ft. 6 in.	....	....	1	
Ash street, opposite Emery	25	6	....	16 ft. 6 in.	....	1		
Blair street, north corner of Otis	31	6	....	18 ft.	....	....	....	1
Bley street, southeast side, 181 feet 8 inches northeast of northeast house line of Hull	25	6	....	7 ft. 8 in.	....	1		
Bodine street, west side, 226 feet north of north house line of Oxford	17	6	....	10 ft.	....	....	1	
Bowers street, east corner of Trenton avenue	19	6	....	10 ft. 10 in.	....	....	1	
Bridge street, southwest side, 39 feet northwest of northwest house line of Young	25	10	....	17 ft.	....	....	1	
Bridge street, southwest side, 4 feet southeast of east house line of Water	25	10	....	15 ft. 6 in.	....	....	1	
Cedar street, southeast corner of Commerce	31	6	....	16 ft.	....	....	1	
Cambria street, north side, 6 feet east of east house line of Ella	25	6	....	15 ft. 6 in.	....	....	1	
Church street, south side, west house line of Garden	25	6	....	12 ft. 6 in.	....	....	1	

New Fire Hydrants—Third District—*Continued.*

Street. Location.	Ward.	Size of Main in inches.	Connection.		Style.			
			4 in.	6 in.	Old.	New, No. 1.	New, No. 2.	New, No. 3.
Church street, north side, 10 feet 5 inches west of west house line of Richmond	25	6		12 ft. 6 in.			1	
Church street, north side, 520 feet west of west house line of Richmond	25	6		12 ft. 6 in.			1	
Church street, northeast corner of Washington	25	6		17 ft. 6 in.				1
Church street, south side, east house line of George	25	6		12 ft. 6 in.			1	
Clearfield street, south corner of Frankford avenue	25	6		24 ft. 6 in.				1
Cope street, northeast side, 263 feet southeast of southeast house line of Amber	25	6		8 ft.		1		
Diamond street, northeast side, 3 feet south of Orkney	19	6		15 ft.			1	
Edmund street, west side, 6 feet 5 inches south of south house line of Margaretta	25	6		14 ft. 6 in.			1	
Elizabeth street, east corner of Kensington avenue	31	6		8 ft. 8 in.				1
Emerald street, northwest side, northeast house line of Dauphin	31	6		15 ft.		1		
Emerald street, southeast side, 2 feet southwest of southwest house line of York	31	12		6 ft. 6 in.			1	
Emerald street, south corner of Letterly	31	12		6 ft. 6 in.			1	
Emerald street, south corner of Sergeant	31	12		7 ft.				1
Emerald street, southeast side, northeast house line of Huntingdon	31	12		6 ft. 3 in.			1	
Emerald street, southeast side, 297 feet northeast of northeast house line of Huntingdon	31	12		6 ft. 3 in.			1	
Emerald street, east corner of Stella avenue	25	6		18 ft. 6 in.				1

New Fire Hydrants—Third District—*Continued.*

Street.	Location.	Ward.	Size of Main in inches.	Connection. 4 in.	Connection. 6 in.	Style. Old.	Style. New, No. 1.	Style. New, No. 2.	Style. New, No. 3.
Emery street,	east side, 226 feet north of north house line of Buckius	25	6	....	7 ft. 8 in.	....	1		
Fairhill street,	west side, 137 feet north of north house line of York	19	6	....	13 ft. 9 in.	....	....	1	
Fourth street,	west side, 82 feet south of south honse line of Columbia avenue	19	6	....	14 ft.	....	....	1	
Frankford avenue,	northeast corner of Hanover	18	10	....	19 ft. 9 in.	....	....	....	1
Garden street,	northeast corner of Jenks	25	6	....	11 ft.	....	....	1	
Garden street,	west side, 159 feet south of south house line of Reynolds	25	6	....	11 ft.	....	....	1	
Gaul street,	northeast corner of Cumberland	31	10	....	12 ft. 6 in.	....	....	....	1
Germantown avenue,	east side, 379 feet south of Green	25	6	....	18 ft.	....	1		
Girard avenue,	south side, 12 feet 6 inches west of west house line of Front	16	12	....	11 ft. 6 in.	....	....	1	
Girard avenue,	south side, 4 feet east of east house line of Charlotte	16	10	....	8 ft. 6 in.	....	....	1	
Girard avenue,	southeast corner of Germantown avenue	16	12	....	12 ft.	....	....	....	1
Green street,	north side, 72 feet east of east house line of Paul	23	6	....	12 ft.	....	1		
Hancock street,	east side, from 3 feet south to 6 feet north of 36-inch main on Lehigh avenue	25	36	....	9 ft.				
Hazzard street,	east corner of Jasper	31	6	....	18 ft. 6 in.	....	....	1	
Hope street,	northwest corner of Lehigh avenue	25	6	....	9 ft.	....	....	....	1
Huntingdon street,	northwest corner of Hutchinson	19	6	....	14 ft. 6 in.	....	....	1	

New Fire Hydrants—Third Distict—*Continued.*

Street. Location.	Ward.	Size of Main in inches.	Connection. 4 in.	Connection. 6 in.	Style. Old.	Style. New, No. 1.	Style. New, No. 2.	Style. New, No. 3.
Indiana street, southwest corner of Orianna	25	6	....	15 ft. 9 in.	....	1		
Indiana street, south side, 215 feet east of house line of Third	25	6	....	15 ft. 6 in.	....	1		
James street, west side, 2 feet north of south house line of Taylor	25	6	....	17 ft. 2 in.	....	....	1	
James street, west side, 4 feet north of north house line of Pratt	25	6	....	18 ft. 10 in.	....	....	1	
James street, west side, 301 feet north of north house line of Orthodox	23	6	....	17 ft.	....	1		
Kensington avenue, northwest side, 24 feet southwest of northeast house line of Sergeant	19	6	....	10 ft. 4 in.	....	....	1	
Kensington avenue, north corner of Lehigh avenue	25	6	....	11 ft. 3 in.	....	....	....	1
Lawrence street, east side, 180 feet 6 inches north of north house line of Brown	12	6	....	12 ft.	....	....	1	
Lawrence street, west side, 146 feet south of south house line of Clearfield	25	6	....	14 ft. 2 in.	....	1		
Lehigh avenue, south corner of Sepviva	31	30	....	19 ft.	....	....	....	1
Lehigh avenue, southeast side, southeast house line of Martha	31	30	....	18 ft.	....	....	1	
Lehigh avenue, northeast side, northwest house line of Frankford avenue	31	30	....	23 ft.	....	....	1	
Lehigh avenue, northeast side, south east house line of Jasper	31	30	....	32 ft.	....	....	1	
Lehigh avenue, northwest corner of Filmore	25	36	....	28 ft.	....	....	....	1
Lehigh avenue, south side, 258 feet east of east house line of Front	19	6	....	12 ft.	....	....	....	1
Lehigh avenue, northeast corner of Front	25	6	....	12 ft. 8 in.	....	....	....	1

New Fire Hydrants—Third District—*Continued.*

Street. Location.	Ward	Size of Main in inches.	Connection. 4 in.	Connection. 6 in.	Style. Old.	Style. New, No. 1.	Style. New, No. 2.	Style. New, No. 3.
Lehigh avenue, northwest corner of Howard	25	36	....	28 ft.	....	....	....	1
Lehigh avenue, northeast corner of Mascher	25	36	....	28 ft.	....	....	....	1
Lehigh avenue, south side, east house line of Germantown avenue	19	6	....	19 ft. 9 in.	....	....	1	
Leithgow street, west side, 127 feet north of north curb line of Somerset	25	6	....	7 ft. 6 in.	....	1		
Master street, northeast corner of Sixth	17	6	....	18 ft.	....	....	....	1
Meadow street, west side, opposite Orchard	25	6	....	11 ft. 7 in.	....	1		
Mintzer street, west side, 164 feet south of south house line of Brown	12	6	....	4 ft. 3 in.	....	1		
Norris street, northwest corner of Front	19	6	....	15 ft. 7 in.	....	....	....	1
Norris street, northeast corner of Howard	19	6	....	17 ft. 7 in.	....	....	....	1
Norris street, southeast corner of Mascher	19	6	....	17 ft.	....	....	....	1
Orianna street, west side, 265 feet south of south house line of Cambria	25	6	....	7 ft.	....	1		
Orkney street, southeast corner of Susquehanna avenue	19	6	....	10 ft. 6 in.	....	....	....	1
Orkney street, east side, 118 feet south of south house line of Somerset	25	6	....	8 ft. 6 in.	....	1		
Paul street, northwest corner Ruan	23	6	....	13 ft.	....	....	....	1
Reynolds street, south side, 143 feet west of west house line of Garden	25	6	....	9 ft. 4 in.	....	1		
Richmond street, northwest side, 143 feet northeast of northeast house line of Palmer	18	6	....	14 ft. 8 in.	....	1		
Richmond street, southeast side, 262 feet, southwest of southwest house line of Neff	25	6	....	19 ft.	....	....	1	

New Fire Hydrants—Third District—*Continued.*

Street. Location.	Ward.	Size of Main in inches.	Connection. 4 in.	Connection. 6 in.	Style. Old.	Style. New, No. 1.	Style. New, No. 2.	Style. New, No. 3.
Richmond street, northwest side, northeast house line of Tioga	25	12	....	18 ft. 5 in.	....	....	1	
Richmond street, northwest side, 233 feet southwest of southwest house line of Venango	25	12	....	18 ft. 2 in.	....	1		
Richmond street, northwest side, northeast house line of Venango	25	12	....	18 ft.	....	....	1	
Richmond street, south corner of Olivia	25	12	....	21 ft.	....	....	....	1
Richmond street, northwest side, 99 feet southwest of southwest house line of Wheat Sheaf lane	25	12	....	18 ft. 10 in.	....	1		
Richmond street, northwest side, opposite Jenks	25	6	....	18 ft.	....	....	1	
Salmon street, southeast side, 210 feet southwest of southwest house line of Ash	25	6	....	10 ft. 10 in.	....	....	1	
Second street, from 36-inch main on Lehigh avenue north	25	36	....	6 ft.				
Second street, west side, 195 feet south of south house line of Somerset	25	6	....	19 ft.	....	....	1	
Sellers street, southwest side, 21 feet northwest of northwest house line of Wingohocking	23	6	....	14 ft. 8 in.	....	....	1	
Silver street, south side, east house line of Germantown avenue	25	6	....	11 ft. 7 in.	....	....	1	
Stella avenue, northeast side, 180 feet northwest of northwest house line of Frankford avenue	25	4	....	18 ft. 6 in.	....	1		
Tacony road, west side, 126 feet northeast of northeast house line of Frankford avenue	23	6	....	12 ft.	....	....	1	
Third street, east side, south house line of Cumberland	19	6	....	13 ft. 6 in.	....	....	1	
Thompson street, west side, 5 feet northeast of Weiser	25	6	....	15 ft.	....	1		
Tioga street, northeast side, 9 feet northwest of northwest house line of Sepviva	25	6	....	17 ft. 6 in.	....	....	1	
Tioga street, southwest side, 6 feet southeast of southeast house line of Weikel	25	6	....	8 ft.	....	1		

New Fire Hydrants—Third District—*Continued.*

Street. Location.	Ward.	Size of Main in inches.	Connection. 4 in.	Connection. 6 in.	Style. Old.	Style. New, No. 1.	Style. New, No. 2.	Style. New, No. 3.
Tioga street, southwest side, 7 feet northwest of northwest house line of Agate	25	6	....	8 ft.	....	1		
Tulip street, south corner Dauphin	31	12	....	13 ft.	....	....	....	1
Tulip street, southeast side, 6 feet northeast of northeast house line of York	31	12	....	9 ft.	....	....	1	
Tulip street, east corner of Cumberland	31	12	....	13 ft.	....	....	....	1
Tulip street, east corner of Sergeant	31	12	....	10 ft.	....	....	....	1
Tulip street, southeast side, northeast house line of Huntingdon	31	12	....	9 ft.	....	....	1	
Tulip street, south corner of Lehigh avenue	31	12	....	14 ft. 6 in.	....	....	....	1
Tyson street, south side, 5 feet east of east house line of Ninth	19	6	....	9 ft.	....	....	....	1
Vienna street, southwest side, 143 feet southeast of southeast house line of Belgrade	18	6	....	14 ft. 5 in.	....	1		
Wellington street, northeast side, 213 feet west of Jasper	25	6	....	15 ft. 2 in.	....	....	1	
Wildey street, southwest corner of Eyre	18	6	....	17 ft.	....	1		
William street, northwest side, 200 feet northeast of northeast house line of Ash	25	6	....	11 ft.	....	1		
Willow street, southeast side, 212 feet northeast of northeast house line of Harrison	23	6	....	16 ft. 9 in.	....	1		
Willow street, southwest corner of Wakeling	23	6	....	17 ft.	....	....	....	1
Worth street, southeast side, southwest house line of Orthodox	23	6	....	15 ft. 3 in.	....	....	1	
Total	....	....	....	1,542 ft.	....	28	50	32

New Fire Hydrants—Continued.

Fourth District.

Street.	Location.	Ward.	Size of main in inches.	Connection. 4 in.	Connection. 6 in.	Style. Old.	Style. New, No. 1.	Style. New, No. 2.	Style. New, No. 3.
Allegheny avenue,	36 feet west of Germantown Railroad	28	6	....	39 ft. 1 in.	1			
Arizona street,	north side, 170 feet east of east house line of Twenty-seventh	28	6	....	6 ft. 7 in.	....	....	1	
Biddle street,	northwest corner Twenty-third	15	6	....	17 ft. 6 in.	....	....	....	1
Biddle street,	southwest corner Twenty-fourth	15	6	....	11 ft.	....	....	1	
Bucknell street,	east side, 251 feet north of north house line of Montgomery	28	6	....	4 ft.	....	....	1	
Burns street,	southeast corner Parrish	15	6	....	9 ft.	....	....	1	
Buttonwood street,	southeast corner Twelfth	14	6	....	22 ft.	....	....	....	1
Buttonwood street,	southeast corner Thirteenth	14	6	....	21 ft.	....	....	....	1
Callowhill street,	northeast side, southeast corner Hamilton	15	10	....	42 ft.	....	....	1	
Callowhill street,	south side, west house line of Twenty-first	15	10	....	10 ft.	....	....	1	
Callowhill street,	southwest corner Twenty-fourth	15	6	....	9 ft. 6 in.	....	....	....	1
Clarence street,	northwest corner Twenty-sixth	28	6	....	19 ft. 6 in.	....	....	....	1
Columbia avenue,	northeast corner Tenth	20	6	....	20 ft. 6 in.	....	....	....	1
Darien street,	northwest corner Berks	20	6	....	11 ft.	....	....	1	
Dauphin street,	southwest corner Eighth	28	20	....	23 ft.	....	....	....	1

NEW FIRE HYDRANTS—FOURTH DISTRICT—*Continued.*

Street.	Location.	Ward.	Size of main in inches.	Connection. 4 in.	Connection. 6 in.	Style. Old.	Style. New, No. 1.	Style. New, No. 2.	Style. New, No. 3.
Dauphin street	southwest corner Twenty-ninth	28	6	....	19 ft.	....	....	....	1
Diamond street	southwest corner Eighth	20	6	....	16 ft.	....	....	....	1
Diamond street	southeast corner Twentieth	28	6	....	2 ft. 8 in.	....	....	....	1
Diamond street	southeast corner Twenty-third	28	6	....	3 ft.	....	....	....	1
Eighth street	southeast corner Germantown avenue	28	6	....	17 ft.	....	....	....	1
Fairmount avenue	southwest corner Eleventh	14	10	....	18 ft.	....	....	....	1
Fifteenth street	southwest corner Norris	28	6	....	24 ft. 10 in.	....	....	....	1
Fifteenth street	southeast corner York	28	6	....	13 ft.	....	....	1	
Fifteenth street	southeast corner Cumberland	28	6	....	10 ft.	....	....	....	1
Garden street	southeast corner Noble	14	6	....	15 ft.	....	....	....	1
Garden street	northwest corner Wood	14	6	....	15 ft.	....	....	....	1
Garden street	northwest corner Callowhill	14	6	....	12 ft. 6 in.	....	....	....	1
Garden street	southwest corner Buttonwood	14	6	....	17 ft.	....	....	....	1
Girard avenue	southeast corner Kurtz	20	6	....	11 ft.	....	....	1	
Girard avenue	south side, east house line of Broad	20	6	....	11 ft.	....	....	1	
Girard avenue	northeast corner Darien	20	6	....	14 ft. 5 in.	....	....	1	

NEW FIRE HYDRANTS—FOURTH DISTRICT—*Continued.*

Street. Location.	Ward.	Size of main in inches.	Connection. 4 in.	Connection. 6 in.	Style. Old.	Style. New, No. 1.	Style. New, No. 2.	Style. New, No. 3.
Girard avenue, northeast corner Hutchinson	20	6	....	17 ft. 7 in.	....	....	....	1
Girard avenue, southeast corner Tenth	20	6	....	17 ft.	....	....	....	1
Girard avenue, south side, west house line of Eighth	20	6	....	12 ft.	....	....	1	
Girard avenue, north side, west house line of Thirty-first	29	10	....	29 ft.	....	....	1	
Gratz street, southeast corner Norris	28	6	....	10 ft.	....	....	....	1
Hamilton street, southwest corner Twenty-first	15	48	....	21 ft.	....	....	....	1
Hare street, northeast corner Twenty-third	15	8	....	25 ft.	....	....	....	1
Hare street, northwest corner Twenty-fifth	15	6	....	24 ft.	....	....	1	
Hare street, southwest corner Twenty-fourth	15	6	....	20 ft.	....	....	1	
Herman street, southwest corner Twenty-ninth	28	6	....	20 ft. 6 in.	....	....	....	1
Herman street, northeast corner Twenty-seventh	28	6	....	19 ft. 6 in.	....	....	....	1
Keith street, northwest corner Columbia avenue	29	6	....	13 ft.	....	....	....	1
Lehigh avenue, northeast corner Eleventh	28	6	....	14 ft.	....	....	....	1
Linn street, northwest corner Twenty-second	15	6	....	7 ft. 5 in.	....	....	....	1
Linn street, northwest corner Twenty-third	15	6	....	18 ft.	....	....	....	1
Master street, southeast corner Seventh	20	6	....	14 ft. 6 in.	....	....	1	

NEW FIRE HYDRANTS—FOURTH DISTRICT—*Continued.*

Street. Location.	Ward.	Size of main in inches.	Connection. 4 in.	Connection. 6 in.	Style. Old.	Style. New, No. 1.	Style. New, No. 2.	Style. New, No. 3.
Marshall street, east side, 134 feet south of south house line of Girard avenue	20	6		15 ft.			1	
Montgomery avenue, northeast corner Darien	20	6		23 ft.			1	
Montgomery avenue, southeast corner Eighth	20	6		21 ft.				1
Ninth street, east side, 267 feet north of north house line of Susquehanna avenue	28	30		7 ft.			1	
Ninth street, southwest corner Dauphin	28	30		20 ft.				1
Ninth street, northeast corner Susquehanna avenue	28	6		9 ft.				1
Parrish street, northwest corner Ringgold	15	6		13 ft. 10 in.				1
Parrish street, northwest corner Twenty-fifth	15	6		15 ft. 3 in.				1
Pennsylvania avenue, southeast corner Twenty-first	15	48		10 ft.				1
Pennsylvania avenue, southeast corner Twenty-third	15	6		10 ft.				1
Perot street, northeast corner Twenty-sixth	15	6		19 ft.			1	
Poplar street, southeast corner Pennock	15	6		20 ft.				1
Richfield street, southeast corner Thirteenth	28	6		11 ft. 6 in.				1
Ringgold street, west side, 59 feet south of south house line of Brown	15	6		7 ft.		1		
Shamokin street, southwest corner Twenty-second	15	6		8 ft. 10 in.				1
Sixteenth street, southeast corner Brandywine	15	6		21 ft. 6 in.				1

New Fire Hydrants—Fourth District—*Continued.*

Street. Location.	Ward.	Size of Main in inches.	Connection. 4 in.	Connection. 6 in.	Style. Old.	Style. New, No. 1.	Style. New, No. 2.	Style. New, No. 3.
Sixteenth street, southeast corner Wallace	15	20		9 ft.				1
Spring Garden street, southeast corner Twenty-first	15	48		12 ft.				1
Spring Garden street, southeast corner Twenty-fourth	15	20		22 ft.				1
Spring Garden street, northwest corner Twenty-fourth	15	48		28 ft. 5 in.				1
Spring Garden street, north side, 21 feet west of west house line of Pennsylvania avenue	15	48		27 ft.			1	
Spring Garden street, south side, 80 feet west of west house line of Twenty-third	15	6		15 ft.			1	
Spring Garden street, southwest corner Twenty-second	15	48		43 ft. 6 in.				1
Stillman street, southeast corner of Montgomery avenue	29	6		11 ft.				1
Tenth street, west side, 221 feet north of north house line of Columbia avenue	20	6		10 ft.			1	
Taylor street, north side, 177 feet west of west house line of Twenty-fourth	28	6		9 ft.			1	
Thompson street, southwest corner of West College avenue	29	6		17 ft.			1	
Thirteenth street, west side, 176 feet north of north house line of Jefferson	29	6		14 ft.			1	
Thirtieth street, southeast corner Herman	28	12		17 ft.				1
Thirtieth street, northwest corner Girard avenue	29	10		15 ft.				1
Thirty-first street, southeast corner Dauphin	28	6		22 ft. 2 in.			1	
Thirty-first street, west side, northeast house line of Ridge avenue	28	6		17 ft. 4 in.			1	
Thirty-second street, west side, northeast house line of Ridge avenue	28	6		14 ft.			1	
Twenty-first street, northwest corner Vine	15	48		20 ft. 6 in.				1

New Fire Hydrants—Fourth District—*Continued.*

Street. Location.	Ward.	Size of Main in inches.	Connection. 4 in.	Connection. 6 in.	Style. Old.	Style. New, No. 1.	Style. New, No. 2.	Style. New, No. 3.
Twenty-fourth street, northwest corner Parrish	15	6	....	8 ft. 4 in.	....	....	1	
Twenty-fifth street, southeast corner Brown	15	6	....	15 ft.	....	....	....	1
Twenty-fifth street, northeast corner Spring Garden	15	48	....	11 ft.				
Twenty-sixth street, southwest corner Parrish	15	6	....	13 ft. 6 in.	....	....	....	1
Twenty-sixth street, northeast corner Fletcher	28	6	....	19 ft.	....	....	....	1
Twenty-sixth street, northeast corner Dauphin	28	6	....	20 ft.	....	....	....	1
Twenty-sixth street, southeast corner York	28	6	....	20 ft.	....	....	....	1
Twenty-ninth street, east side, 9 feet 6 inches north of north house line of Parrish	15	6	....	18 ft.	....	....	....	1
Uber street, west side, 278 feet north of north house line of Montgomery avenue	28	6	....	11 ft.	....	1		
Walter street, northwest corner Twenty-ninth	28	6	....	14 ft	....	....	1	
Wood street, southeast corner Twelfth	14	6	....	19 ft.	....	....	1	
Wood street, northwest corner Thirteenth	14	6	....	18 ft. 6 in.	....	....	....	1
Wood street, southwest corner Twenty-first	15	48	....	21 ft.	....	....	....	1
York street, south side, opposite Dover	28	6	....	14 ft.	....	....	1	
York street, southwest corner Sedgley	28	6	....	28 ft.	....	....	1	
York street, southwest corner Ninth	28	6	....	20 ft.	....	....	....	1
Total	......	....	....	1,594 ft.	1	2	35	58

New Fire Hydrants Set in 1886—Continued.

Fifth District (Manayunk).

Street.	Location.	Ward.	Size of Main in inches.	Connection. 4 in.	Connection. 6 in.	Style. Old.	Style. New, No. 1.	Style. New, No. 2.	Style. New, No. 3.
Centre street, northwest side	10 feet southwest of southwest house line of Webster	21	6		11 ft.			1	
Chestnut street, southwest side,	13 feet southeast of southeast house line of Ripka	21	6		9 ft.			1	
Cotton street, southeast side,	62 feet southwest of southwest house line of Main	21	6		12 ft.			1	
Cresson street, northeast side,	241 feet southeast of southeast house line of Adams	21	6		9 ft.	1			
Division street, northeast side,	23 feet southeast of southeast house line of Mount Vernon	21	6		13 ft.		1		
Fleeson street, southeast side,	354 feet southwest of southwest house line of Ridge avenue	21	6		12 ft.			1	
Jackson street, southeast side,	52 feet southwest of southwest house line of Cresson	21	6		9 ft.	1			
Mifflin street, southeast side,	2 feet east of east house line of Brewer	28	6		8 ft.	1			
Leverington street, northwest side,	3 feet northeast of northeast house line of Chestnut	21	6		14 ft.				1
Ogle street, southwest side,	254 feet northwest of northwest house line of Fountain	21	6		11 ft.		1		
Queen, southeast side,	189 feet northeast of northeast house line of Cresson	28	6		19 ft.			1	
Smick street, northeast side,	45 feet southeast of southeast house line of Ripka	21	6		12 ft.			1	
Sunnyside street, northwest side,	25 feet northeast of northeast house line of Cresson	21	6		10 ft.		1		
Sunnyside street, southeast side,	278 feet northeast of northeast house line of Thirty-fifth	28	6		11 ft.		1		
Total					160 ft.	3	4	6	1

New Fire Hydrants Set in 1886—Continued.

SIXTH DISTRICT (GERMANTOWN).

Street Location.	Ward.	Size of Main in inches.	Connection. 4 in.	Connection. 6 in.	Style. Old.	Style. New, No. 1.	Style. New, No. 2.	Style. New, No. 3.
Allen lane, northwest side, southwest of southwest house line of Germantown avenue.........	22	16	....	10 ft.	....	....	1	
Carpenter street, southeast side, 275 feet southwest of southwest house line of Green...........	22	6	....	12 ft.	....	1		
Carpenter street, northwest side, 302 feet northeast of northeast house line of Green...........	22	6	....	12 ft.	....	1		
Carpenter street, northwest side, 260 feet southwest of southwest house line of Lincoln ave...	22	6	....	14 ft.	....	1		
Carpenter street, northwest side, 17 feet northeast of northeast house line of Lincoln ave......	22	6	....	14 ft.	....	1		
Carpenter street, northwest side, 417 feet northeast of northeast house line of Lincoln ave.....	22	6	....	14 ft.	....	....	1	
Clapier street, southeast side, 18 feet southwest of southwest house line of McKean avenue....	22	6	....	16 ft.	....	....	1	
Clapier street, northwest side, 356 feet southwest of southwest house line of McKean avenue.	22	6	....	17 ft.	....	....	1	
Clapier street, northeast house line of Fern...	22	6	....	15 ft.	....	....	1	
Douglas street, on dead end, 268 feet southwest of southwest house line of Hancock.............	22	6	....	14 ft.	1			
Duval street, north corner of Jefferson..	22	6	....	19 ft.	....	....	....	1
Germantown avenue, south corner of Rittenhouse...	22	6	....	13 ft.	....	....	....	1
Germantown avenue, northeast side, 100 feet northwest of northwest house line of Duval.....	22	10	....	9 ft.	....	....	1	
Germantown aveuue, northeast side, northwest house line of Clivedon..................................	22	10	....	7 ft.	....	....	1	
Germantown avenue, northeast side, 19 feet northwest of northwest house line of Sharpnack.	22	10	....	3 ft.	....	....	1	

New Fire Hydrants—Sixth District (Germantown)—*Continued.*

Street. Location.	Ward.	Size of Main in inches.	Connection. 4 in.	Connection. 6 in.	Style. Old.	New, No. 1.	New, No. 2.	New, No. 3.
Green street, southwest side, 9 feet northwest of northwest house line of Frank	22	6	....	12 ft.	....	1		
Highland ave., northwest side, 75 feet southwest of southwest house line of Twenty-seventh.	22	6	....	15 ft.	....	1		
Highland avenue, southeast side, 74 feet northeast of northeast house line of Twenty-eighth.	22	6	....	22 ft.	....	1		
Jefferson street, southeast side, 576 feet 10 inches northeast of northeast house line of Mercer	22	6	....	10 ft.	....	....	1	
Johnson street, southeast side, 299 feet northeast of northeast house line of Green	22	6	....	17 ft.	....	1		
Knox street, southwest side, 158 feet northwest of northwest house line of Chelton avenue	22	6	....	10 ft.	....	....	1	
Knox street, northeast side, 183 feet northwest of northwest house line of Manheim	22	6	....	17 ft.	....	1		
Lehman street, south corner of Morris	22	6	....	14 ft.	....	....	....	1
Lehman street, northeast side, 387 feet southwest of southwest house line of Morris	22	6	....	15 ft.	....	....	1	
Mt. Airy avenue, northwest side, 9 feet southwest of southwest house line of Anderson	22	6	....	9 ft.	....	....	1	
Mather street, southwest corner of Venango	28	6	....	14 ft.	....	....	....	1
Mercer street, northeast side, 183 feet northwest of northwest house line of Jefferson	22	6	....	18 ft.	....	1		
Morris street, northeast side, 287 feet southwest of southwest house line of Queen	22	6	....	16 ft.	....	1		
Morton street, southwest side, 250 feet northwest of northwest house line of Washington	22	6	....	15 ft.	....	1		
Morton street, northeast side, 150 feet northwest of northwest house line of Duval	22	6	....	17 ft.	....	1		
Morton street, northeast side, 150 feet northwest of northwest house line of Johnson	22	6	....	16 ft.	....	1		

New Fire Hydrants—Sixth District (Germantown)—*Continued.*

Street. Location.	Ward.	Size of Main in inches.	Connection. 4 in.	Connection. 6 in.	Style. Old.	Style. New, No. 1.	Style. New, No. 2.	Style. New, No. 3.
Morton street, northeast side, 180 feet northwest of northwest house line of Clivedon..........	22	6	....	16 ft.	....	1		
Ontario street, south side, 206 feet west of west house line of Twenty-first........................	28	6	....	13 ft.	....	1		
Philellena street, northwest side, 6 feet northeast of northeast house line of Sherman...........	22	6	....	16 ft.	....	1		
Sedgwick street, southeast side, 430 feet northeast of northeast house line of Germantown ave	22	6	....	16 ft.	....	....	1	
Sedgwick street, southeast side, 4 feet northeast of northeast house line of Green..	22	6	....	14 ft.	....	....	1	
St. Paul's Square, south side, 220 feet west of west house line of Sixteenth..........................	25	6	....	16 ft.	....	1		
Walnut lane, southeast side, 8 feet northeast of northeast house line of Green......................	22	6	....	21 ft.	....	1		
Total..	......	....	....	538 ft.	1	19	14	4

FIRE HYDRANTS RENEWED.

First District.

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Street. Location.	Ward.	Size of Main in inches.	Connection. 6 in.	Style. Old, removed.	Replaced by Old.	New, No. 1.	New, No. 2.	New, No. 3.
Alaska street, south side, 115 feet east of east house line of Eighth	1	6	....	1	1			
Almond street, south side, 18 feet east of east house line of Front	4	6	19 ft.	1	....	....	1	
Anita street, south side, 116 feet 4 inches east of east house line of Eleventh	26	6	8 ft.	1	....	....	1	
Anita street, south side, 305 feet west of west house line of Twelfth	26	6	7 ft. 6 in.	1	....	1		
Austin street, west side, 121 feet north of north house line of Wharton	26	6	6 ft. 6 in.	1	....	....	1	
Bainbridge street, north side, 125 feet east of east house line of Passyunk avenue	4	6	....	1	1			
Bainbridge street, north side, 147 feet east of east house line of Sixteenth	30	36	6 ft. 6 in.	1	....	....	1	
Bainbridge street, south side, 15 feet east of east house line of Twentieth	30	6	12 ft.	1	....	....	1	
Bainbridge street, south side, 232 feet east of east house line of Twenty-first	30	36	18 ft. 6 in.	1	....	....	1	
Bainbridge street, south side. 83 feet west of west house line of Twenty-first	30	6	13 ft.	1	....	1		
Bayard street, north side, 7 feet 6 inches east of east house line of Eighth	1	4	3 ft.	1	....	1		
Broad street, east side, south house line of Catharine								
Broad street, east side, north house line of Wolfe	1	6	3 ft.	1	....	....	1	

Fire Hydrants Renewed—First District—*Continued.*

Street. Location.	Ward.	Size of Main in inches.	Connection. 6 in.	Old, removed.	Style. Replaced by Old.	New, No. 1.	New, No. 2.	New, No. 3.
Broad street, east side, 12 feet north of north house line of Snyder avenue	1	6	3 ft.	1	....	....	1	....
Campbell street, southwest corner of Clymer	3	6	5 ft. 4 in.	1	....	1	....	....
Christian street, north side, 6 feet 6 inches east of east house line of Broad	3	6	19 ft.	1	....	....	1	
Christian street, south side, 4 feet west of west house line of Twenty-first	30	6	18 ft. 7 in.	1	....	....	1	
Cuba street, east side, 87 feet south of south house line of Moore	1	4	....	1	1			
Clarion street, east side, 100 feet south of south house line of Jackson	1	4	....	1	1			
Dickinson street, north side, 175 feet east of east house line of Sixth	1	4	....	1	1			
Eighteenth street, west side, 12 feet 6 inches south of south house line of Carpenter	30	6	13 ft.	1	....	....	1	
Eleventh street, east side, 5 feet 6 inches north of north house line of Reed	26	12	9 ft. 6 in.	1	....	....	1	
Ellsworth street, south side, 17 feet 4 inches east of east house line of Nineteenth	26	6	14 ft.	1	1			
Ellsworth street, south side, 20 feet west of west house line of Seventeenth	26	6	....	1				
Evergreen street, north side, 183 feet 2 inches west of west house line of Twentieth	30	4	3 ft.	1	....	....	1	
Federal street, south side, 1 foot 8 inches east of east house line of Second	2	6	13 ft.	1	....	....	1	
Federal street, north side, 9 feet east of east house line of Ninth	26	6	....	1	1			

Fire Hydrants Renewed—First District—*Continued.*

Street. Location.	Ward.	Size of Main in inches.	Connection. 6 in.	Style. Old, removed.	Replaced by Old.	Replaced by New, No. 1.	Replaced by New, No. 2.	Replaced by New, No. 3.
Federal street, south side, 170 feet 6 inches west of west house line of Fifteenth	26	6	13 ft.	1			1	
Federal street, south side, 13 feet west of west house line of Twenty-fifth	26	6	14 ft.	1			1	
Federal street, north side, 14 feet 4 inches west of west house line of Twenty-sixth	26	6	13 ft.	1			1	
Fifteenth street, north side, 5 feet north of north house line of Moore	26	6		1	1			
Fourth street, west side, south house line of Moore	3	6	14 ft. 6 in.	1			1	
Front street, west side 8 feet north of north house line of Tasker	1	6	14 ft. 6 in.	1			1	
Front street, west side, 8 feet north of north house line of Reed	1	8	13 ft.	1			1	
Front street, east side, 1 foot north of north house line of Prime	2	8	15 ft. 2 in.	1			1	
Front street, west side, 111 feet south of south house line of Carpenter	2	8	15 ft.	1			1	
Francis street, south side, 318 feet west of west house line of Twelfth	2	4		1	1			
German street, north side, 175 feet west of west house line of Third	4	10		1	1			
Gray's Ferry road, northeast side, 14 feet west of west house line of Thirty-fifth	26	20	6 ft.	1			1	
Gray's Ferry road, northwest side, 186 feet west of west house line of Thirty-fifth	26	20	6 ft. 7 in.	1			1	
Hoffman street, southeast corner of Sixth	1	4		1	1			

FIRE HYDRANTS RENEWED—FIRST DISTRICT—*Continued.*

Street. Location.	Ward.	Size of Main in inches.	Connection. 6 in.	Style. Old, removed.	Replaced by Old.	Replaced by New, No. 1.	Replaced by New, No. 2.	Replaced by New, No. 3.
Jackson street, north side, 122 feet west of west house line of Thirteenth	1	6	17 ft.	1				1
Kater street, north side, 4 feet west of west house line of Juniper	4	4		1	1			
Marriott street, north side, 143 feet 7 inches east of east house line of Ninth	2	6	10 ft. 8 in.	1			1	
Mount Holly street, east side, 50 feet south of south house line of Dickinson	26	6		1	1			
Naylor street, south side, 44 feet west of west house line of Austin	26	6	6 ft. 4 in.	1			1	
Newton street, east side, 55 feet 3 inches south of south house line of Carpenter	2	6	3 ft. 3 in.	1		1		
Passyunk avenue, east side, 291 feet north of north house line of Federal	2	6	7 ft. 2 in.	1			1	
Passyunk avenue, east side, 3 feet 8 inches south of south house line of Washington av.	2	8	7 ft. 8 in.	1			1	
Passyunk avenue, east side, 36 feet south of south house line of Marriott	2	6	7 ft.	1			1	
Pemberton street, south side, 7 feet east of east house line of Twentieth	30	6	7 ft. 6 in.	1			1	
Pemberton street, south side, 101 feet west of west house line of Twentieth	30	6	7 ft.	1		1		
Pemberton street, north side, 122 feet west of west house line of Twenty-first	30	6	8 ft. 10 in.	1			1	
Pemberton street, north side, 33 ft. 8 in. east of east house line of Grays' Ferry road	30	6		1	1			
Patton street, east side, 200 feet north of north house line of Wharton	26	6		1	1			

FIRE HYDRANTS RENEWED—FIRST DISTRICT—*Continued.*

Street. Location.	Ward.	Size of Main in inches.	CONNECTION.	STYLE.				
			6 in.	Old, removed.	Replaced by			
					Old.	New, No. 1.	New, No. 2.	New, No. 3.
Second street, east side, 22 feet south of south curb-line of McKean........	1	6	13 ft. 9 in.	1	....	....	1	
Seventh street, east side, 148 feet 3 inches south of south house line of Bainbridge........	4	6	14 ft. 6 in.	1	....	....	1	
Sutherland street, west side, 177 feet north of north house line of Christian........	30	6	5 ft. 10 in.	1	....	....	1	
Third street, west side, north house line of German........	4	6	14 ft.	1	....	....	1	
Thirty-first street, west side, 16 feet north of north house line of Gray's Ferry road......	26	6	3 ft.	1	....	1		
Thirty-third street, west side, 10 feet north of north house line of Tasker street........	26	6	....	1	1			
Twelfth street, west side, south house line of Everett........	2	6	13 ft.	1	....	....	1	
Twentieth street, east side, 35 feet south of south house line of Wharton........	26	6	....	1	1			
Washington avenue, north side, 40 feet east of east house line of Second........	2	10	11 ft. 6 in.	1	....	....	1	
Washington avenue, south side, 108 feet 6 inches east of east house line of Ninth........	2	4	....	1	1			
Washington avenue, south side, 5 feet 4 inches west of west house line of Twenty-first...	26	6	....	1	....	....	1	
Wharton street, southwest corner of Thirty-first........	26	6	3 ft.	1	1			
Watkins street, south side, 144 feet east of east house line of Eighth........	1	4	4 ft.	1	....	1		
Total........	......	....	485 ft.	67	19	8	39	1

Fire Hydrants Renewed—Continued.

Second District.

Street. Location.	Ward.	Size of Main in inches.	Connection. 6 in.	Style. Removed. Old.	No. 2.	No. 3.	No. 5.	Replaced by Old.	New, No. 1.	New, No. 2.	New, No. 3.	New, No. 5.
Arch street, south side, 184 feet west of west house line of Nineteenth	9	6	10 ft. 9 in.	1	....	....	....	....	1			
Aspen street, south side, 12 feet 6 inches west of west house line of Lex	24	6	17 ft. 7 in.	1	....	....	....	....	....	1		
Aspen street, south side, opposite centre of Thirty-sixth and One-half street	24	6	13 ft. 2 in.	1	....	....	....	....	....	1		
Atlanta street, south side, 221 feet west of west house line of Thirty-eighth	24	6	....	1	....	....	....	1				
Baltimore avenue, south side, 108 feet west of west house line of Fiftieth	27	8	....	1	....	....	....	1				
Bingham street, east side, 254 feet north of north house line of Spruce	5	6	6 ft. 7 in.	1	....	....	....	....	....	1		
Bissell Place, 9 feet west of west house line of Bedell Place	6	6	7 ft. 4 in.	1	....	....	....	....	1			
Broad street, east side, 252 feet south of south house line of Vine	10	20	....	....	....	....	1	....	....	....	....	1
Carter street, south side, 108 feet 7 inches west of west house line of Second	5	6	6 ft. 5 in.	1	....	....	....	....	1			

Fire Hydrants Renewed—Second District—*Continued.*

Street. Location.	Ward.	Size of Main in inches.	Connection. 6 in.	Style. Removed. Old.	No. 2.	No. 3.	No. 5.	Replaced by Old.	New, No. 1.	New, No. 2.	New, No. 3.	New, No. 5.
Chester street, west side, 52 feet north of north house line of Mackinaw	10	6	10 ft. 6 in.	1	....	....	....	....	....	1		
Chestnut street, south side, 11 feet west of west house line of Exchange Place	5	10	6 ft. 6 in.	1	....	....	....	....	....	1		
Chestnut street, south side, 36 feet west of west house line of Thirtieth	27	6	22 ft. 10 in.	1	....	....	....	....	....	1		
Chestnut street, north side, 234 feet west of west house line of Fifty-third	27	8	....	1	....	....	....	1				
Chestnut street, south side, 240 feet east of east house line of Thirty-eighth	27	8	....	1	....	....	....	1				
Dean street, west side, 61 feet south of south house line of Budd	7	4	....	1	....	....	....	1				
Eighteenth street, west side, 21 feet n rth of north house line of Summer	10	12	....	1	....	....	....	1				
Eighth street, west side, 86 feet south of south house line of Filbert	9	10	....	1	....	....	....	1				
Eleventh street, west side, north house line of Clover	9	10	13 ft. 9 in.	1	....	....	....	....	....	1		
Elm avenue, south side, 350 feet west of west house line of Fiftieth	24	10	....	1	....	....	....	1				

Fire Hydrants Renewed—Second District—*Continued.*

Street. Location.	Ward.	Size of Main in Inches.	Connection. 6 in.	Style. Removed. Old.	No. 2.	No. 3.	No. 5.	Replaced by Old.	New, No. 1.	New, No. 2.	New, No. 3.	New, No. 5.
Factory street, north side, 67 feet east of east house line of Twenty-sixth	7	3	2 ft. 6 in.	1	....	....	....	1				
Fifth street, west side, north house line of Adelphia	6	10	6 ft. 6 in.	1	....	....	....	....	....	1		
Fifth street, east side, 229 feet south house line of Spruce	5	10	13 ft. 2 in.	1	....	....	....	....	....	1		
Fifth street, east side, 159 feet south of south house line of Arch	6	10	....	1	....	....	....	1				
Fifty-second street, east side, 25 feet north of north house line of Locust	27	6	....	1	....	....	....	1				
Fifty-second street, east side, 8 feet 6 inches south of south house line of Jefferson	24	6	....	1	....	....	....	1				
Filbert street, south side, 191 feet east of east house line of Thirty-eighth	24	6	....	1	....	....	....	1				
Forty-first street, southeast corner of Ogden	......	6	....	1	....	....	....	1				
Forty-first street, west side, 126 feet north of north house line of Chester avenue	27	6	3 ft.	1	....	....	....	1				
Forty-second street, east side, 127 feet south of south house line of Parrish	24	6	....	1	....	....	....	1				
Forty-second street, west side, 285 feet north of north house line of Girard avenue	24	6	....	1	....	....	....	1				

Fire Hydrants Renewed—Second District—*Continued.*

Street. Location.	Ward.	Size of Main in inches.	Connection. 6 in.	Style. Removed. Old.	No. 2.	No. 3.	No. 5.	Replaced by Old.	New, No. 1.	New, No. 2.	New, No. 3.	New, No. 5.
Forty-third and One-half streets, west side, 132 feet north of north house line of Haverford	24	6		1				1				
Forty-fourth street, west side, 43 feet south of south house line of Wallace	24	6		1				1				
Fourth street, west side, south house line of Race	6	6					1					1
Front street, west side, 5 feet south of south house line of Coombs alley	6	8	15 ft. 4 in.	1							1	
Grubb street, north side, 13 feet east of Sycamore	8	4	21 ft. 8 in.	1				1				
Haverford street, south side, 267 feet west of west house line of Fifty-fourth	24	12	21 ft. 8 in.	1						1		
Haverford street, south side, 222 feet east of east house line of Sixty-first	24	12		1				1				
Hillsdale street, 129 feet south of south house line of Race	6	6		1				1				
Lancaster avenue, north side, 121 feet west of west house line of Fiftieth	24	6	28 ft. 1 in.	1						1		
Lancaster avenue, opposite house No. 3904	24	6	2 ft. 6 in.	1				1				
Lee street, south side, 284 feet west of west house line of Eighteenth	9	6	8 ft.	1					1			

Fire Hydrants Renewed—Second District—*Continued.*

Street. Location.	Ward.	Size of Main in inches.	Connection. 6 in.	Style. Removed. Old.	No. 2.	No. 3.	No. 5.	Replaced by Old.	New, No. 1.	New, No. 2.	New, No. 3.	New, No. 5.
Locust street, north side, 121 feet east of east house line of Thirty-sixth	27	6	....	1	....	....	....	1				
Market street, southeast corner Third	6	6	....	....	....	....	1	....	....	1		
Market street, south side, 13 feet east of east house line of Fourth	......	....	....	....	1	....	....	....	....	....	1	
Market street, south side, 230 feet west of west house line of Thirty-seventh	27	10	18 ft. 10 in.	1	....	....	....	....	....	1		
Market street, north side, 158 feet west of west house line of Fortieth street	24	10	41 ft. 6 in.	1	....	....	....	....	....	1		
Market street, north side, 65 feet west of west house line of Forty-first	24	10	38 ft. 10 in.	1	....	....	....	....	....	1		
Market street, north side, 247 feet east of east house line of Thirty-fourth	24	10	....	1	....	....	....	1				
Market st., S. side, 15 feet west of west house line of Thirty-sixth	27	10	....	1	....	....	....	1				
Market street, south side, 150 feet east of Forty-fifth	27	10	....	1	....	....	....	1				
Morgan street, north side, 171 feet west of west house line of Ninth	10	6	10 ft. 6 in.	1	....	....	....	....	....	1		
Osage avenue, south side, 129 feet west of west house line of Forty-fourth	27	6	....	1	....	....	....	1				

Fire Hydrants Renewed—Second District—*Continued.*

Street. Location.	Ward.	Size of Main in inches.	Connection. 6 in.	Style. Removed. Old.	Removed. No. 2.	Removed. No. 3.	Removed. No. 5.	Replaced by Old.	Replaced by New, No. 1.	Replaced by New, No. 2.	Replaced by New, No. 3.	Replaced by New, No. 5.
Preston street, east side, 16 feet south of south house line of Westminster avenue	24	6	3 ft.	1					1			
Race street, south side, west house line of Jacoby	10	3		1				1				
Race street, south side, 79 feet west of west house line of Twenty-second	10	6	13 ft. 9 in.	1					1			
Schell street, west side, 185 feet north of north house line of Maple	10	6	3 ft. 3 in.	1						1		
Second street, east side, 2 feet north of north house line of Lombard	5	10	11 ft. 5 in.	1						1		
Second street, west side of Market house, 17 feet south of south house line of Pine	5	6		1				1				
Second street, east side, 33 feet north of north house line of Craven	6	6		1				1				
Second street, northeast corner Spruce street	5	6				1					1	
Sixteenth street, west side, north house line of Moravian	8	6	16 ft. 6 in.	1						1		
Third street, west side, 1 foot north of south house line of Cherry.	6	6		1				1				
Thirteenth street, east side, 59 feet south of south house line of Silver	9	6		1				1				

Fire Hydrants Renewed—Second District—*Continued*.

Street. Location.	Ward.	Size of Main in inches.	Connection. 6 in.	Style. Removed. Old.	Removed. No. 2.	Removed. No. 3.	Removed. No. 5.	Replaced by Old.	Replaced by New, No. 1.	Replaced by New, No. 2.	Replaced by New, No. 3.	Replaced by New, No. 5.
Thirtieth street, east side, 19 feet 6 inches north of north house line of Walnut	27	6	3 ft.	1	...	...	...	1				
Thirty-eighth street, east side, 28 feet south of south house line of Centre	24	6	...	1	...	...	...	1				
Thirty-ninth street, east side, 35 feet south of south house line of Aspen	24	6	21 ft.	1	...	...	...	...	1			
Thirty-ninth street, west side, south house line of Melon	24	6	...	1	...	...	...	1				
Thirty-ninth street, east side, 173 feet south of south house line of Baring street	24	6	...	1	...	...	...	1				
Thirty-third street, west side, 133 feet south of south house line of Filbert	9	4	3 ft.	1	...	...	...	...	1			
Twenty-first street, west side, 45 feet south of south house line of Summer	10	6	1 ft. 6 in.	1	...	...	...	...	1			
Twenty-second street, east side, 8 feet north of north house line of Cuthbert	9	12	...	1	...	...	...	1				
Twenty-sixth street, east side, 94 feet north of north house line of Pine	7	3	...	1	...	...	...	1				
Vine street, south side, 13 feet east of east house line of Albion	10	12	6 ft. 6 in.	1	...	...	...	...	...	1		

Fire Hydrants Renewed—Second District—*Continued.*

Street. Location.	Ward.	Size of Main in inches.	Connection. 6 in.	Style. Removed. Old.	No. 2.	No. 3.	No. 5.	Replaced by Old.	New, No. 1.	New, No. 2.	New, No. 3.	New, No. 5.
Vine street, south side, 194 feet west of west house line of Eighteenth	10	12	7 ft. 6 in.	1	......	......	......	......	......	1		
Vine street, south side, 51 feet east of east house line of Fifty-fifth	24	6	3 ft.	1	......	......	......	1				
Vine street, north side, 204 feet east of east house line of Sixteenth	15	12	3 ft. 6 in.	1	......	......	......	1				
Walnut street, north side, 155 feet east of east house line of Eighth	8	6	5 ft. 8 in.	1	......	......	......	......	1			
Walnut street, north side, 182 feet west of west house line of Tenth	8	6	......	......	......	......	1	......	......	1		
Walnut street, 178 feet west of west curb line of Forty-sixth	27	8	20 ft. 5 in.	1	......	......	......	......	......	1		
Walnut street, south side, east house line of Duponceau	8	12	......	......	......	......	1	......	......	......	......	1
Walnut street, north side, 7 feet east of east house line of Forty-fifth	27	8	......	1	......	......	......	1				
Woodland avenue, south side, 80 feet east of east house line of Thirty-seventh	27	6	22 ft. 5 in.	1	......	......	......	......	......	1		
Total	......	......	493 ft.	75	1	1	5	42	9	25	3	3

Fire Hydrants Renewed—Continued.

THIRD DISTRICT.

Street. Location.	Ward.	Size of Mrin in inches.	Connection. 6 in.	Style. Old removed.	Replaced by Old.	New, No. 1.	New, No. 2.	New, No. 3.
Beach street, west side, 287 feet north of north house line of Shackamaxon..................	18	6	14 ft.	1	....	....	1	
Belrose street, west side, 6 feet south of south house line of Noble..............................	12	6	5 ft. 5 in.	1	....	1		
Cambria street, south side, 25 feet 6 inches east of east house line of Boudinot..............	25	6	15 ft. 3 in.	1	....	1		
Charlotte street, east side, 10 feet south of south house line of Master..........................	17	6	2 ft. 6 in.	1	....	1		
Church street, northeast corner of Washington..	25	6	6 ft.					
Clearfield street, north side, 50 feet west of west house line of Janney.........................	25	6	18 ft. 6 in.	1	....	....	1	
Collins street, southwest side, 96 feet northwest of northwest house line of Cumberland	31	6	10 ft.	1	....	....	1	
Cumberland street, northeast side, 14 feet 8 inches southeast of Coral...........................	31	6	17 ft. 10 in.	1	....	....	....	1
Dauphin street, south side, 16 feet east of east house line of Germantown avenue...........	19	6	14 ft.	1	....	....	1	
Fairmount avenue, north side, 18 feet east of east house line of Fifth..........................	12	6	16 ft. 9 in.	1	....	....	1	
Fourth street, west side, 21 feet 6 inches north of north house line of Girard avenue......	17	6	15 ft.	1	....	....	1	
Fox street, southwest side, 185 feet northwest of northwest house line of Cedar.............	31	6	3 ft. 6 in.	1	....	1		
Glenwood street, west side, 124 feet south of south house line of Noble..........................	11	6	7 ft. 9 in.	1	1			

FIRE HYDRANTS RENEWED—THIRD DISTRICT—*Continued.*

Street. Location.	Ward.	Size of Main in inches.	Connection. 6 in.	Style. Old removed.	Replaced by Old.	Replaced by New, No. 1.	Replaced by New, No. 2.	Replaced by New, No. 3.
Hancock street, west side, 150 feet north of north house line of Thompson	17	6	15 ft.	1			1	
Hancock street, east side, 7 feet north of north house line of Berks	19	6	15 ft. 9 in.	1			1	
Hanover street, northeast side, northwest house line of Ireland	18	6	14 ft. 4 in.	1			1	
Hockley street, east side, 27 feet south of south house line of Emerick	18	6	5 ft.	1		1		
Kensington avenue, northwest side, 387 feet southwest of southwest house line of Cumberland	31	6	10 ft. 6 in.	1			1	
Lehigh avenue, northeast side, 50 feet southeast of southeast house line of Belgrade	25	6	6 ft. 6 in.	1			1	
Lehigh avenue, south side, 9 feet west of west house line of Hancock	19	6	8 ft.	1			1	
Lehigh avenue, north side, 336 feet east of east house line of Eighth	25	6	3 ft.	1			1	
Madison avenue, south side, 99 feet east of east house line of Jasper	25	6	16 ft. 6 in.	1			1	
Marshall street, west side, 212 feet 8 inches north of north house line of Dauphin	19	6	11 ft. 8 in.	1		1		
Master street, north side, 5 feet east of east house line of Brinton	17	6	15 ft.	1		1		
Moore street, south side, 66 feet east of east house line of Coral	31	6	5 ft.	1		1		
Neff street, north side, 27 feet east of east house line of Almond	25	6	16 ft. 6 in.	1			1	
Norris street, south side, 108 feet east of east house line of Fifth	19	6	14 ft. 6 in.	1			1	

Fire Hydrants Renewed—Third District—*Continued.*

Street. Location.	Ward.	Size of Main in inches.	Connection. 6 in.	Style. Old removed.	Replaced by Old.	New, No. 1.	New, No. 2.	New, No. 3.
Reese street, east side, 251 feet 8 inches north of north house line of Dauphin	19	6	5 ft. 10 in.	1	....	1		
Richmond street, west side, 256 feet south of south house line of Butler	25	12	6 ft. 10 in.					
Richmond street, east side, 182 feet north of north house line of Olivia	25	12	11 ft.					
Rush street, south side, 27 feet west of house line of Amber	25	6	5 ft.	1	....	1		
Sixth street, west side, north house line of Tyson	19	6	12 ft. 5 in.	1	....	....	1	
Third street, west side, 11 feet south of south house line of Beaver	16	10	16 ft.	1	....	....	1	
Tulip street, northwest side, 7 feet northeast of northeast house line of Gordon	31	6	16 ft.	1	....	....	1	
Tulip street, southeast side, northeast house line of Tucker	31	12	9 ft. 6 in.	1	....	....	1	
Waterloo street, west side, 216 feet 8 inches north of north house line of York	19	6	5 ft. 6 in.	1	....	1		
York avevue, west side, 7 feet south of south house line of Noble	12	6	18 ft. 7 in.	1	....	....	1	
York street, northeast side, 3 feet northwest of northwest house line of Amber	31	6	14 ft. 9 in.	1	....	....	1	
York street, south side, west house line of Fifth	19	6	14 ft. 9 in.	1	....	....	1	
Total	......	....	440 ft.	36	1	11	23	1

Fire Hydrants Renewed—Continued.

Fourth District.

Street. Location.	Ward.	Size of Main in inches.	Connection. 6 in.	Style. Old, removed.	Replaced by Old.	Replaced by New, No. 1.	Replaced by New, No. 2.	Replaced by New, No. 3.
Alder street, west side, 46 feet south of south house line of Oxford..............................	20	6	7 ft. 6 in.	1	....	....	1	
Buttonwood street, south side, 162 feet west of west house line of Eighteenth.................	15	6	9 ft. 10 in.	1	....	....	1	
Callowhill street, south side, 4 feet 6 inches east of east house line of Broad....................	10	6	4 ft. 7 in.	1	....	....	....	1
Eighth street, west side, 126 feet north of north house line of Susquehanna avenue.........	28	6	18 ft.	1	....	....	1	
Fairmount avenue, north side, 150 feet west of west house line of Twenty-first..............	15	10	25 ft. 6 in.	1	....	....	1	
Fairmount avenue, south side, 10 feet west of west house line of Nineteenth..................	15	10	26 ft. 6 in.	1	....	....	1	
Jefferson street, south side, 17 feet east of east house line of Sydenham.........................	29	6	10 ft.	1	....	....	1	
Master street, north side, 39 feet 6 inches east of east house line of Twenty-eighth.........	29	6	7 ft. 10 in.	1	....	....	1	
Norris street, south side, 177 feet east of east house line of Twenty-first........................	28	6	14 ft. 10 in.	1	....	....	1	
Pearl street, south side, 100 feet east of east house line of Seventeenth..........................	15	6	4 ft.	1	....	1		
Taylor street, east side, 5 feet south of south house line of Brown...................................	15	6	10 ft.	1	....	1		
Thompson street, north side, 33 feet east of east house line of Thirty-first.....................	29	6	4 ft.	1	....	....	1	
Thompson street, south side, west of house line of Carlisle..	29	4	6 ft. 8 in.	1	....	1		

Fire Hydrants Renewed—Fourth District—*Continued.*

Street.	Location.	Ward.	Size of Main in inches.	Connection. 6 in.	Style. Old, removed.	Replaced by Old.	Replaced by New, No. 1.	Replaced by New, No. 2.	Replaced by New, No. 3.
Twelfth street, west side,	3 feet south of south house line of Girard avenue	20	6	13 ft. 6 in.	1			1	
Wallace street, north side,	104 feet west of west house line of Seventh	13	6	14 ft. 6 in.	1			1	
Wallace street, south side,	15 feet west of west house line of Twenty-second	15	6	6 ft.	1	1			
Woodstock street, east side,	229 feet south of south house line of Montgomery avenue	29	6	11 ft.	1			1	
Total				195 ft.		1	3	13	1

Fire Hydrants Renewed—Continued.

Fifth District (Manayunk).

Street. Location.	Ward.	Size of Main in inches.	Connection. 6 in.	Style. Old, removed.	Replaced by Old.	Replaced by New, No. 1.	Replaced by New, No. 2.	Replaced by New, No. 3.
Cotton street, northwest side, 69 feet 6 inches northeast of northeast house line of Main..	21	6	5 ft.	1	....	1		
Cotton street, northwest side, 156 feet 6 inches southwest of southwest house line of Wood	21	6	16 ft.	1	....	1		
Grape street, north side, 20 feet east of east house line of Cresson..........................	21	6	3 ft.	1	....	1		
Grape street, north side, 26 feet southeast of southeast house line of Wood......................	21	6	12 ft. 6 in.	1	....	1		
Main street, northeast side, 26 feet 6 inches southeast of southeast house line of Centre...	21	6	15 ft.	1	....	....	....	1
Main street, northeast side, 96 feet southeast of southeast house line of Grape................	21	6	12 ft.	1	....	....	1	
Ridge avenue, east side, 278 feet south of south house line of Clearfield..........................	28	6	7 ft.	1	....	1		
Spencer street, northwest side, 184 feet southwest of southwest house line of Cresson......	28	6	13 ft. 6 in.	1	....	1		
Total..	......	....	85 ft.	8	....	6	1	1

Fire Hydrants Renewed—Continued.

Sixth District (Germantown).

Street. Location.	Ward.	Size of Main in inches.	Connection. 6 in.	Style. Old, removed.	Replaced by Old.	Replaced by New, No. 1.	Replaced by New, No. 2.	Replaced by New, No. 3.
Armat street, southeast side, 74 feet southwest of southwest house line of Cumberland...	22	6	13 ft. 6 in.	1	....	....	1	
Bellevue street, south side, 150 feet east of east house line of Twenty-second..................	22	6	....	1	1			
Duy's lane, south side, 90 feet west of west house line of Wakefield..............................	22	6	....	1	1			
Eighth street, west side, 169 feet north of north house line of Tioga............................	25	6	12 ft. 6 in.	1	....	....	1	
Germantown avenue, southwest side, 53 feet southeast of south house line of Venango...	28	6	9 ft. 6 in.	1	....	....	1	
Germantown avenue, southwest side, 150 feet south of south house line of Westmoreland	28	6	....	1	1			
Germantown avenue, east side, 213 feet north of north house line of Cayuga................	28	6	....	1	1			
Germantown avenue, southwest side, 300 feet northwest of north house line of Venango	28	6	8 ft.	1	....	....	1	
Germantown avenue, northeast side, 60 feet northwest of north house line of Erie ave...	25	6	24 ft.	1	....	....	1	
Germantown avenue, southwest side, 35 feet southeast of south house line of Butler......	28	6	12 ft.	1	....	....	1	
Germantown avenue, southwest side, 150 feet southeast of southeast house line of Nicetown lane..	28	6	6 ft. 3 in.	1	....	....	1	
Germantown avenue, northeast side, 237 feet 6 inches southeast of southeast house line of Duval..........	22	10	7 ft.	1	....	....	1	

FIRE HYDRANTS RENEWEW—SIXTH DISTRICT (GERMANTOWN)—*Continued.*

Street. Location.	Ward.	Size of Main in inches.	Connection. 6 in.	Style. Old, removed.	Replaced by Old.	Replaced by New, No. 1.	Replaced by New, No. 2.	Replaced by New, No. 3.
Germantown avenue, northeast side, 63 feet northwest of northwest house line of Johnson.	22	10	8 ft.	1	....	....	1	....
Germantown avenue, northeast side, 82 feet southeast of southeast house line of Church	22	10	6 ft. 8 in.	1	....	....	1	
Germantown avenue, northeast side, 164 feet northwest of northwest house line of Church..........	22	10	7 ft. 6 in.	1	....	....	1	
Germantown avenue, northeast side 285 feet southeast of southeast house line of Pleasant	22	10	10 ft.	1	....	....	1	
Germantown avenue, northeast side, 117 feet southeast of southeast house line of Meehan..	22	10	6 ft. 9 in.	1	....	....	1	
Germantown avenue, northeast side, 3 feet southeast of southeast house line of Gorgas..	22	10	3 ft.	1	....	....	1	
Green street, northeast side, 8 feet southeast of southeast house line of Tulpehocken......	22	8	16 ft.	1	....	....	....	1
Green street, east side, 160 feet north of north house line of Berkley..........	22	6	....	1	1			
Green street, northeast side, 319 feet northwest of northwest house line of Walnut lane..	22	6	2 ft. 6 in.	1	....	....	1	
Highland avenue, southeast side, 271 feet northeast of northeast house line of Twenty-seventh..........	22	6	22 ft.	1	....	1		
Highland avenue, northwest side, 92 feet northeast of northeast house line of Twenty-ninth..........	22	6	14 ft. 6 in.	1	....	1		
Manheim street, south side, 267 feet west of west house line of Pulaski..........	22	6	....	1	1			
Patton avenue, southwest side, 186 feet northwest of northwest house line of Queen......	22	6	10 ft. 6 in.	1	....	1		

Fire Hydrants Renewed—Sixth District (Germantown)—*Continued.*

Street. Location.	Ward.	Size of Main in inches.	Connection. 6 in.	Style. Old, removed.	Replaced by Old.	Replaced by New, No. 1.	Replaced by New, No. 2.	Replaced by New, No. 3.
Seymour street, southeast side, 27 feet 6 inches southwest of southwest house line of Germantown avenue	22	6	17 ft.	1	....	....	1	
Stenton avenue, west side, 180 feet south of south house line of New	22	4	....	1	1			
Wayne street, west side, 7 feet north of north house line of Manheim	22	4	....	1	1			
Willow Grove avenue, southeast side, 182 northeast of northeast house line of Thirty-fifth	22	6	6 ft.	1	....	1		
Total	......	....	223 ft.	29	8	4	16	1

Recapitulation of Fire Hydrants Set, Renewed, and Removed.

	Districts.	Style. Old.	No. 1, 1-way.	No. 2, 2-way.	No. 3, 3-way.	No. 4. 3-way.	No. 5, 3-way.	Total.
Set.	First	1	4	63	18	....	....	86
	Second	3	11	50	22	....	2	88
	Third	....	28	50	32	....	....	110
	Fourth	1	2	35	58	....	....	96
	Germantown	1	19	14	4	....	....	38
	Manayunk	3	4	6	1	....	....	14
	Totals	9	68	218	135	....	2	432
Renewed.	First	19	8	39	1	....	....	67
	Second	42	9	25	3	....	3	82
	Third	1	11	23	1	....	....	36
	Fourth	1	3	13	1	....	....	18
	Germantown	8	4	16	1	....	....	29
	Manayunk	....	6	1	1	....	....	8
	Totals	71	41	117	8	....	3	240
	Total New Hydrants	80	109	335	143	....	5	672
Removed.	First	21	....	....	....	....	....	21
	Second	49	....	....	....	....	....	49
	Third	14	....	....	....	....	....	14
	Fourth	46	....	....	....	....	....	46
	Germantown	5	....	....	....	....	....	5
	Manayunk	2	....	....	....	....	....	2
	Totals	137	....	....	....	....	....	137
	Total added during 1886	....	....	....	....	....	....	295

FIRE HYDRANTS, BY PURVEYORS' DISTRICTS,
And the diameter of the pipes to which they are connected.

Purveyors' Districts.	Sizes of Pipes in Inches.												Total.
	3	4	6	8	10	12	16	18	20	30	36	48	
First	55	245	839	26	35	15	4	......	13	1	7	......	1,240
Second	55	65	1,009	154	141	167	29	......	22	14	8	8	1,672
Third	1	237	1,037	4	133	31	2	4	5	4	6	......	1,464
Fourth	1	160	880	2	93	34	12	......	8	13	1	9	1,213
Manayunk	......	20	241	......	10	7	3	......	5	......	......	......	286
Germantown	32	63	423	14	37	27	17	......	2	......	......	......	615
Totals	144	790	4,429	200	449	281	67	4	55	32	22	17	6,490

FIRE HYDRANTS BY WARDS.

And the diameter of the pipes to which they are connected.

WARDS.	Sizes of Pipes in Inches.												Total.
	3	4	6	8	10	12	16	18	20	30	36	48	
First	5	103	212	3			1						324
Second	26	36	111	9	5	1	2		1				191
Third	9	6	71	9	15								110
Fourth	9	8	70	2	11					1			101
Fifth	4	9	67	36	31	9	1						157
Sixth	1		107	11	11		1		1	7			139
Seventh	11	5	109		8	16	14		1			3	167
Eighth	11	2	100		13	31	8		2			2	169
Ninth	4	4	94		16	11	5		4	5		2	145
Tenth	10	9	85	3	13	11			9	2		1	143
Eleventh		14	44	1	18								77
Twelfth		13	41		26	2	2						84
Thirteenth		18	72		16	6							112
Fourteenth		14	71		20	5	1			2			113
Fifteenth	1	44	184	1	29	5	2		5	2		9	282
Sixteenth		21	41		23	2							87
Seventeenth	1	23	56		8	2							90
Eighteenth		36	79		23								138
Nineteenth		64	199		9			4			1		277
Twentieth		58	157		5	7				2			229
Twenty-first		21	205		10	4	3		5				248
Twenty-second	32	63	332	14	35	18	17		2				513
Twenty-third		3	115			1			5				124
Twenty-fourth	14	21	325	20	26	50			5	5			466
Twenty-fifth		21	339	3	21	14					5		403
Twenty-sixth	3	58	246	3	2	10			8				330
Twenty-seventh		15	120	84	21	33					3		276
Twenty-eighth		1	323		2	26			3	3			358
Twenty-ninth		24	171	1	21	2	9			4	1		233
Thirtieth	3	34	129		2	4	1		4		7		184
Thirty-first		42	154		9	11				4			220
	144	790	4,429	200	449	281	67	4	55	37	17	17	6,490

STATEMENT OF THE NUMBER OF FIRE HYDRANTS, BY DISTRICTS AND WARDS,

During 1886, and total previous thereto.

	FIRST DISTRICT.							SECOND DISTRICT.										THIRD DISTRICT.									FOURTH DISTRICT.						MANAYUNK.			GERMANTOWN.				Total.
	Wards.						Total.	Wards.									Total.	Wards.								Total.	Wards.					Total.	Wards.		Total.	Wards.			Total.	
	1	2	3	4	26	30		5	6	7	8	9	10	12	24	27		12	16	17	18	19	23	25	31		14	15	20	28	29		21	28		22	25	28		
Prior to 1886	...	...	...	...	...	...	1,175	...	...	...	...	...	...	...	...	...	1,633	...	...	...	...	...	...	...	...	1,368	...	...	...	...	...	1,163	......	......	274	......	...	...	582	6,195
During 1886	20	13	7	3	32	11	86	7	7	13	12	8	14	1	15	11	88	2	3	3	4	14	8	51	25	110	9	34	14	33	6	96	11	3	14	35	1	2	38	432
Totals	...	...	...	..	...	...	1,261	...	...	...	...	...	...	...	...	...	1,721	...	...	...	...	...	...	...	...	1,478	...	...	...	...	...	1,259	......	......	288	......	...	...	620	6,627
Taken out in 1886	...	...	...	...	...	...	21	...	...	...	...	...	...	...	...	...	49	...	...	...	...	...	...	...	...	14	...	...	...	...	...	46	......	......	2	......	...	...	5	137
Totals in city	...	...	...	...	..	...	1,240	...	...	...	...	...	...	...	...	...	1,672	...	...	...	...	...	...	...	...	1,464	...	...	...	...	...	1,213	......	......	286	......	...	...	615	6,490

Number of attachments for fire purposes previously reported.............................. 285

Made during 1886	**First District**..	**1**
	Second "	**3**
	Third "	**7**
	Fourth "	**4**
	Manayunk District..	**2**
	Germantown "	**3**
	Total..	**305**

ATTACHMENTS, ETC., MADE BY THE PURVEYORS.

In accordance with permits issued by the Registrar, arranged by months.

Months.	Drills.						Shut-offs.					Attachments.					
	Size.					Total.						Drawn.					
	½ inch.	⅝ inch.	¾ inch.	1 inch.	2 inch.		Repairs.	Re-drive.	Discontinue.	Transfer.	Total.	Discontinued and abandoned.	Duplicate.	Delinquent.	Leak.	Total.	Re-driven.
January	56	1	1	6	....	64	9	14	....	....	23	2	....	....	8	10	
February	34	2	2	3	....	41	10	11	....	2	23	1	....	....	5	6	2
March	426	15	15	12	5	473	34	16	4	4	58	4	....	....	10	14	3
April	537	14	7	11	5	574	69	15	8	6	98	2	2	....	5	9	12
May	583	19	10	10	3	625	48	11	7	7	73	6	....	....	11	17	2
June	485	13	7	10	3	518	36	23	2	1	62	5	....	....	7	12	199
July	822	22	8	13	2	867	65	13	4	2	84	6	....	1	10	17	209
August	930	27	11	13	....	981	43	9	6	2	60	14	....	....	11	25	49
September	907	59	9	9	3	987	42	13	4	9	68	25	1	....	13	39	326
October	917	29	10	17	5	978	66	15	7	7	95	17	....	....	18	35	378
November	1,170	38	21	20	4	1,253	50	17	15	8	90	27	1	....	11	39	306
December	615	19	3	9	2	648	18	17	4	2	41	13	....	....	25	38	1
Totals	7,482	258	104	133	32	8,009	490	174	61	50	775	122	4	1	134	261	1,487

ATTACHMENTS, ETC., MADE BY THE PURVEYORS.

In accordance with permits issued by the Registrar, arranged by Purveyors Districts.

Districts.	Drills.						Shut-offs.					Attachments.					
	Size.											Drawn.					
	1/4 inch.	5/8 inch.	3/4 inch.	1 inch.	2 inch.	Total.	Repairs.	Redrive.	Discontinue.	Transfer.	Total.	Discontinued and abandoned.	Duplicate.	Delinquent.	Leak.	Total.	Re-driven.
First	1,416	11	7	18	2	1,454	61	24	16	4	105	4	....	....	7	11	482
Second	1,182	83	46	46	11	1,368	107	47	4	19	177	92	1	1	35	129	592
Third	2,224	34	9	29	14	2,310	145	37	10	9	201	17	3	....	34	54	3
Fourth	1,726	115	33	30	5	1,909	155	48	30	4	237	6	....	....	51	57	387
Germantown	743	12	9	6	....	770	14	12	....	10	36	2	....	....	5	7	22
Manayunk	191	3	....	4	....	198	8	6	1	4	19	1	....	....	2	3	1
Totals	7,482	258	104	133	32	8,009	490	174	61	50	775	122	4	1	134	261	1,487

Account of New Stops for 1886.

Districts.	Water Department.		Viney.			Barton.	Total.
	Two-Way.	Butter-fly.	Three-way.	Four-way.	Five-way.	Four-way	
First	147	....	....	2	1	....	150
Second	96	....	....	11	....	6	113
Third	237	....	....	3	....	....	240
Fourth	101	1	5	5	7	....	119
Manayunk	41	....	....	....	....	....	41
Germantown	72	....	....	....	1	....	73
Totals	694	1	5	21	9	6	736

Repairs to Mains, Stops, and Fire Hydrants, and Stops Taken Out During 1886.

Districts.	Repairs to Mains.	Stops.			Fire Hydrants.		
		Repaired.	Renewed.	Taken out.	Repaired.	Renewed.	Taken out.
First	67	590	48	....	1,433	67	21
Second	172	825	70	6	2,235	82	36
Third	109	295	15	....	473	36	13
Fourth	188	292	25	....	627	18	46
Manayunk	26	315	2	....	507	8	5
Germantown	59	34	2	2	143	29	2
Totals	621	2,351	162	8	5,423	240	123

NUMBER OF COMPLAINTS RECEIVED AND EXAMINED DURING 1885 AND 1886.

MONTHS.	Hydrants.		Service Pipes.		Wash Paves.		Spigots.		Water Closets.		Horse Troughs.		No. Leaks.		Total.	
	1885.	1886.	1885.	1886.	1885.	1886.	1885.	1886.	1885.	1886.	1885.	1886.	1885.	1886.	1885.	1886.
January........	525	296	139	108	59	31	1	1	....	2	2	2	120	25	846	465
February......	975	307	162	102	158	40	1	1	....	1	....	2	205	98	1,501	551
March...........	665	446	184	100	99	43	....	3	1	2	....	....	75	49	1,024	643
April............	355	262	127	67	20	8	....	....	....	....	....	....	116	29	618	366
May..............	286	233	88	59	8	11	....	4	2	....	....	....	103	22	487	329
June.............	221	300	77	78	8	17	....	....	4	....	2	3	102	32	414	430
July..............	215	383	60	89	7	8	....	4	....	....	....	1	48	25	330	510
August	262	273	77	67	13	8	....	....	....	2	1	....	58	43	411	393
September	349	241	98	65	14	9	2	....	....	....	....	....	106	25	569	340
October	264	293	97	99	15	6	1	1	....	1	1	....	53	22	431	422
November.....	303	231	80	69	7	12	1	6	2	2	1	....	34	17	428	337
December	348	298	125	97	12	4	....	1	....	2	....	....	40	25	525	427
Total.........	4,768	3,563	1,314	1,000	420	197	6	21	9	12	7	8	1,060	412	7,584	5,213

NUMBER OF VALVES RAISED IN THE SEVERAL DISTRICTS DURING THE YEAR 1886.

Also, in each year since 1873.

Districts.	6-inch Barton.	8-inch Barton.	3-inch.	4-inch.	6-inch.	8-inch.	10-inch.	12-inch.	16-inch.	20-inch.	30-inch.	36-inch.	Total.
First	......	......	......	......	1	1	......	......	......	......	......	......	2
Second	11	......	13	1	7	......	......	......	......	......	......	......	32
Third	1	......	......	1	7	......	1	......	......	......	1	......	11
Fourth	......	......	......	16	42	......	2	......	......	......	......	......	60
Totals for 1886	12	......	13	18	57	1	3	......	......	......	1	......	105
" " 1885	......	......	11	24	97	1	9	......	2	......	1	......	145
" " 1884	......	......	7	13	71	1	4	2	1	3	6	1	109
" " 1883	......	......	4	27	88	......	8	......	1	......	1	1	130
" " 1882	......	1	14	25	58	1	5	1	......	......	1	......	106
" " 1881	......	......	15	44	90	......	5	7	......	......	......	......	161
" " 1880	......	......	7	23	47	......	8	1	......	......	1	......	87
" " 1879	......	......	9	16	60	1	3	2	......	......	1	1	93
" " 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
Totals for 13 years	12	1	152	322	998	15	70	19	11	7	15	3	1,625

TABULAR STATEMENT OF WORK CONNECTED WITH THE DISTRIBUTION.

For the seven years 1880 to 1886, inclusive.

Years.	Pipe.										Additional stops.	Additional fire hydrants.	Fire hydrants in use.	Meters in use.	Service Attachments.					
	Extensions.		Repairs and relays.		Total pipe handled.		Total amount in use.		Total amount handled.											
	Feet.	Pounds.	Feet.	Pounds.	Feet.	Pounds.	Feet.	Pounds.	Feet.	Pounds.					½ in.	⅝ in.	¾ in.	1 in	2 in.	Total.
1880......	23,085	844,946	9,557	262,826	32,642	1,107,772	3,927,623	192,816,906	4,164,768	200,136,708	138	70	5,358	34	2,687	118	49	89	......	2,943
1881......	56,616	2,832,623	3,832	199,649	60,448	3,032,272	3,984,239	195,649,529	4,225,216	203,168,980	249	144	5,502	42	3,166	137	59	121	......	3,483
1882......	56,860	5,396,165	7,740	484,092	64,600	5,880,257	4,041,099	201,045,694	4,289,816	209,019,237	312	120	5,622	45	3,169	110	76	129	......	3,484
1883......	63,215	3,048,645	12,605	675,420	75,880	3,724,065	4,104,314	204,094,339	4,365,696	212,773,301	281	130	5,752	63	4,576	97	71	133	......	4,877
1884......	*84,451	7,155,385	18,079	1,380,271	102,530	8,535,656	4,188,765	211,249,724	4,468,226	221,308,957	324	147	5,887	560	5,529	185	84	140	7	5,945
1885......	137,967	12,234,074	93,783	3,265,537	231,850	15,499,611	4,326,732	223,483,798	4,700,076	236,808,568	539	307	†6,195	305	6,734	254	121	160	16	7,285
1886......	136,831	18,238,457	121,210	4,883,826	258,011	23,122,283	4,463,563	241,722,255	4,958,117	259,930,851	736	295	6,490	284	7,482	258	104	133	32	8,009

* 589 feet of pipe omitted in 1884. † One fire hydrant omitted 1885.

GENERAL SUMMARY OF METER OPERATIONS DURING 1886.

Style of Meter.	In stock January 1, 1886.						In use January 1, 1886.							Totals.	Set.		Renewed.	
	Crown.	Keystone.	Equitable.	Union.	Worthington.	Total.	Crown.	Keystone.	Equitable.	Union.	Marsland.	Worthington.	Total.		Crown.	Total.	Crown.	Total.
½ inch........	31	...	...	...	..	31	2	...	...	...	...	...	2	33	1	1	....	....
¾ "	55	23	...	...	...	78	25	2	...	...	...	...	27	105	...	...	....	....
1 "	83	...	1	...	16	100	51	...	1	...	...	9	61	161	...	...	4	4
1½ "	35	4	...	16	...	55	57	...	...	9	1	2	69	124	1	1	8	8
2 "	33	...	...	...	1	34	103	...	...	...	...	1	104	138	2	2	7	7
3 "	20	...	...	...	...	20	22	...	...	...	...	3	25	45	...	...	2	2
4 "	6	...	...	...	...	6	13	...	...	...	...	...	13	19	2	2	1	1
6 "	...	...	...	...	..	......	4	...	...	...	...	...	4	4	...	...	.. ...	....
Totals.....	263	27	1	16	17	324	277	2	1	9	1	15	305	629	6	6	22	22

Style of Meter.	Removed.				In use December 31, 1886.							Repaired.				In stock December 31, 1886.					
	Crown.	Keystone.	Union.	Total.	Crown.	Keystone.	Equitable.	Union.	Marsland.	Worthington.	Total.	Crown.	Union.	Worthington.	Total.	Crown.	Keystone.	Equitable.	Union.	Worthington.	Total.
½ inch........	...	...	...	...	3	...	...	...	...	...	3	...	...	...	......	30	...	...	...	...	30
¾ "	2	1	...	3	23	1	...	...	...	...	24	3	...	...	3	57	24	...	...	...	81
1 "	14	...	...	14	41	...	1	...	...	9	51	10	...	...	10	93	...	1	...	16	110
1½ "	9	...	3	12	57	...	...	6	1	2	66	14	2	...	16	35	4	...	19	...	58
2 "	15	...	...	15	97	...	...	...	...	1	98	40	...	1	41	39	...	...	...	1	40
3 "	2	...	...	2	22	...	...	...	...	3	25	11	...	6	17	20	...	...	...	...	20
4 "	2	...	...	2	14	...	...	...	...	...	14	11	...	...	11	5	...	...	...	...	5
6 "	1	...	...	1	3	...	...	...	...	...	3	5	...		5	1	...	..	...	...	1
Totals.....	45	1	3	49	260	1	1	6	1	15	284	91	2	7	103	280	28	1	19	17	345

NOTE.—The one ¾-inch Keystone and two 1½-inch Worthington meters are private meters.

APPENDIX E.

REPORT

ON THE

OPERATIONS OF THE SHOP

DURING 1886.

PHILADELPHIA WATER DEPARTMENT.
CHERRY STREET SHOP.

January 17, 1887.

JOHN L. OGDEN,
Chief Engineer.

SIR:—I respectfully submit the Annual Report of the operations of the Cherry Street Shop, for the year ending December 31, 1886.

Respectfully,
W. F. COURTNEY,
Superintendent.

MERCHANDISE.	DR.	
To Stock on hand January 1, 1886	$6,936	19
Bolts and nuts	1,877	99
Bricks and lime	831	35
Brass fittings	857	20
Brass castings, 36,407 lbs	4,60[illegible]	85
Chandlery	106	45
Castings, iron, 968,046 lbs	16,134	11
Coke, 160 bushels	12	00
Coal, 165 tons	926	25
Galvanizing, 10,110½ lbs	404	42
Gum goods	6,337	01
Hardware	387	63
Ice	4	42

Iron, wrought, 73,217 lbs	1,544 04
Lumber, 64,068 feet	1,718 82
Machinery	1,283 80
Miscellaneous	2 00
Oils and tallow	92 01
Paints and oils	76 99
Stationery	42 40
Steel, 5,102½ lbs	700 38
Tickets	90 00
Wrought iron fittings	133 09
Distribution	10 40
Wages	30,967 54
	$75,078 34

Merchandise. Cr.

By repairs and supplies First District	$16,180 25	
" " " Second "	11,040 03	
" " " Third "	15,306 54	
" " " Fourth "	14,634 63	
" " " Fifth "	2,393 50	
" " " Sixth "	4,636 27	
		$64,191 22

Fairmount Pumping Station.

By repairs to machinery	$1,176 24	
" " buildings and grounds	277 09	
		1,453 33

Spring Garden Pumping Station.

By repairs to machinery	$1,148 97	
" " boilers	539 44	
" " buildings and grounds	227 13	
		1,915 54
By supplies to store house	78 96	
		78 96

Belmont Pumping Station.

By repairs to machinery	504 96	
repairs to boilers	287 06	
repairs to buildings and grounds	96 14	
		888 16

Roxborough Pumping Station.

By repairs to machinery	$1,465 85	
repairs to boilers	99 55	
repairs to buildings and grounds	14 21	
		1,579 61

Chestnut Hill Pumping Station.

By repairs to machinery	$272 13	
		272 13

Mt. Airy Pumping Station.

By repairs to machinery	$16 22	
repairs to boilers	5 51	
		21 73

Frankford Pumping Station.

By repairs to machinery	$737 55	
repairs to boilers	52 82	
repairs to buildings and grounds	98.76	
		889 13

Kensington Pumping Station.

By repairs to machinery	$165 11	
repairs to boilers	63 37	
repairs to buildings and grounds	43 29	
		271 77

Main Office.

By supplies and repairs	$95 75	
		95 75

Cherry Street Shop.

By supplies and repairs	$357 70	
		357 70

General Buildings and Grounds.

By supplies (Lehigh Avenue Basin)	$6 81	
supplies (Cherry Street Shop)	4 20	
		11 01
By supplies and labor (New Shop)	$6,444 01	
		6,444 01

Water Meters.

By supplies and repairs	$120 73	
		120 73

Fixed Patterns.

By supplies and repairs	$523 62	

Distribution.

By supplies and labor	$663 77	
		663 77

Ferrules.

By labor on corporation cocks	$46 11	
		46 11

Old Metals.

By sales	$589 22	589 22

Inspection and Surveys.

By repairs	$18 13	18 13

Machinery.

By supplies, repairs and labor	$1,599 20	1,599 20
		$82,030 38
By stock on hand January 1, 1887		11,567 76
Cr		$93,598 59
Dr		75,078 34
Balance to Cr		$18,520 25

INVENTORY, JANUARY 1, 1887.

4	4-inch stop cocks, at $22 00	$88 00	
18	6-inch " " 25 00	450 00	
6	10-inch " " 40 00	240 00	
5	12-inch " " 45 00	225 00	
2	16-inch " " 60 00	120 00	
2	36-inch " " 360 00	720 00	
			$1,843 00
6	8-inch O. S. stop screws, at $3 25	$19 50	
7	10-inch " " " 4 50	31 50	
11	12-inch " " " 5 00	55 00	
12	16-inch " " " 6 50	78 00	
12	20-inch " " " 8 25	99 00	
3	36-inch " " " 22 00	66 00	
			349 00
14	4-inch N. S. square-top stop screws, at $2 25	$31 50	
22	6-inch " " " " " 2 50	55 00	
14	10-inch " " " " " 4 50	63 00	
6	12-inch " " " " " 5 00	30 00	
4	16-inch " " " " " 6 50	26 00	
3	20-inch " " " " " 8 25	24 75	
8	30-inch " " " " " 10 25	82 00	
1	36-inch " " " " " 22 00	22 00	
8	Barton stop screws, bonnets, etc, at $8	64 00	
			398 25

25	3-inch socket screws, at $1 50	$37 50	
29	4-inch " " 1 50	43 50	
58	6-inch " " 1 75	101 50	
11	8-inch " " 2 00	22 00	
16	10-inch " " 2 25	36 00	
22	12-inch " " 2 50	55 00	
			295 50
17	4-inch spindles, at $1 50	$25 50	
10	6-inch " " 1 75	17 50	
8	8-inch " " 2 00	16 00	
12	12-inch " " 2 50	30 00	
16	16-inch " " 3 00	48 00	
			137 00
3	4-inch iron bands at $2 15	$6 45	
5	6-inch " " 2 15	10 75	
3	12-inch " " 7 50	22 50	
5	16-inch " " 10 00	50 00	
			89 70
19	pairs stop monkey legs, W. I., at $1 50	$28 50	
59	" " " " C. I., " 3 25	191 75	
6	cross heads and nuts, " 2 50	15 00	
211	wood plugs, " 50	105 50	
			340 75
1	No. 1 fire hydrants	$26 00	
15	No. 2 " " at $33 00	495 00	
3	No. 3 " " " 34 25	102 75	
50	4-inch plug nuts, at 25 cts	12 50	
5	6-inch top caps, at 65 cts	3 25	
77	frost rods and valves, at 57 cts	43 89	
66	top ends, No. 1 valve rods, at 60 cts	39 60	
35	" " Nos. 2 and 3 valve rods, at 60 cents	21 00	
2	6-inch valve rods, at $1 50	3 00	
274	4-inch gum valves, at $2 25	616 50	
490	6-inch " " " 5 00	2,450 00	
151	gooseneck gaskets, 75½ lbs., at 96 cts. per lb	72 48	
14	lbs. gum washers, at 96 cts. per lb	13 44	
305	gum gaskets for top caps, 15 lbs., at 96 cts. per lb.	14 40	
			$3,913 81
762	lbs. iron forgings, at 8 cts	60 96	
2,521	lbs. finished brass castings, at 30 cts	756 30	
6	hydrant keys, at $2 25	13 50	
4	caulking tools, at 50 cts	2 00	
15	gouge chisels	7 60	

25	cutter chisels	17 55	
110	flat chisels, at 35 cts	38 50	
12	stub end straps, at $8 00	96 00	
217	brass ferrule plugs, at 50 cts	108 50	
			$1,100 91
1	street key	$5 00	
10	pairs hook bolts, at 15 cents	1 50	
8	8-inch stop valves, with rings, at $1 75	14 00	
12	8-inch stop sides, with rings, at $2 30	27 60	
6	large lead pots, at $4 00	24 00	
6	medium lead pots, at $2 50	15 00	
6	small lead pots, at $1 35	8 10	
40	flushing nozzles, at $1 70	68 00	
5	brass reducers for fire hydrants, at $2 25	11 25	
3	reducing caps for pressure gauges, at $1 75	5 25	
1	1½-inch brass lever Ludlow valve	6 80	
100	frost valves, at 30 cts	30 00	
40	lbs. ⅛-inch sheet gum, at 44 cts	17 60	
45	clevises, at 75 cts. per dozen	2 81	
66	stop and plug monkey keys	2 32	
105	lbs. Babbitt metal, at 20 cts	21 00	
			$260 23
	Chandlery	$13 95	
2,943	feet lumber	169 89	
23,898	lbs. wrought bar iron, at 2½ cts	597 45	
3,893	lbs. steel	531 89	
4,999	lbs. brass castings, unfinished, at 12 cts	599 88	
	Paints and oils	9 02	
	Oils and tallow	5 57	
	Bolts, nuts, washers, rivets	417 40	
	Hardware	188 21	
18,381	lbs. iron castings, at 1⅝ cts	$306 35	
			$2,839 61
			$11,567 76

MANUFACTURED.

22	4-inch stop cocks, at $22.00	$484 00
731	6-inch " " " 25.00	18,275 00
12	8-inch " " " 30.00	360 00
63	10-inch " " " 40.00	2,520 00
65	12-inch " " " 45.00	2,925 00
20	16-inch " " " 60.00	1,200 00

20	20-inch stop-cocks, at 95.00	1,900 00	
12	30-inch " " " 189.00	2,268 00	
8	36-inch " " " 360.00	2,880 00	
			$32,812 00
39	10-inch socket screws at $2.25	$87 75	
75	12-inch " " " 2.50	187 50	
1	14-inch " "	3 00	
2	16-inch " " at $3.00	6 00	
			284 25
21	4-inch N. S. stop screws, at $2.25	$47 25	
105	6-inch " " " " 2.50	262 50	
3	10-inch " " " " 4.50	13 50	
1	16-inch " " "	6 50	
1	20-inch " " "	8 25	
1	30-inch " " "	10 25	
1	36-inch " " "	22 00	
11	Barton stop screws, bonnets, etc., at $8.00	88 00	
12	6-inch spindles, at $1.50	18 00	
12	10-inch " " 2.25	27 00	
			503 25
10	cross heads, at 75 cts	$7 50	
12	stop nuts, at $2.00	24 00	
19½	dozen stop monkey keys, at 25 cents	19 13	
143	stop monkey legs, C. I., at $1.50	215 50	
31	" " " W. I., at $3.25	100 75	
927	frames and covers, 176,130 lbs., at .01⅔	2,935 50	
107	hat flanges	296 90	
			3,599 28
122	N. S. 4-inch No. 1 fire hydrant, at $26.00	$3,172 00	
382	" 6-inch No. 2 " " " 33.00	12,606 00	
122	" 6-inch No. 3 " " " 34.25	4,178 50	
49	O. S. casings, at $5.00	245 00	
129½	dozen S. hooks, at 75 cts per dozen	97 13	
63½	" clevises, at 75 cts "	47 56	
74	" plug monkey keys, at 25 cts. per dozen	18 50	
38	risers at $2.00	76 00	
8	valve rods, at 75 cts	6 00	
7	frost rods, at 75 cts	5 25	
			20,451 94
35	wrenches, at $1.75	$61 25	
8	fish traps, at $5.25	42 00	
6	pressure caps, at $1.75	10 50	
12	reducing caps for fire hydrants, at $2.25	27 00	

30	crow bars, at $1.15	34 50	
122	caulking and gasket irons, at 60 cents	73 20	
265	cutting chisels, at 60 cents	159 00	
			$407 45
			$58,058 17

33	4-inch iron bands,	at $2	15	$70 95	
161	6-inch "	" 2	15	346 15	
27	8-inch "	" 4	00	108 00	
29	10-inch "	" 5	00	145 00	
37	12-inch "	" 7	50	277 50	
20	16-inch "	" 10	00	200 00	
1	18-inch "	" 10	00	10 00	
14	20-inch "	" 10	50	147 00	
2	22-inch "	" 11	00	22 00	
2	36-inch "	" 20	00	40 00	
					1,366 60

530	flat and cape chisels,	at $	35	185 50	
75	gouge chisels,	"	60	45 00	
1,027	wood plugs,	"	50	513 50	
163	iron plugs,	"	50	81 50	
31	large lead pots,	" 4	00	124 00	
16	medium "	" 2	50	40 00	
26	small "	" 1	35	35 10	
6	hydrant keys,	" 2	25	13 50	
8	stop keys,	" 5	00	40 00	
233	brass ferrule plugs,	"	50	166 50	
6	furnaces, complete,	" 14	30	85 80	
6	" grates,	" 6	75	40 50	
16	caulking hammers,	" 1	00	16 00	
6	sledge "	" 2	25	13 50	
373	wedges,	"	50	186 50	
					1,586 90
					$61,011 67

Stop-cocks, Frames and Covers, Fire Hydrants, Cases, etc., delivered from Cherry Street Shop during 1886, to the Purveyors' Districts, Works, etc.

Districts.	Stop-Cocks.									Fire Hydrants.					Frames and Covers.	Brass Ferrule Plugs.	Lead Pots.	Hat Flanges.
	4-inch.	6-inch.	8-inch.	10-inch.	12-inch.	16-inch.	20-inch.	30-inch.	36-inch.	Old Style.	No. 1.	No. 2.	No. 3.	O. S. Cases.				
First	4	171	12	24	12	4	5	1	3	......	12	118	17	6	310	......	11	13
Second	5	148	......	1	10	......	......	......	......	1	21	83	23	28	142	109	10	55
Third	5	215	......	26	33	......	......	......	......	......	45	81	27	3	215	54	13	34
Fourth	2	82	......	6	5	12	15	10	3	1	9	49	48	7	193	60	17	4
Fifth	2	41	......	......	......	......	......	1	......	......	10	12	1	2	52	24	2	......
Sixth	......	59	......	......	......	2	......	......	......	1	23	23	2	6	25	6	2	1
Distribution	......	......	......	....	......	......	......	......	......	......	1	1	1					
	18	716	12	57	60	18	20	12	6	3	121	367	119	52	927	253	36	107

Stop-cocks, Frames and Covers, etc.—*Continued.*

Districts.	Furnaces.	Furnace Grates.	Iron Bands.									Plugs.		Keys.		Gasket Irons.	Caulking Tools.	Crowbars.
			4-inch.	6-inch.	8-inch.	10-inch.	12-inch.	16-inch.	18-inch.	20-inch.	36-inch.	Iron.	Wood.	Hydrant.	Street.			
First	1	1	......	13	......	1	1	......	......	......	......	......	298	......	......	6	16	6
Second	1	1	......	21	9	1	1	......	......	......	......	88	270	......	4	1	4	6
Third	1	1	......	72	18	12	6	......	1	1	......	17	197	......	1	6	89	24
Fourth	1	1	36	60	......	5	12	12	......	20	2	5	284	......	2	12	84	
Fifth	1	1	......	6	......	......	......	......	......	......	......	......	12	......	......	3	8	
Sixth	1	1	......	12	......	10	12	12	......	......	......	6	38	......	......	......	4	
Distribution	......	......	......	......	......	......	3	1	......	......	......	1	....	8	......	......	2	
	6	6	36	184	27	29	35	25	1	21	2	117	1,099	8	7	28	207	36

Stop-Cocks, Frames and Covers, etc.—*Continued.*

Districts.	Stop Screws.						Caps.						Stop.					
	4-inch.	6-inch.	10-inch.	12-inch.	16-inch.	36-inch.	Barton.	Pressure.	Reducing.	Caulking Hammers.	Water Traps.	Fish Screens.	Monkey Legs, C. I.	Monkey Legs, W. I.	Cross Heads.	Nuts.	Spindle Keys.	Spindles.
First	......	13	....	....	....	......	......	......	2	......	......	......	55	6	......	12		
Second	7	16	2	1	1	......	10	1	2	6	......	......	13	6	25	27	60	19
Third	......	26	....	....	......	......	......	1	2	6	......	......	7	6	19	6	48	6
Fourth	30	27	....	2	......	1	1	1	1	......	......	......	31	30	36	13	48	24
Fifth	......	6	....	....	......	......	......	......	......	......	......	......	......	......	......	......	12	
Sixth	......	......	....	....	......	......	......	......	......	2								
Distribution	......	......	....	....	......	......	......	......	......	1								
Meters	......	......	....	....	......	......	......	......	......	......	8	12						
	37	88	2	3	1	1	11	3	7	15	8	12	106	48	80	58	168	49

List of Articles delivered Purveyors' Districts, 1886—*Continued.*

Districts.	Gate Chisels.	Wrenches.	Plug Valve Rods.	Plug Frost Rods.	S. Hooks.	Clevises.	Plug Monkey Keys.	Chisels.					Monkeys.	Wedges.
								Flat.	Cape.	Cutter.	Gouge.	Risers.		
First	......	3	1	1	252	164	78	121	......	100	24	......	4	39
Second	......	3	3	......	364	132	230	72	......	67	......	4	8	18
Third	10	5	......	......	564	120	264	72	......	50	18	......	8	25
Fourth	......	7	6	6	288	288	242	72	....	72	......	3	15	14
Fifth	......	3	......	......	24	......	48	24	......	24	6	2	......	12
Sixth	......	1	......	......	60	12	24	24	......	15	12	8	......	24
Distribution	......	3												
Works	......	5	......	......	......	......	......	37	23	10	......	......	......	241
Meters	......	5												
	10	35	10	7	1,552	716	886	422	23	338	60	17	35	373

PURCHASED ARTICLES SUPPLIED TO DISTRICTS, WORKS, ETC.

202	gallons headlight oil, at $11\frac{1}{4}$ cts. per gallon	$22 73
68	" lubricating oil, at $12\frac{1}{2}$ cts. per gallon	8 50
11	" lard oil, at 54 cts. per gallon	5 94
531	doz. bolts and nuts, at 75 cts. per doz	398 25
700	lbs. washers, at 6 cts per lb	42 00
66	6-inch gum joint rings, at 60 cts	39 60
40	lbs. rivets, at 8 cts. per lb	3 20
60	files, at 50 cts	30 00
24	4-inch rubber valves, at $2 25	54 00
5	6-inch " " " 5 00	25 00
6	frost valves, at 30 cts	1 80
$2\frac{1}{2}$	doz. sledge handles, at 85 cts. per doz	2 13
$4\frac{2}{3}$	doz. hammer handles, at 45 cts. per doz	2 10
284	gland bolts, at 10 cts	28 40
104	O. S. joint rings, at 50 cts	52 00
		$715 65

APPENDIX F.

REPORT OF JOHN E. CODMAN,

CHIEF DRAUGHTSMAN.

PHILADELPHIA WATER DEPARTMENT.

February 24, 1887.

MR. JOHN L. OGDEN,
Chief Engineer.

SIR:—The following report of work under my charge during the year 1886 is respectfully submitted.

The urgent demand for new boilers to supply the places of a number worn out and unsafe, the variety of forms, varying degrees of economy and expense, and maintenance of those at present in use in the department, led to directions being given to make efficiency tests with a view of adopting a better form for new boilers to meet the requirements of the department.

Tests were made of the plain cylinder boilers at Belmont on February 10 and 11, 1886; the results have been published in the last annual report, for the year 1885.

Calorimetrical tests were made of the double-decked boilers at the Spring Garden station April 20, 21, and 22, and of the marine boilers May 3, 5, and 6, 1886; the results obtained are given in the annexed table, "Calorimetrical Tests of Boilers."

An efficiency and capacity test of the double-decked boilers at the Belmont station was made on October 27 and 28, 1886; the results are given in the table "Efficiency and Capacity Tests of Double-decked Boilers at the Belmont Pumping Station."

A drawing is also presented showing the setting of boilers, waterline, flues, etc. The table is divided into four periods of time. The first column shows the results for the whole twenty-four hours; the second column shows the results for sixteen hours, with 5½ inches of water in the upper drum measured from the bottom of the drum; the third column shows the results for eight hours, with 12½ inches of water in upper drum; the fourth column shows the results for the six hours immediately following the eight hour run, with 5½ inches of water in upper drum. The difference in water level was not as much as is sometimes carried in this class of boilers, but enough data was obtained to show that economy of fuel and steam laid in the direction of using the upper drum for superheating.

The plain tubular boilers in use at Mt. Airy, Roxborough, Chestnut Hill, and Department Machine Shop were tested for efficiency and capacity at Mt. Airy station on November 16 and 17, 1886. This form of boilers gives a very good quality of steam. The general results are above the average and very satisfactory. Drawings of these boilers are presented, showing setting, flues, etc. The results obtained are given in the table "Efficiency and Capacity Test of Tubular Boilers at Mt. Airy Pumping Station."

From the data collected, a form of boiler was designed to meet the requirements of the Department for dry steam, facilities for cleaning, accessibility to all parts for repairs, economy in fuel and space, and cost of construction. A complete set of working drawings was prepared, bids advertised for, and the contract awarded to Messrs. I. P. Morris & Co., for seven boilers at a cost of about $2,000 less per boiler or $1.50 less per square foot of heating surface than was paid for the marine boilers at the Spring Garden and Frankford stations.

The bids offered by the Water Tube Boiler representative, which were apparently so much below the cost of the Department boilers, can perhaps be accounted for by the following comparison:

The two boilers offered were rated at 120 H. P. each, or 240 H. P. for two of the following dimensions: "each boiler is to be composed of seven sections or slabs, each section to be composed of nine best lap-welded wrought iron boiler tubes four inches in diameter and eighteen feet long;" "steam and water drums 36 inches diameter;" "mud drums 18 inches diameter." These boilers contained about 973 square feet of heating surface each, and it was intended to develop one H. P. from 8.1 square feet. The published tests of this class of boilers show that from 10 to 12½ square feet of heating surface are required to develop one H. P. by the evaporation of 30 lbs. of water per hour from a temperature of 100 F. to steam of 70 lbs. gauge pressure.

In an article in the "Engineer" the writer says that "the water tube boiler will not, space for space, make more than 60 per cent. of the steam that an ordinary marine boiler will;" then, if 40 per cent. more heating surface and 40 per cent. more efficiency were required to compare with the marine boilers, it is clearly seen that the water tube boiler, as offered to the Department, was the most expensive even in first cost. The experience with a water tube boiler in use for some years at the Roxborough Pumping Station was very unsatisfactory. The estimated capacity of the boiler was more than it should properly have been called upon to perform; consequently the tubes were often found filled up with scale, causing frequent and costly repairs.

The annexed table of tests made by William Kent, M. E., May, 1884, at the Augustine Paper Mills, Wilmington, Delaware, furnished the Department by Pusey, Jones & Co., of Wilmington, shows the results obtained with a water tube boiler and an ordinary plain tubular boiler.

The two furnace flue tubular boilers contracted for with Messrs. I. P. Morris & Co., for the Roxborough station, were delivered and set upon the foundations by the contractor on

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December 6, 1886. All the steam, feed, blow-off, etc., connections were made by the Department to the present steam pipe. The specifications required the contractor to cover the boilers with some first-class covering, to be approved by the Chief Engineer. The material selected is composed of asbestos and some cementing material, and is applied to the boilers when under steam. It presents a neat and finished appearance, adheres closely to the boilers on sides and ends, and is an almost perfect non-conductor. A capacity test of these boilers was made February 18 and 19, 1887. The results obtained are very satisfactory, and show that the conclusions arrived at in the design were correct. The quality of the steam, .9864, is above the average obtained for boilers without any super-heating surface. The boilers were estimated by heating surface at 80 H. P. each. The results obtained from the two boilers of 160 H. P., by the evaporation of 30 pounds of water from 100 degrees F. into steam of 70 pounds gauge pressure, were 230 H. P., or 44 per cent. above the rated capacity, and at the same time gave an economic evaporation of 11.02 pounds of water from and at 212 F. per pound of combustible. The results obtained from these boilers are given in the table "Efficiency and Capacity Test of the Furnace Flue Tubular Boilers at Roxborough Station, February 18 and 19, 1887." A drawing is also presented, showing the arrangement of furnace flues, smoke boxes, gas flue, etc.

The five boilers for the Spring Garden station were placed upon the foundations by the contractors, February 14, 1887. Coupons from 55 of the steel plates used in constructing the Spring Garden boilers and 24 from the plates used in the Roxborough boilers, were tested for strength of material under the inspection of James H. Hand, with the following results:

Brand of steel, Park Bros. Black Diamond.

Average tensile strength per square inch	55,936 lbs.
Average limit of elasticity per square inch	36,150 lbs.
Average elongation in 8 inches	1.79 in.
Average per cent. of elongation in original length	22.35
Average per cent. in reduction of area	61.36

The attached strain diagram shows graphically the average results obtained from the tests of the material.

One sample of the double riveted seams was sent to the United States Arsenal, Watertown, Mass., for testing. The results obtained are shown on the accompanying drawing and table for both steel and iron plate.

Specifications and plans for rebuilding one of the brick stacks at the Spring Garden station were prepared in the Department and bids advertised for. Thomas Gamon contracted to rebuild it for the sum of $2,475. Work was begun November 1, 1886. Some delay was occasioned by the storm of November 18, 1886, in which the scaffolding was blown down. The work was completed on December 18, 1886.

During the year, 93 drawings of machinery, plans, etc., were made, some of them involving a large amount of work. A number of blue prints have been received from outside parties, showing the location of conduits, sewers, railroad tracks, etc., and placed on file; one blue print from the Holly Manufacturing Company, Lockport, N. Y., showing plan of new engine.

I am, respectfully,

JOHN E. CODMAN,

Chief Draughtsman.

Results of the Trials of two regular 120 Horse-power Water-tube Boilers and two Tubular Boilers at Wilmington, Delaware, to Determine Efficiency and Capacity.

		Water tube.	Tubular.
Date of trial	May, 1884.		
Duration of trial	Hours	24	23
Dimensions and Proportions.			
Number in use		2	2
Diameter of boilers	Feet		5
Length of boiler	Feet		16
Numbers of furnaces		2	1
Type of furnaces		Brick.	Brick.
Number of tubes in each boiler			44
Diameter of tubes	Inches		4
Length of tubes	Feet		16
Total heating surface in two boilers	Square feet	2,760	2,024
Total tube cross section area	Square feet		3.36
Ratio of tube cross section to grate surface			1 to 8
Grate surface water tube, 4 ft. 5 in.; tubular, 10 ft. 10 in.; wide, water tube, 7 ft.; tubular, 5 ft	Square feet	61.9	54.2
Water heating surface	Square feet	2,760	2,024
Ratio of water heating surface to grate surface		44.6 to 1	37.3 to 1
Average Pressures.			
Steam pressure in boiler by gauge	Pounds	76	74.8
Absolute steam pressure	Pounds	90.68	89.48
Atmospheric pressure per barometer	Inches	29.96	29.96
Force of draught in inches of water	Inches	0.16	0.26
Average Temperatures.			
Of escaping gases	Degrees Fah.	336	500
Of feed water	Degrees Fah.	126.1	127.4
Fuel.			
Total amount of coal consumed	Pounds	16,181	15,233
Kind of fuel used	Wm. Penn Schuylkill anthracite egg.		
Total refuse, dry, in pounds	Pounds	1,871	1,519

Results of the Trials of two 120 Horse-power Water-tube Boilers—*Continued.*

		Water tube.	Tubular.
FUEL—*Continued.*			
Total combustible (dry weight of coal, less refuse).	Pounds.........	14,310	13,714
Per cent. of ash...	....	11.61	9.98
Combustible consumed per hour............................	Pounds.........	596.2	596.2
RESULTS OF CALORIMETRIC TESTS.			
Percentage of moisture in steam..........................	Per cent.......	1.69	1.02
WATER.			
Total weight of water pumped into boiler, and apparently evaporated..	Pounds.........	133,211	137,363
Water evaporated into steam per hour..................	Pounds.........	5,550	5,972
ECONOMIC EVAPORATION.			
Water actually evaporated, per pound of coal, from actual pressure and temperature...............	Pounds.........	8.233	9.018
Equivalent water evaporated, per pound of coal, from and at 212° F..	Pounds.........	9.254	10.127
Equivalent water evaporated, per pound of combustible, from and at 212° F............................	Pounds.........	10.467	11.249
RATE OF COMBUSTION.			
Coal actually burned per square foot of grate surface per hour..	Pounds.........	10.89	12.25
RATE OF EVAPORATION.			
Water evaporated per square foot of heating surface per hour..	Pounds.........	2.011	2.95
COMMERCIAL HORSE-POWER.			
Horse-power developed from 212° F. of feed, and 70 pounds pressure...	....	201.3	216.1
Horse-power, builders' rating, at 11½ square feet per horse-power...	....	240	176
Per cent. developed above or below, rating............	....	Below, 16.1	Above, 22.8

Table showing Results of Calorimetric Tests of Three Different Forms of Boilers at the Spring Garden and Belmont Pumping Stations, 1886.

Description of boilers	Marine Tubular.			Double-deck Tub'r.			Cylinder.
Location "	Spring Garden.			Spring Garden.			Belmont.
Number of boilers in use	10			5			8
Diameter of boilers in feet	11½			6			4½
Number of tubes in each boiler	188 (3 in.)			92 (4 in.)			
Square feet of fire surface (total)	1,360 (8.7 per ct.)			720 (10.5 per ct.)			4,000
Square feet of tube " "	14,150			6,135			
Total heating surface	15,510			6,855			4,000
	May, 1886.			April, 1886.			Feb., 1886.
Date of tests	3d.	5th.	6th.	20th.	21st.	22d.	10th.
Number of tests each day	9	8	18	16	16	6	16
Highest steam pressure by gauge	58	56	58	58	55	56	43
Lowest " " "	53	53	54	47	51	51	40
Average " " "	56	54½	55	53½	53	54	41½
Height of water in upper drum	....	....	....	12 to 5	12 to 8	11 to 9	
Average temperature of feed-water to boilers	120 F.	120	120	140	140	140	113¼
Average temperature of feed-condensing water	66	70	70	68	69	69	43
Average temperature of external air	60	72	61	65	54	66	40.8
Pounds of steam taken from boilers per hour, measured from indicator card	....	19,980	20,880	....	6,350		
Pounds of steam taken from boilers per hour, measured by water actually weighed and pumped into boilers	....	....	....	....	....	....	19,657
Pounds of steam per square foot of heating surface (per hour)	....	1.29	1.35	....	.92	....	4.9
Horse-power developed from indicator card	....	832	889	....	391		
Pounds of steam per horse-power per hour	....	24	23½	....	16.1		
Pounds of coal burned per hour	....	3,170	3,358	....	1,270	....	3,063
Pounds of coal per square foot of grate surface per hour	....	7.54	8.00	....	7.5	....	15.32
Pounds of water evaporated per pound of coal from actual pressure and temperature	....	6.3	6.2	....	5.00	....	6.15
Average per cent. of moisture in steam for each day	7.3	6.05	7.4	5.75	4.62	3.62	4.05
Average per cent. of moisture in three days	....	6.91	....	....	4.66	....	4.05

Table showing results of Calorimetric Tests of Boilers—*Continued.*

Comparison of Results between Marine and Double-deck Boilers.

Difference in faver of double-deck boiler in quality of steam	2.25	per cent.
Difference in favor of marine boiler in economic evaporation in pounds	1.25	
Less 2.25 per cent. for moisture in steam, pounds	1.22	
Per cent. in favor of marine boiler in economic evaporation	2.4	per cent.
Difference in favor of marine boiler in water evaporated per square foot of heating surface, in pounds 0.4	4.3	per cent.

NOTE.—Same quality and size of coal used under all the boilers during the tests.

Results of the Trials of 4 (Nos. 9, 10, 11, and 12) Double-decked Tubular Boilersat Belmont Pumping Station, to Determine Efficiency and Capacity.

Date of trial, Oct. 27 and 28, 1886					
Duration of trial	Hours	24	16	8	6
Height of water in glass gauges	Inches		5.5	12	5.2
DIMENSIONS AND PROPORTIONS.					
Type of boilers—double-decked tubular					
Number in use		4	4	4	4
Diameter of boilers	Inches	72			
Length of boilers	Feet	12			
Numbers of furnaces		4			
Width of furnace	Feet	6′ 5″			
Length of furnace	Feet	5			
Number of tubes in each boiler		86			
Diameter of tubes	Inches	4			
Length of tubes	Feet	12			
Diameter of drum	Feet	4			
Length of drum	Feet	14			
Heating surface in one boiler	Sq. feet	1,381			
Heating surface of furnace	Sq. feet	144			
Tubes	Sq. feet	1,147			
Under drum	Sq. feet	80			
Total heating surface in 4 boilers	Sq. feet	5,484			
Total tube cross section area	Sq feet	7.5			
Ratio of tube cross section to grate surface		1 to 4			
Height of stack		100			
Area of stack at base	Sq. feet	25			

Results of the Trials of four Double-decked Tubular Boilers—*Continued.*

Grate surface 6 ft. 5 in. wide, 5 ft. long, 32 ft. area; 4 furnaces	Sq. feet...	128			
Water-heating surface	Sq. feet...	5,484			
Ratio of water-heating surface to grate surface	....	43 to 1			
AVERAGE PRESSURES.					
Steam pressure in boiler by gauge	Pounds...	51.14	51.2	50.98	52.8
Absolute steam pressure	Pounds...	65.84	65.9	65.68	67.5
Atmospheric pressure per barometer...	Pounds ..	29.975	29.975	29.975	29.975
Force of draught in inches of water...	Inches...	0.308	0.308	0.308	0.308
AVERAGE TEMPERATURES.					
Of external air	Fahr......	54.22	54.80	54	52
Of fire room	Fahr......	64.7	66.00	64.00	63.00
Of steam	Fahr......	330.64	330.7	330.48	332.2
Of escaping gases	Fahr	374.8	377.0	370.0	372.0
Of feed water	Fahr......	104.4	103.4	106.3	107.53
FUEL.					
Total amount of coal consumed	Pounds...	52,869	36,173	16,696	12,990
Moisture in coal	Per cent.	2.56	2.56	2.56	2.56
Dry coal consumed	Pounds...	51,516	35,244	16,272	12,657
Total refuse dry, per cent., 15.7	Pounds...	8,098	5,538	2,560	1,987
Total combustible (dry weight of coal, less refuse)	Pounds...	43,416	29,706	13,712	10,670
Dry coal consumed per hour	Pounds...	2,146	2,214	2,034	2,109
Combustible consumed per hour	Pounds...	1,809	1,866	1,714	1,778
RESULTS OF ANEMOMETER READINGS.					
Cubic feet of air per hour	....	381,456			
" " " " per sq. foot of grate	....	2,980			
Pounds of air per pound of coal	....	13.54			
" " " of combustible	....	16.14			
RESULTS OF CALORIMETRIC TESTS.					
Quality of steam, dry steam being taken as unity	....	.9263	.9355	.92	.9332
Percentage of moisture in steam	Per cent.	7.37	6.45	8.	6.68
Factor of evaporation	....	1.139	1.141	1.138	1.137

Results of the Trials of four Double-decked Tubular Boilers—*Continued.*

WATER.					
Total weight of water pumped into boiler and apparently evaporated......	Pounds...	386,488	258,258	128,230	96,046
Water actually evaporated, corrected for quality of steam........................	Pounds...	358,004	241,600	117,972	89,630
Equivalent water evaporated into dry steam from and at 212° F..................	Pounds...	407,766	275,665	134,252	101.909
Equivalent total heat derived from fuel in British thermal units............	....	394,162,404			
Equivalent water evaporated into dry steam from and at 212° F. per hour...	Pounds...	16,990	17,229	16,781	16,985
ECONOMIC EVAPORATION.					
Water actually evaporated per pound of dry coal from actual pressure and temperature....................................	Pounds...	6.95	6.85	7.25	7.08
Equivalent water evaporated per pound of dry coal from and at 212° F..........	Pounds...	7.91	7.81	8.25	8.05
Equivalent water evaporated per pound of combustible from and at 212° F....	Pounds...	9.38	9.28	9.79	9.55
COMMERCIAL EVAPORATION.					
Equivalent water evaporated per pound of dry coal, with one-sixth refuse, at 70 pounds gauge pressure, from temperature 100° F. = last item ("Economic Evaporation") multiplied by 0.7249.	Pounds...	6.80	6.72	7.09	6.92
RATE OF COMBUSTION.					
Dry coal actually burned per sq. foot of grate surface per hour.................	Pounds...	16.7	17.2	15.9	16.5
Consumption of dry coal per hour—coal assumed with one-sixth refuse—per square foot of grate surface........	Pounds...	17.0	17.5	16.0	16.6
Consumption of dry coal per hour—coal assumed with one-sixth refuse—per square foot of water-heating surface...	Pounds.	0.40	0.41	0.37	0.39
Consumption of dry coal per hour—coal assumed with one-sixth refuse—per sq. foot of least area for draught.	Pounds...	135	140	129	133.5
RATE OF EVAPORATION.					
Water evaporated from and at 212° F. per square foot of heating surface per hour.	Pounds...	3.1	3.2	3.1	3.1
Water evaporated per hour from temperature of 100° F. into steam of 70 lbs. gauge pressure per square foot of grate surface....................................	Pounds...	116	117	114	115

Results of the Trials of four Double-decked Tubular Boilers—*Continued.*

Water evaporated per hour from temperature of 100° F. into steam of 70 lbs. gauge pressure per square foot of water-heating surface	Pounds...	2.7	2.53	2.66	2.52
Water evaporated per hour from temperature of 100° F. into steam of 70 lbs. gauge pressure per square foot of least area for draught	Pounds...	923	937	912	928
COMMERCIAL HORSE-POWER.					
On a basis of 30 lbs. of water per hour evaporated from temperature of 100° F. into steam of 70 lbs. gauge pressure (= $34\frac{1}{2}$ lbs. from and at 212° F.)	....	492	500	486	492
Horse-power, builders' rating at 10 and 15 square feet per horse-power	....	360			
Per cent. developed above rating	Per cent.	36	40	35	36

Results of the Trials of two Tubular Boilers at Mount Airy Pumping-Station, to determine Efficiency and Capacity. Date of Trial, November 16th and 17th. Duration of Trial, twenty-four hours.

DIMENSIONS AND PROPORTIONS.		
Type of boilers, tubular		
Number in use		2
Diameter of boilers	Feet	4
Length of boilers	Feet	10
Number of furnaces		1
Width of furnaces	Feet	4 ft. 2 in.
Length of furnaces	Feet	4 ft. 0 in.
Number of tubes in each boiler		48
Diameter of tubes	Inches	3
Length of tubes	Feet	10
Heating surface in one boiler:	Square feet	461
Heating surface of shell	Square feet	84
Tubes	Square feet	377
Total heating surface in two boilers	Square feet	922
Total tube cross section area	Square feet	4.2
Ratio of tube cross section to grate surface		1 to 4
Height of stack	Feet	51
Area of stack at base	Square feet	$7\frac{9}{16}$

Results of the Trials of two Tubular Boilers—*Continued.*

Grate surface, 4 feet 2 inches wide; 4 feet long; $16\frac{2}{3}$ feet area, (2 furnaces)	Square feet	$33\frac{1}{3}$
Water heating surface	Square feet	922
Ratio of water heating surface to grate surface		27 to 1
AVERAGE PRESSURES.		
Steam pressure in boiler by gauge	Pounds	58.68
Absolute steam pressure	Pounds	73.588
Atmospheric pressure per barometer	Pounds	30.363
Force of draught in inches of water	Inches	0.16
AVERAGE TEMPERATURES.		
Of external air	Fahrenheit	44.08
Of fire room	Fahrenheit	59.04
Of steam	Fahrenheit	305.66
Of escaping gases	Fahrenheit	450.
Of feed water	Fahrenheit	46.875
FUEL.		
Total amount of coal consumed	Pounds	9015.
Moisture in coal	Per cent	0.0
Dry coal consumed	Pounds	9015.
Total refuse dry, pounds		1682.
Total combustible (dry weight of coal, less refuse)	Pounds	7333.
Dry coal consumed per hour	Pounds	375.62
Combustible consumed per hour	Pounds	305.57
RESULTS OF ANEMOMETER READINGS.		
Cubic feet of air per hour		51,854
Cubic feet of air per hour, per square foot of grate		3,113
Pounds of air per pound of coal		10.5
Pounds of air per pound of combustible		13.
RESULTS OF CALORIMETRIC TESTS.		
Quality of steam, dry steam being taken as unity		.99726
Percentage of moisture in steam	Per cent	$\frac{274}{1000}$
Factor of evaporation		1.2016
WATER.		
Total weight of water pumped into boiler and apparently evaporated	Pounds	63,193

Results of the Trials of two Tubular Boilers—*Continued.*

Water actually evaporated, corrected for quality of steam........	Pounds	63,020
Equivalent water evaporated into dry steam from and at 212° F.	Pounds	75,725
Equivalent total heat derived from fuel in British thermal units	....	73.128.408
Equivalent water evaporated into dry steam from and at 212° F. per hour..	Pounds	3155.
Economic Evaporation.		
Water actually evaporated per pound of dry coal from actual pressure and temperature..	Pounds	7.01
Equivalent water evaporated per pound of dry coal from and at 212° F...	Pounds	8.40
Equivalent water evaporated per pound of combustible from and at 212° F..	Pounds	10.33
Commercial Evaporation.		
Equivalent water evaporated per pound of dry coal, with one-sixth refuse, at 70 pounds gauge pressure, from temperature of 100° F. = last item ("economic evaporation") multiplied by 0.7249..	Pounds	7.49
Rate of Combustion.		
Dry coal actually burned per square foot of grate surface per hour..	Pounds	22.55
Consumption of dry coal per hour, coal assumed with one-sixth refuse:		
Per square foot of grate surface..	Pounds	22.0
Per square foot of water heating surface..........................	Pounds	.40
Per square foot of least area for draught..........................	Pounds	61.1
Rate of Evaporation.		
Water evaporated from and at 212° F, per square foot of heating surface per hour..	Pounds	3.42
Water evaporated per hour from temperature of 100° F. into steam of 70 lbs. gauge pressure:		
Per square foot of grate surface..	Pounds	164.72
Per square foot of water heating surface..........................	Pounds	3.00
Per square foot of least area for draught..........................	Pounds	457.3
Commercial Horse-Power.		
On a basis of 30 pounds of water per hour evaporated from temperature of 100° F. into steam of 70 pounds gauge pressure (= 34½ lbs. from and at 212° F.)..	Horse power.	92
Horse-power, builders' rating at 10 and 15 square feet per horse-power	Horse power.	60
Per cent. developed above rating..	Per cent........	53

Results of the Trials of two Furnace-flue Tubular Boilers at Roxborough Pumping Station, to determine Efficiency and Capacity. Date of Trial, February 18th and 19th, 1887. Duration of Trial, twenty-four hours.

Dimensions and Proportions.		
Type of Boilers: Furnace-flue Tubular.		
Number in use		2
Diameter of boilers	Feet	8′ 6″
Length of boilers	Feet	20
Number of furnaces in each boiler		2
Type of Furnaces: Fox's Corrugated.		
Diameter of furnaces	Feet	3′ 6″
Length of furnaces	Feet	7′ 6″
Number of tubes in each boiler		90
Diameter of tubes	Inches	4
Length of tubes	Feet	10
Heating surface in one boiler	Sq. ft.	1,119
Heating surface of two furnaces	Sq. ft.	136
Heating surface of combustion chamber	Sq. ft.	47
Heating surface of tubes	Sq. ft.	936
Total heating surface in two boilers	Sq. ft.	2,238
Total tube cross-section area in one boiler	Sq. ft.	8
Ratio of tube cross-section to grate surface		1 to 5.25
Height of stack	Feet	100
Area of stack at base	Sq. ft.	25
Grate surface, 3 ft. 6 in. wide; 6 ft. long; 42 sq. ft. area		
Water-heating surface	Sq. ft.	1,119
Ratio of water-heating surface to grate surface		26⅔ to 1
Average Pressures.		
Steam pressure in boiler by gauge	Pounds	48.2
Absolute steam pressure	Pounds	62.9
Atmospheric pressure per barometer	Inches	29.73
Force of draught in inches of water	Inches	0.42
Average Temperatures.		
Of external air	Deg. F.	49.8
Of fire-room	Deg. F.	64
Of steam	Deg. F.	296

Results of the Trials of two Furnace-flue Tubular Boilers—*Continued.*

Of escaping gases	Deg. F.	623
Of feed-water	Deg. F.	94
Fuel.		
Total amount of coal consumed	Pounds	23,912
Moisture in coal	Per cent.	9
Dry coal consumed	Pounds	21,760
Total refuse dry (pounds)	Pounds	4,524
Total combustible (dry weight of coal, less refuse)	Pounds	17,236
Dry coal consumed per hour	Pounds	906⅔
Combustible consumed per hour	Pounds	717.81
Kind of coal: Schuylkill pea coal.		
Results of Anemometer Readings.		
Cubic feet of air per hour		141,120
Cubic feet of air per hour per square feet of grate		1,680
Pounds of air per pound of coal		10.8
Pounds of air per pound of combustible		15
Results of Calorimetric Tests.		
Quality of steam, dry steam being taken as unity		.9864
Percentage of moisture in steam		.0136
Factor of evaporation		1.15
Water.		
Total weight of water pumped into boiler and apparently evaporated	Pounds	165,032
Water actually evaporated, corrected for quality of steam and surface water	Pounds	164,940
Equivalent water evaporated into dry steam from and at 212° F.	Pounds	190,004
Equivalent total heat derived from fuel in British thermal units		199,602,141
Equivalent water evaporated into dry steam from and at 212° F. per hour	Pounds	7,917
Economic Evaporation.		
Water actually evaporated per pound of dry coal from actual pressure and temperature	Pounds	7.58
Equivalent water evaporated per pound of dry coal from and at 212° F.	Pounds	8.73
Equivalent water evaporated per pound of combustible from and at 212° F.	Pounds	11.02

Results of the Trials of two Furnace-flue Tubular Boilers—*Continued.*

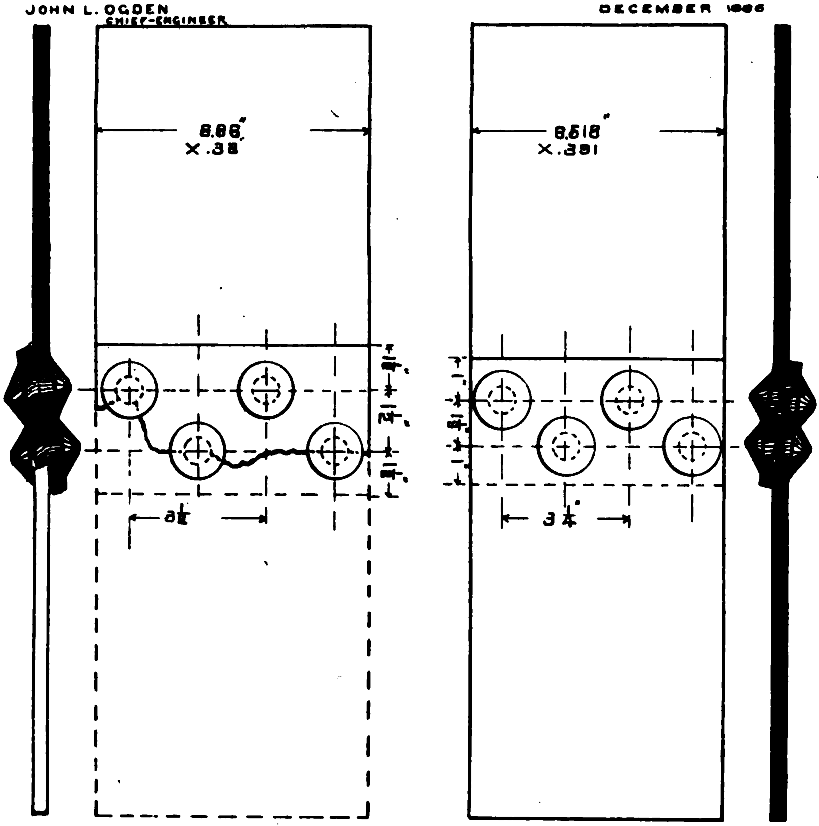
COMMERCIAL EVAPORATION.		
Equivalent water evaporated per pound of dry coal, with one-sixth refuse, at 70 pounds gauge pressure, from temperature of 100° F. = last item ("Economic Evaporation") multiplied by 0.7249	Pounds...	7.99
RATE OF COMBUSTION.		
Dry coal actually burned per square foot of grate surface per hour	Pounds...	10.8
Consumption of dry coal per hour, coal assumed with one-sixth refuse:		
Per square foot of grate surface	Pounds...	10.25
Per square foot of water-heating surface	Pounds...	0.77
Per square foot of least area for draught	Pounds...	172
RATE OF EVAPORATION.		
Water evaporated from and at 212° F. per square foot of heating surface per hour	Pounds...	7.07
Water evaporated per hour from temperature of 100° F. into steam of 70 pounds gauge pressure:		
Per square foot of grate surface	Pounds...	82
Per square foot of water-heating surface	Pounds...	6.24
Per square foot of least area for draught	Pounds...	137.7
COMMERCIAL HORSE-POWER.		
On a basis of 30 pounds of water per hour evaporated from temperature of 100° F. into steam of 70 pounds gauge pressure (= 34½ pounds from and at 212° F.)	H. P.	230
Horse-power, builders' rating at 10 and 15 square feet per horse-power	H. P.	160
Per cent. developed above rating	Per cent...	44

SAMPLES OF RIVETED JOINTS.

PHILADELPHIA WATER DEPARTMENT BOILERS

JOHN L. OGDEN
CHIEF-ENGINEER

DECEMBER 1886



	IRON PLATE, IRON RIVETS, PUNCHED HOLES, HYDRAULIC RIVETING. FRACTURED PLATE.	STEEL PLATE, STEEL RIVETS, DRILLED HOLES, MACHINE RIVETING. SHEARED RIVETS.
PLATES: WIDTH AND THICKNESS	6.96"X.38"	6.51 X.391
PLATES: SECTIONAL AREA, GROSS	2.645"	2.545"
PLATES: STRENGTH AS FOUND BY COUPONS ON EACH PLATE	48.850 LBS. PER SQ. IN.	57.128
STRESS ON JOINT: TOTAL	81.800 LBS.	98.900
STRESS PER SQUARE INCH: GROSS AREA OF JOINT	30.926 LBS.	38.816
PLATES SECTIONAL AREA, NET	2.01"	1.915"
STRESS PER SQUARE INCH: NET AREA OF PLATE	40.700 LBS.	51.700
RIVETS: DIAMETER, NUMBER AND AREA	.75"-4-1.767"	.75"-4-1.767"
SHEARING STRESS PER SQUARE INCH OF RIVET AREA:	46.300 LBS.	55.970
RATIO OF JOINT TO SOLID PLATE PERCENT:	64	70
SHEARING STRENGTH OF RIVETS COMPARED WITH TENSILE STRENGTH OF NET SECTION OF PLATE, PERCENT		90

John E. Codman.
CHIEF DRAUGHTSMAN
J.E.C.

STRAIN DIAGRAM

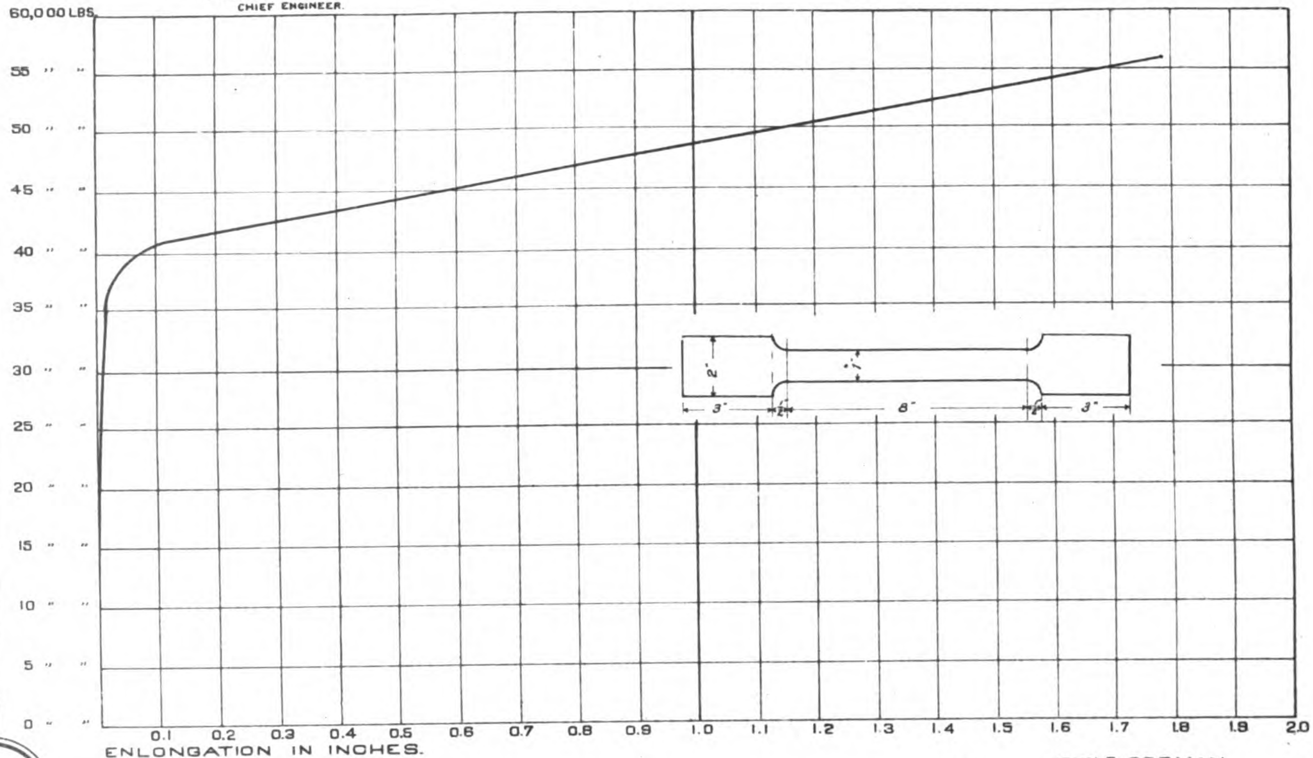
OF STEEL PLATES USED IN CONSTRUCTING

SPRING GARDEN AND ROXBOROUGH BOILERS.

PHILADELPHIA WATER DEPARTMENT

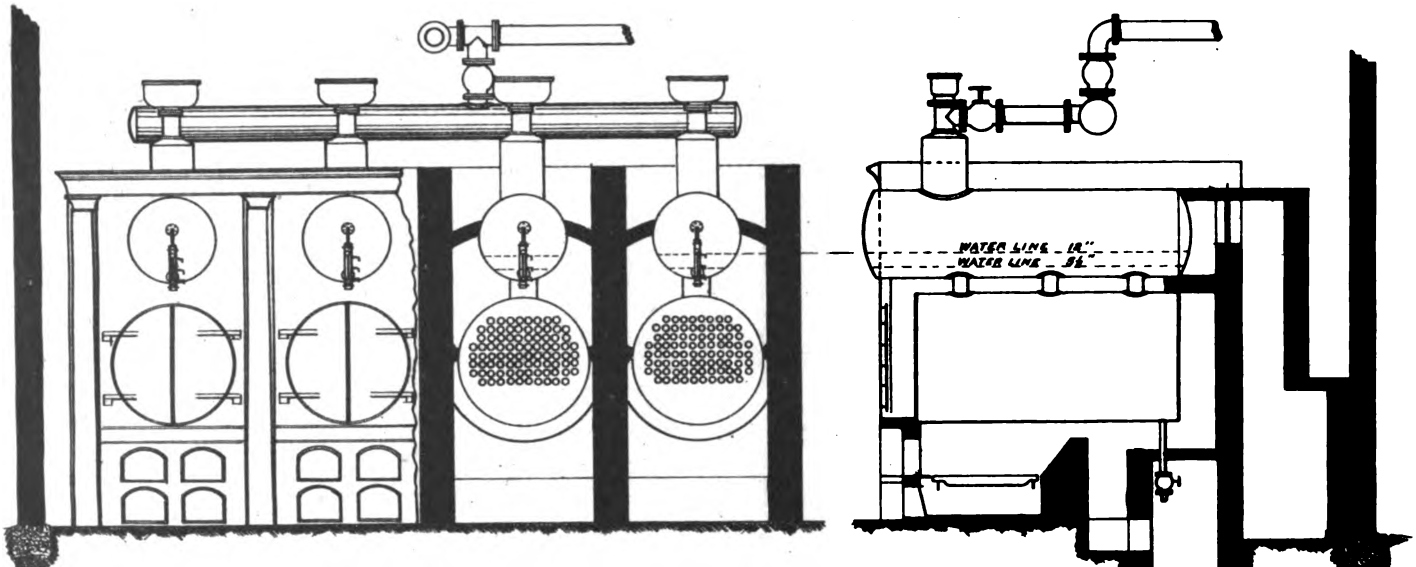
JOHN L. OGDEN,
CHIEF ENGINEER.

SEPTEMBER 1886.



J.E.C. DEL.

JOHN E. CODMAN,
CHIEF DRAUGHTSMAN.



DOUBLE DECKED CYLINDER BOILERS

in use at Spring Garden and Belmont Stations

Tested at Belmont for evaporative efficiency, Oct. 27-28, 1886

by John E. Codman, Chief draughtsman.

Phila. Water Dept.

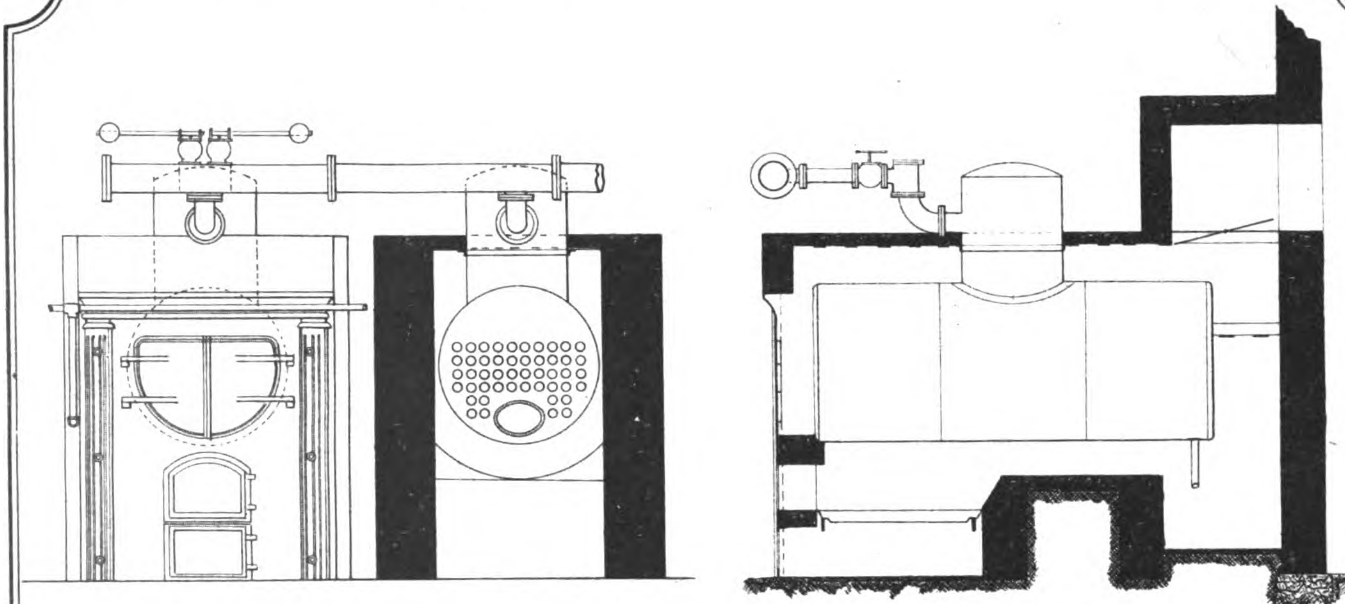
John L. Ogden, chief-Eng'r

Scale

1 0 5 10 FEET

IN.

J.E.C. del.

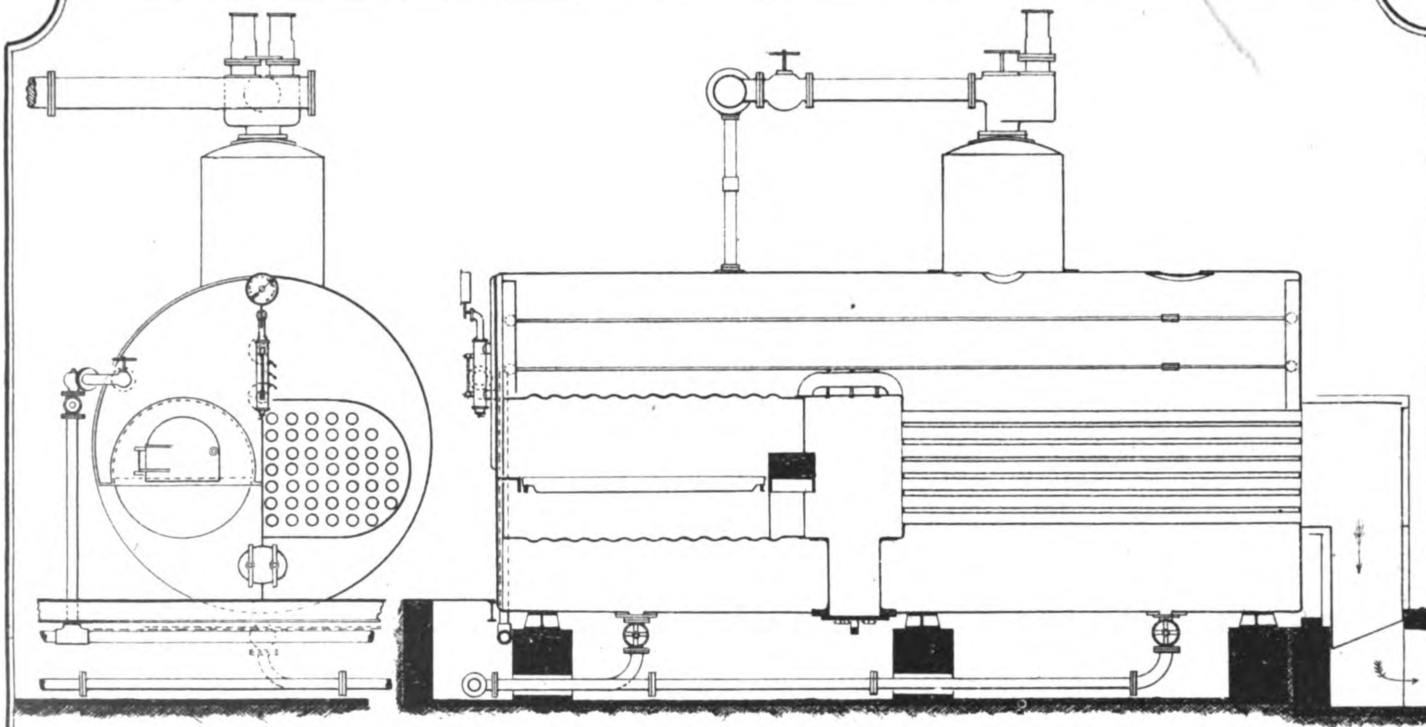


RETURN TUBULAR BOILERS

in use at Mt Airy Chestnut Hill, Rexborough Pumping Sta. and Water Dep't Machine Shop.—
Tested at Mount Airy for Evaporative Efficiency. November 16-17-86.
by John E. Codman. Chief Draughtsman.

PHILA. WATER DEP'T
John L. Ogden. Chief-Eng'r.

J.E.C. Del.



FURNACE FLUE AND TUBULAR BOILER,

in use at Spring Garden and Roxborough Pumping Stations.

Phila. Water Department,
John L. Ogden, Chief Eng'r.

Tested for Evaporative Efficiency at Roxborough Feb. 16th–19th 1887
by John E. Codman, Chief Draughtsman

Scale
1 0 1 4 5 6 FEET
IN.

J.E.C. Del.

APPENDIX G.

REPORT OF AMASA ELY.

ASSISTANT IN CHARGE OF HYDROGRAPHIC WORK IN CONNECTION WITH FUTURE SUPPLY.

PHILADELPHIA WATER DEPARTMENT,
February 11, 1887.

JOHN L. OGDEN, ESQ.,
Chief Engineer.

SIR:—Herewith is submitted the following report of progress during the year 1886, of the Hydrographic work in connection with the investigations of sources for a future water supply.

The following streams have been gauged throughout the entire year, viz.: The Perkiomen creek, at Frederick Station, on the Perkiomen Railroad; the Neshaminy Creek, a short distance below the forks formed by the meeting of the Big and Little Neshaminy creeks; and the Tohickon creek, about one-half of a mile above its mouth at Point Pleasant.

During the year rainfall observations have been taken at ten stations, established by the Department, namely:

Office of the Water Department, Philadelphia, Pa.
Germantown, Philadelphia, Pa.
Siesholtzville, Berks County, Pa.
Frederick, Montgomery County, Pa.
Ottsville, Bucks County, Pa.
Quakertown, Bucks County, Pa.
Smith's Corner, Bucks County, Pa.
Point Pleasant, Bucks County, Pa.
Forks of Neshaminy, Bucks County, Pa.
Lansdale, Montgomery County, Pa.

The Department has also received annual rainfall reports from the following places:

United States Signal Service Station, Philadelphia, Pa.
Pennsylvania Hospital, Philadelphia, Pa.
Lebanon, Lebanon County, Pa.
Schuylkill Haven, Schuylkill County, Pa.
Reading, Berks County, Pa.
Pottstown, Montgomery County, Pa.
Browers, Montgomery County, Pa.
Easton, Northampton County, Pa.
Phillipsburg, Warren County, N. J.
Princeton, Mercer County, N. J.
Fallsington, Bucks County, Pa.
Moorestown, Burlington County, N. J.
West Chester, Chester County, Pa.

A new pine crest was placed on the Tohickon weir in July, the old crest having been carried away by the ice during the previous winter.

As it was necessary to have measurements of high flows on the Tohickon, to refer to gauge readings taken at the new automatic stream gauge, and as the channel under the road bridge at Point Pleasant had changed, so that correct measurements could no longer be obtained at that point, other means of measuring the high flows had to be found. About 150 feet above the Tohickon weir a one-quarter inch galvanized wire cable was stretched from shore to shore, high enough to clear the flows intended to be measured. The ends were securely anchored to trees, a pulley block with tackle attached was placed on the cable, and a small boat attached to the tackle. Guy ropes were fastened to either shore and placed in the boat. As the velocity of the water at this point is very great, sometimes reaching twelve to fourteen feet per second, it was necessary to have everything very secure. With this apparatus, persons in the boat engaged in taking measurements could place themselves at any point in the stream, from one shore to the other, and from the weir to a point 150 feet above it. Sections were carefully taken with a level at two stations, as it seemed probable that under certain conditions it would be advisable to make the measurement at one station, while under different conditions it would be better to use the other. Current meters and floats have been used to determine the velocity of the water. The surface slope of the water between stations 75 feet apart was obtained at each measurement, and the measurement checked by calculating the flow from the section of the stream and the surface slope, as applied in Kutter's formula. It is surprising how closely the results agreed, considering the extremely rough character of the bed of the stream. Five measurements of high flows were made on the Tohickon during the year, three of which gave good results, one only fair, and one unsatisfactory.

Three stream gauges were replaced by new ones during the year.

The rainfall for the year is generally somewhat above the average, although in a few localities it does not differ from the average to any great amount. At the Pennsylvania Hospital, Philadelphia, the average annual rainfall for the past sixty-two years, including the year 1886, is 44.452 inches, while the rainfall for the year 1886 is 47.060 inches. There were only two storms during the year that can be called heavy. The first occurred on February 11, and amounted to about 2.6 inches; the second occurred on May 8th, and amounted to 3.5 inches nearly. The storm of February 11 caused unusually high water in all the streams, the water reaching a greater height than it had attained since the year 1869. A report of the damage sustained by the hydrographic work from this storm will be found on pages 376 and 377 of the Annual Report for 1885.

Table 1, following this report, contains a comparison for the past year, of the rainfall at twenty-two stations in the Delaware and Schuylkill watersheds, with the rainfall at the United States Signal Service Station at Philadelphia.

Table 2 gives the details of the storms of greatest intensity occurring during the year 1886.

In Table 3, containing a comparison of the rainfall with the streamflow in the three watersheds under investigation, it will be noticed that the year is begun on October 1st instead of January 1st. The reasons for so doing are; first, the minimum streamflow occurs about October 1st each year, but the maximum flow cannot be said to occur at any well defined date, varying in different years from about the 1st of January to the latter part of March; and second, rains occurring about January 1st almost invariably raise the streams and change decidedly the total for the year; but rains occurring about October 1st, unless of considerable magnitude, have very little effect upon the streams. As it is advisable to begin the year at a time when the streamflow possesses the same general character each year, the 1st of October has been selected.

The yield of the various streams for the past year is somewhat above the average annual yield.

By an inspection of the column, giving the percentage of rainfall reaching the stream in Table 3, it will be seen that the Perkiomen percentages are less in the winter and greater in the summer months than the percentages of the other streams. The character of the Perkiomen watershed fully explains this greater steadiness of flow, being more heavily wooded in proportion to its area than either of the other watersheds, and having its most heavily wooded areas about the sources of the stream.

Although the Tohickon watershed is considerably smaller than that of the Neshaminy below the Forks, yet the stream flow for the past year is about the same in each. This can be accounted for by several facts. The percentage of rainfall reaching the stream has always been considerably larger in the Tohickon watershed than in the Neshaminy. In the year 1885, the Neshaminy and the Tohickon gave very nearly the same streamflow, although that of the Tohickon was slightly less. During the past year the rainfall in the Tohickon watershed was slightly greater than that in the Neshaminy, although the difference is not sufficient in itself to account for the increased stream flow in the former. All the freshets occurred from January 5th to May 9th, during the winter and spring months, at a time when the Tohickon watershed gives off a much larger percentage of rainfall into the stream than either of the other watersheds.

Table 4 contains the average annual stream flow in the various water-sheds under investigation, compared with the average annual stream flow in the Sudbury and Croton watersheds. In the last column will be found the stream flow reduced to cubic feet per second per square mile of watershed, but by glancing at the column containing the rainfall, it will be seen that the rainfall varies in the different watersheds; and therefore, to compare the stream flow as given in the last column of the table, it will be necessary to still further reduce it to a common basis of rainfall. I have taken each quantity in the last column, and divided it by its respective annual rainfall, and have obtained the following quantities, each being the stream flow in the respective watersheds in cubic feet per second per square mile of drainage area, for each inch of rainfall:

Tohickon	0.047
Perkiomen, at Frederick	0.041
Croton	0.041
Neshaminy, below Forks	0.038
Sudbury	0.035

Table 5 contains the monthly streamflow for the year 1886.

Both the Delaware and Lehigh rivers reached a lower point during 1886 than they have since the Department began to gauge them. Unfortunately, through lack of funds, no measurements could be taken during the period of low flow at White Haven, Delaware Water Gap, and Point Pleasant.

The following persons have been engaged on the work during the entire year:

John G. Hilsman, rodman.
George W. Wood, rodman.
R. C. Stover, gauge observer.
E. F. Heavener, gauge observer.
George Lowder, gauge observer.
Dr. J. A. Roth, gauge observer.
H. L. Shull, gauge observer.

The Department is indebted to the following persons who have kindly furnished rainfall records:

Mr. Thomas Meehan, Germantown, Pa.
Mr. J. L. Heacock, Quakertown, Pa.
Sergeant L. M. Dey, U. S. Signal Service, Philadelphia.
Mr. E. F. Smith, Chief Engineer of Canals, Reading, Pa.
Mr. Benjamin Shoemaker, Pennsylvania Hospital, Philadelphia, Pa.
Mr. Thomas J. Beans, Moorestown, N. J.
Dr. Charles Moore, Pottstown, Pa.
Mr. B. B. Lehman, Lebanon, Pa.
Mr. Milnor Gillingham, Fallsington, Pa.
Mr. Malcolm McNeill, Princeton, N. J.
Miss Emily Kent, Phillipsburg, N. J.
Prof. James W. Moore, M. D., Easton, Pa.
Dr. J. C. Green, Westchester, Pa.

The three automatic stream gauges in use are all in good condition, and a new gauge that has never been in use is held in reserve in case of accident to any one of the others. The automatic gauge at the Neshaminy is placed higher and protected better than the gauge carried away last winter, and I think that no apprehension need be felt in regard to its injury from running ice. The three automatic rain gauges in use are in good condition, and have required but few repairs during the year. At present the Department possesses twelve ordinary rain gauges, seven of which are in good condition, three in fair condition, and two are unfit for use.

The two current meters in the possession of the Department are at Point Pleasant, and are in fair order. The batteries and electric registers will require a few repairs to place them in good condition for use.

Both levels used on hydrographic work were thoroughly overhauled and cleaned by the makers during the summer, and one has not been used since; the other has had considerable usage, but is in fair condition.

Respectfully submitted,

AMASA ELY,

Assistant in Charge of Hydrographic Work.

TABLE II.

Rain-storms of Greatest Intensity, as Recorded by Automatic Gauges during 1886.

Station—Water Department, Philadelphia.

Date. 1886.	Total Fall.		Heavy Fall.		Maximum Fall.		
	Amount, Inches.	Duration, Hrs. Min.	Amount, Inches.	Duration, Hrs. Min.	Amount, Inches.	Duration, Min.	Rate per Min. Inches.
February 11..	2.284	25 15	2.269	11 50	1.177	210	0.006
May 8...........	3.365	27 30	2.205	17 04	0.159	11	0.014
May 27.........	0.583	12 30	0.490	2 13	0.153	2	0.077
July 10.........	0.895	3 20	0.800	1 25	0.147	2	0.074
November 12.	1.294	15 10	0.935	3 33	0.500	38	0.013
November 18.	0.853	2 35	0.790	1 05	0.520	9	0.058

Station—Frederick, Montgomery County, Pa.

Date, 1886.	Total Fall.		Heavy Fall.		Maximum Fall.		
	Amount, Inches.	Duration, Hrs. Min.	Amount, Inches.	Duration, Hrs. Min.	Amount, Inches.	Duration, Min.	Rate per Min. Inches.
February 11..	2.612	54 00	2.516	19 32	0.215	17	0.013
May 8...........	3.445	27 00	3.416	23 13	0.228	26	0.009
June 14.........	1.780	11 35	1.760	9 54	0.255	8	0.032
July 10.........	1.576	5 20	1.490	2 04	0.300	7	0.043
October 26.....	1.404	18 00	1.344	13 03	0.100	8	0.013
November 18.	1.029	7 00	1.001	1 20	0.897	37	0.024

Station—Forks of Neshaminy, Bucks County, Pa.

Date, 1886.	Total Fall.		Heavy Fall.		Maximum Fall.		
	Amount, Inches.	Duration, Hrs. Min.	Amount, Inches.	Duration, Hrs. Min.	Amount, Inches.	Duration, Min.	Rate per Min. Inches.
January 4.....	1.456	13 30	1.154	6 16	0.103	24	0.004
May 8...........	2.561	26 42	2.462	18 18	0.127	10	0.013
July 10.........	1.308	4 40	1.267	2 44	0.600	36	0.017
October 26.....	1.268	20 40	0.766	4 40	0.062	6	0.010
November 12.	1.103	17 00	1.032	9 10	0.493	48	0.010

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Frederick[rner].		Point Pleasant.		Lansdale.		Forks of Neshaminy.	
Precipitation, Inches.	Difference, Inches.	Precipitation, Inches.	Difference, Inches.	Precipitation, Inches.	Difference, Inches.	Precipitation, Inches.	Difference, Inches.
3.71	+0.62	4.61	+0.92	3.73	+0.04	6.49	+2.80
5.11	+1.07	7.06	+2.41	5.86	+1.21	6.50	+1.88
3.80	+1.04	5.23	+2.06	3.54	[illegible]	5.89	+0.72
2.85	+1.10	3.94	+1.21	2.97	−0.27	2.89	+0.19
6.88	+2.89	7.77	+3.27	5.83	1.73	5.76	1.26
5.45	+1.99	3.92	−1.06	6.53	+2.57	4.82	+1.96
5.41	+1.53	6.47	+2.21	6.50	+2.27	4.31	+0.33
1.14	−0.16	1.38	0.00	1.67	[illegible]	1.52	+0.14
1.41	+0.51	1.35	+0.15	1.19	−0.06	0.63	−0.57
2.43	+0.61	2.56	+0.67	3.09	+1.20	2.46	0.57
5.42	+0.62	5.74	+1.83	3.57	−0.31	4.28	0.57
2.90	−0.25	3.39	+0.30	2.74	−0.55	3.85	+0.76
46.51	2.07	53.42	+16.18	47.22	+9.98	47.40	+10.16
125	....	143	....	127	....	127	....

TABLE IV.

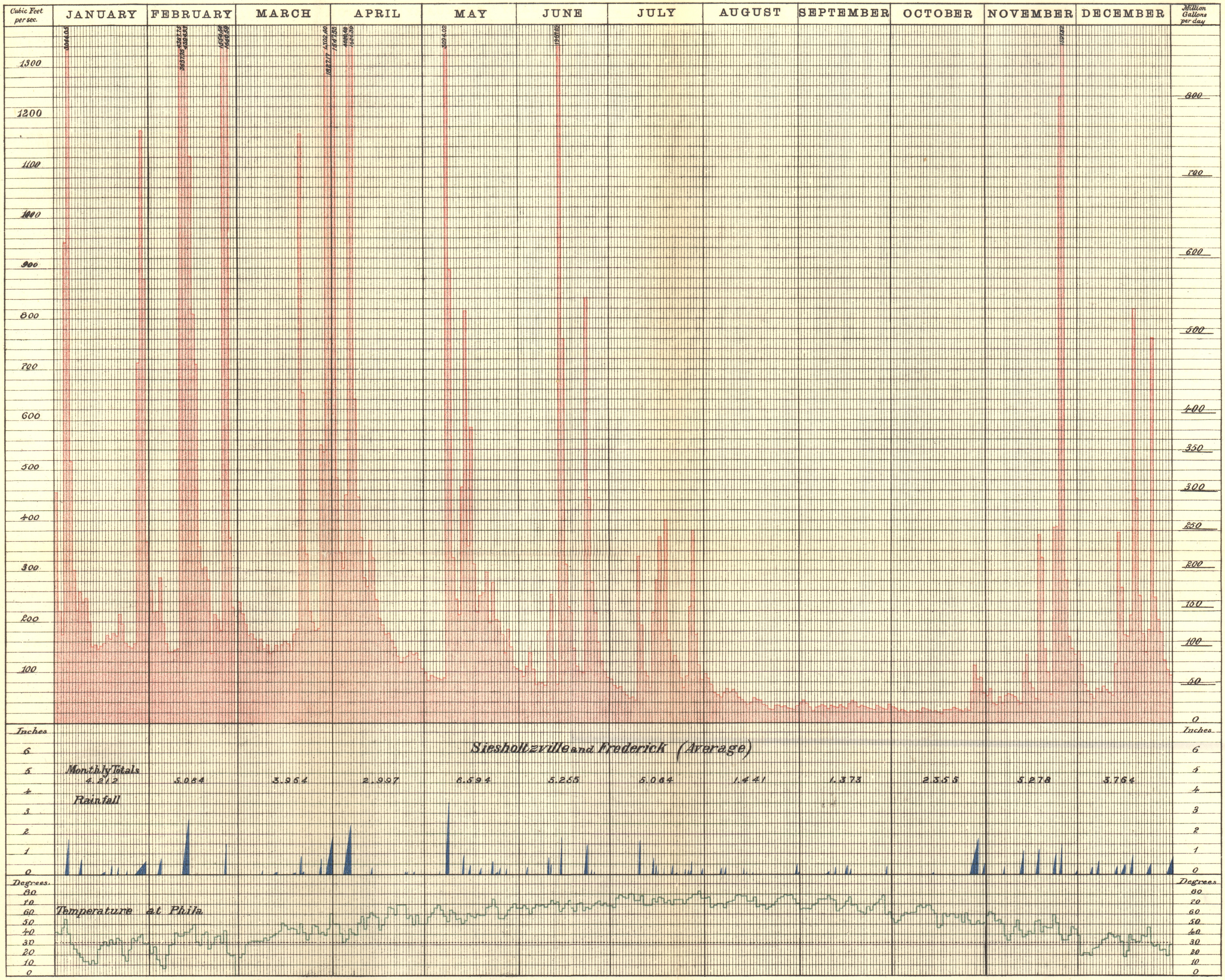
Average Annual Yield of Sundry Streams.

Watersheds.	Area in miles.	Rainfall.	Average annual yield in gallons.	Average daily yield in gallons.	Average yield in cubic feet per second per sq. mile of drainage area.
Perkiomen, at Frederick—3 years..	152.0	44.72	64,885,447,738	177,768,350	1.814
Neshaminy, below Forks—3 years.	139.3	45.79	56,067,490,998	153,609,564	1.746
Tohickon—3 years.................	102.2	47.23	53,836,741,094	147,497,921	2.222
Sudbury, Mass.—6 years................	70.0	46.10	29,606,810,000	81,040,500	1.615
Croton, N. Y.—6 years..................	361.0	46.50	106,600,000,000	440,000,000	1.890

TABLE V.—YIELD OF SUNDRY STREAMS FOR THE YEAR 1886.

1886.	Perkiomen, at Frederick.			Neshaminy, below Forks.			Tohickon.		
	Monthly yield.	Average daily yield.		Monthly yield.	Average daily yield.		Monthly yield.	Average daily yield.	
	Cubic feet.	Cubic feet.	Gallons.	Cubic feet.	Cubic feet.	Gallons.	Cubic feet.	Cubic feet.	Gallons.
January	1,072,515,168	34,597,263	258,787,527	1,631,098,080	52,616,067	393,568,181	1,038,702,528	33,506,533	250,628,867
February	1,989,017,568	70,714,913	528,947,549	2,040,046,560	72,858,806	544,983,869	2,201,872,032	78,638,287	588,214,387
March	899,849,952	29,027,418	217,125,087	713,223,360	23,007,205	172,093,893	1,024,187,328	33,038,301	247,126,491
April	1,198,224,576	39,940,819	298,757,326	1,117,960,704	37,265,357	278,744,870	1,135,463,616	37,848,787	283,108,927
May	918,837,216	29,639,910	221,706,527	652,346,784	21,043,445	157,404,969	813,964,896	26,256,932	196,401,851
June	662,555,808	22,085,194	165,197,251	284,441,760	9,481,392	70,920,812	334,774,944	11,159,165	83,470,554
July	388,850,976	12,543,580	93,825,978	246,320,352	7,945,818	59,434,719	184,469,184	5,950,619	44,510,630
August	119,937,888	3,868,964	28,939,851	45,550,944	1,469,385	10,991,000	24,315,552	784,373	5,867,110
September	81,259,200	2,708,640	20,260,627	12,856,320	428,544	3,205,509	6,496,416	216,547	1,619,772
October	88,160,832	2,843,898	21,272,357	16,068,672	518,344	3,877,213	10,578,816	341,252	2,552,565
November	543,992,544	18,133,085	135,635,476	173,050,560	5,768,352	43,147,273	466,444,224	15,548,141	116,300,095
December	508,314,768	16,398,218	122,658,671	728,338,176	23,494,780	175,740,954	567,617,760	18,310,250	136,960,670
Total	8,462,546,496	23,185,059	173,424,241	7,661,302,272	20,989,869	157,004,220	7,808,887,296	21,394,212	160,028,706

STREAM FLOW
1886
PERKIOMEN CREEK AT FREDERICK



APPENDIX H.

SURVEYS

FOR THE

FUTURE WATER SUPPLY

OF THE CITY OF PHILADELPHIA.

FINAL REPORT

OF

RUDOLPH HERING,

Engineer-in-Charge.

Philadelphia, July, 1886.

MR. J. L. OGDEN,

Chief Engineer.

SIR:—I have the honor to present to you the following report of progress of the surveys for a future water supply for the City of Philadelphia during the present year. As the investigation is completed, this report is also the final one.

The office corps has been engaged in computing the stream-flows of the Perkiomen, Tohickon, and Neshaminy creeks, in ascertaining the available storage in each of the respective valleys, in estimating its cost and in arranging and compiling the tables, maps, and charts for the final report.

The rainfall and stream-flow observations have been continued, though not as extensively as during the previous year. The rainfall stations at Sellersville, Doylestown, and Green Lane were abandoned January 1. The two automatic gauges are now at Frederick, Montgomery county, and at the forks of the Neshaminy, Bucks county; the ordinary gauges are at Seisholtzville, in Berks county, and at Quakertown. Lansdale, Ottsville, and Smith's Corner, near Point Pleasant, in Bucks county.

The stream-flow stations are confined to the Tohickon at Point Pleasant, the Neshaminy below the forks, and the Perkiomen at Frederick.

In view of the final results revealed by the investigation, it is quite necessary that both the rainfall and stream-flow observations be continued, at least near the Tohickon watershed, and it would be very desirable for future considerations to continue them, for the present also in the adjoining watersheds of the Neshaminy and the Upper Perkiomen.

In approaching the solution of the question as to where the city should go for better water, when the Schuylkill river is no longer a fit source of supply, the definite conclusions arrived at in the previous reports were substantially as follows:

Two sources present themselves as excellent and superior to all others, viz., certain tributaries of the Delaware and Lehigh rivers in the Blue mountains.

While either of these rivers, or both, must be made use of at some distant date, other sources are at hand which, at a much smaller outlay, will furnish water for some time of satisfactory quality and quantity.

It was found that the Delaware river above Trenton, the Tohickon creek and the Upper Perkiomen creek with its branches above Frederick (excepting the Macoby creek) would all furnish a supply to which, as far as the quality of water is concerned, no reasonable objection can be made. The selection of the best among these near sources, however, depended upon the quantity of water available from each, either directly or by storage, in order to supply the city daily with 200,000,000 gallons, and upon the comparative cost of securing this quantity.

The two latter questions were not fully answered in the last report. They have now been finally determined. The Upper Perkiomen creek and its branches cannot be relied upon to furnish more than 89,000,000 gallons per day during a year of minimum rainfall. An increase over this quantity would have to be obtained from the Blue mountains. The Tohickon creek could not be depended upon ordinarily to furnish more than 90,000,000 gallons per day, and in the minimum years not more than 80,000,000 gallons. An increase beyond this amount would have to be obtained from the Delaware river at Point Pleasant.

Estimates of cost for supplying 210,000,000 gallons daily, which was the amount to be provided for, and which can be conveyed to the city by an aqueduct twelve feet in diameter, show that the project contemplating the furnishing of 90,000,000 gallons of Tohickon water by gravity, and of pumping 120,000,000 gallons from the Delaware river by water-power, in other words, the "Point Pleasant scheme," is decidedly the most economical, and it is therefore the project recommended to the city in this report.

In reviewing the work done, and the detailed conclusions arrived at during the present year, I shall adhere as far as practicable to the order maintained in the previous reports of the subjects discussed.

AQUEDUCTS.

But little needs to be added on this subject. Descriptions of the available routes to the different points where water could be obtained have already been given, and the best of them have been carefully surveyed, mapped, and studied, by means of profiles and estimates of cost. The aqueducts were estimated as having twelve feet in diameter and a grade of one in six thousand. In building the same it will be advantageous in many instances to deviate from a circular form, and other slight changes from the preliminary plans will be advisable. As the object of the present investigation was the solution of the broad question as to the best source for the future supply and the probable cost, it was not considered necessary to enter upon details regarding the construction of the aqueducts when the cost was not materially affected thereby.

Last year's report contains a map showing all the various practicable lines of aqueducts from the Blue mountains, from the Perkiomen and Tohickon creeks, and from other sources that had been considered. It contains further the profiles of the most available and important lines reduced from large and detailed drawings now on file in the Department. It finally contains detailed estimates of the cost of all of the aqueducts that were studied, from pages 334 to 349, a recapitulation of the same on page 353, and a statement of their relative advantages and disadvantages on pages 311 to 321. No information, therefore, is wanting to arrive at an intelligent judgment of their relative value.

General Watersheds.

The surveys made to ascertain the suitability of certain watersheds to furnish water of a good quality had also been completed before the present year and have been reported upon. The physical features, viz., the contour and elevation of the ground, the untillable areas, those covered with timber and those under cultivation, also the towns, villages, roads, &c., had all been mapped. The sanitary features, viz., the distribution and amount of population residing upon the watershed, their principal occupation, death rate, disposal of sewage, extent and character of mills, factories, slaughter-houses, cemeteries, &c., had also been ascertained and entered upon the maps, or described. The present report contains (Table 1) a tabular statement in detail of the statistics of the several proposed collecting areas of the Tohickon, Neshaminy, and Perkiomen creeks, a brief summary of which had been given on page 350 of last year's report.

The following table shows the population on the proposed collecting areas:

Table 4.

Population on proposed collecting areas.

Collecting Areas.	Square miles.	Total population.	Population per square mile.
Tohickon Creek	102.3	*9,843	*96
Neshaminy Creek	139.4	*15,039	*108
Perkiomen Creek, above Frederick	152.1	16,734	110
Perkiomen Creek, above Schwenksville, including West Swamp Creek and Northeast Branch	266.3	32,600	122
Western affluents of Delaware River, from Water Gap to Bushkill	440.5	11,000	25
Lehigh River, above White Haven, and eastern tributaries above Lehigh Gap	542.5	10,000	18.4

* Not including Quakertown nor Doylestown, the drainage of which can be diverted into other watersheds.

It will be seen that in the Blue Mountains there resides one person on every thirty acres, and in the Perkiomen, Tohickon, and Neshaminy watersheds one person on every six acres; a population which if distributed is in every case too sparse to seriously affect the condition of the water draining from any of the areas. In the case of the Tohickon and Neshaminy a fortunate circumstance permits the sewage from the only two centres of population to be diverted to other watersheds: Namely, the Doylestown drainage can be carried into Mill creek, and thence to the Neshaminy below the proposed dam; and the Quakertown drainage can be carried by a short sewer into the Perkiomen creek, if the Tohickon project is used in preference to that of the Perkiomen. This circumstance reduces the population per unit of area to less than that of the Perkiomen, and leaves it more generally distributed and less likely ever to affect the water..

During the present year a map has been compiled from the best attainable data, showing the available collecting areas north of the Blue Mountains between the Lehigh and Delaware rivers. An aneroid barometer survey was made and plotted over a portion of the same, to show the contour and elevation of the ground, but owing to insufficient funds the survey was not completed.

Attached to the present report is a chart, Plate II., which shows the triangulation made in 1884 over part of Bucks and Montgomery counties, described in the report for the same year. It should here be added that while it was not feasible within the allotted time to connect the triangulation with the United States Coast Survey station at Topton, a check upon the same was obtained by calculation through the triangle Topton-Geryville-Fagleyville, the result of which was quite satisfactory. The latter stations which had been determined from the line Haycock-Goathill checked within twelve inches.

There is also appended as Plate V. a section of topography near Point Pleasant, showing the manner in which the surveys were mapped.

It might be repeated here that the large scale to which the surveys were plotted, viz., 400 feet to one inch, the comparative accuracy of the survey and the amount of detail contained on the map render them a valuable contribution to the survey of the State, inasmuch as they cover an area of 446 square miles in Bucks, Montgomery, and Lehigh counties. They will not only permit of a careful location of the geological features, but facilitate the detailed study of new railroad lines and other improvements.

PRECIPITATION.

In order to secure a supply of water which will be reliable in its quantity at all times, it is necessary to calculate only for the amount which the streams can furnish during the dryest years, as otherwise there would be a scarcity of water during such periods.

It is rarely possible, during the limited time granted for preliminary investigation, to observe the streams during a minimum year. Therefore it usually becomes necessary to obtain the desired quantities through deduction, by establishing the relation between the amount of rain and snow, which directly or indirectly feeds the streams, and the amount of water flowing in them, a relation varying somewhat with the topographical and geological conditions. Such a deduction becomes possible, if we know the minimum quantity of rain that can be relied upon.

Rainfall observations in this section of the country have extended over many years. In Philadelphia they have been recorded for over half a century. It is possible therefore to state with considerable accuracy what the least precipitation is likely to be, and how often droughts may be expected. But the quantity of rain falling in Philadelphia is not the same as that falling upon the watersheds in question, owing to the difference in elevation and other causes. Even in the city itself it varies with the locality and the position of the gauges. Fortunately these differences are very nearly constant quantities, because the conditions causing them remain the same. By observing and comparing the precipitation at a number of points in or near the watersheds, these differences may be ascertained during a period of several years with some precision, and thus the last link would be supplied in the process of determining the probable minimum flow of the streams under investigation.

Records of the rainfall in Philadelphia have been kept at the Pennsylvania Hospital since 1825. They are given in Table 5. To permit of a more thorough analysis I have added Table 6, giving the maximum and minimum falls per month, quarter, year, and two years, and have also given the order of the months with relation to their degree of humidity. The quarterly totals and the two annual totals, one limiting the year from January 1 to December 31, the other from October 1 to September 30, have also been added. On account of the small stream-flow in the early fall it is better to reckon the year from this season instead of from January 1; because while slight rains just before or just after January 1 almost invariably produce high water and greatly change the total of the respective year. heavy rains about the first of October generally cause freshets of little importance.

An examination of these tables I think justifies the assumption that the minimum precipitation per annum, as recorded at the Pennsylvania Hospital, could be assumed at 33.6 inches, or 76 per cent. of the mean annual fall, the actual minimum records being 33.53 inches for 1827 and 33.93 inches for 1856. The apparently remarkable low record of the year 1825, viz., 29.37 inches, being the first in the series, may have been undermeasured and should hardly receive the same weight as the records of more recent years. Further, the precipitation of the years preceding and succeeding the minimum year 1856 is considerably greater, viz., 44.1 and 48.3 inches, which would have a favorable effect on the stored quantity of water in the reservoirs at the beginning of the year 1856, and also in supplying any deficiency early in the following year. By reckoning from October 1 to September 30 we get a minimum of 39.20 instead of 33.93 inches.

To throw still further light on the question I have compiled the following tables showing the minimum precipitation at points within 150 miles of Philadelphia.

TABLE 8.

Precipitation in percentages of means within 150 miles of Philadelphia, during years of minimum precipitation.

LOCALITY.	1825	1834	1848	1856	1870	1874	1880
Flatbush, N. Y.	....	91	77	92	77	....	....
Jamaica, N. Y.	....	87	84	....	....	....	....
Fort Hamilton, N. Y.	....	....	80	85	93	80	80
Fort Columbus, N. Y.	....	....	85	83	93	99	84
Newark, N. J.	....	....	82	77	104	111	....
Lumberville, N. J.	....	....	78	74	....	....	....
Morrisville, N. J.	67	80	79	70	83	85	....
Haddonfield, N. J.	....	....	....	....	84	90	....
Trenton, N. J.	....	....	....	....	....	87	....
Philadelphia, Pa.	66	77	78	76	100	91	90
Pottstown, Pa.	....	....	....	....	....	105	85
Reading, Pa.	....	....	....	....	....	....	89
Lebanon, Pa.	....	83	80	78	98	84	89
Gettysburg, Pa.	....	....	86	73	....	....	....
Baltimore, Md.	....	....	87	56	90	77	98
Washington, D. C.	65	....	62	90	97	94	89

The numbers indicate the percentages of the mean rainfall of each locality. The years of extreme drought in this neighborhood appear to have been 1825, 1834, 1848, 1856, 1870, 1874, 1880. A glance at Table 8 shows that the year 1825 was no doubt phenomenal in its low rainfall, extending from Washington to Philadelphia, and Morrisville, New Jersey. Other extremely low records, though more local, are found to be 62 per cent. of the mean for Washington in 1848, and 56 per cent. for Baltimore in 1856. The existence of these few instances has not caused me to lower the assumed minimum for Philadelphia below 76 per cent. of the mean, because the table indicates that the minimum quantity in most of the localities has been increased, and that in Philadelphia no rainfall has been lower than the assumed figure since 1826.

Low quantities are recorded for some of the cities during years not given.

They were omitted in the table because the intention was to compare the rain of the surrounding territory with that of Philadelphia, only during the years of minimum fall in the latter, in order to show the extent of the droughts in this neighborhood.

The following table, recording the minimum precipitation for two-year periods, still further justifies the assumption that I have made.

All localities within the 150-mile radius show that while a single year minimum has given slightly less than 76 per cent. in a few instances, a two-year minimum has not done so anywhere since 1826, except towards the south in Baltimore and Washington.

As a basis for comparison I have selected the U. S. Signal Service station in Philadelphia. As it has been in existence only since 1872 it was necessary to discover the constant difference between this station and the hospital, which would be due to the different positions of the gauges, the one at the hospital being near the surface of the ground and the Government gauge being upon the high roof of the post office building.

The observations at the hospital have lately, not always, been taken with the greatest care. In the winter of 1884 to 1885 we found that snow was being measured as such, and not as melted snow. In 1874 and 1881 the annual amounts vary considerably from those recorded by the Government. In the latter year no apparent reason was found, but in the former it seems, on comparing the single rainfalls, that some of them had not been recorded at the hospital, although the

TABLE 9.

Precipitation in percentages of means within 150 miles of Philadelphia, during two-year periods of minimum precipitation, the numbers being the average per year.

Locality.	1825–26.	1834–35.	1844–45.	1848–49.	1855–56.	1863–64.	1871–72.	1874–75.	1879–80.	1880–81.
Flatbush, N. Y.	.....	89	82	76	92	76	.....	.....	.....	83
Jamaica, N. Y.	.....	80	100	80	.....	.....	.....	.....	.....	83
Fort Hamilton, N. Y.	.....	.....	79	75	90	.....	.....	.....	.....	.....
Fort Columbus, N. Y.	.....	.....	82	80	93	.....	105	98	86	89
Newark, N. J.	.....	.....	85	85	88	.....	.....	.....	.....	.....
Lumberville, N. J.	.....	.....	94	88	88	.....	.....	.....	.....	.....
Morrisville, N. J.	79	86	90	.....	85	94	.....	88	.....	.....
Philadelphia, Pa.	72	83	90	87	88	107	106	93	96	91
Pottstown, Pa.	.....	.....	.....	.....	.....	.....	.....	108	87	86
Reading, Pa.	.....	.....	.....	.....	.....	.....	.....	.....	88	99
Lebanon, Pa.	.....	86	78	82	103	114	94	92	86	88
Baltimore, Md.	.....	.....	73	83	64	88	80	92	91	107
Washington, D. C.	57	.....	.....	.....	83	93	80	87	82	93

rain was shown to have been steady and prolonged hardly a quarter of a mile away at the post office building.

It seems that the fall at the hospital may be taken at 112, if that recorded by the Signal Service is 100. Then, as the minimum rainfall at the former was assumed to be 33.6 inches, the minimum fall at the latter should be taken at 30 inches per annum.

TABLE 10.

Comparison of Rainfall, recorded by the U. S. Signal Service and the Pennsylvania Hospital, in Philadelphia.

Year.	U. S. Signal Service.	Pennsylvania Hospital.	Percentage.
1872	47.83	51.12	107
1873	54.62	58.29	107
1874	46.31	40.91	88
1875	40.19	41.84	104
1876	47.38	49.32	104
1877	37.36	45.15	121
1878	34.53	43.72	127
1879	36.75	44.65	121
1880	33.64	39.68	118
1881	30.21	40.28	133
1882	45.58	50.31	110
1883	39.17	41.28	105
1884	39.34	46.18	117
1885	33.35	40.69	122
Totals and averages	566.26	633.42	112

Elevations of Gauges.—U. S. Signal Service, 140 feet above tide. Pennsylvania Hospital, 50 feet above tide.

Distance apart—One-quarter of a mile.

The next step which became necessary was to establish the minimum precipitation upon the watersheds to be investigated. The quantity falling upon them since the beginning of the surveys has been reported every year, but not until last year was it practicable to make a comparison, because of the short period over which the observations had extended (see Table, Report, 1885). The rainfall at the various stations was expressed in percentages of the fall recorded at the Government station in Philadelphia. Unfortunately some of the totals were incorrectly printed. They should have been as follows: (*See Table 7.*)

		Inches per annum.	Per cent.
Philadelphia Series	U. S. Signal Service	37.25	100
	Water Department Office	35.29	95
	Pennsylvania Hospital	42.72	115
	Germantown	41.25	111
Schuylkill Series	Lebanon	46.72	125
	Schuylkill Haven	39.03	105
	Reading	42.91	115
	Pottstown	44.52	119
	Browers	43.68	118
Perkiomen Series	Seisholtzville	47.05	127
	Green Lane	44.19	119
	Frederick	45.41	122
Delaware Series	Easton	43.16	116
	Phillipsburg	40.57	109
	Princeton	37.74	101
	Fallsington	43.10	116
	Moorestown	41.78	112
	West Chester	50.59	136
Tohickon and Neshaminy Series	Ottsville	48.04	130
	Quakertown	43.81	118
	Doylestown	45.83	124
	Sellersville	45.57	124
	Lansdale	42.92	115
	Forks of Neshaminy	45.68	124

A longer time will be required to arrive at percentages which will represent the true mean values. For the present I have assumed the above results as being the best available data for the purpose. In order to determine from them the quantity of rain representing the average fall upon each of the water-sheds which could be used for storing water, it was necessary to carefully compare their topographical features, their mean elevation, the wooded areas, the relative amount of exposure to the rain-bringing winds and the elevation of the gauges above the surface of the ground. This comparison indicated the results as given by Table 11.

The minimum precipitation on the different water-sheds is given both in inches and in percentages of the rainfall recorded at the Signal Service Station in Philadelphia. The average minimum monthly falls are given in inches. Their relation to the annual fall was obtained from the ratios of the mean monthly to the mean annual fall at Philadelphia, as given in the first column of the table. It will be evident that the figures for each separate month cannot represent the absolute minimum for said month, but only the average minimum, and that therefore the mean monthly stream-flows, which were estimated from these figures, also do not represent an absolute minimum flow during the month, but an average. Inasmuch as the storage reservoirs hold and equalize the flow for over half a year, the latter quantity is the proper one to use in calculation.

It is to be hoped that the rainfall observations on the water-sheds in question can be continued, so that these quantities may be established with a greater degree of precision, in order to make it possible to better adjust the size of the storage basins. As the stream-flow is less than the consumption from about May 1 to December 1, the minimum rainfall of this interval should be deduced from the records of the Pennsylvania Hospital gauge, before the sizes of the storage basins are finally determined.

I have appended to this report, as Plate VIII., a specimen sheet of the rainfall charts showing how the records have been

TABLE 11.

Deduced average minimum rainfall on sundry watersheds.

	Mean monthly divided by mean annual, Signal Service, Philadelphia.	Tohickon.	Big Neshaminy.	Little Neshaminy.	Perkiomen, at Green Lane.	East Swamp.	Macoby.	Perkiomen, at Frederick.	West Swamp.	Northeast Branch.
	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.
January	0.078	2.902	2.878	2.878	2.925	2.902	2.878	2.902	2.878	2.878
February	0.070	2.604	2.583	2.583	2.625	2.604	2.583	2.604	2.583	2.583
March	0.080	2.976	2.952	2.952	3.000	2.976	2.952	2.976	2.952	2.952
April	0.079	2.939	2.915	2.915	2.962	2.939	2.915	2.939	2.915	2.915
May	0.087	3.236	3.210	3.210	3.262	3.236	3.210	3.236	3.210	3.210
June	0.092	3.422	3.395	3.395	3.450	3.422	3.395	3.422	3.395	3.395
July	0.093	3.460	3.432	3.432	3.488	3.460	3.432	3.460	3.432	3.432
August	0.105	3.906	3.874	3.874	3.938	3.906	3.874	3.906	3.874	3.874
September	0.081	3.013	2.989	2 989	3.038	3.013	2.989	3.013	2.989	2 989
October	0.075	2.790	2.768	2.768	2.812	2.790	2.768	2.790	2.768	2.768
November	0.080	2.976	2.952	2.952	3.000	2.976	2.952	2.976	2.952	2.952
December	0.080	2.976	2.952	2.952	3.000	2.976	2.952	2.976	2.952	2.952
Annual	1.000	37.200	36.900	36.900	37.500	37.200	36.900	37.200	36.900	36.900
Percentage	100	124	123	123	125	124	123	124	123	123

plotted. They admit of ready comparison, and indicate at a glance the depth of fall by the blue lines representing each separate fall, and also the rate by the degree of their inclination.

I have also appended, as Plates VI. and VII., drawings of the ordinary and of the automatic gauges. The former were made by Messrs. Schultzbach & Co., in Washington, the latter by Messrs. Black & Pfister, in New York.

STREAM-FLOW.

Not until during the present year has it been possible to present the results of the stream gaugings since the beginning of this investigation, because we had been unable to obtain certain necessary measurements of high flows until last winter, which it was essential to have before the high flows of previous years could be computed.

In former reports the methods of gauging streams have been described. It therefore remains now only to state the results thereof. The daily flow where gauge stations had been established has been tabulated, and the records are on file in the department. Tables 12 and 13 of this report show the monthly and annual yields of the streams. On Table 13 the first column gives the area, the second the average rainfall, and the last the average flow per second per square mile. I have added for comparison similar data concerning the streams supplying New York and Boston with water, viz., the Croton and Sudbury rivers. For reasons already mentioned the years have been reckoned from October 1st to September 30th. The results of only two such years could be embodied in the table. The first year shows a flow above the average and the second a flow below it. The results of the Sudbury and Croton rivers are derived from observations extending over six years. It is interesting to note that the Tohickon creek gives the greatest average yield per square mile, and the Perkiomen creek above Green Lane the next greatest, while the North East Branch of the Perkiomen gives the least.

Table 13.

Annual yield of sundry streams.

Watershed.	Area in miles.	Rain fall.	Total yield in gallons.	Average daily yield in gallons.	Average yield in cubic feet per second per square mile.
October 1, 1883, to September 30, 1884.					
Tohickon	102.2	50.08	62,819,221,766	171,637,218	2.582
Neshaminy, below Forks	139.3	48.84	68,600,047,000	187,431,000	2.159
Perkiomen, at Frederick	152.0	48.00	78,577,400,000	214,692,000	2.196
Perkiomen, at Green Lane	72.0	48.57	39,268,288,000	107,290,000	2.345
East Swamp	48.9	48.96	24,517,840,000	66,989,000	2.164
West Swamp	55.8	47.00	25,052,391,556	68,449,157	2.034
North East Branch	58.5	45.52	27,777,423,295	75,894,599	1.985
October 1, 1884, to September 30, 1885.					
Tohickon	102.2	41.21	39,729,506,573	108,847,963	1.637
Neshaminy, below Forks	139.3	38.28	41,158,207,158	112,762,211	1.299
Perkiomen, at Frederick	152.0	38.37	49,112,167,484	134,553,884	1.377
Perkiomen, at Green Lane	72.0	42.60	24,661,560,000	67,566,000	1.477
East Swamp	48.9	42.17	16,216,640,000	44,429,000	1.435
West Swamp	55.8	40.00	16,442,717,196	45,048,540	1.339
North East Branch	58.5	39.05	17,730,181,498	48,575,840	1.271
Sudbury, Mass., 6 years	70.	46.1	29,606,810,000	81,040,500	1.615
Croton, N. Y., 6 years	361.	46.5	160,600,000,000	440,000,000	1.89

Table 16 gives the maximum and minimum daily flows that have been observed in our watersheds and in those of the Sudbury and Croton rivers. It will be noticed that the least summer flow is generally found in those streams that also have the greatest winter flow. The Perkiomen at Frederick has the largest summer flow per square mile of any of the streams observed, which no doubt is due to the mountainous and wooded region near its head. The variation in the flow during the different months is very great. It is apparently even greater here than in the Croton and Sudbury rivers. The Perkiomen has a smaller maximum and larger minimum flow than the Tohickon and Neshaminy creeks, due to the somewhat greater rainfall in the higher altitudes of the Perkiomen watershed, and partly to the greater area of wooded territory, which tends to retain the water and deliver it into the streams more gradually.

Tables 14 and 15 are summaries of the flow in different streams for each month. In one table the flow has been reduced to cubic feet per minute per square mile; in the other, to ratios of the average monthly quantities. In these forms the results of our gauges have been compared with the quantities given by Fanning in his treatise on "Water Supply" for the Cochituate and Sudbury rivers in Massachusetts, and for the Croton and West Croton rivers in New York. An examination shows again that our creeks have a larger proportion of flow in the winter months and are dryer in summer than the Massachusetts and New York rivers. This is due partly to the lower latitudes of the former, permitting the accumulation of less snow, but mainly to the larger proportion of cultivated and open ground in our watersheds, which allows the rain-water to run off more rapidly.

Plate XIV is appended as a specimen of the stream-flow charts, showing the discharge for every day in the year and having for comparison both the rainfall and the daily temperature plotted. Plates XI, XII and XIII show the various stream gauges which have been previously described.

TABLE 16.

Table showing maximum and minimum daily flows in sundry streams.

Watersheds.	Maximum daily flow.			Minimum daily flow.		
	Date.	Total in gallons.	Cubic feet per sec. per square mile.	Date.	Total in gallons.	Cubic feet per sec. per square mile.
Tohickon	June 26, 1884	2,830,115,566	40.980	July 23, 1885	129,254	0.002
Neshaminy, below forks	February 10, 1885	2,898,071,067	33.390	September 28, 1885	814,303	0.009
Perkiomen, at Frederick	December 7, 1884	2,213,643,168	22.646	September 4, 1885	4,885,816	0.050
Sudbury, Mass.	March 26, 1876	2,080,000,000	41.39	1877	1,800,000	0.036
Croton, N. Y.		2,000,000,000*	7.78		10,000,000	0.039

* Probably not the largest flow.

From the facts recited it is clear not only that our streams will require very large storage reservoirs to equalize the flow for a uniform daily delivery throughout the year, but that there will be required a greater proportionate storage capacity than on the Sudbury and Croton watersheds.

In order to calculate the required amount of storage the minimum stream flow must first be determined. This quantity, as already said, is obtained from the minimum rainfall upon the watersheds. As this has been given above, it remains to discover the relation between the rainfall and stream-flows, or, in other words, the proportion of the rain-water reaching the creeks.

Tables 17, 18, and 19 contain the percentages of rain flowing off the watersheds in question. For comparison I have added the same percentages recorded for the Croton, Cochituate, and Sudbury watersheds. The last line of Table 17 gives the monthly percentages that were finally assumed for our cases. Generally they are practically the same as those found by observation during the last two and a half years, and given in the first line of the table. It was thought well to decrease them somewhat for January, February, and March in the winter, as it seemed probable that our observed results were greater than they would be for a longer term of years. The figures from June to October were likewise decreased for the same reason.

As these percentages were to be applied to the minimum and not to the average rainfall, the question arose whether they would hold good for minimum years. Inasmuch as the difference would be small, and as further time is required to establish a number of points, for instance, the actual minimum rainfall upon the watersheds, which might affect the result in a greater degree, it was deemed sufficient for the present to assume the percentages to be the same. It is evident, however, that they cannot be alike for all of the watersheds under consideration owing to the different topographical and other conditions. Yet with the limited time at our disposal and

TABLE 17.

Average Monthly Percentages of Rain flowing off sundry Watersheds.

	Jan.	Feb.	March.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
Tohickon, Neshaminy, and Perkiomen Watersheds, Pa. (average for two and one-half years)	93.9	122.9	144.0	92.3	23.2	21.3	17.8	12.1	11.8	11.6	35.7	53.4
Croton Watershed, N. Y., (average for six years)	79.7	75.0	86.7	80.6	48.4	45.0	21.0	19.4	30.1	81.1	60.4	62.1
Cochituate, Mass. (average for nine years)........	54.8	77.7	71.3	80.6	45.1	35.1	20.3	20.0	24.7	26.6	27.9	64.3
Sudbury, Mass. (average for six years)...............	45.3	93.0	96.0	108.0	106.2	23.6	8.6	14.9	15.4	15.1	32.7	86.1
Assumed Values for Watersheds near Philadelphia	90.	110.	140.	92.	23.	16.	12.	11.	8.	10.	35.	53.

with the rainfall and stream-flow observations extending over so short a time, it was decided to use them only as an average for the whole territory, leaving it for the future to discover the pereentage for each special watershed.

TABLE 18.

Annual Precipitation on Sundry Watersheds, and Percentages of same reaching the Streams.

Watersheds.	1884.		1885.	
	Rainfall.	Percentage flowing off.	Rainfall.	Percentage flowing off.
Tohickon	53.77	71	39.97	54
Neshaminy	51.28	64	38.78	46
Perkiomen, at Green Lane	51.28	64	37.50	*47
East Swamp and Rich Valley	52.44	55	37.20	*48
Perkiomen, above Schwenksville	49.90	*58	36.89	49
North East Branch	48.70	66	38.13	45

* Partially estimated.

Watersheds.	Rainfall.	Percentage flowing off.
Cochichuate, Mass	55.03	45.6
Sudbury, Mass	46.1	47.6
Croton, N. Y	46.5	57.5
West Croton, N. Y	44.43	71.0

Table 20 contains the results as derived from the above data. It gives the supposed mimimum yield for each stream for each month and the daily average for the year. It is not understood that during any one month the computed flow represents the least flow that can be counted on during the same, for Table 12 shows that this is not the case. But it is understood that for the whole minimum year there will be a general distribution resembling that which is given. As it will be necessary during such a year to draw water from large storage reservoirs capable of holding more than half a year's supply, the particular flow during one month is of no importance as compared with the average flow for several months.

The computed average minimum daily yield in million gallons from each watershed is as follows; Tohickon, 86.5; Neshaminy, 112.1; Perkiomen at Frederick, 129.3; Perkiomen at Green Lane, 60.1; East Swamp creek, 40.3; West Swamp creek, 43.4; North East Branch, 49.7.

From what was said above it will be evident that these values must be too great for some areas and too small for others. This will not be a serious matter, however, for the present purpose, as the average topographical conditions for each of the two gravity schemes remains nearly the same. The Neshaminy resembles the North-east Branch and the West Swamp creek of the Lower Perkiomen, while the Tohickon resembles the Upper Perkiomen. The error that is made will tend to give a greater quantity than would actually be available for the lower and open watersheds and a smaller quantity for the Upper Perkiomen and Tohickon. We can see that this is really the case by comparing the flows for 1885, which closely approach a minimum year, with the flows deduced by means of the assumed percentages from the minimum rainfall. Expressed in million gallons per annum the following table gives the yield of the different watersheds for 1885, the computed minimum yield and the resulting differences.

The Neshaminy, West Swamp creek and North East Branch show that the estimated minimum flows are too great, while those of the Tohickon and Upper Perkiomen are probably not large enough. Rounding off the figures and taking this point into consideration, we may designate the probable average minimum daily yield in million gallons to be as follows: Tohickon, 90; Neshaminy, 110; Perkiomen at Frederick, 130; Perkiomen at Green Lane, 61; East Swamp creek, 41; West Swamp creek, 41, and North East Branch, 46.

TABLE 20.

Average minimum flow deduced from assumed minimum rainfall.

Month.	Tohickon.	Neshaminy, below forks.	Little Neshaminy.	Perkiomen, at Frederick.	Perkiomen, at Green lane.	East Swamp.	West Swamp.	Northeast Branch.
	Cubic feet.	Cubic feet.	Cubic feet.	Cubic feet.	Cubic feet.	Cubic feet.	Cubic feet.	Cubic feet.
January	624,128,698	808,184,992	268,478,433	917,721,442	432,943,035	290,709,118	313,271,148	355,914,157
February	684,491,249	886,521,352	294,505,396	1,006,478,788	474,880,537	318,825,024	343,628,314	390,417,302
March	995,679,634	1,289,485,603	428,371,484	1,463,969,146	690,735,326	463,745,489	499,823,002	567,879,612
April	667,202,133	864,040,845	287,037,217	981,056,800	462,776,223	310,772,032	334,914,549	380,517,057
May	177,833,849	230,358,890	76,526,014	361,521,447	123,388,354	82,842,860	89,290,390	101,666,824
June	130,838,098	169,485,235	56,303,552	192,404,885	90,783,937	60,942,285	65,694,893	74,816,336
July	99,218,254	128,499,262	42,687,888	145,890,934	68,836,709	46,214,268	49,808,146	56,730,600
August	94,630,127	120,873,675	40,154,640	137,247,107	64,764,662	43,476,140	46,852,359	53,334,813
September	56,001,154	74,608,448	24,785,176	84,695,450	43,970,551	26,829,208	29,559,298	32,951,845
October	66,671,225	86,365,083	28,690,765	98,033,658	46,246,375	31,054,385	33,476,337	39,491,330
November	248,919,909	322,371,401	107,092,860	365,992,286	172,683,832	116,636,372	124,927,770	142,383,208
December	376,935,862	488,162,407	162,169,188	554,216,891	261,492,659	176,620,792	189,176,308	215,608,858
Total, cubic feet	4,222,550,192	5,468,957,193	1,816,802,613	6,309,228,834	2,933,502,190	1,968,667,973	2,120,422,514	2,411,711,938
Total, gallons	31,584,675,436	40,907,799,804	13,589,683,545	47,193,031,678	21,942,596,381	14,725,736,438	15,860,760,405	18,039,605,296
Assumed minimum rainfall	37.2 inches.	36.9 inches.	36.9 inches.	37.4 inches.	37.5 inches.	37.2 inches.	36.9 inches.	36.9 inches.
	Million galls.	Million galls.	Million galls.	Million galls.	Million galls.	Million galls.	Million galls.	Million galls.
Average daily flow, computed	86.5	112.1	37.2	129.3	60.1	40.3	43.4	49.7
Average daily flow, adjusted	90	110	35	130	61	41	41	46

Table 21.

Minimum Stream Flows in Million Gallons.

	Tohickon.	Neshaminy.	Perkiomen at Frederick.	Perkiomen at Green Lane.	East Swamp.	West Swamp.	North East Branch.
Flow for 1885	5311	5502	6565	3297	2168	2198	2370
Computed minimum flow	4222	5468	6309	2933	1968	2120	2411
Difference	+1089	+34	+256	+364	+200	+78	—41

It was found that a uniform delivery of 25,000,000 gallons a day from the Neshaminy dam would supply all the mills below it and obviate the necessity of paying damages to riparian owners. This quantity of water has been provided for in the estimates, and it may be added that the 25,000,000 gallons can, if properly utilized, develop two hundred and fifty horse-power at the dam in descending to the stream.

But while it is possible to spare enough water for compensation from the Neshaminy creek, owing to the practicability of pumping any deficiency from the Delaware river at Point Pleasant, it is not possible to spare it in the Perkiomen valley without curtailing the available supply for the city. During the dry seasons the entire quantity would be needed by it. I have therefore included in the estimate for the Lower Perkiomen scheme the value of all the mill privileges between Schwenksville and the Schuylkill river, amounting to $130,000, and in the estimate for the Upper Perkiomen scheme between Green lane and the Schuylkill, amounting to $160,000. These figures are included in the amount given in Table 35 under the heading "Cost of Storage." If a compensation of 25,000,000 gallons daily must be given to the riparian owners, the available amount for the city from the Perkiomen would be reduced to 169,000,000 gallons during the years of minimum rainfall.

The Delaware river below Point Pleasant (see Table, page 351, Report of 1885), having a minimum flow at this point of some 1,500,000,000 gallons daily, would not be damaged by the extraction of 200,000,000 gallons.

Storage Reservoirs.

From an inspection of the territory and with the assistance of the topographical maps all the available sites for storage or impounding reservoirs were noted. Tables 22, 23, and 24 give a list of the same, with their principal features indicated, together with the cost of storage in each case. Time did not permit of making as detailed a study of the more important ones as would be desirable for an accurate estimate of the cost. The capacities were computed from the contour lines as taken from the general maps, and the profiles of the sites for dams were taken in most cases likewise from the contour maps, special surveys having been made only in a few cases. For preliminary estimates, however, the results are sufficiently close. Plate I. is a general map of the entire water-shed investigated, showing all the reservoir sites that were considered. The total storage capacity in the Tohickon watershed is over 25,000,000,000 gallons, and in the Neshaminy about 23,400,000,000 gallons. In the Perkiomen watershed there is a capacity beyond what could be used, and a selection of the best and least expensive sites was possible. In the Lehigh watershed rough approximations had to be made because there was no time for more detailed work, nor did the necessities of the case absolutely demand it.

The natural facilities for impounding water in most of the valleys are quite good, and the expense is therefore not excessive. The cost of the principal reservoirs, for instance, is as follows:

Tohickon valley at Haycock, about 18,000 mill. gal. at $82.53 per mill.
Perkiomen valley at Green Lane, about 12,000 mill. gal. at $93.88 per mill.
E. Swamp creek val. at Millville, about 8,000 mill. gal., at $103.13 per mill.
W. Swamp cr. val. ab. Zieglersville, about 12,000 mill. gal. at $76.21 per mill.
N. E. branch at Lederachville, about 15,000 mill. gal. at $100.20 per mill.

The average cost of the storage basins in the Croton valley is given at $200 per million gallons, and the estimated cost of the large Croton reservoir, about to be built, as $125 per million gallons.

In order to select the reservoirs that are required from the list contained in Table 22, it is necessary first to ascertain the amount of storage which must be provided in each valley to equalize the flow.

TABLE 25.

Relative consumption of water in Philadelphia.

Average daily amount in percentage of annual mean.

January	106	July	92
February	98	August	101
March	94	September	111
April	85	October	114
May	85	November	115
June	88	December	111
Year	100		

With the data contained in the previous pages, it would now be possible to estimate the same for the constant delivery of a uniform daily supply. As the supply, however, is not quite uniform, the summer months showing a greater consumption per day than those of the winter, it remains to ascertain what quantity of water is likely to be needed during each month. Table 25 has been prepared for this purpose from the experience gained in Philadelphia during the last six years. The values are percentages of the average daily supply for the year, or the actual number of million gallons per day, if the average daily supply for the year is 100,000,000 gallons. It will be seen that while in August the consumption is 15 per cent. greater, in January and February it is 15 per cent. less than the average.

The quantity of water which must be impounded in a given watershed increases in a greater ratio than the supply to be daily furnished. As the latter becomes greater in proportion, not only a larger quantity of stored water must be drawn, but it must be drawn for a longer time, because the period when the stream carries a deficient amount becomes longer.

In the Sudbury watershed, in order to furnish 70,000,000 gallons daily, a storage capacity is required of 2,909,000,000 cubic feet, and for 40,000,000 gallons daily, a capacity of only 450,000,000 cubic feet is needed. The reservoir capacity is in a ratio of $6\frac{1}{2}$ to 1, while the daily supplies are in a ratio of $1\frac{3}{4}$ to 1.

In the Croton watershed, in order to furnish 100,000,000 gallons daily, a storage capacity of 1,200,000,000 cubic feet is required; for 200,000,000 gallons a capacity of 4,000,000,000 cubic feet, and for 300,000,000 gallons daily, a capacity of 7,300,000,000 cubic feet. The reservoir capacity is in a ratio of 6 to $3\frac{1}{2}$ to 1, while the daily supply is in a ratio of 3 to 2 to 1.

It is evident that the expense of storage becomes comparatively great when the amount of water used approaches the total flow of the streams.

From the average minimum daily yield of the creeks that we are considering, it will be seen that the entire flow during years of minimum rainfall must be impounded in order to furnish the required supply.

With the above data it is now possible to compute the necessary storage capacity for each valley. Tables 26 to 31 inclusive, give the results for the Tohickon, Neshaminy, Perkiomen at Green Lane, East Swamp, Perkiomen above Schwenksville, and the North East Branch valleys. Column 1 in each table contains the monthly stream-flow; column 2 the loss by evaporation and percolation from the reservoirs; column 3 the water consumption for each month; column 4 the water added to or drawn from the reservoirs, and column 5 the water stored in the reservoir at the end of each month.

Inasmuch as May is usually the first month in which the consumption exceeds the stream-flow, it has been assumed that the reservoir shall be full at the end of April. At the end of November, on the other hand, the reservoirs would be drawn down to the lowest point.

To provide for the contingency of an extremely dry summer and fall, and also to prevent the necessity of drawing all the water from the reservoir at any time, it has further been assumed that the amount of water in the reservoir at the end of November should be equal to two months' consumption.

In order to study this question further, the lowest possible rainfall for the seven months, from May 1 to November 30, should be carefully considered with the aid of the long record at Philadelphia given in Table 5.

With these conditions the tables give the following requisite storage capacities and the greatest mean daily supply for the different watersheds:

Tohickon, 2454 mil. cu. ft., 80 mil. gals. daily.

Neshaminy, 3181 mil. cu. ft., 101.3 mil. gals. daily.

Perkiomen, at Green Lane, 1705 mil. cu. ft., 52.8 mil. gals. daily.

East Swamp creek, 1144 mil. cu. ft., 36.2 mil. gals. daily.

Perkiomen, above Schwenksville, 4829 mil. cu. ft., 151.2 mil. gals. daily.

North East Branch, 1402 mil. cu. ft., 43.5 mil. gals. daily.

It will be seen that the Tohickon and Neshaminy, embodying together one project, could not furnish more than 181.3 million gallons daily; the entire Perkiomen, above Schwenksville, together with the North East Branch, not more than 194.7 million gallons; and the Perkiomen, above Green Lane, with the East Swamp creek, only 89,000,000 gallons.

At the beginning of the investigation it appeared probable that a very close discrimination might be required between the different watersheds, because their general character was quite similar. Besides making a careful topographical survey and gauging of the rainfall and stream-flow at as many points as possible, it was thought desirable also to have at hand whatever data might otherwise throw light on the relation between the rain and stream-flow from the separate areas. It was therefore concluded to abstract the following data from the topographical maps, which would assist in this direction. The areas were divided into vertical sections; the first comprising all the territory between 0 and 200 feet elevation; the second that between 200 and 400 feet elevation, and so on, each section being bounded by a 200 feet contour line. This division would facilitate the making of a mean profile of the areas and of their respective surface characteristics, with which a better interpretation of the above relation might be obtained.

The surface characteristics noted were the areas of the ground slope less than 2 feet per 100, between 2 feet and 20 feet per 100 and over 20 feet per 100; also the areas of the roads, of the cultivated soil, of the wooded and untillable ground and of the swamps and meadows. Tables 2 and 3 contain these data.

In addition to this compilation some field work was undertaken, which, in connection with other work, could be done without much expense. Certain areas of different surface characteristics were staked out, a rain gauge set up in the middle of each, and a meter placed at the lowest point to measure the water which ran off during each rain. A comparison of the general rain and stream-flow with the data in the above compilation would have been very much facilitated by these observations.

Should the progress of the investigation have made it certain that only stored water from the Perkiomen and neighboring watersheds could be used for a future supply, it would have been necessary to enter into the question of storage and available quantity more fully, and these data would have become useful. As, howewer, the economy of procuring the Delaware water at Point Pleasant and the superior quality of the water in the Tohickon watershed as compared with the Neshaminy, and particularly of the Lower Perkiomen, became evident, it was not considered essential to spend the necessary time for the comparison outlined above. The deductions which have been made above and the results reached therefrom were considered sufficiently close under the circumstances.

After having determined the amount of storage required, the most suitable reservoirs from among those given in Table 22 were chosen. It was evident that certain reservoirs were absolutely necessary, although their selection incurred either a heavy expense or other disadvantages. For instance, Reservoir No. 7 at Schwenksville had to be selected, although flooding several villages, because the water required a delivery at a certain elevation, and Reservoir No. 1 at Sumneytown required a long conduit to deliver the water into the main aqueduct.

Among determining elements also the following should be considered. The larger the reservoirs the better will be the quality of the water. A large surface facilitates wave action, and thereby a better aeration of the water, which is quite essential where the creek water to be stored comes from agricultural areas. Large and long reservoirs act also as excellent settling basins, because the slow velocity of the water passing through them allows the suspended particles to settle. Deep reservoirs, further, keep the water cooler, cause less evaporation, and retard the growth of organic matter. Steep banks allow a minimum amount of surface to be alternately wet and dry, consequently to develop low vegetation which is injurious to health. Table 23 gives the flooded areas for each 10 feet elevation, and permits this point be to readily considered. The lower down the reservoirs are in the valley the more rapidly will rains fill them after having been drawn down.

The geological structure of the valley sometimes has a great effect on its ability to store water. If the stratification across the valley is synclinal, it will favor the retention of the water, while if it is anticlinal it will facilitate leakage. Fissured trap rock which forms the dyke at Schwenksville through which the Perkiomen has worn its path, would allow water to escape more readily than compact rocks. The question of percolation has, however, not been considered a serious one. The water from all the creeks is more or less muddy after rains, and the fine silt will in a short time close the pores of the porous materials and practically make them water-tight. Want of funds precluded a geological survey of the proposed reservoir sites.

On the Neshaminy watershed every one of the available sites is needed to furnish the required supply. In the Tohickon valley Reservoirs No. 1 and No. 2 were selected as being the best. For the Upper Perkiomen scheme it was necessary to consider the proper storage in each of the several valleys. In that of the East Swamp Creek Reservoirs No. 1 and No. 2 were chosen, although not particularly favorable sites. Reservoir No. 5, at Green Lane, was the best one for storing the water of the Perkiomen, and Reservoir No. 8, at Dale Forge, for storing the water of the West Branch. Reservoirs No. 1 and No. 8 were the best in the valleys of the North East Branch and the West Swamp creek. Reservoir No. 7, finally, was necessary to store the water above Schwenksville.

Table 32 gives the list of these reservoirs, with their capacity and cost. It will be seen that the average cost per million gallons is $122.70 for the Tohickon, $165.89 for the Neshaminy, $133.61 for the Upper Perkiomen, $135.31 for the Perkiomen above Schwenksville, and $100.20 for the North East Branch. A brief description of the selected reservoirs follows:

Reservoir No. 1 of the Tohickon watershed was located at a point about one mile north of Point Pleasant, where the valley is quite narrow, and separated from the Delaware river by a distance of only 1700 feet, which makes its location favorable for an extension of the aqueduct further up the Delaware river. The dam will also serve the secondary purpose of a crossing for the aqueduct when extended, thus saving the expense of syphoning. The height of the dam at the deepest point is about 150 feet, including the foundation, and the extreme length is 946 feet. The flooded territory covers an area of 316 acres, which is about one-half covered with timber, and is of little use for cultivation, owing to the steep rocky nature of the ground. There would be flooded: 1 grist-mill, 1 grist and saw-mill, 6 dwellings, and 2 barns. There is also 1 grist and saw-mill below the dam, which would have to be abandoned.

Reservoir No. 2 is located on the Tohickon creek, just below the mouth of Haycock run, and forms a very large reservoir, being capable of storing about 18,000 million gallons, and extending back 7½ miles. For the most part the valley is favorable for a reservoir, the slopes drop off quickly and the valley widens above the dam to large proportions. The territory to be flooded is mostly under cultivation, the wooded area not being more than about one-third of the whole. The dam is 100 feet high above the creek, and 1,510 feet long. It floods an area of 1,829 acres, with 7 grist and saw-mills, 2 creameries, 1 tannery, 35 dwellings, and 27 barns.

It was found that while there was an abundance of storage capacity on the Little Neshaminy, only a portion of the flow could be stored in the valley of the Big Neshaminy without going to a great expense. By a fortunate circumstance it is practicable to store the water of the latter in the reservoir of the former by connecting the two valleys with a short tunnel 12 feet in diameter. Reservoir No. 1 is situated on the Little Neshaminy, three-fourths of a mile above its mouth. It has a favorable site for a dam, as the sides of the valley approach each other sufficiently to make its extreme length 1,550 feet, and extreme height 98 feet, while the valley opens out to three-fourths of a mile in width. The slopes of the reservoir vary from steep to nearly level, but for the most part they are steep. The dam backs water over 2,531 acres, of which 189 acres are wooded, and it floods 88 buildings, as follows: 4 grist-mills, 2 saw-mills, 2 school-houses, 2 chapels, 1 creamery, 41 dwellings, and 36 barns.

Owing to the great width between the banks, and the bays formed by tributary creeks, the cost of changing the location of the roads and of bridging is very large.

The Big Neshaminy is such a wide and open valley throughout that it was difficult to decide on a suitable location for a dam. The point selected is 1¾ miles above the forks. The right bank of the valley rises up almost perpendicularly over 100 feet, but the left bank rises gradually at a grade of about 7 feet per hundred to the proposed height of the top of the aqueduct, from where it continues nearly level for a distance of over 4,000 feet, thus requiring a very long dam. It is proposed to build 1,200 feet of masonry across the valley, and the remaining 4,725 feet of earth. The greatest height of the dam, including foundations, is 89 feet, and the area flooded covers 2,273 acres, of which 203 are wooded. The territory flooded has a long, irregular shape, its length is about 11 miles, and it reaches as far back as New Britain. The slopes of the valley average from 5 to 12 feet per 100 over a surface that will alternately be covered with water and again exposed, except at the extreme upper end, where level and shallow areas occur that will have to be kept flooded by subsidiary dams. The storage capacity of the reservoir is not more than one-half of the size required to store the minimum flow of the stream, the remainder being provided for in Reservoir No. 1 on the Little Neshaminy. Seventy-two buildings will be flooded, viz.: 7 grist and saw mills, 1 store, 1 schoolhouse, 38 dwellings, and 25 barns.

Reservoir No. 3, on the north branch of the Neshaminy, floods an area of 369 acres, which is nearly all cultivated. The average slopes of the sides of the valley are about 5 feet per 100. The height of the dam is 47 feet, and its length 1,420 feet. The sites of 1 mill, 7 dwellings, and 2 barns will be submerged.

Reservoir No. 1 of the Upper Perkiomen is located on the East Swamp creek, above Sumneytown. The dam is 71 feet high and 1,030 feet long, and floods a valley of 196 acres heavily wooded. The sides of the valley are steep and in some places precipitous, forming a deep and narrow reservoir. The country is of little value for farming purposes. The dam floods 2 mills, 8 dwelling-houses, and 2 barns. If not used in connection with the Lower Perkiomen scheme it will be necessary to connect this reservoir and Rich Valley creek with the main aqueduct at Green Lane or Perkiomenville by constructing a branch conduit.

Reservoir No. 2 is located on the East Swamp Creek below Millville, and covers over 1,648 acres, of which 232 are wooded. The valley at the lower end has steep slopes, but the upper portion is comparatively level, so that about two-thirds of the reservoir has a shallow depth varying from 10 to 20 feet, which is exposed when the water is drawn down The dam is 55 feet high, including foundation, and 800 feet long. It floods 5 grist and saw mills, 1 hotel, 24 dwellings, and 7 barns.

Reservoir No. 5 is located on the Perkiomen creek just above Green Lane. The site is a very favorable one for a dam, the valley being narrow and steep at this point, and widening out above it to large proportions. The territory flooded covers an area of 1,705 acres, of which 209 are wooded. The reservoir slopes are steep for the most part as far up as Red Hill. Above this point they begin to flatten, and in some cases become nearly level, forming shallow areas from 10 to 15 feet deep, exposed during low water. Seventy-nine buildings will be flooded, viz., 6 grist and saw mills, 36 dwellings, and 37 barns. The height of the dam, including foundations, is 95 feet, and the length is 634 feet. About one-third of the territory flooded is good farming country.

Reservoir No. 8 is situated on the west branch of the Perkiomen creek near Dale Forge. It is the highest of all the reservoirs proposed, being 609 feet above tide-water, and floods only a few important buildings. The height of the dam is 78 feet, and its length 384 feet. The flooded area is 226 acres.

Reservoir No. 1 of the Lower Perkiomen scheme is located on the North East Branch west of Lederachville. The dam is 100 feet high and 4,025 feet long, more than half of which has an average depth of only 8 feet. The dam floods an area of 1,928 acres, of which 117 are wooded. The slopes of the reservoir are generally good, and there are but few shallow places except at the extreme upper end. The area flooded is generally good farming land, with 99 buildings, as follows: 5 grist and saw mills, 1 meeting house, 1 hotel and store, 58 dwellings, and 34 barns. This reservoir is connected with the main aqueduct by an auxiliary conduit nearly one mile long.

Reservoir No. 7 is located on Perkiomen creek, above Schwenksville. The dam is to be built in the gorge at Zieglersville station, and floods 2,307 acres. Its capacity is limited only on account of the villages Green Lane and Sumneytown, which are situated on the proposed banks of the same. The available depth of water is only 12 feet. The dam is 99 feet high and 1,430 feet long. Two small villages, viz., Frederick Station and Perkiomenville, are flooded out entirely, and of Sumneytown and Zieglersville the lower buildings.

The slopes of the valley are good, aud about one-seventh of the flooded area is wooded. Two hundred and fifty-four buildings would be submerged, viz., 15 grist and saw mills, 1 planing-mill, 1 powder-mill, 4 hotels, 1 tannery, 2 creameries, and the remainder are dwelling-houses, barns, and ice-houses. From the proposed dam to near Green Lane the present line of the Perkiomen Railroad would also be flooded, and an estimate was made for the following new location: Leaving the present line south of Schwenksville, and extending up the valley to the left at a maximum grade of 50 feet per 100, it crosses the proposed reservoir south of Zieglersville, and then extends due north until it again reaches the present line just below Green Lane. In this reservoir, and also in the following one, the change of roads, bridges, etc., will be very costly on account of the large area and configuration of the territory flooded.

Reservoir No. 8 is located on the West Swamp creek, a little over three miles above its mouth. The location for the dam is the most economical one of any that have been proposed. The valley at this point is a narrow gorge, and immediately above it widens out into a large basin of 2,301 acres. The reservoir thus formed covers a flat and nearly level country, so that over a large portion the water is very shallow. The slope of the ground averages not more than 2 feet per 100, which leaves a large area exposed at low stages of the water. The country is a good farming district with very little woods, the latter covering about one-tenth of the area. The dam is

85 feet high and 498 feet long. Five grist and saw mills, 1 tannery, 3 stores, 51 dwelling-houses, and 28 barns would be submerged.

WATER-POWER AT POINT PLEASANT.

The economical feature of the project for obtaining water at Point Pleasant lies in the existence of an undeveloped water-power sufficient to raise into the aqueduct a daily quantity of Delaware water equal to 120 million gallons during the low-water stage.

A close examination with a view of utilizing the same was made last spring. The site of the proposed dam is above the bridge; its elevation is assumed at 85 feet above tide-water, which backs the water to the head of Wharford's First Rift, or about one and one-half miles, and gives an available head of 15 feet. The flood waters, based on the freshet of 1862, would raise the level of the pool 20 feet. It would therefore be necessary to raise the tracks of the Belvidere Division of the Pennsylvania Railroad about 10 feet, and to protect the canal at the proposed dam with double gates, to be used in times of extreme high water.

The minimum flow of the river was assumed at 1,500 million gallons per day (see Table, page 351, Report of 1885). Deducting the quantity to be raised into the aqueduct, there will remain enough water to supply power equivalent to 3,640 horse-power. Assuming that the motors employed will utilize 80 per cent. of the theoretical power, there will remain 2,912 actual horse-power. The aqueduct at Point Pleasant is 217 feet above tide-water. Adding for friction, etc., the lift of the pumps would be 137 feet. The pumping mains are 30 inches in diameter, and the distance to the aqueduct is 600 feet. The velocity in the same is assumed to be 3½ feet per second. Computing the loss by friction of the pumps at 3 per cent., it is found that 117,463,000 gallons can be raised into the acqueduct every twenty-four hours during the lowest stages of the river. As it is practicable to supply a much larger quantity of water during ordinary stages of the river, and at favorable times to pump into the lower storage reservoir of the Tohickon valley, I have assumed the available capacity of the Delaware river to be 120 million gallons per day with a slight increase of cost.

Table 33 gives the cost of the water-power in detail as prepared by Mr. Harvey Linton, assistant.

Table 33.

Cost of Water-power at Point Pleasant.

23,191 cubic yards masonry in dam, protection-wall, fore-bay and foundations for pumping-engines, at	$15 00	$347,865 00
1,106 cubic yards coping	30 00	33,180 00
300 wrought-iron dowel-pins, 3" x 2 feet = 14,333 pounds, at	03	430 00
Drilling for dowel-pins, 150 days, at	3 50	625 00
500 cubic yards riprap, at	1 00	500 00
12,153 cubic yards rock excavation, at	2 00	24,306 00
36,100 cubic yards earth excavation, at	75	27,075 00
30,000 square feet shoring, at	04	1,200 00
7,220 cubic feet of timber in coffer-dam, at	48	3,465 00
5,388 pounds ¾-inch iron bolts, at	03	161 60
1,000 cubic yards puddling for coffer-dam, at	1 00	1,000 00
Pumping water from coffer-dam and foundations		5,000 00
2½ miles grading and track laying Belvidere Division Pennsylvania Railroad		20,000 00
Water-power privilege and fifty acres of land		50,000 00
Buildings for pumping station		50,000 00
Damages to buildings and property near site of proposed dam		4,000 00
12 30-inch mains, each 600 feet in length, = 2,884,960 pounds cast iron, at	15	43,274 40
7,200 lineal feet trenching, jointing, and laying, at	1 00	7,200 00
500 cubic yards soiling, at	40	200 00
15 double acting pumps, at	15,500 00	232,500 00
15 turbines, each 84" diameter, at	2,000 00	30,000 00
Setting turbines and pumps, including foundation excavation		18,750 00
15 gates at discharge chamber, at	200 00	3,000 00
		$903,732 00
Add 20 per cent. for contingencies		180,746 40
		$1,084,478 40

PERSONNEL.

The following persons have been engaged on the work:

Engineer Corps.

F. L. Paddock, Principal Assistant, June 1, 1883, to July 31, 1886.

Harvey Linton, Assistant, May 20, 1883, to February 28, 1886.

C. S. Gowen, Assistant, June 24, 1883, to February 28, 1884.

H. W. Sanborn, Assistant, July 20, 1883, to May 31, 1886.

Geo. B. Mifflin, Assistant, June 12, 1883, to June 30, 1886.

W. T. Forsythe, Assistant, June 10, 1883, to November 30, 1885.

Kenneth Allen, Assistant, May 30, 1883, to November 30, 1885.

A. P. Berlin, Assistant, July 19 to September 4, 1883.

E. C. Bull, Sub-assistant, June 5 to December 20, 1883.

C. E. Taylor, Sub-assistant, June 18, 1883, to November 30, 1885.

George S. Cheney, Sub-assistant, June 4, 1883, to October 31, 1885.

William E. Parker, Sub-assistant, September 10, 1883, to June 30, 1886.

H. A. Schofield, Sub-assistant, May 28, 1883, to June 30, 1886.

Amasa Ely, Sub-assistant, May 28, 1883, to date.

E. A. Miller, Sub-assistant, June 1, 1884, to July 31, 1886.

J. P. Watson, Rodman, June 1 to December 31, 1884.

William S. Gleim, Rodman, July 14, 1884, to May 30, 1885.

H. Taylor, Rodman, September 24 to December 24, 1884.

A. P. Allen, Rodman, September 1 to October 31, 1884.

F. D. Jones, Rodman, November 1 to December 24, 1884.

R. T. Vaughan, Rodman, May 30 to December 22, 1883.

Max Atlee, Rodman, May 28 to December 22, 1883; June 1 to July 12, 1884.

Jacob Stadleman, Rodman, June 4 to July 7, 1883.

Isaac Forsythe, Rodman, June 4 to December 20, 1883.

C. P. Bassett, Rodman, July 23 to August 17, 1883.

E. S. Crawley, Rodman, June 25 to September 8, 1883.

H. C. Shurtleff, Rodman, October 2 to December 11, 1883.

Benjamin Franklin, Rodman, July 17 to August 17, 1883.

E. S. Campbell, Rodman, August 20 to September 8, 1883.

G. A. Luccareni, Rodman, September 6 to October 31, 1883.

George W. Wood, Axman and Gauger, at Frederick, Montgomery county, June 4 to December 22, 1883; June 7 to December 20, 1884; May 1, 1885, to date.

J. G. Hillsman, Gauger at Forks of Neshaminy, June 30, 1883, to date.

R. C. Stover, Gauger at Point Pleasant, January 1, 1884, to date.

Ross Kirk, Chainman, July 9 to November 3, 1883.

Thomas Jamison, Chainman, June 5 to December 20, 1883; June 10 to December 31, 1884.

Special Work.

Dana C. Barber, Sanitary Surveyor.

R. H. Sanders, Geologist.

Murray Rush, Appraiser.

Department Observers.

J. Kirk, Forks of Neshaminy, January 1 to May 14, 1884.

J. Wisler, Schwenksville, January 1 to May 1, 1884.

N. S. Renninger, Green Lane, July 24, 1883, to April 1, 1884.

G. H. Hart, Pennsburg, September 9, 1883, to June 1, 1884.

G. W. Roth, Ottsville, September 1, 1883, to August 1, 1884.

Thomas H. Walton, Doylestown, October 5, 1883, to December 31, 1885.

Dr. J. A. Roth, Seisholtzville, June 1, 1884, to date.

J. H. Steltz, Green Lane, December 1, 1884, to December 31, 1885.

Edwin F. Heavner, Ottsville, August 1, 1884, to date.

Dr. C. D. Fretz, Sellersville, May 24 to December 31, 1885.
H. L. Shull, Lansdale, May 1, 1884, to date.
George Lowder, Smith's Corner, January 15, 1886, to date.
Albert Stover, Point Pleasant, October 23 to December 31, 1885.

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Serg. C. H. Kitchel, U. S. Signal Service, Philadelphia.
Serg. L. M. Dey, U. S. Signal Service, Philadelphia.
Mr. E. F. Smith, Chief Engineer Canals, Reading, Pa.
Mr. Thomas Meehan, Germantown, Pa.
Pennsylvania Hospital, Philadelphia.
Mr. Thoman J. Beans, Moorestown, N. J.
Dr. Charles Moore, Pottstown, Pa.
Mr. S. B. Lehman, Lebanon, Pa.
Milnor Gillingham, Fallsington, Pa.
Mr. M. McNeill, Princeton, N. J.
Mr. J. L. Heacock, Quakertown, Pa.
Miss Emily Kent, Phillipsburg, N. J.
Prof. S. J. Coffin, Easton, Pa.
Dr. J. C. Green, West Chester, Pa.

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Col. H. M. Robert, Corps of Engineers, U. S. A.
Pennsylvania Railroad Company.
Philadelphia and Reading Railroad Company.
Lehigh Valley Railroad Company.
Joseph S. Harris, President Lehigh Coal and Navigation Company.
Prof. James Hall, Geologist, New York.

It is due to the members of the corps, and particularly to Mr. F. L. Paddock, Principal Assistant, to state that they displayed praiseworthy industry and skill, without which it would not have been possible to complete the investigation within the given time, nor for the available funds.

General Conclusions.

It remains now briefly to recapitulate the final conclusions that have been arrived at from the examinations described above. In making these investigations it has been taken for granted from the outset that the water from any point in the Schuylkill river, and from any point in the Delaware river below Trenton, will not be of a sufficiently good quality to furnish a future supply for the city, although the fact has been admitted that at present the Delaware water at Lardner's Point, within the city limits, is not only fairly good, but is likely to remain so for some time.

In looking about for an improved supply every practicable scheme was considered. No success could be expected from a supply by artesian or driven wells in this locality, nor would filtering or purifying the water of the Schuylkill or Lower Delaware give permanent satisfaction. The only schemes worth investigating were those which bring to the city the water of running streams in the Schuylkill, Delaware, or Lehigh watersheds.

It required but little thought to see that the water from the streams north of the Blue mountains would be the best available in quality not only now, but for an indefinite future, and that this region would therefore have to be the ultimate source of water supply for Philadelphia, and probably also for other cities lying between the mountains and the seaboard.

To obtain an intelligent opinion on the cost of such a supply, surveys and examinations were made which showed that inasmuch as water of good quality can be secured at a less expense from nearer localities, it is not advisable at once to go to the Blue mountains.

In adopting a scheme for an earlier future, this ultimate source, however, should be considered, so that the aqueducts now constructed could be available for the final source of supply. The quantity of water which it was thought best to calculate for at present was at least 200,000,000 gallons per day, or more than double the present consumption. The elevation at which the water should be delivered was fixed at about 170 feet above datum (the height of the present basin at Wentz's farm and the proposed basin at Cambria), because it gives the most favorable distribution for the city.

The streams offering a good water supply nearer than the Blue mountains are the Perkiomen creek, a tributary of the Schuylkill river, the Tohickon and Neshaminy creeks, tributaries of the Delaware river, and the Delaware river itself, above Trenton. In point of quality the water of the latter has been found to be the best; that of the Upper Perkiomen and Tohickon creeks comes next in quality; and that of the Neshaminy and Lower Perkiomen creeks is least good.

An estimate of the cost of obtaining Delaware water alone (Table 34) indicates that above Lardner's Point the most economical scheme is to bring it from Point Pleasant, as stated in the last report, because the river has quite a descent near this place, which materially reduces the height of pumping as compared with points lower down the river, such as Lumberville, New Hope, and Yardleyville. Another advantage gained by this sudden descent is the water power, which can be developed to furnish a daily supply of 120,000,000 gallons during the dry season.

The cost of the aqueduct, pumping plant, and capitalized cost of pumping amount to $19,622,543, if 210,000,000 gallons of water daily are pumped by steam, and to $15,475,262, if only 120,000,000 gallons are pumped by water and the remainder by steam.

Purely gravity supplies, without pumping (Table 35), can be obtained from either the Perkiomen creek or from the Tohickon and Neshaminy creeks combined. The latter project cannot be made to furnish a daily supply of over 156,000,000 gallons in years of minimum rainfall. While the water furnished by the Tohickon and Upper Perkiomen creeks is good, that which is taken from the Neshaminy and Lower Perkiomen, as already stated, will be of much inferior quality. Neither of these purely gravity schemes would therefore be quite satisfactory.

The cost of procuring a supply from the Perkiomen creek is $13,674,493, and from the Tohickon and Neshaminy creeks together, $13,846,662.

Finally, a combined gravity and pumping scheme (Table 36) is possible by procuring water from the Tohickon creek and from the Delaware river at Point Pleasant. The former can furnish on the average between 90,000,000 and 100,000,000 gallons per day by gravity; in minimum years only 80,000,000 gallons can be depended upon. The Delaware river, as we have seen, can furnish 120,000,000 gallons by water-power. Both the Tohickon and Delaware waters have been found not only to be of good quality, but much better than the waters of the Neshaminy, and particularly of the Lower Perkiomen creeks.

The cost of this scheme is $12,695,941, if the water power is utilized, and $17,717,025, if steam-power is used.

It is therefore clear that the best and most economical project to supply the city of Philadelphia with water is to bring to it the Tohickon water by gravity, and to pump from the Delaware river, at Point Pleasant, by water-power.

In order to perceive the relative values of the different schemes with still more distinctness, I have made three estimates, one for completely filling the aqueduct, one for furnishing 150,000,000 gallons, and one for only 90,000,000 gallons per day (See Table 37).

To supply the latter quantity of water from the Perkiomen creek requires an expenditure of $10,495,000. In bringing

90,000,000 gallons daily from the Delaware watershed, it is found that the Neshaminy creek alone could furnish the amount, except during years of minimum rainfall, at a total expense of $7,875,000. The Tohickon creek also could furnish a quantity up to 90,000,000 gallons, except during very dry years, at a cost of $10,008,000. If the Delaware water at Point Pleasant is used, the cost for 90,000,000 gallons is $12,775,000, if pumped by steam, and $9,673,000, if pumped by water-power. At Lardner's Point the cost would be $7,064,000.

TABLE 37.

Cost for delivering 90, 150, 210 million gallons daily.

A, 90,000,000 gallons daily.

Delaware River, at Lardner's Point, pumping by steam	$7,064,000 00
Neshaminy Creek, by gravity	7,875,000 00
Delaware River, at Point Pleasant, pumping by water-power	9,673,000 00
Tohickon Creek, by gravity	10,0'8,000 00
Perkiomen Creek, above Green Lane, by gravity	10,495,000 00
Perkiomen Creek, above Schwenksville, by gravity	11,167,000 00
Delaware River, at Point Pleasant, pumping by steam	12,775,000 00

B, 150,000,000 gallons daily.

Delaware River, at Lardner's Point, pumping by steam	10,415,000 00
Tohickon Creek, by gravity, and Delaware River, at Point Pleasant, pumping by water-power	11,215,000 00
Perkiomen Creek, above Schwenksville, by gravity	12,139,000 00
Tohickon and Neshaminy Creeks, by gravity	13,597,000 00
Tohickon Creek, by gravity, and Delaware River, at Point Pleasant, pumping by steam	14,275,000 00
Delaware River, at Point Pleasant, pumping by steam	16,355,000 00
Perkiomen Creek, above Green Lane, and Lehigh affluents, by gravity	17,635,000 00

C, 210,000,000 gallons daily.

Tohickon Creek, by gravity, and Delaware River, at Point Pleasant, pumping by water-power	12,695,941 00
Northeast Branch and Perkiomen, above Schwenksville, by gravity	13,674,493 00
Delaware River, at Lardner's Point, pumping by steam	13,766,085 00
Delaware River, at Point Pleasant, pumping by water-power and by steam	15,475,262 00
Tohickon Creek and Neshaminy Creek, by gravity, and Delaware River, at Point Pleasant, pumping by steam	17,174,998 00
Tohickon Creek, by gravity, and Delaware River, at Point Pleasant, pumping by steam	17,717,025 00
Perkiomen, above Green Lane, and Lehigh affluents, by gravity	18,833,400 00
Delaware River, at Water Gap, by gravity	19,278,061 00
Delaware River, at Point Pleasant, pumping by steam	19,622,543 00

Therefore, to supply the city with 90,000,000 gallons daily of good water, which is the present consumption, the cheapest project is to pump the Delaware water at Lardner's Point, the next is the Neshaminy scheme, and the third is pumping Delaware water at Point Pleasant.

To increase the supply to 150,000,000 gallons requires a total expenditure of about $12,139,000, if the Perkiomen water only is used, and a total expenditure of about $17,635,000, if no water is taken from below Green Lane, and the deficiency supplied from the eastern affluents of the Lehigh river above the Lehigh Gap.

On the Delaware areas the water stored from the Neshaminy and Tohickon creeks together could furnish an amount up to 156,000,000 gallons at a cost of $13,846,662. If, instead of using the Neshaminy water, Delaware water is pumped at Point Pleasant the cost would be $14,275,000, if steam, and $11,215,000, if water-power is employed. To supply Delaware water only would cost, if pumped by steam at Point Pleasant, $16,355,000, and at Lardner's Point, $10,415,000.

For supplying 150,000,000 gallons daily therefore from beyond Lardner's Point, the project contemplating the use both of the Tohickon and Delaware water at Point Pleasant, pumping the latter by water-power is the least expensive one.

Finally, to increase the supply to 210,000,000 gallons, the Point Pleasant scheme, as already stated, is again the most economical one, besides furnishing decidedly the best quality of water.

It therefore appears with sufficient clearness, I think, that whenever good water can no longer be obtained from Lardner's Point by the pumps which it may be considered advisable to place at this point, the city should build an aqueduct to Point Pleasant, pump Delaware water by water-power, and supplement the quantity as it may become necessary by storing the water from the Tohickon creek, first in the lower, and then the upper reservoir.

After the aqueduct is taxed to its full capacity, at which time it will probably be necessary to go to the Blue Mountains for an increased supply, another aqueduct will have to be built. It is premature, I think, to say definitely at present whether this second aqueduct extending to the Blue Mountains should go by way of the Delaware or Lehigh river. If the South Mountain region should preserve its present character, there can be no doubt that it should extend by way of the Perkiomen valley, and, after receiving the South Mountain water at Green Lane, follow up the Lehigh river. The cost of this scheme, which now is relatively greater than that of others, would then probably be less. The Point Pleasant aqueduct could later also be carried to the mountains whenever the quality of the water, owing to the pollution from the Lehigh river, becomes objectionable. And its extension would then most economically be to the Delaware Water Gap.

It is better to build two separate aqueducts in this way than only one with double the capacity, because in the latter case the risk from accident becomes greater. New York, Boston, Washington, and Paris have each two. London has even more.

When the above-mentioned aqueducts are built the city of Philadelphia will be supplied with the best water obtainable in Eastern Pennsylvania.

Respectfully submitted,

(Signed) RUDOLPH HERING.

CITY OF CHICAGO.

Department of Public Works.

Office of Drainage and Water Supply Commission.

October 26, 1886.

John L. Ogden, Esq.,
Chief Engineer Water Department.

Dear Sir:—Having heard that a proposition was to be urged recommending the diversion of the Tohickon water into the Perkiomen valley, and having considered this scheme over a year ago and rejected it, but failed to give the reasons for such rejection in my final report, I think it is proper that a note should be added. I enclose the same and beg you kindly to insert it at the place indicated and to consider it as a part of the report.

Had I not been so pressed for time and so anxious to get the report finished at the time promised, I should have reported on this scheme in greater detail.

Very truly yours,

RUDOLPH HERING.

NOTE.—After the topographical surveys of Bucks County had been plotted (during the spring of 1885) it became apparent to me that in addition to the various projects outlined in previous reports another one was feasible, namely, a diversion of the waters of the Tohickon creek, by means of a dam situated just below the mouth of the Haycock creek, through a comparatively short tunnel near Keelersville into the northeast branch of the Perkiomen. By this diversion it would be possible to substitute the Tohickon water for that of the West Swamp creek in the Lower Perkiomen scheme, which would not only improve the quality of water otherwise obtained, but also reduce the cost, as the inhabited territory between Green Lane and Schwenksville would not require to be flooded.

While I examined this scheme in a general way, I did not work it up in detail, for comparison with those that had been previously indicated for the following reasons: There were no features which promised superiority over the Delaware-Tohickon project. Inasmuch as the appropriation available for the investigation was barely enough to complete the same as originally outlined, it was therefore not considered advisable to extend it any farther. Such a course was thought proper, particularly on account of the marked disadvantages possessed by this project over the other one. The sewage and surface water from Quakertown could not be diverted from the city's supply, but might add pollution to the same. The Northeast Branch valley contains the two growing centres of population —Sellersville and Perkasie, which would still further add to the danger. In view of the constantly accumulating evidence that it is to a certain degree dangerous to have even small towns drain into a stream which subsequently requires impounding, this circumstance must be given considerable weight. The general physical characteristics of the Northeast Branch watershed are also inferior to those of the Tohickon, shown particularly in the heavy discoloration of its water after rains, so that the Tohickon water would be deteriorated by admixture with that of the Northeast Branch. The Tohickon water at Point Pleasant compares favorably with the water of the Upper Perkiomen, while if diverted, as above, it would be less good than at the Point, because it is deprived of considerable aeration which it gets in reaching the same, and of the excellent water received on its lower course through a rugged and sparsely populated region. Further, it is a well known fact that running water from large streams is healthier and generally more palatable than water which has been stored in reservoirs, and in this instance the large quantity of Delaware water which is available through the Point Pleasant project would furnish, as shown by the analysis, a much superior supply to that of any of the Lower Perkiomen affluents, even before storage. Finally, the estimated cost of the "diversion" as against that of the scheme recommended was not found to be in its favor.

TABLE VI.

Maximum and Minimum Precipitation at the Pennsylvania Hospital, Philadelphia, from 1826 to 1885, inclusive.

The year 1825 was omitted, as the notes were considered doubtful.

Bi-annual.

	Time.	Amount.	Average per annum.
Maximum	January 1, 1867, to December 31, 1868	112.59	56.30
Minimum	January 1, 1834, to December 31, 1835	73.54	36.77
Maximum	October 1, 1866, to September 30, 1868	111.35	55.67
Minimum	October 1, 1847, to September 30, 1849	74.67	37.33

Annual.

	Time.	Amount.
Maximum	January 1, to December 31, 1867	61.187
Minimum	January 1, to December 31, 1856	33.927
Maximum	October 1, 1866, to September 30, 1867	60.567
Minimum	October 1, 1826, to September 30, 1827	33.53

Quarterly.

	January—March.	April—June.	July—September.	October—December.
Maximum	1859. 17.320	1867. 20.155	1872. 23.354	1833. 17.90
Minimum	1872. 5.829	1847. 5.457	1881. 4.556	1882. 4.323

Monthly.

	Jan.	Feb.	Mar.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
Maximum	1841. 7.837	1866. 6.615	1859. 6.985	1854. 7.750	1864. 8.685	1867. 11.025	1842. 11.805	1867. 15.816	1882. 13.904	1833. 10.05	1876. 9.025	1879. 6.351
Minimum	1849. 0.730	1864. 0.551	1885. 0.260	1848. 0.585	1826. 0.19	1873. 0.887	1860. 0.985	1834. 0.62	1846. 0.249	1879. 0.447	1882. 1.036	1828. 0.26

Months in the Order of their Relative Degree of Wetness.

Aug.	July.	June.	May.	Sept.	Dec.	Nov.	Mar.	April.	Jan.	Oct.	Feb.
4.675	4.117	4.079	3.864	3.580	3.571	3.557	3.553	3.504	3.452	3.354	3.103

TABLE 14.

Yield of Sundry Streams in Cubic Feet per Minute per Square Mile.

		Jan.	Feb.	March.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
Tohickon creek	1884	410.03	577.67	338.46	101.96	33.15	183.33	141.21	14.36	3.86	6.85	62.87	205.92
Tohickon creek	1885	233.95	198.23	154.83	242.12	25.71	3.92	11.39	65.57	1.91	18.01	137.60	92.38
Neshaminy creek, below forks	1885	170.48	262.97	90.50	76.44	28.97	4.23	2.64	50.02	1.68	9.32	82.51	89.24
Perkiomen creek, at Frederick	1885	171.01	124.27	131.10	147.92	56.26	14.80	8.99	64.54	8.63	22.33	95.14	127.13
Cochituate, mean of nine years		99.17	150.42	174.76	169.80	131.80	44.27	45.27	49.15	42.84	62.45	75.90	78.94
Sudbury, mean of six years		73.71	145.58	266.60	218.93	100.80	42.19	16.83	29.40	12.54	33.27	88.60	84.32
Croton, mean of six years		91.48	147.69	177.02	132.63	164.49	115.12	48.37	70.22	85.99	81.08	124 92	106.23
West Croton, mean of several years		158.95	185.19	290.56	272.60	161.60	103.86	40.02	103.12	147.59	96.26	107.85	164.07
Proposed for Atl'c Coast streams by J. T. Fanning		116.60	106.00	116.60	102.29	59.89	53.00	24.91	17.49	21.20	31.80	84.80	113.42

TABLE 15.

Ratios of Average Monthly Flow in Sundry Streams.—(*Unity equals the mean monthly, or one-twelfth the mean annual flow.*)

		Jan.	Feb.	March.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
Tohickon creek	1884	2.366	3.333	1.953	0.583	0.191	1.058	0.815	0.083	0.022	0.040	0.363	1.188
Tohickon creek	1885	2.368	2.006	1.567	2.451	0.260	0.040	0.115	0.664	0.019	0.182	1.393	0.935
Neshaminy creek, below forks	1885	2.354	3.631	1.250	1.056	0.400	0.058	0.036	0.691	0.023	0.129	1.139	1.232
Perkiomen creek, at Frederick	1885	2.111	1.534	1.618	1.826	0.694	0.183	0.111	0.797	0.107	0.276	1,174	1.569
Cochituate, mean of nine years		1.05	1.60	1.86	1.81	1.11	0.47	0.48	0.52	0.46	0.67	0.81	0.84
Sudbury, mean of six years		0.79	1.57	2.87	2.36	1.09	0.45	0.18	0.32	0.14	0.36	0.96	0.91
Croton, mean of six years		0.82	1.32	1.58	1.18	1.47	1.03	0.43	0.63	0.77	0.72	1.11	0.95
West Croton, mean of several years		1.04	1.21	1.90	1.79	1.06	0.68	0.26	0.68	0.97	0.63	0.71	1.07
Proposed for Atl'c Coast streams by J.T. Fanning		1:65	1.50	1.65	1.45	0.85	0.75	0.35	0.25	0.30	0.45	1.20	1.60

Table 24.

ESTIMATED COST OF STORAGE RESERVOIRS.

I.—TOHICKON WATERSHED.

Reservoir No. 1.—Point Pleasant.

Storage Capacity, 458,194,000 cubic feet—3,427,291,120 gallons.

316 acres of land, including buildings	$90,000
124,152 cubic yards of masonry in large dam, at $6	744,912
Gate house, overflow, screens, etc	60,000
New roads and bridging	52,045
162 acres of grubbing and clearing, at $300	48,600
127,407 cubic yards earthwork and soil excavation, at 25 cents,	31,852
2,000 cubic yards of masonry in minor dams, at $5	10,000
	$1,037,409
Add 10 per cent	103,741
	$1,141,150

Cost of storage per million gallons, $332.96.

Reservoir No. 2.—Near Haycock Creek.

Storage Capacity, 2,398,992,000 cubic feet—17,944,460,160 gallons.

1,901 acres of land, including buildings	$196,680
89,298 cubic yards of masonry in large dam, at $6	535,788
Gate house, overflow, screens, etc	40,000
New roads and bridging	349,166
134 acres of grubbing and clearing, at $300	40,200
737,780 cubic yards earth and soil excavation, at 25 cents	184,445
	$1,346,279
Add 10 per cent	134,628
	$1,480,907

Cost of storage per million gallons, $82.53.

RESERVOIR NO. 3.—NEAR KIMBAL'S CREEK.

Storage Capacity, 217,656,000 cubic feet—1,628,066,880 gallons.

780 acres of land, including buildings	$80,600
5,389 cubic yards of masonry in large dam, at $6	32,334
Gate house, overflow, screens, etc	25,000
New roads and bridging	80,954
160 acres of grubbing and clearing, at $300	48,000
286,489 cubic yards of earth and soil excavation, at 25 cents..	71,622
3,000 cubic yards of masonry in minor dams, at $5	15,000
	$353,510
Add 10 per cent	35,351
	$388,861

Cost of storage per million gallons, $238.85.

RESERVOIR NO. 4.—ON DEEP RUN.

Storage Capacity, 274,936,000 cubic feet—2,056,521,280 gallons.

300 acres of land, including buildings	$30,000
25,174 cubic yards of masonry in dam, at $6	151,044
Gate house, overflow, screens, etc	30,000
New roads and bridging	47,770
1 acre of grubbing and clearing	300
113,140 cubic yards of earth and soil excavation, at 25 cents..	28,285
	$287,399
Add 10 per cent	28,740
	$316,139

Cost of storage per million gallons, $153.73.

II.—NESHAMINY WATERSHED.

Reservoir No. 7.—Little Neshaminy.

Storage Capacity, 1,669,056,000 cubic feet—12,484,538,880 gallons.

2,781 acres of land, including buildings	$310,310
83,672 cubic yards masonry in dam, at $6	502,032
Gate house, overflow, screens, etc	50,000
New roads and bridging	303,868
189 acres grubbing and clearing, at $300	56,700
1,020,740 cubic yards earth and soil excavation, at 25 cents	255,185
5,000 cubic yards masonry in minor dams, at $5	25,000
	$1,503,095
Add 10 per cent	150,309
	$1,653,404

Cost of storage per millon gallons, $132.44.

Reservoir No. 2.—Big Neshaminy.

Storage Capacity, 1,243,442,160 cubic feet—9,300,947,357 gallons.

2,476 acres of land, including buildings	$286,160
102,140 cubic yards of masonry in dam, at $6	612,840
Gate house, overflow, screens, etc	50,000
New roads and bridging	321,793
203 acres grubbing and clearing, at $300	60,900
916,607 cubic yards earth and soil excavation, at 25 cents	229,152
5,000 cubic yards of masonry in minor dams, at $5	25,000
	$1,585,845
Tunnel to dam No. 1	173,658
	$1,759,503
Add 10 per cent	175,950
	$1,935,453

Cost of storage per million gallons, $208.09.

Reservoir No. 3.—On North Branch of Neshaminy.

Storage Capacity, 223,416,000 cubic feet—1,671,151,680 gallons.

400 acres of land, including buildings	$40,000
15,480 cubic yards masonry in dam, at $6	92,880
Gate house, overflow, screens, etc	25,000
New roads and bridging	72,432
25 acres grubbing and clearing, at $300	7,500
148,636 cubic yards earth and soil excavation, at 25 cents	37,159
	$274,971
Add 10 per cent	27,497
	$302,468

Cost of storage per million gallons, $180.99.

III.—UPPER PERKIOMEN WATERSHED.

Reservoir No. 1.—East Swamp Creek, near Sumneytown.

Storage Capacity, 228,286,000 cubic feet—1,707,579,280 gallons.

206 acres of land, including buildings	$11,700
40,429 cubic yards masonry in dam, at $6	242,574
Gate house, overflow, screens, etc	40,000
New roads and bridging	40,136
116 acres of grubbing and clearing, at $300	34,800
78,755 cubic yards earth aud soil excavation, at 25 cents	19,689
1,000 cubic yards masonry in minor dams, at $5	5,000
11,830 lineal feet of aqueduct connecting with main aqueduct	429,717
	$823,616
Add 10 per cent	82,362
	$905,978

Cost of storage per million gallon, $530.56.

Reservoir No. 2.—East Swamp Creek, near Millville.

Storage Capacity, 1,108,768,000 cubic feet—8,293,584,640 gallons.

1,708 acres of land, including buildings	$131,050
20,052 cubic yards masonry in dam, at $6	120,312
Gate house, overflow, screens, etc	45,000
New roads and bridging	225,511
232 acres of grubbing and clearing, at $300	69,600
664,370 cubic yards earth and soil excavation, at 25 cents	166,092
4,000 cubic yards masonry in minor dams, at $5	20,000
	$777,565
Add 10 per cent	77,756
	$855,321

Cost of storage per million gallons, $103.13.

Reservoir No. 3.—Rich Valley Creek.

Storage Capacity, 163,872,000 cubic feet—1,225,762,560 gallons.

95 acres of land, including buildings	$5,300
33,758 cubic yards masonry in dam, at $6	202,548
Gate house, overflow, screens, etc	30,000
New roads and bridging	532
76 acres grubbing and clearing, at $300	22,800
36,178 cubic yards earth and soil excavation, at 25 cents	9,044
8,530 lineal feet connecting aqueduct	152,515
	$422,739
Add 10 per cent	42,274
	$465,013

Cost of storage per million gallons, $379.38.

Reservoir No. 4.—Deep Creek.

Storage Capacity, 895,264,000 cubic feet—6,696,574,720 gallons.

735 acres of land, including buildings	$56,350
98,105 cubic yards masonry in dam, at $6	588,630
Gate house, overflow, screens, etc	35,000
New roads and bridging	101,350
173 acres grubbing and clearing, at $300	51,900
280,150 cubic feet earth and soil excavation, at 25 cents	70,038
1,820 lineal feet tunnel connecting Green Lane dam	120,825
2,000 cubic yards masonry in minor dam, at $5	10,000
	$1,034,093
Add 10 per cent	103,409
	$1,137,502

Cost of storage per million gallons, $169.86.

Reservoir No. 5.—Perkiomen Creek at Green Lane.

Storage capacity, 1,592,496,000 cubic feet—11,911,870,080 gallons.

1,790 acres of land, including buildings	$201,500
36,272 cubic yards masonry in dam, at $6	217,632
Gate house, overflow, screens, etc	50,000
New roads and bridging	287,852
209 acres of grubbing and clearing, at $300	62,700
687,792 cubic yards earth and soil excavation, at 25 cents	171,948
5,000 cubic yards masonry in minor dams, at $5	25,000
	$1,016,632
Add 10 per cent	101,663
	$1,118,295

Cost of storage per million gallons, $93.88.

Reservoir No. 6.—Macoby Creek.

Storage capacity, 123,008,000 cubic feet—920,099,840 gallons.

266 acres of land, including buildings	$35,800
13,899 cubic yards masonry in dam, at $6	83,394
Gate house, overflow, screens, etc	20,000
New roads and bridging	75,493
99,068 cubic yards earth and soil excavation, at 25 cents	$24,767
500 cubic yards of masonry in minor dams, at $5	2,500
14,200 lineal feet in 3 inch pipe line connecting dam and aqueduct	99,995
	$341,949
Add 10 per cent	34,195
	$376,144

Cost of storage per million gallons, $408.81.

Reservoir No. 7.—West Branch of Perkiomen near County Line.

Storage capacity, 919,156,000 cubic feet—6,875,286,880 gallons.

1,155 acres of land, including buildings	$191,700
36,590 cubic yards masonry in dam, at $6	219,540
Gate house, overflow, screens, etc	50,000
New roads and bridging	131,967
81 acres grubbing and clearing, at $300	24,300
441,511 cubic yards earth and solid excavation, at 25 cents	110,378
3,000 cubic yards masonry in minor dams, at $5	15,000
	$742,885
Add 10 per cent	74,288
	$817,173

Cost of storage per million gallons, $118.86.

RESERVOIR No. 8.—WEST BRANCH OF PERKIOMEN NEAR DALE FORGE.

Storage capacity, 248,448,000 cubic feet—1,858,391,040 gallons.

246 acres of land, including buildings	$44,850
20,032 cubic yards masonry in dam, at $6	120,192
Gate house, overflow, screens, etc	25,000
New roads and bridging	38,786
45 acres of grubbing and clearing, at $300	13,500
91,022 cubic yards earth and soil excavation, at 25 cents	22,755
	$265,083
Add 10 per cent	26,508
	$291,591

Cost of storage per million gallons, $156.90.

RESERVOIR No. 9.—WEST BRANCH OF PERKIOMEN, AT MENCH'S MILL.

Storage Capacity, 136,328,000 cubic feet—1,019,733,440 gallons.

306 acres of land, including buildings	$53,150
1,283 cubic yards masonry in dam, at $6	7,698
Gate house, overflow, screens, etc	10,060
New roads and bridging	87,460
30 acres grubbing and clearing, at $300	9,000
11,452 cubic yards earth and soil excavation, at 25 cents	2,863
	$170,171
Add 10 per cent	17,017
	$187,188

Cost of storage per million gallons, $183.56.

Reservoir No. 10.—Perkiomen Creek, Near Palm Station, P. R. R.

Storage Capacity, 271,366,000 cubic feet—2,029,817,680 gallons.

522 acres of land, including buildings	$111,100
20,493 cubic yards masonry in dam, at $6	122,958
Gate house, overflow, screens, etc	20,000
New roads and bridging	61,134
52 acres grubbing and clearing, at $300	15,600
190,230 cubic yards earth and soil excavation, at 25 cents	47,558
500 cubic yards masonry in minor dams, at $5	2,500
	$380,850
Add 10 per cent	38,085
	$418,935

Cost of storage per million gallons, $206.39.

Reservoir No. 11.—Perkiomen Creek, Above Treichlersville.

Storage Capacity, 124,800,000 cubic feet—933,504,000 gallons.

129 acres of land, including buildings	$29,450
17,826 cubic yards masonry in dam, at $6	106,956
Gate house, overflow, screens, etc	15,000
New roads and bridging	20,014
23.5 acres grubbing and clearing, at $300	7,050
47,408 cubic yards earth and soil excavation, at 25 cents	11,852
	$190,322
Add 10 per cent	19,032
	$209,354

Cost of storage per million gallons, $224.26.

Reservoir No. 12.—Hossensack Creek.

Storage Capacity, 82,560,000 cubic feet—617,548,800 gallons.

103 acres of land, including buildings	$16,080
17,947 cubic yards masonry in dam, at $6	107,682
Gate house, overflow, screens, etc	10,000
New roads and bridging	4,669
41 acres grubbing and clearing, at $300	12,300
31,022 cubic yards earth and soil excavation, at 25 cents	7,755
	$158,486
Add 10 per cent	15,849
	$174,335

Cost of storage per million gallons, $282.31.

Reservoir No. 13.—West Branch of Hossensack Creek.

Storage Capacity, 80,720,000 cubic feet—603,785,600 gallons.

115 acres of land, including buildings	$16,680
3,159 cubic yards masonry in dam, at $6	18,954
Gate house, overflow, screens, etc	10,000
New roads and bridging	26,527
7 acres grubbing and clearing, at $300	2,100
42,193 cubic yards earth and soil excavation, at 25 cents	10,548
	$84,809
Add 10 per cent	8,481
	$93,290

Cost of storage per million gallons, $154.51.

Reservoir No. 14.—Indian Creek No. 1.

Storage Capacity, 79,872,000 cubic feet—597,442,560 gallons.

138 acres of land, including buildings	$17,240
8,476 cubic yards masonry in dam, at $6	50,856
Gate house, overflow, screens, etc.	10,000
New roads and bridging	35,681
25 acres of grubbing and clearing, at $300	7,500
51,000 cubic yards earth and soil excavation, at 25 cents	12,750
	$134,027
Add 10 per cent	13,403
	$147,430

Cost of storage per million gallons, $246.77.

Reservoir No. 15.—Indian Creek No. 2.

Storage Capacity, 64,640,000 cubic feet—483,507,200 gallons.

116 acres of land, including buildings	$16,040
6,664 cubic yards masonry in dam, at $6	39,984
Gate house, overflow, screens, etc.	10,000
New roads and bridging	1,193
16 acres grubbing and clearing, at $300	4,800
42,903 cubic yards earth and soil excavation, at 25 cents	10,726
	$82,743
Add 10 per cent	8,274
	$91,017

Cost of storage per million gallons, $188.25.

IV.—LOWER PERKIOMEN WATERSHED.

Reservoir No. 1.—On N. E. Branch of Perkiomen, W. of Lederachville.

Storage Capacity, 2,048,984,000 cubic feet—15,326,400,320 gallons.

2,010 acres of land, including buildings	$252,600
79,117 cubic yards masonry in dam, at $6	474,702
Gate house, overflow, screens, etc	50,000
New roads and bridging	227,775
160.5 acres grubbing and clearing, at $300	48,150
777,615 cubic yards earth and soil excavation, at 25 cents	194,404
5,000 cubic yards masonry in minor dams, at $5	25,000
4,780 lineal feet of aqueduct, connecting dam with main aqueduct	123,475
	$1,396,106
Add 10 per cent	139,611
	$1,535,717

Cost of storage per million gallons, $100.20.

Reservoir No. 2.—On Indian Creek.

Storage Capacity, 60,384,000 cubic feet—451,672,320 gallons.

108 acres of land, including buildings	$10,680
12,208 cubic yards masonry in dam, at $6	73,248
Gate house, overflow, screens, etc	20,000
New roads and bridging	25,000
36,592 cubic yards earth and soil excavation, at 25 cents	9,148
	$138,076
Add 10 per cent	13,808
	$151,884

Cost of storage per million gallons, $336.27.

Reservoir No. 3.—Pleasant Spring.

Storage Capacity, 195,768,000 cubic feet—1,464,344,640 gallons.

264 acres of land, including buildings	$28,740
20,238 cubic yards masonry in dam, at $6	121,428
Gate house, overflow, screens, etc	25,000
New roads and bridging	41,509
1 acre of grubbing and clearing	300
106,268 cubic yards earth and soil excavation, at 25 cents	26,567
500 cubic yards masonry in minor dams, at $5,	2,500
	$246,044
Add 10 per cent	24,604
	$270,648

Cost of storage per million gallons, $184.82.

Reservoir No. 4—Mill Creek.

Storage Capacity, 38,056,000 cubic feet—284,658,880 gallons.

81 acres of land, including buildings	$21,360
4,238 cubic yards masonry in dam, at $6	25,428
Gate house, overflow, screens, etc	15,000
New roads and bridging	10,953
28,640 cubic yards earth and soil excavation, at 25 cents	7,160
	$79,901
Add 10 per cent	7,990
	$87,891

Cost of storage per million gallons, $308.76.

Reservoir No. 5.—Morris Run.

Storage Capacity, 77,888,000 cubic feet—582,602,240 gallons.

149 acres of land, inclnding buildings	$18,650
12,419 cubic yards masonry in dam, at $6	74,514
Gate house, overflow, screens, etc	20,000
New roads and bridging	1,961
16 acres of grubbing and clearing, at $300	4,800
51,970 cubic yards earth and soil excavation, at 25 cents	12,992
	$132,917
Add 10 per cent	13,292
	$146,209

Cost of storage per million gallons, $250.96.

Reservoir No. 6.—N. E. Branch of Perkiomen, S. of Tylersport.

Storage Capacity, 260,408,000 cubic feet—1,947,851,840 gallons.

450 acres of land, including buildings	$52,900
15,765 cubic yards of masonry in dam, at $6	94,590
Gate house, overflow, screens, etc.	30,000
New roads and bridging	42,850
22 acres of grubbing and clearing, at $300	6,600
2,000 cubic yards of masonry in minor dams, at $5	10,000
159,276 cubic yards earth and soil excavation, at 25 cents	39,819
	$276,759
Add 10 per cent	27,676
	$304,435

Cost of storage per million gallons, $158,28.

Reservoir No. 7.—Perkiomen Creek at Zieglersville Station, Perk. R. R.

Storage Capacity, 1,007,424,000 cubic feet—7,535,531,520 gallons.

2,407 acres of land, including buildings.,	$595,270
77,097.5 cubic yards masonry in dam, at $6	462,585
Gate house, overflow, screens, etc	60,000
New roads and bridging	452,459
362 acres of grubbing and clearing, at $300	108,600
930,385 cubic yards earth and soil excavation, at 25 cents	232,596
Change of line of Perkiomen Railroad	387,582
	$2,299,909
Add 10 per cent	229,909
	$2,529,001

Cost of storage per million gallons, $335.61.

Reservoir No. 8.—West Swamp Creek.

Storage Capacity, 1,705,065,760 cubic feet—12,753,891,885 gallons.

2,361 acres of land, including buildings	$226,550
18,983 cubic yards masonary in dam, at $6	113,898
Gate house, overflow, screens, etc	45,000
New roads and bridging	145,590
235 acres of clearing and grubbing, at $300	70,500
928,134 cubic yards earth and soil excavation, at 25 cents	232,034
10,000 cubic yards masonry in minor dams, at $5	50,000
	$883,572
Add 10 per cent	88,357
	$871,929

Cost of storage per million gallons, $72.61.

RESERVOIR No. 9—WEST SWAMP CREEK, NEAR BECHTELSVILLE.

Storage Capacity, 116,736,000 cubic feet—873,185,280 gallons.

111 acres of land, including buildings	$15,150
26,554 cubic yards masonry in dam, at $6	159,324
Gate house, overflow, screens, etc	15,000
New roads and bridging	33,385
7 acres grubbing and clearing, at $300	2,100
40,771 cubic yards earth and soil excavation, at 25 cents	10,193
	$235,152
Add 10 per cent	23,515
	$258,667

Cost of storage per million gallons, $296.24.

NOTE.—The water from this dam can be run by open channel or aqueduct into the west branch of the Perkiomen creek.

Table 26.

Storage capacity required to yield an average daily supply of 80 million gallons from

TOHICKON CREEK.

Month.	Flow of stream. Cubic feet.	Evaporation, etc. Cubic feet.	Water consumption. Cubic feet.	Added to reservoir. Cubic feet.	Water in store at end of month. Cubic feet.
October	66,671,225	19,856,280	344,812,594	—297,997,649	694,702,657
November	248,919,909	13,291,180	318,789,002	— 83,160,273	611,554,412
December	376,935,862	9,302,460	305,777,206	+ 61,856,196	673,410,608
January	624,128,698	7,963,780	276,500,665	+339,664,253	1,013,074,861
February	684,491,249	9,302,460	276,500, 65	+398,688,124	1,411,762,985
March	995,679,631	13,291,180	286,259,512	+696,128,942	2,107,891,927
April	667,202,133	21,254,960	299,271,308	+346,675,865	2,454,567,792
May	177,833,849	38,507,540	328,547,849	—189,221,540	2,265,346,252
June	130,838,098	45,159,960	361,077,339	—275,399,201	1,989,947,051
July	99,218,254	49,148,680	370,836,186	—320,766,612	1,669,180,439
August	94,630,127	53,137,400	374,089,135	—332,596,408	1,336,584,031
September	56,001,154	38,807,540	361,077,339	—343,883,725	992,700,306
Total	4,222,550,192	319,023,420	3,903,538,800		

Table 27.

Storage capacity required to yield an average daily supply of 101.3 million gallons from

NESHAMINY CREEK.

Month.	Flow of stream. Cubic feet.	Evaporation, etc. Cubic feet.	Water consumption. Cubic feet.	Added to reservoir. Cubic feet.	Water in store at end of month. Cubic feet.
October	86,365,083	32,846,757	436,650,782	—383,132,456	877,682,136
November	322,371,401	21,920,367	403,696,006	—103,244,972	774,437,236
December	488,162,407	15,342,000	387,218,618	+ 85,601,789	860,039,027
January	808,184,992	13,134,197	350,144,495	+444,906,300	1,304,945,325
February	886,521,352	15,342,000	350,144,495	+521,034,857	1,825,980,182
March	1,289,485,603	21,920,367	362,502,536	+905,062,700	2,731,042,882
April	864,040,845	35,054,564	378,979,924	+450,006,357	3,181,049,239
May	230,358,890	63,508,236	416,054,047	—249,203,393	2,931,845,846
June	169,485,235	74,479,684	457,247,517	—362,241,966	2,569,603,880
July	128,499,262	81,048,047	469,605,558	—422,154,343	2,147,449,537
August	120,873,675	87,636,410	473,724,905	—440,487,640	1,706,961,897
September	74,608,448	63,508,236	457,247,517	—446,147,305	1,260,814,592
Total	5,468,957,193	525,740,865	4,943,216,400		

TABLE 28.

Storage capacity required to yield an average daily supply of 52.8 million gallons from

PERKIOMEN, AT GREEN LANE.

MONTH.	Flow of stream. Cubic feet.	Evaporation, etc. Cubic feet.	Water consumption. Cubic feet.	Added to reservoir. Cubic feet.	Water in store at end of month. Cubic feet.
October	46,246,375	22,402,928	227,448,864	—203,605,417	455,949,975
November	172,683,832	14,950,650	210,282,912	— 52,549,730	403,399,872
December	261,492,659	10,475,919	201,699,936	+ 49,316,804	452,716,676
January	432,943,035	8,958,058	182,388,240	+241,596,737	694,313,413
February	474,880,537	10,475,919	182,388,240	+282,016,378	976,329,791
March	690,735,326	14,950,650	188,825,472	+486,959,204	1,463,288,995
April	462,776,223	23,908,749	197,408,448	+241,459,026	1,704,748,021
May	123,388,354	43,315,400	216,720,144	—136,647,190	1,568,100,831
June	90,783,937	50,798,341	238,177,584	—198,191,988	1,369,908,843
July	68,836,709	55,285,140	244,614,816	—231,063,247	1,138,845,596
August	64,764,662	59,771,873	246,760,560	—241,767,771	897,077,825
September	43,970,551	43,315,400	238,177,584	—237,522,433	659,555,392
Total	2,933,502,200	358,609,027	2,574,892,800		

TABLE 29.

Storage capacity required to yield an average daily supply of 36.2 million gallons from

EAST SWAMP CREEK.

MONTH.	Flow of stream. Cubic feet.	Evaporation, etc. Cubic feet.	Water consumption. Cubic feet.	Added to reservoir. Cubic feet.	Water in store at end of month. Cubic feet.
October	31,054,385	12,521,304	156,036,134	—137,503,053	313,622,784
November	116,636,372	9,256,124	144,259,822	— 36,879,574	276,743,332
December	176,620,792	5,848,280	138,371,666	+ 32,400,846	309,144,178
January	290,709,118	5,010,239	125,123,315	+160,575,564	469,719,742
February	318,825,024	5,848,280	125,123,315	+187,853,429	657,573,171
March	463,745,489	9,256,124	129,539,432	+324,949,933	982,523,104
April	310,772,032	13,362,928	135,427,588	+161,981,516	1,144,504,620
May	82,842,860	24,209,572	148,675,939	— 90,042,651	1,054,461,969
June	60,942,285	28,391,928	163,396,329	—130,845,972	923,615,997
July	46,214,268	30,899,624	167,812,446	—152,497,802	771,118,195
August	43,476,140	33,407,320	169,284,485	—159,215,665	611,902,530
September	26,829,208	24,209,572	163,396,329	—160,776,693	451,125,837
Total	1,968,667,973	202,221,295	1,766,446,800		

TABLE 30.

Storage capacity required to yield an average daily supply of 151.2 million gallons from

PERKIOMEN, ABOVE SCHWENKSVILLE.

MONTH.	Flow of stream. Cubic feet.	Evaporation, etc. Cubic feet.	Water consumption. Cubic feet.	Added to reservoir. Cubic feet.	Water in store at end of month. Cubic feet.
October	131,509,995	63,749,159	651,658,002	— 583,897,166	1,311,204,414
November	490,920,056	43,877,868	602,476,266	— 155,434,078	1,155,770,796
December	743,393,199	30,709,998	577,885,398	+ 134,797,803	1,290,568,599
January	1,230,992,590	26,290,644	522,555,945	+ 682,146,001	1,972,714,600
February	1,350,107,102	30,709,998	522,555,945	+ 796,841,159	2,769,555,759
March	1,963,792,148	43,877,868	540,999,096	+1,378,915,184	4,148,470,943
April	1,315,971,349	70,168,512	565,589,964	+ 680,212,873	4,828,683,816
May	450,811,837	127,124,059	620,919,417	— 297,231,639	4,531,452,177
June	258,099,778	149,085,541	682,396,587	— 573,382,350	3,958,069,827
July	195,699,080	162,253,411	700,839,738	— 667,394,069	3,290,675,758
August	184,099,466	175,420,291	706,987,455	— 698,308,280	2,592,367,478
September	114,254,748	129,124,059	682,396,587	— 697,265,898	1,895,101,580
Total	8,429,651,348	1,052,391,408	7,377,260,400		

TABLE 31.

Storage Capacity required to yield an Average Daily Supply of 43.5 Million Gallons from

NORTH EAST BRANCH.

MONTH.	Flow of stream. Cubic feet.	Evaporation, etc. Cubic feet.	Water consumption. Cubic feet.	Added to reservoir. Cubic feet.	Water in store at end of month. Cubic feet.
October	39,491,330	18,271,423	187,290,658	—166,070,751	375,141,543
November	142,383,208	12,193,480	173,155,514	— 42,965,786	332,175,884
December	215,608,858	8,534,188	166,087,942	+ 40,986,733	373,162,617
January	355,914,157	7,306,063	150,185,905	+198,422,189	571,584,806
February	390,417,302	8,534,183	150,185,905	+231,697,214	803,282,020
March	567,879,612	12,193,480	155,486,584	+400,199,548	1,203,481,568
April	380,517,057	19,499,543	162,554,156	+198,463,358	1,401,944,928
May	101,666,824	35,327,257	178,456,193	—112,116,626	1,289,828,302
June	74,816,336	41,430,263	196,125,123	—162,739,050	1,127,089,252
July	56,730,600	45,089,560	201,425,802	—189,784,762	937,304,490
August	53,334,813	47,733,779	203,192,695	—197,591,661	739,712,829
September	32,951,845	35,327,257	196,125,123	—198,500,535	541,212,294
Total	2,411,711,942	291,440,471	2,120,271,600		

TABLE 32.

COST OF STORAGE.

Number of reservoir.	Location of proposed reservoirs.	Capacity in cubic feet.	Total cost.	Cost per one million gallons capacity.
	TOHICKON WATERSHED.			
1	Tohickon creek, one mile above Point Pleasant........	458,194,000	$1,141,150 00	$332 96
2	Tohickon creek, near Haycock run..........................	2,898,992,000	1,480,907 00	82 53
	Totals and average..	2,857,186,000	$2,622,057 00	$122 70
	NESHAMINY WATERSHED.			
1	Little Neshaminy creek..	1,669,056,000	$1,653,404 00	$132 44
2	Big Neshaminy creek..	1,243,442,160	1,935,453 00	208 09
3	North Branch of Neshaminy creek.........................	223,416,000	302,468 00	180 99
	Totals and average..	3,135,914,160	$3,891,325 00	$165 89
	UPPER PERKIOMEN WATERSHED.			
1	East Swamp creek, at Sumneytown.........................	228,286,000	$905,978 00	$530 56
2	East Swamp creek, at Millville................................	1,103,768,000	855,321 00	103 13
5	Perkiomen creek, at Green lane..............................	1,592,496,000	1,118,295 00	93 88
8	West Branch of Perkiomen creek, near Dale Forge..	248,448,000	291,591 00	156 90
	Totals and average..	3,172,998,000	$3,171,185 00	$133 61
	PERKIOMEN WATERSHED, ABOVE SCHWENKSVILLE.			
2	East Swamp creek, at Millville................................	1,103,768,000	$855,321 00	$103 13
5	Perkiomen creek, at Green lane..............................	1,592,496,000	1,118,295 00	93 88
7	Perkiomen creek, at Zieglersville............................	1,007,424,000	2,529,001 00	335 61
8	West Swamp creek..	1,705,065,700	971,929 00	76 21
	Totals and average..	5,408,753,700	$5,474,546 00	135 31
	NORTHEAST BRANCH WATERSHED.			
1	Northeast Branch, near Lederachville.....................	2,048,984,000	$1,535,717 00	$100 20
	LEHIGH WATERSHED.			
	Aquanchicola creek..	2,000,000,000	$1,200,000 00	$80 00
	Big creek...	2,170,000,000	1,300,000 00	80 00
	Totals and average..	4,170,000,000	$2,500,000 00	$80 00

TABLE 34.

TOTAL COST OF PROJECTS FOR A SUPPLY BY PUMPING FROM THE DELAWARE RIVER.

Aqueduct.	Quantity of water pumped daily.	Cost of aqueduct.	Cost of pumping plant.	Capitalized cost of pumping, at 4 per cent. for 40 years.	Total cost.	Cost per million gallons.
At Lardner's Point	210 million gallons daily, by steam-power	....	$1,250,000	$12,516,085	$13,766,085	$65,552 79
From Lardner's Point to New Hope—open canal*	210 million gallons daily, by steam-power	$6,232,953	1,250,000	12,516,085	19,999,038	95,233 52
From Wentz Farm basin to Yardleyville—four 5-feet iron pipes	210 million gallons daily, by steam-power	8,845,565	1,250,000	17,294,954	27,390,519	130,431 04
From proposed basin at Twelfth street and Olney avenue, to New Hope—masonry conduit, twelve feet in diameter	210 million gallons daily, by steam-power	6,367,224	1,250,000	13,502,201	21,119,426	100,568 70
From proposed basin at Twelfth street and Olney avenue, to Lumberville—masonry conduit, twelve feet in diameter	210 million gallons daily, by steam-power	6,720,148	1,250,000	12,288,520	20,258,668	96,469 85
From proposed basin at Twelfth street and Olney avenue, to Point Pleasant—masonry conduit, twelve feet in diameter	210 million gallons daily, by steam-power	7,373,559	1,250,000	10,998,984	19,622,543	93,440 68
From proposed basin at Twelfth street and Olney avenue, to Point Pleasant—masonry conduit, twelve feet in diameter	120 million gallons daily, by water-power. 90 million gallons daily, by steam-power.	7,373,559	1,084,478 700,000	1,603,375 4,713,850	15,475,262	73,691 73

* Excluding cost of existing canal and land damages.

TABLE 35.

TOTAL COST OF PROJECTS FOR A SUPPLY BY GRAVITY.

Aqueduct.	Supply.	Cost of aqueduct.	Cost of storage reservoir.	Cost of dam and inlet.	Total cost.	Cost per million gallons.
From proposed basin at Twelfth street and Olney avenue, to Delaware Water Gap and Bushkill creek.	210 million gallons daily, from Blue Mountains	$21,482,558	$2,500,000	....	$23,982,558	$114,202 66
From proposed basin at Twelfth street and Olney avenue, to Delaware river, below Portland.	210 million gallons daily, from Delaware river, at Portland	18,528,061	....	$750,000	19,278,061	91,800 29
From Cambria basin to Perkiomen creek, at Green lane; and from Treichlersville to Big creek, affluent of Lehigh river.	53 million gallons daily, from Perkiomen creek; 36 million gallons daily, from East Swamp creek; 121 million gallons daily, from Aquanchicola and Big creeks	13,002,215	5,831,185	....	*18,833,400	89,682 86
From Cambria basin to the North East Branch and Perkiomen creeks, near Schwenksville.	151 million gallons daily, from Perkiomen creek; 43 million gallons daily, from North East Branch creek	6,534,230	7,140,263	....	13,674,493	70,487 08
From proposed basin at Twelfth street and Olney avenue, to Neshaminy and Tohickon creeks.	80 million gallons daily, from Tohickon creek; 101 million gallons daily, from Neshaminy creek; (25 million gallons daily required for compensation)	7,333,280	6,513,382	....	13,846,662	76,500 90

* Not including compensation for water-rights along the Lehigh river.

Table 36.

TOTAL COST OF PROJECTS FOR A SUPPLY, PARTLY BY GRAVITY AND PARTLY BY PUMPING.

Aqueduct.	Supply.	Cost of aqueduct.	Cost of reservoir.	Cost of pumping plant.	Capitalized cost of pumping.	Total cost.	Cost per million gallons.
From proposed basin at Twelfth st. and Olney avenue, Point Pleasant *via* Storage dam, on Neshaminy creek.	181 million gallons daily from Neshaminy and Tohickon creeks, by gravity, including 25 million gallons daily for compensation; 54 million gallons daily from Delaware river, at Point Pleasant, pumped by steam	$7,333,280	$6,513,382	$500,000	$2,828,336	$17,174,998	$73,085 10
From proposed basin at Twelfth st. and Olney avenue, to Point Pleasant direct.	80 million gallons daily from Tohickon creek, by gravity; 130 million gallons daily from Delaware river, at Point Pleasant, pumped by steam	7,386,009	2,622,057	900,000	6,808,959	17,717,025	84,366 79
From proposed basin at Twelfth st. and Olney avenue to Point Pleasant direct.	80 million gallons daily from Tohickon creek, by gravity; 120 million gallons daily from Delaware river, at Point Pleasant, pumped by water-power	7,386,009	2,622,057	1,084,500	1,603,375	12,695,941	63,479 71

STREAM FLOW
1886
PERKIOMEN CREEK AT FREDERICK

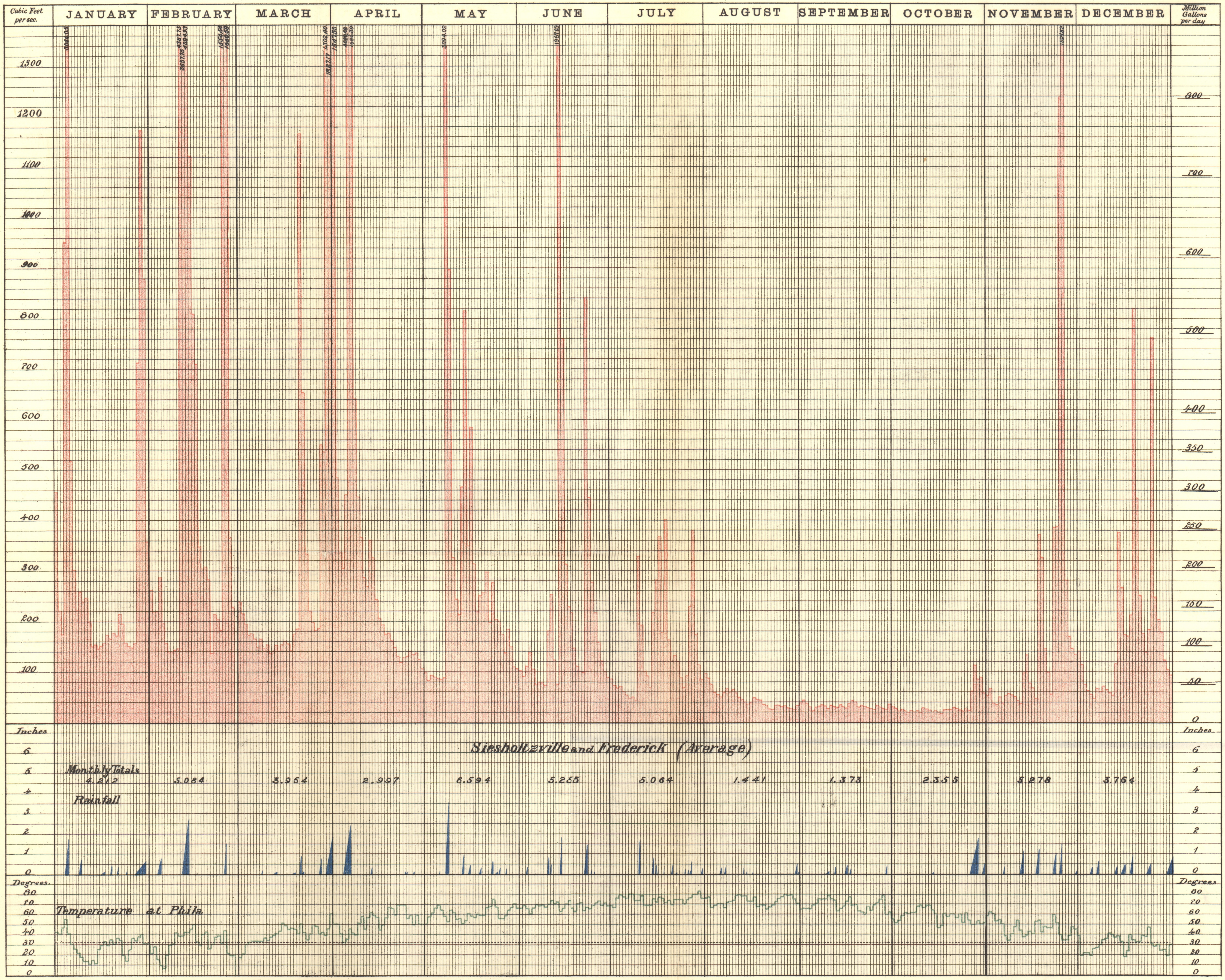


PLATE IV.

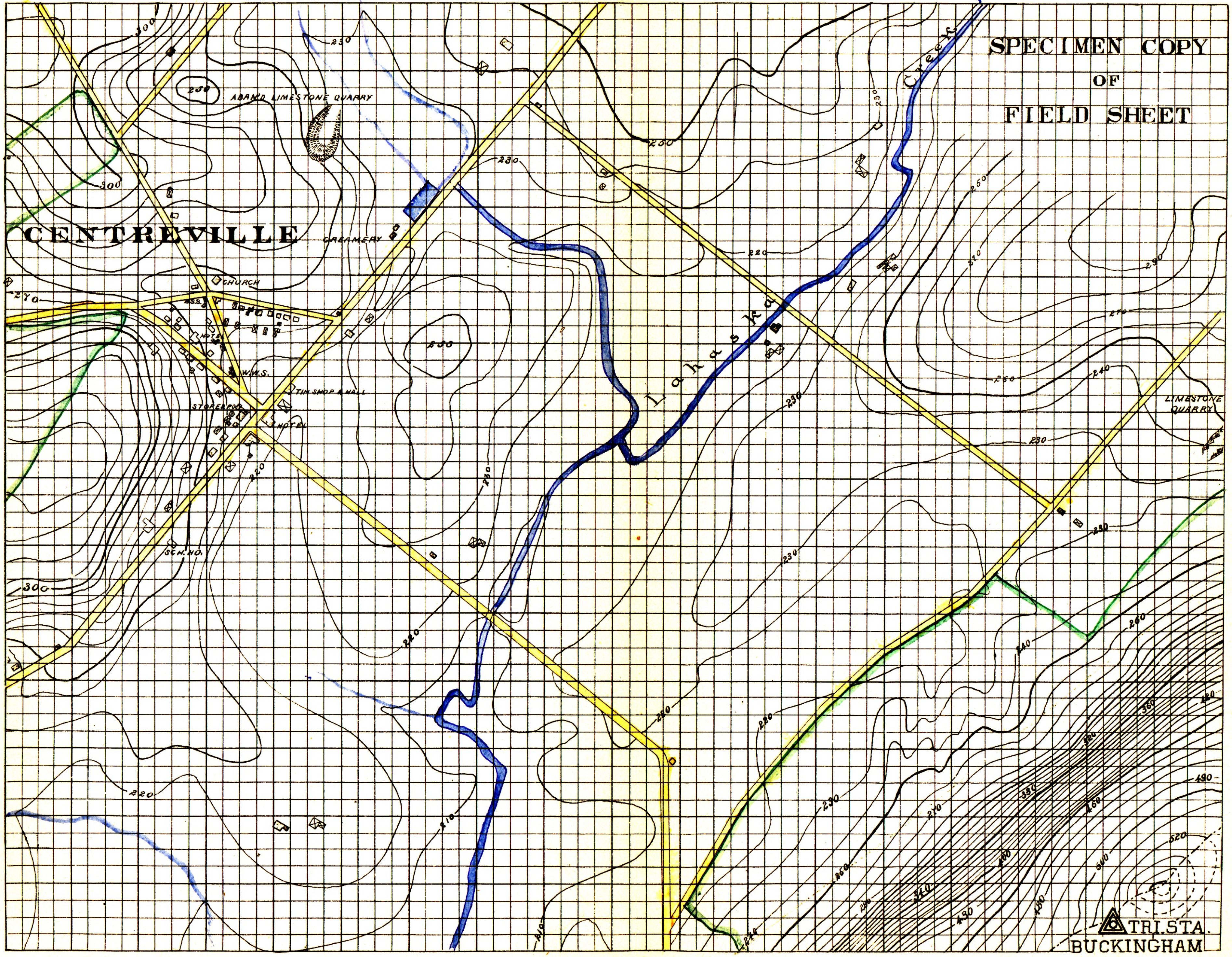

SPECIMEN COPY
OF
FIELD SHEET
CENTREVILLE
ABAND. LIMESTONE QUARRY
CREAMERY
CHURCH
TIN SHOP & HALL
HOTEL
SCH. NO.
Lahaska Creek
LIMESTONE QUARRY
TRI. STA.
BUCKINGHAM

PLATE XV.

SUNDRY COMPARATIVE STATISTICS of proposed COLLECTING AREAS.

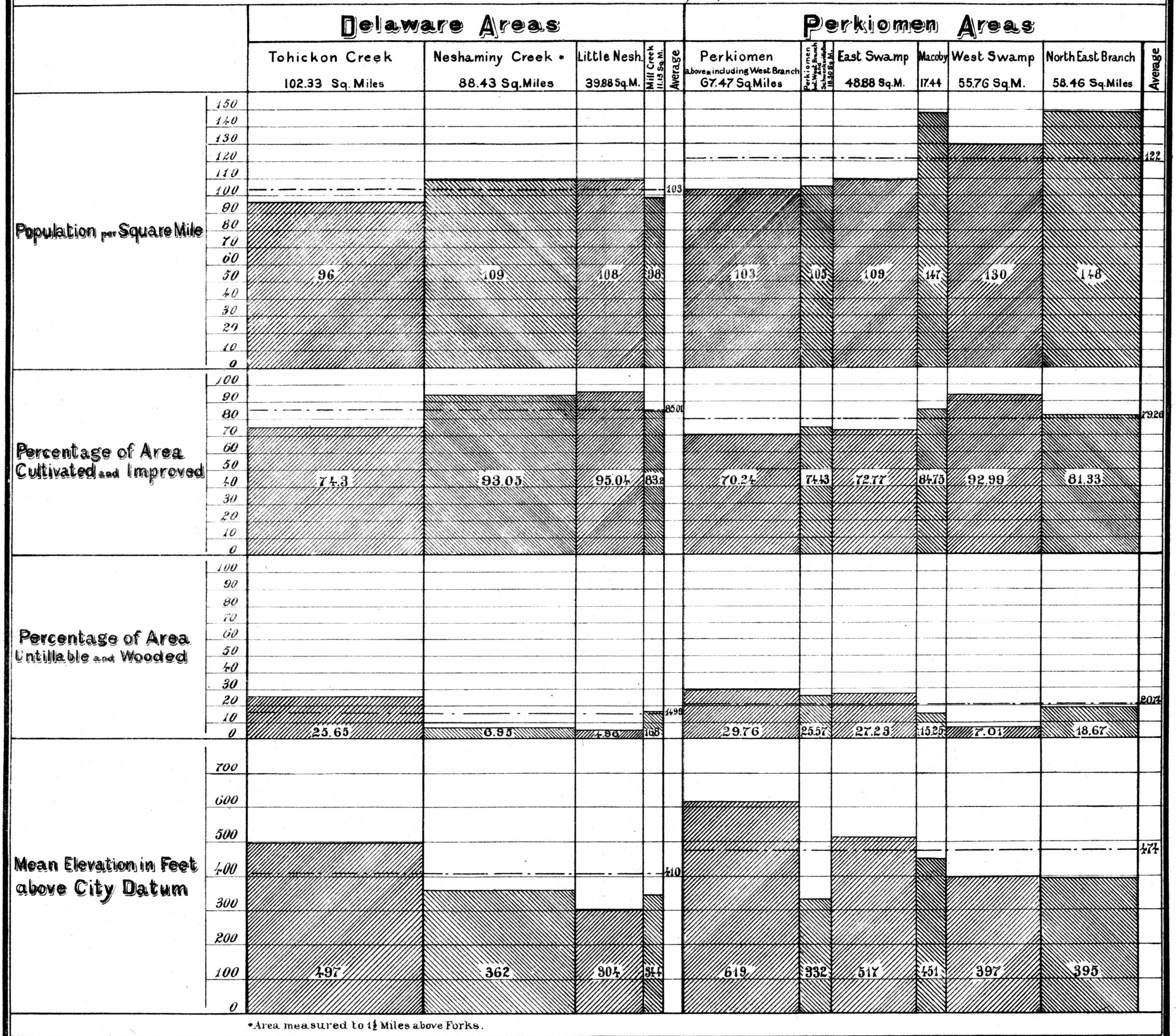


PLATE II.

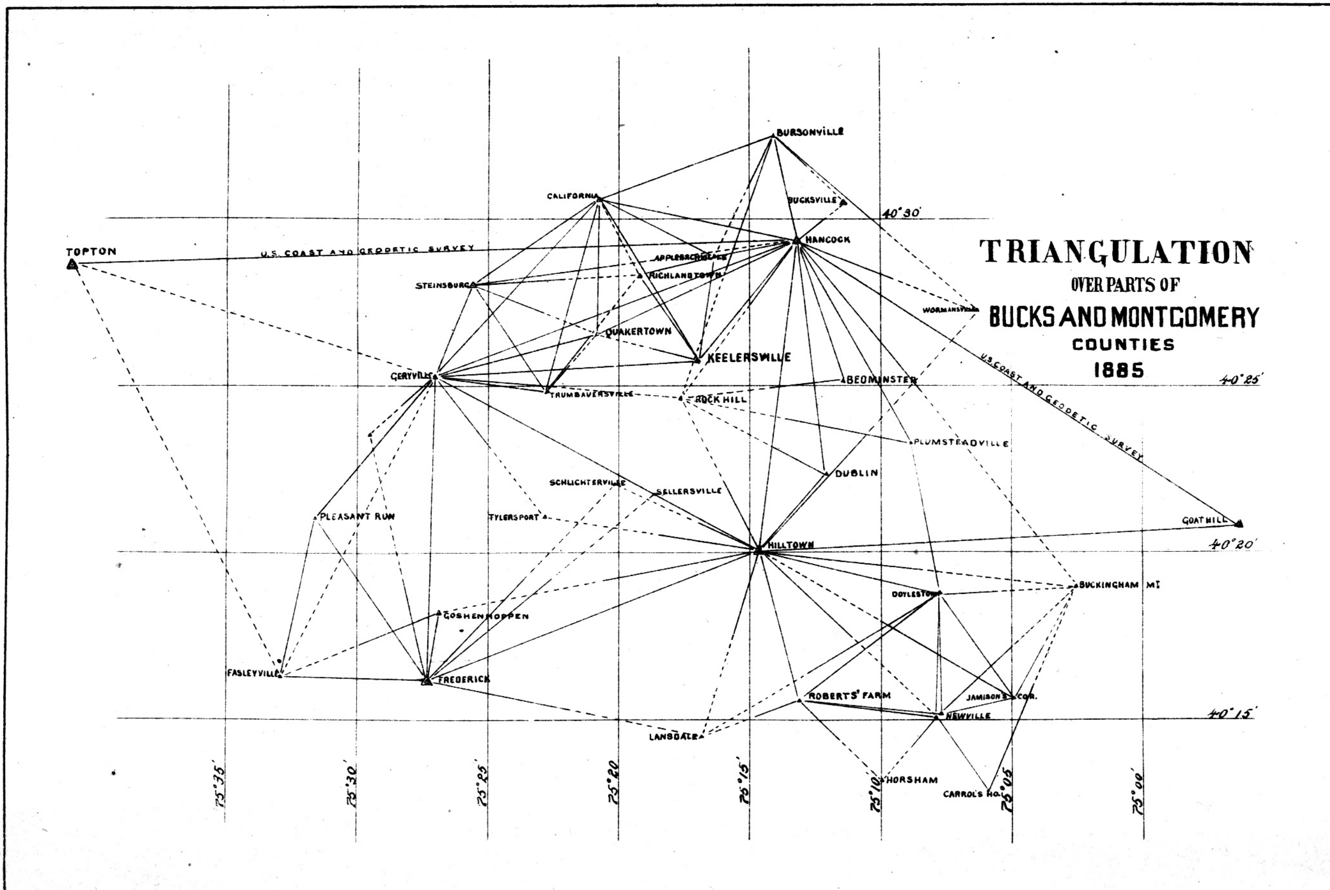
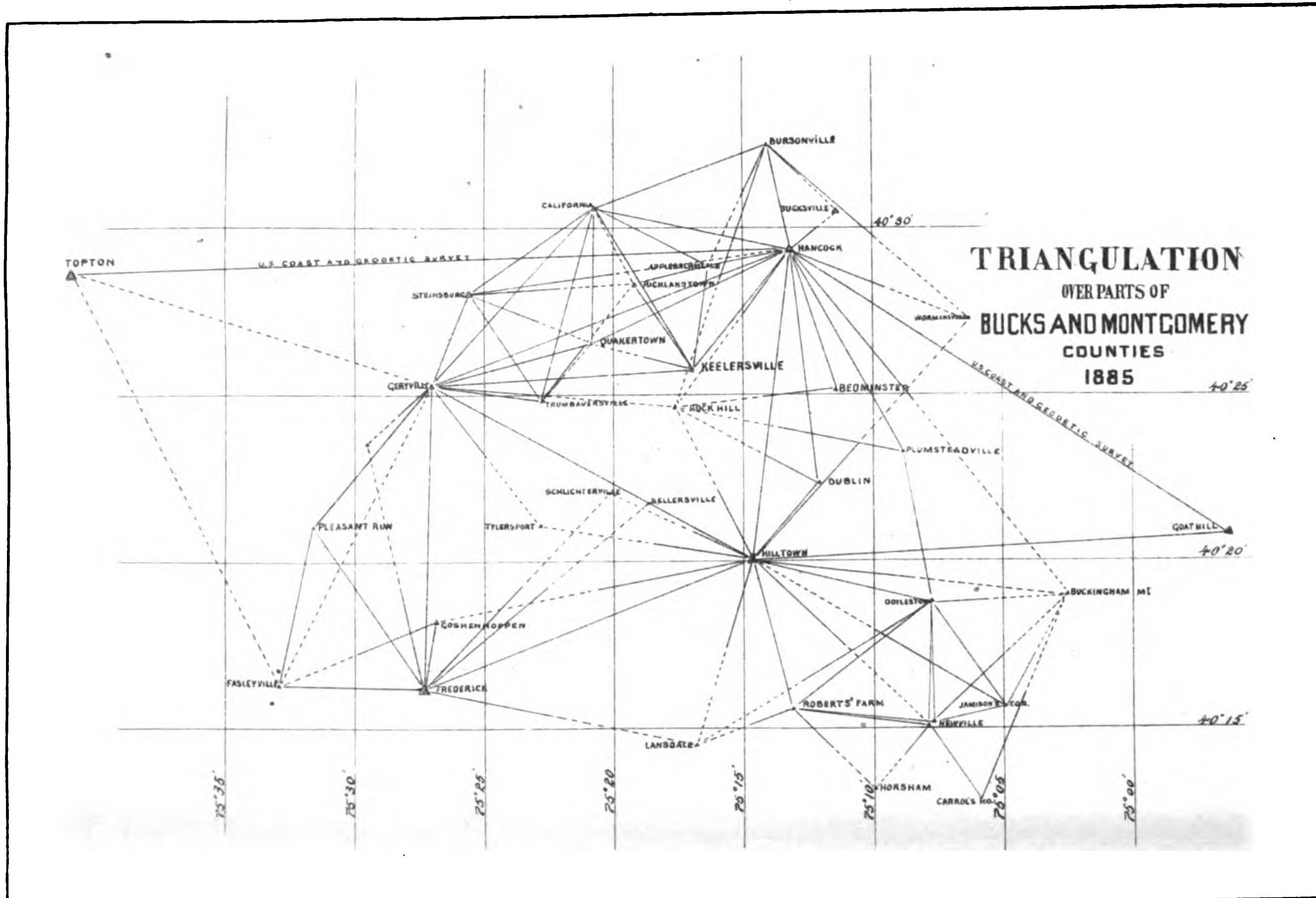

TRIANGULATION
OVER PARTS OF
BUCKS AND MONTGOMERY
COUNTIES
1885
TOPTON
U.S. COAST AND GEODETIC SURVEY
BURSONVILLE
CALIFORNIA
BUCKSVILLE
HANCOCK
RICHLANDTOWN
STEINSBURG
WORMANSVILLE
QUAKERTOWN
KEELERSVILLE
GERYVILLE
TRUMBAUERSVILLE
ROCK HILL
BEDMINSTER
PLUMSTEADVILLE
DUBLIN
SCHLICHTERVILLE
SELLERSVILLE
PLEASANT RUN
TYLERSPORT
HILLTOWN
GOAT HILL
BUCKINGHAM MT.
DOYLESTOWN
GOSHENHOPPEN
FASLEYVILLE
FREDERICK
ROBERTS' FARM
JAMISON'S COR.
NEWVILLE
LANSDALE
HORSHAM
CARROL'S HQ.
40° 30'
40° 25'
40° 20'
40° 15'
75° 35'
75° 30'
75° 25'
75° 20'
75° 15'
75° 10'
75° 05'
75° 00'

PLATE II.



TRIANGULATION
OVER PARTS OF
BUCKS AND MONTGOMERY
COUNTIES
1885
TOPTON
U.S. COAST AND GEODETIC SURVEY
BURSONVILLE
CALIFORNIA
BUCKSVILLE
HANCOCK
STEINSBURG
QUAKERTOWN
KEELERSVILLE
BEDMINSTER
TRUMBAUERSVILLE
ROCK HILL
PLUMSTEADVILLE
DUBLIN
SCHLICHTERVILLE
SELLERSVILLE
PLEASANT RUN
TYLERSPORT
HILLTOWN
GOAT HILL
BUCKINGHAM Mt.
DOYLESTOWN
GOSHENHOPPEN
FREDERICK
ROBERTS' FARM
JAMISON'S COR.
LANSDALE
HORSHAM
CARROL'S HO.
40° 30'
40° 25'
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75° 10'
75° 05'
75° 00'

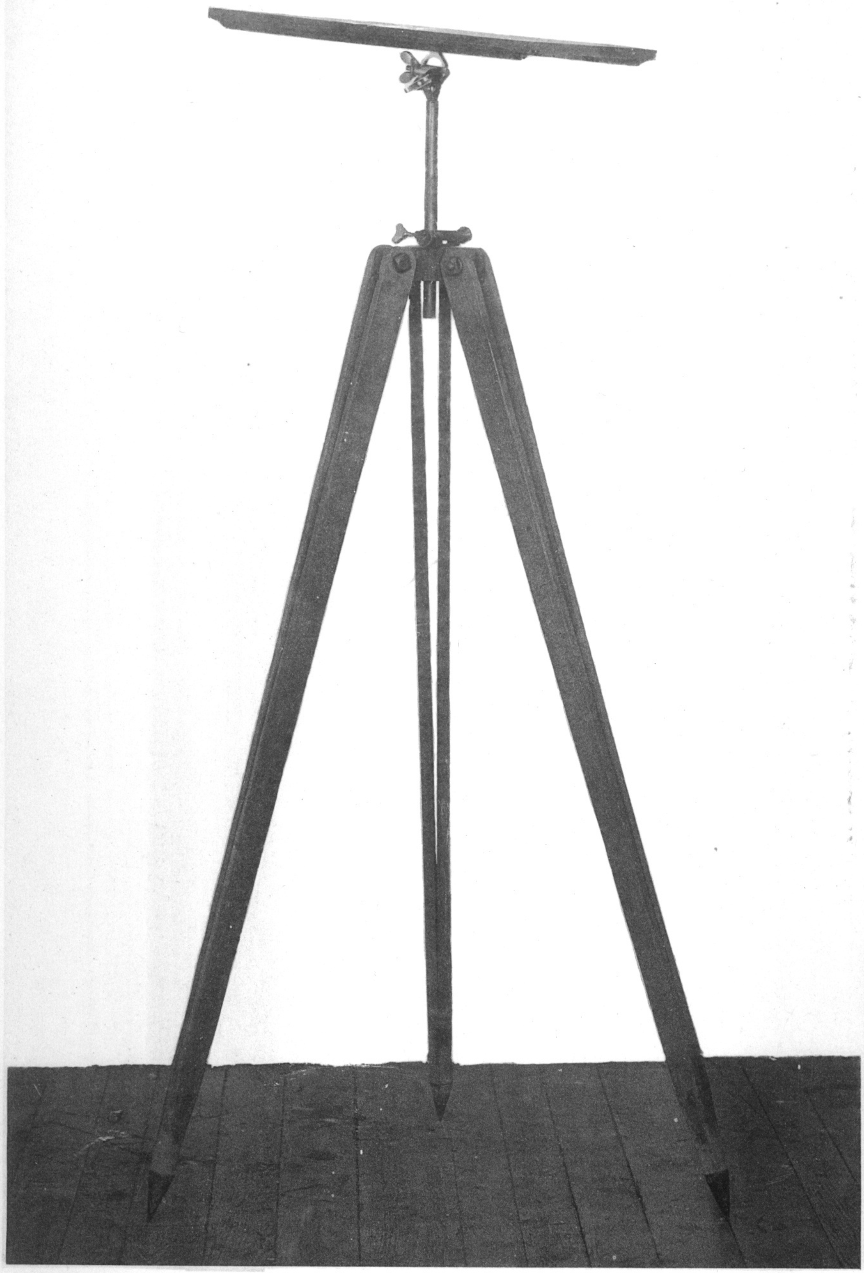


PHOTO-COLLOTYPE WELLS & HOPE CO.

FIELD TABLE.

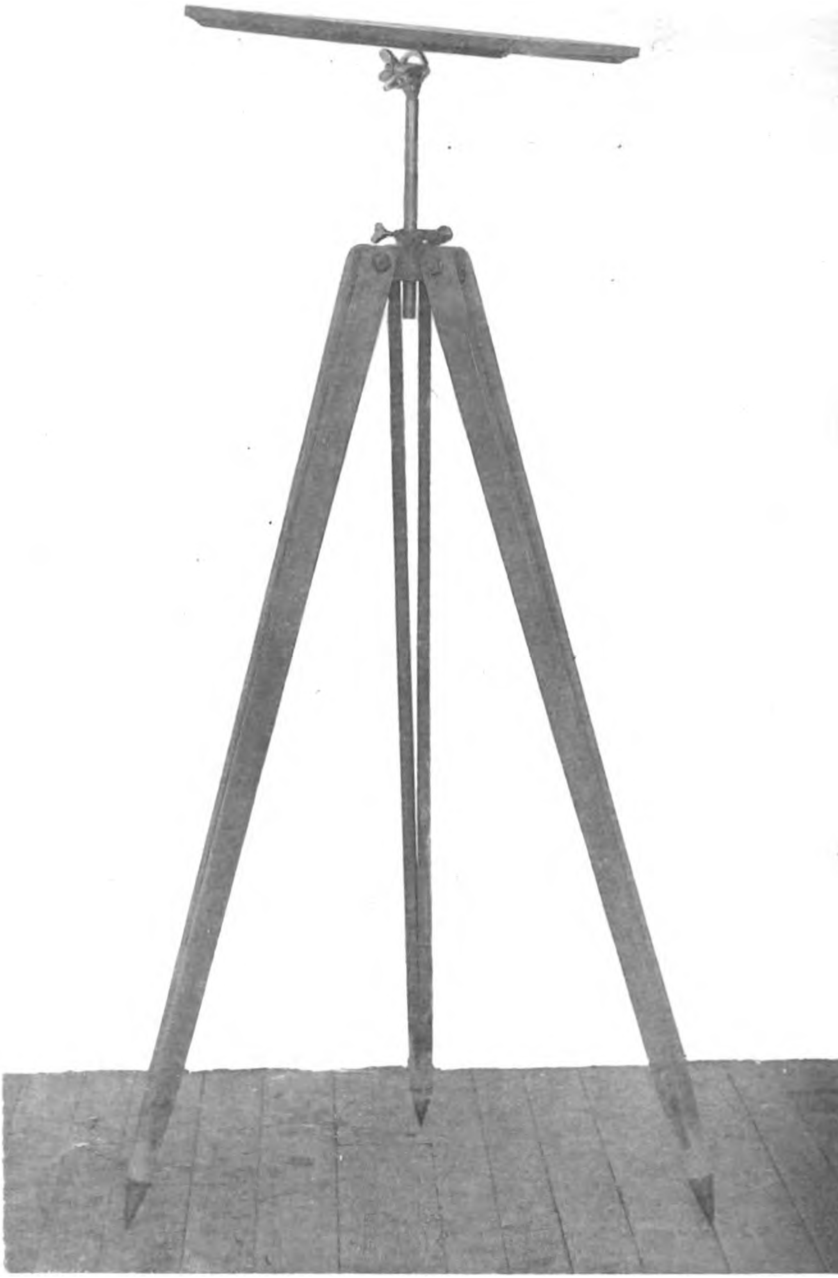


PHOTO-COLLOTYPE WELLS & HOPE CO.

FIELD TABLE.

PLATE V.

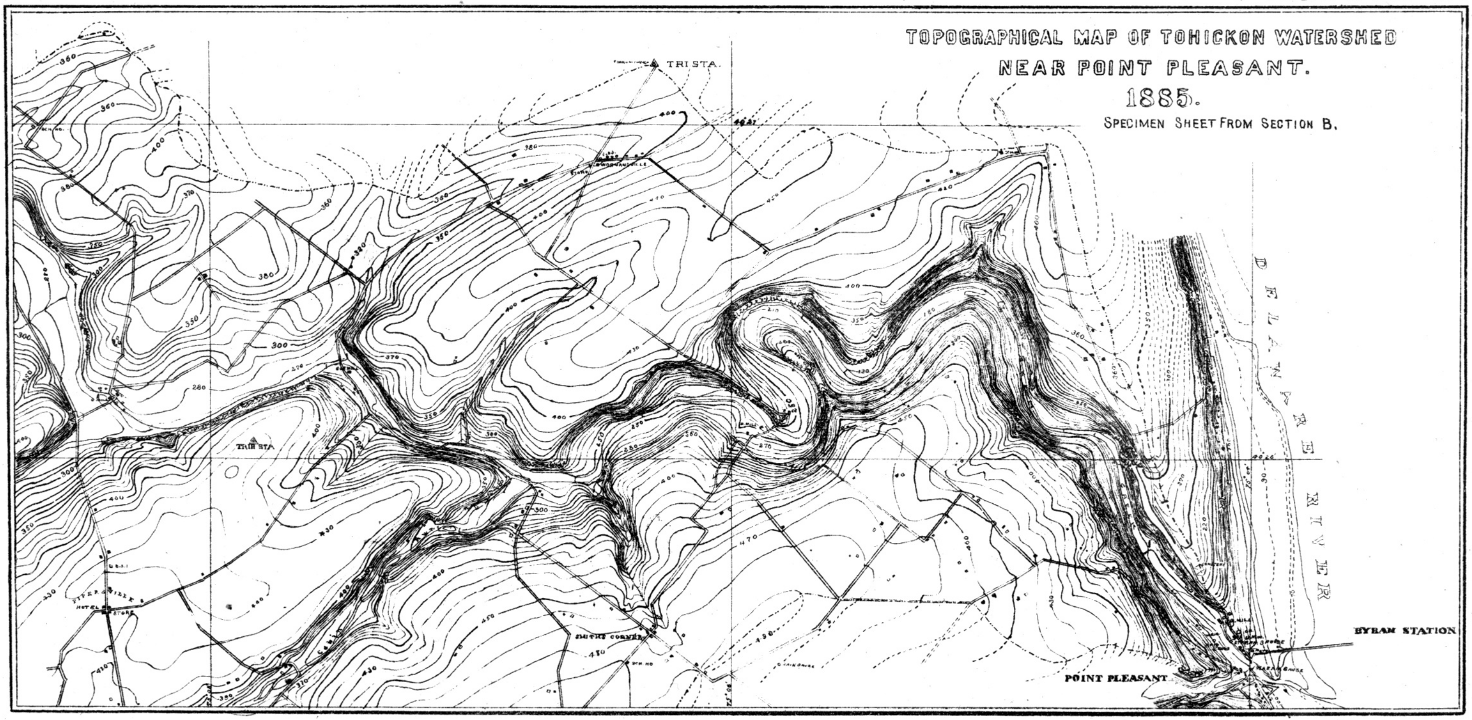
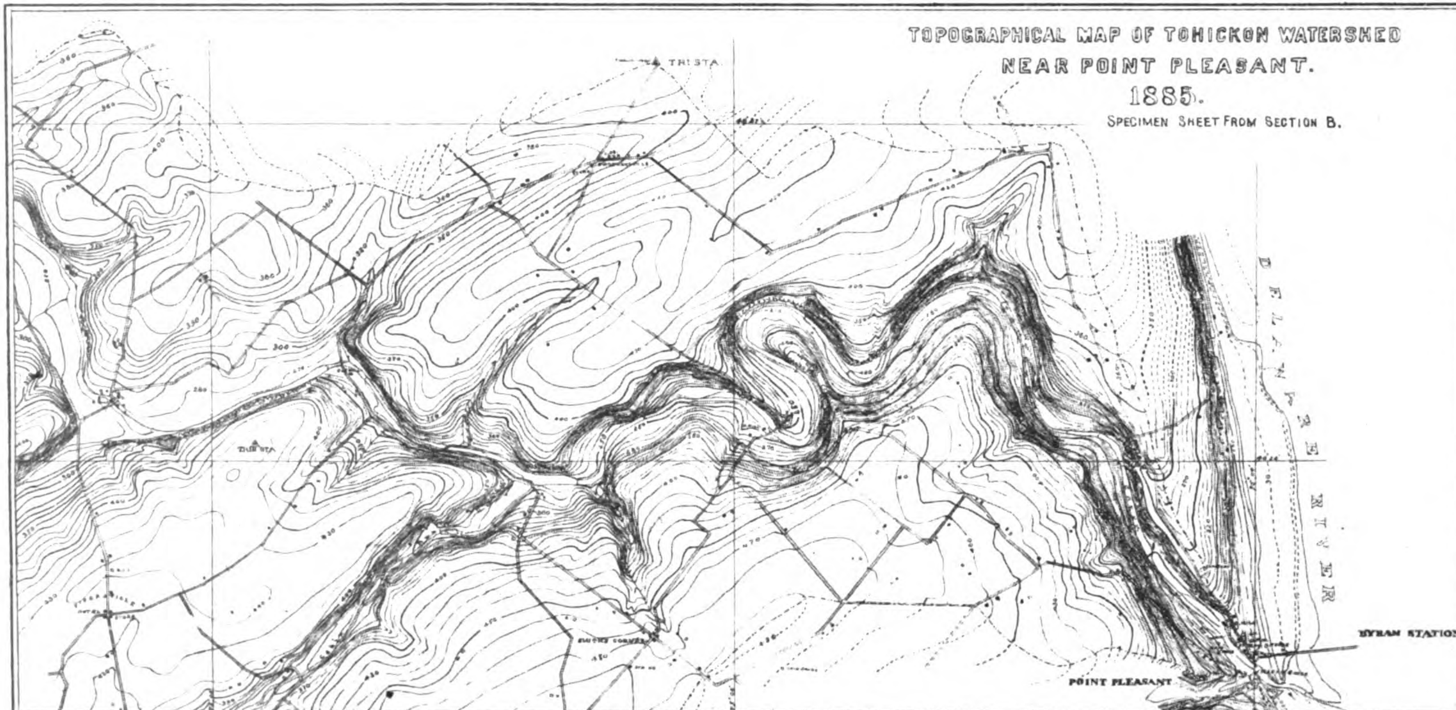

TOPOGRAPHICAL MAP OF TOHICKON WATERSHED
NEAR POINT PLEASANT.
1885.
SPECIMEN SHEET FROM SECTION B.
TRI STA.
TRI STA
DELAWARE RIVER
POINT PLEASANT
BYRAM STATION
SMITHS CORNER

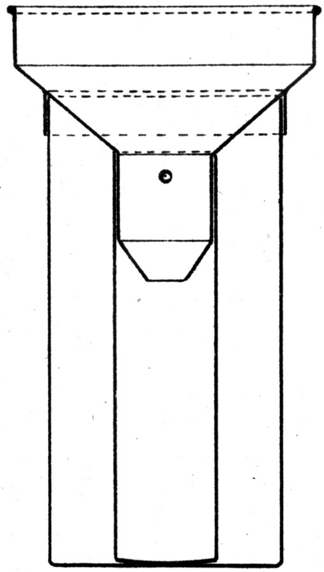
PLATE V.



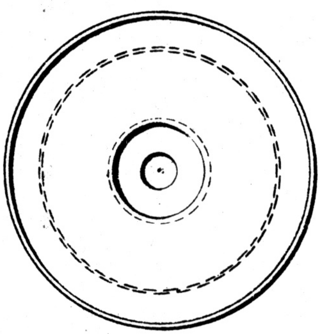
TOPOGRAPHICAL MAP OF TOHICKON WATERSHED
NEAR POINT PLEASANT.
1885.
SPECIMEN SHEET FROM SECTION B.
DELAWARE RIVER
BYRAM STATION
POINT PLEASANT
TRI STA.

PLATE VI.

VERTICAL SECTION



PLAN

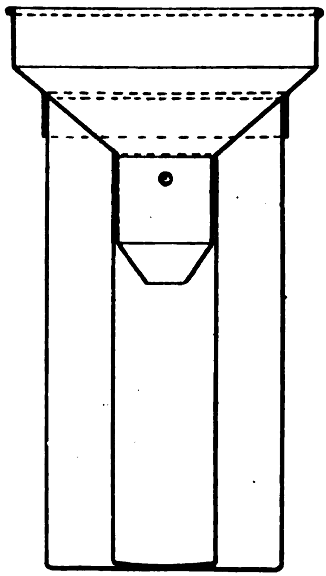


RAIN GAUGE

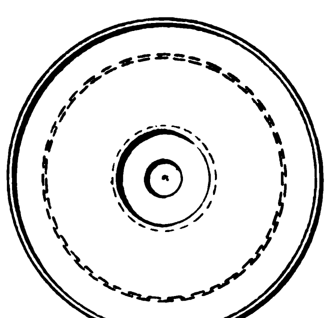
ONE FIFTH SIZE

PLATE VI.

VERTICAL SECTION



PLAN



RAIN GAUGE

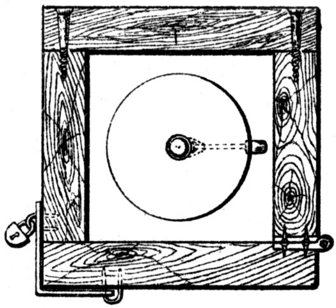
ONE FIFTH SIZE

AUTOMATIC GAUGE

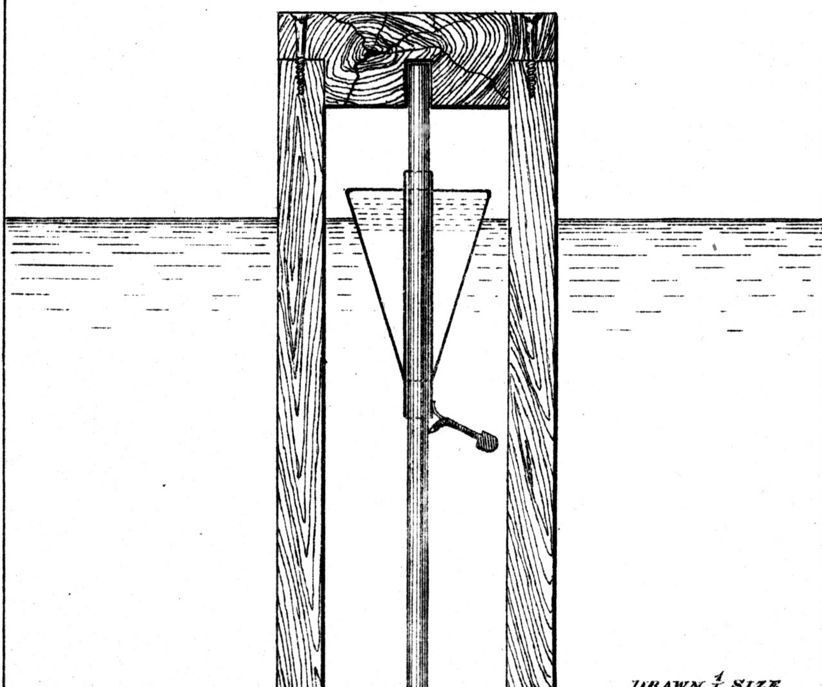
FOR RECORDING

Maximum Height of Streams

HORIZONTAL SECTION



VERTICAL SECTION



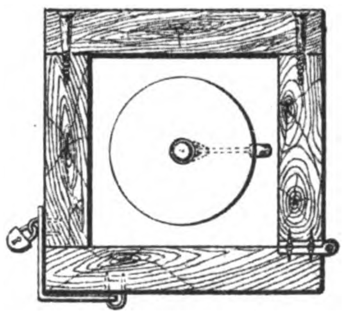
DRAWN $\frac{1}{4}$ SIZE

AUTOMATIC GAUGE

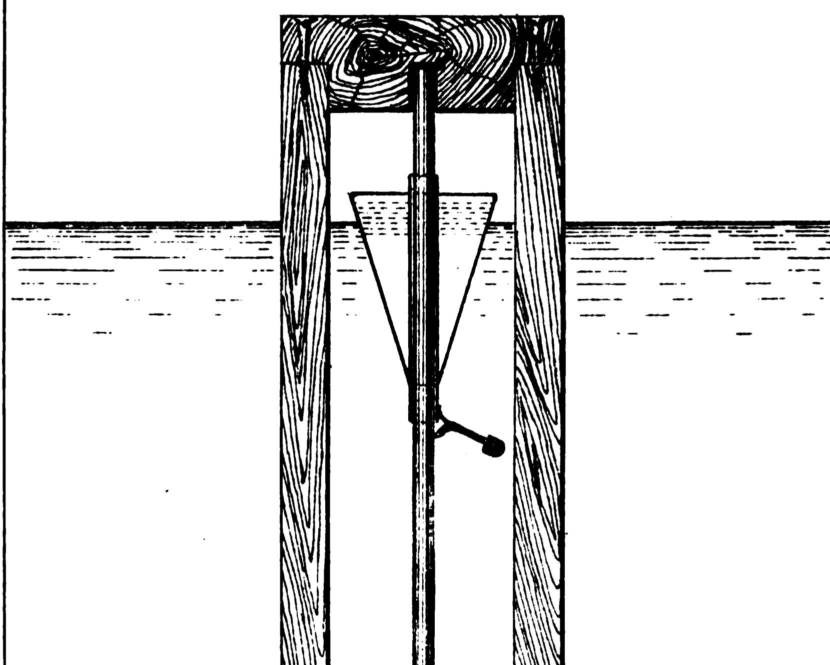
FOR RECORDING

Maximum Height of Streams

HORIZONTAL SECTION



VERTICAL SECTION



DRAWN 1/6 SIZE

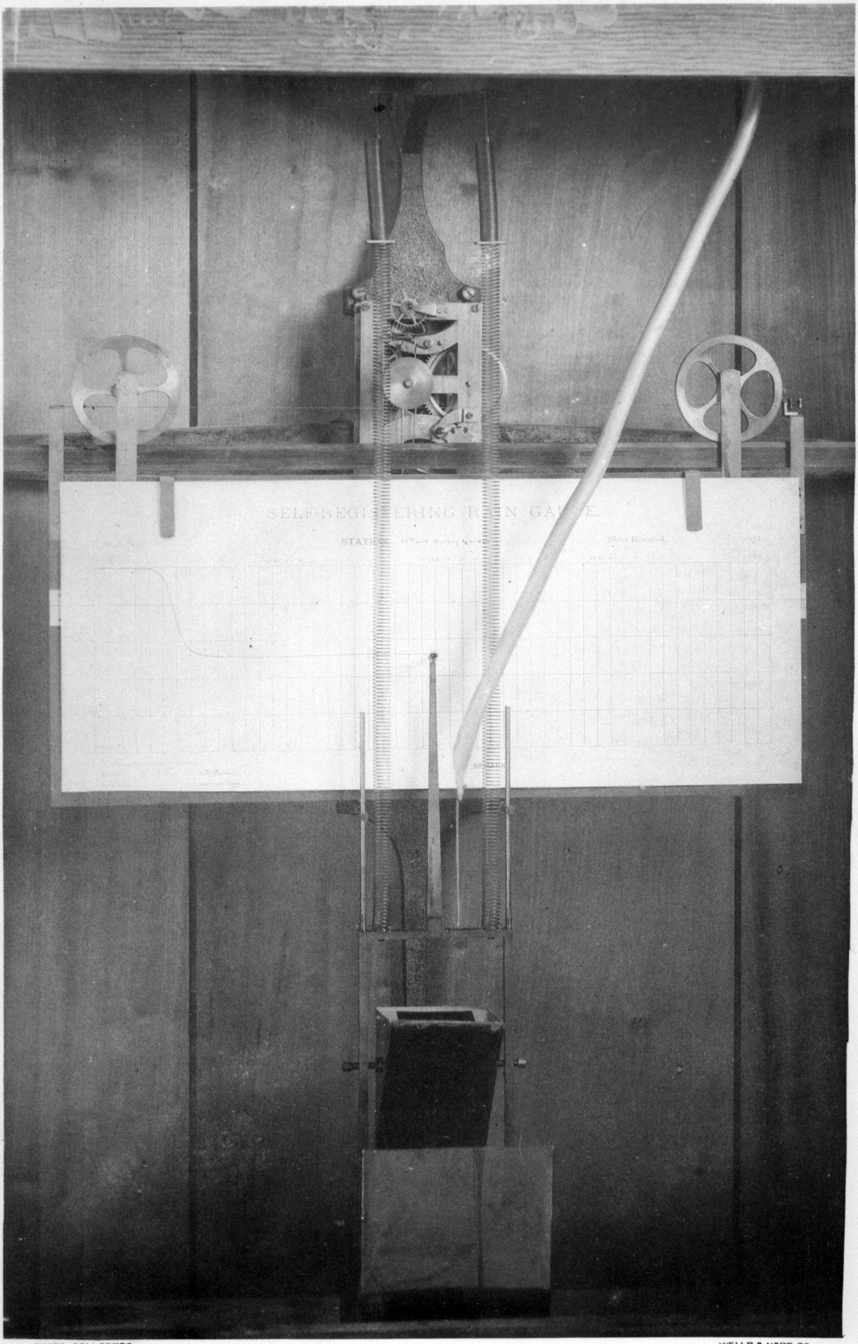


PHOTO-COLLOTYPE WELLS & HOPE CO.

AUTOMATIC RAIN GAUGE.

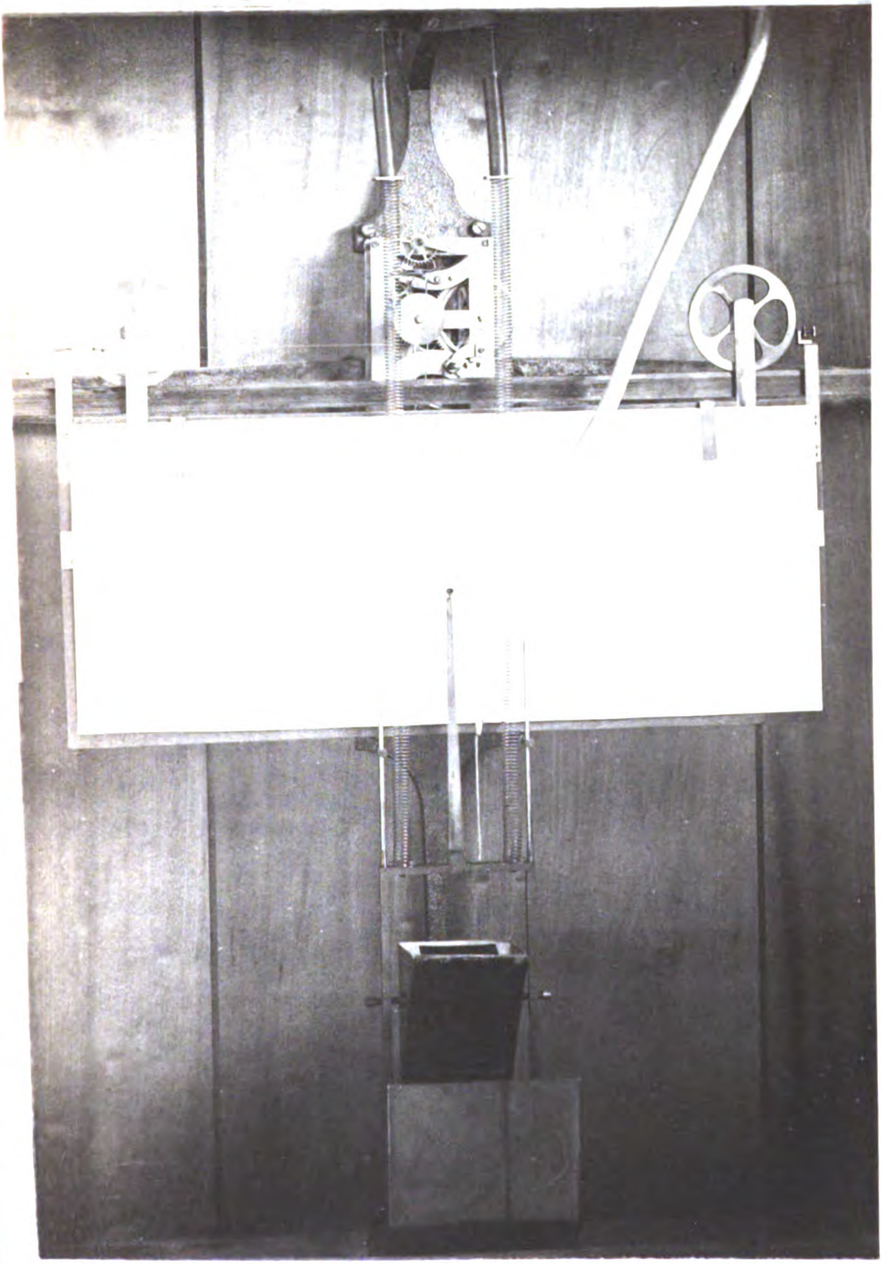


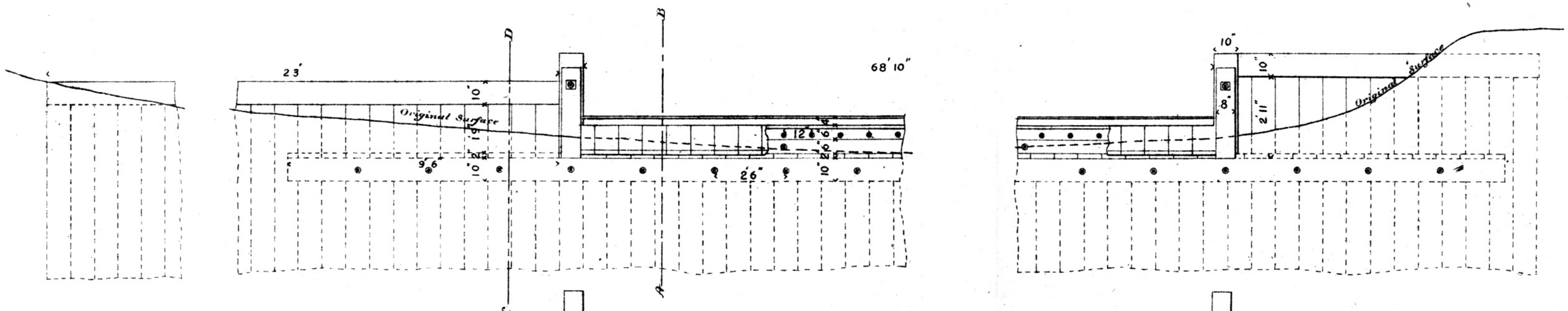
PHOTO-COLLOTYPE WELLS & HOPE CO.

AUTOMATIC RAIN GAUGE.

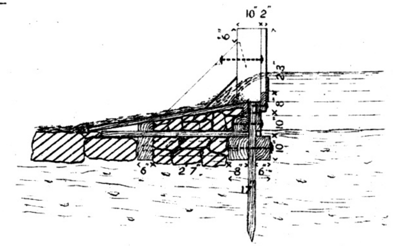
PLATE X.A.

PERKIOMEN MEASURING WEIR

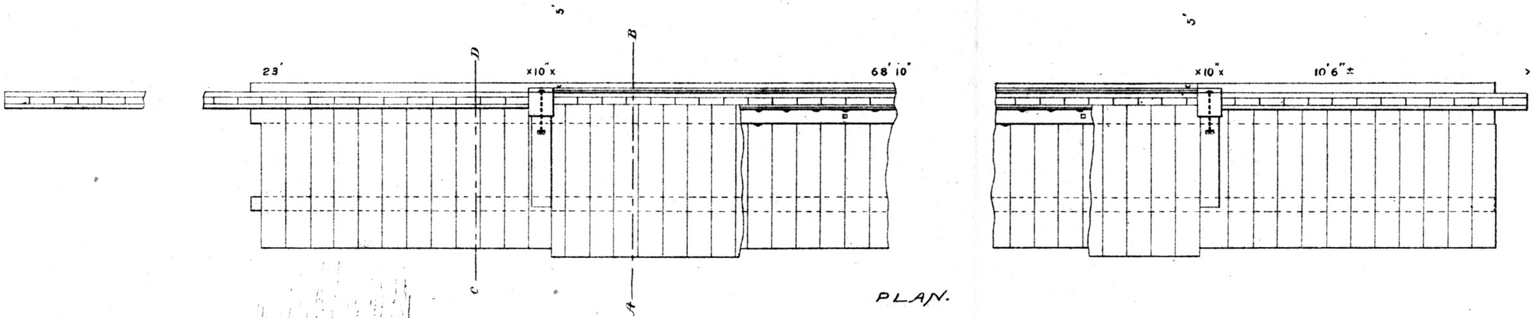
ABOVE GREEN LANE.



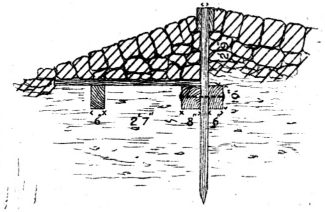
ELEVATION LOOKING UP STREAM.



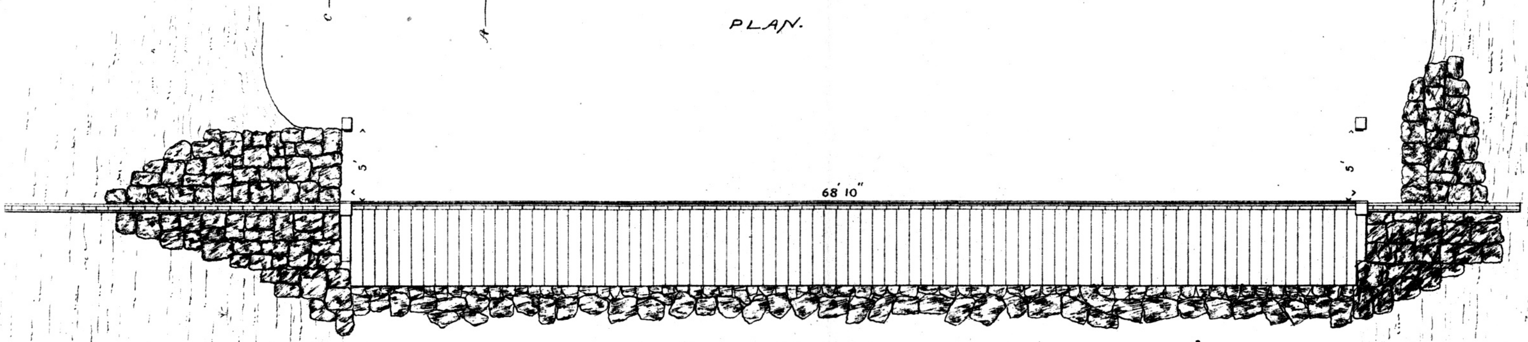
SECTION THRO' 'AB' SHOWING FLASHBOARD.



PLAN.



SECTION THRO' 'CD'.



GENERAL PLAN OF WEIR.

PLATE X.B.

BIG NESHAMINY MEASURING WEIR

AT WARNER'S FORD

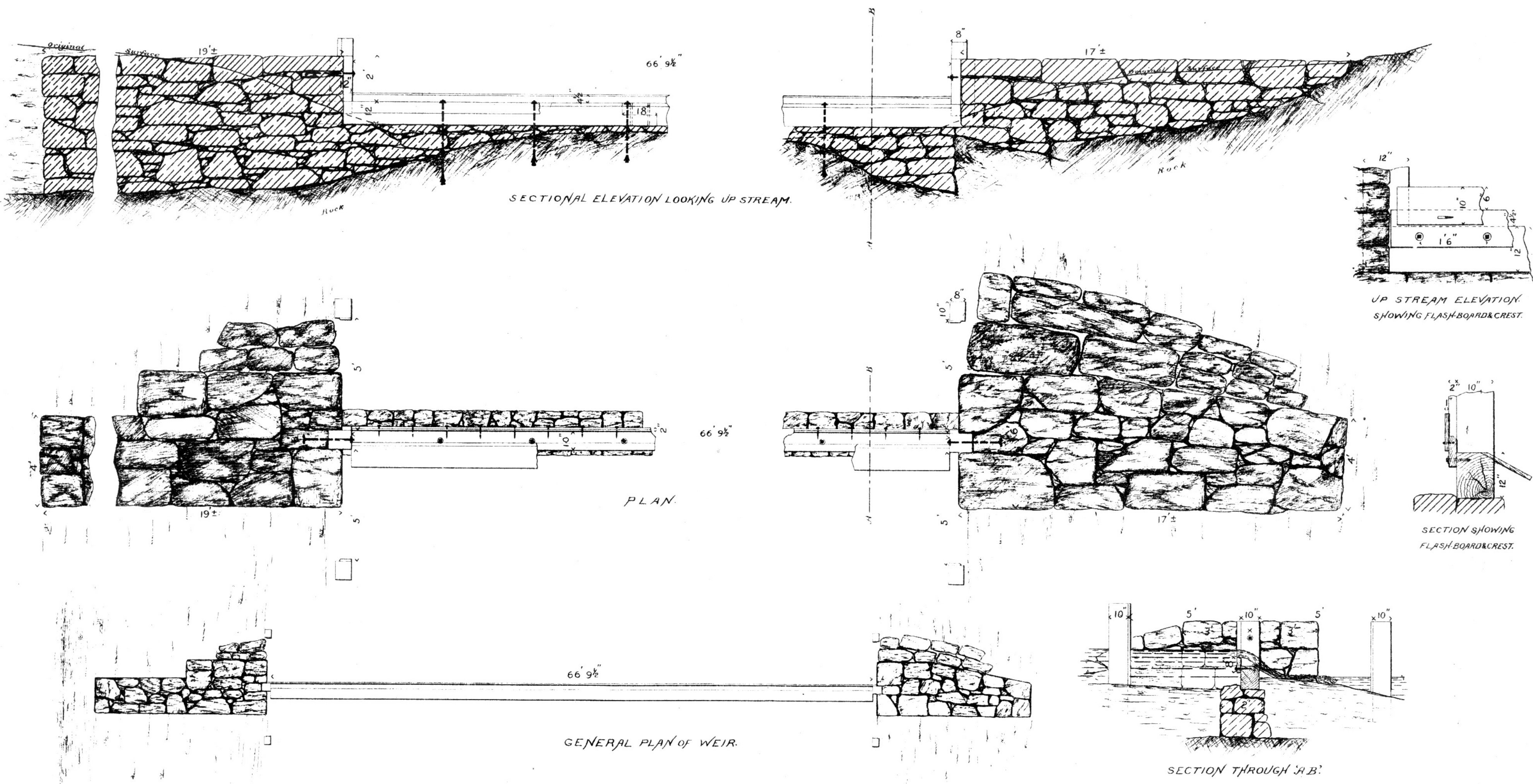


PHOTO-COLLOTYPE

WELLS & HOPE CO.

AUTOMATIC STREAM GAUGE AND GAUGING WEIR,

Tohicken Creek, at Point Pleasant.

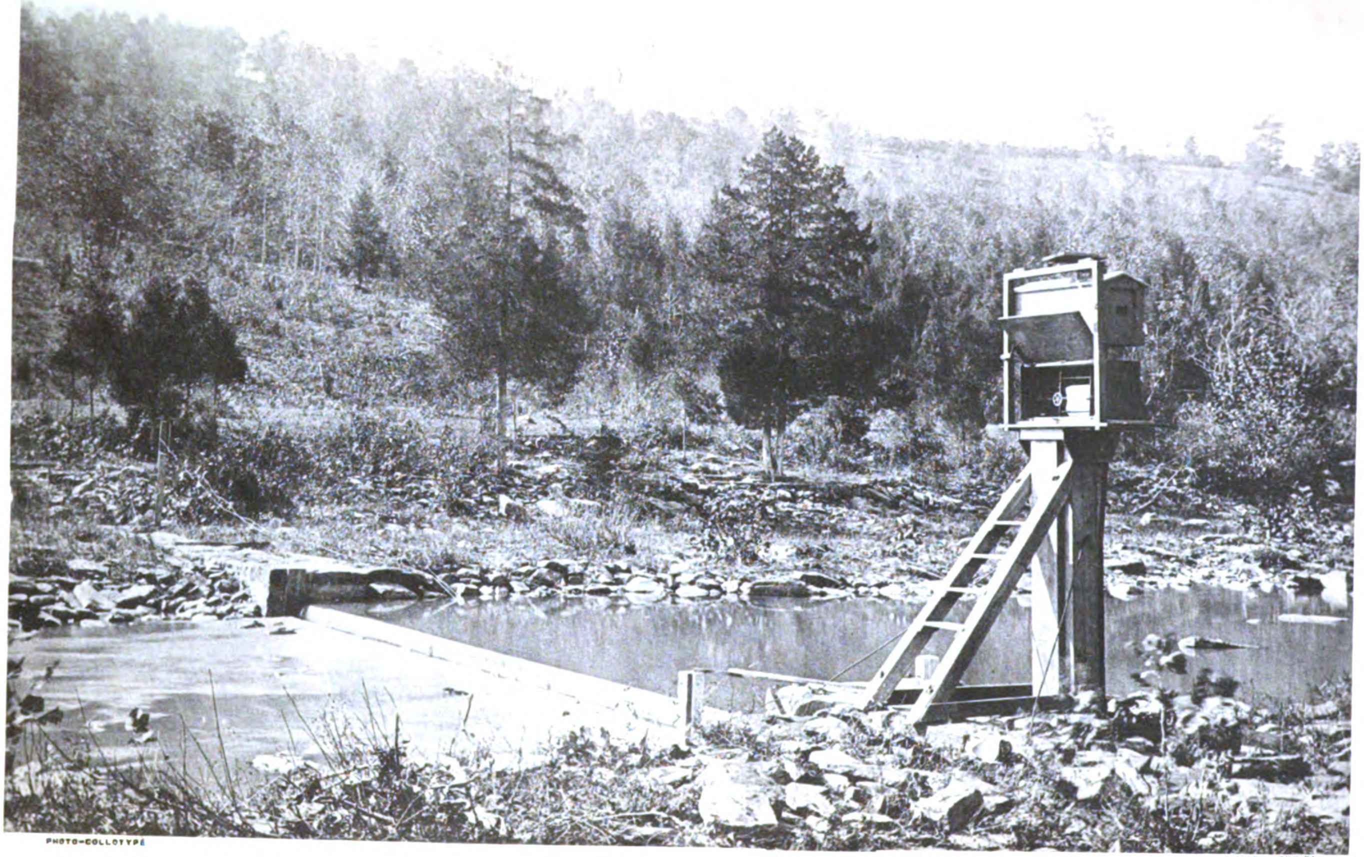


PHOTO-COLLOTYPE

WELLS & HOPE CO.

AUTOMATIC STREAM GAUGE AND GAUGING WEIR,

Tohickon Creek, at Point Pleasant.

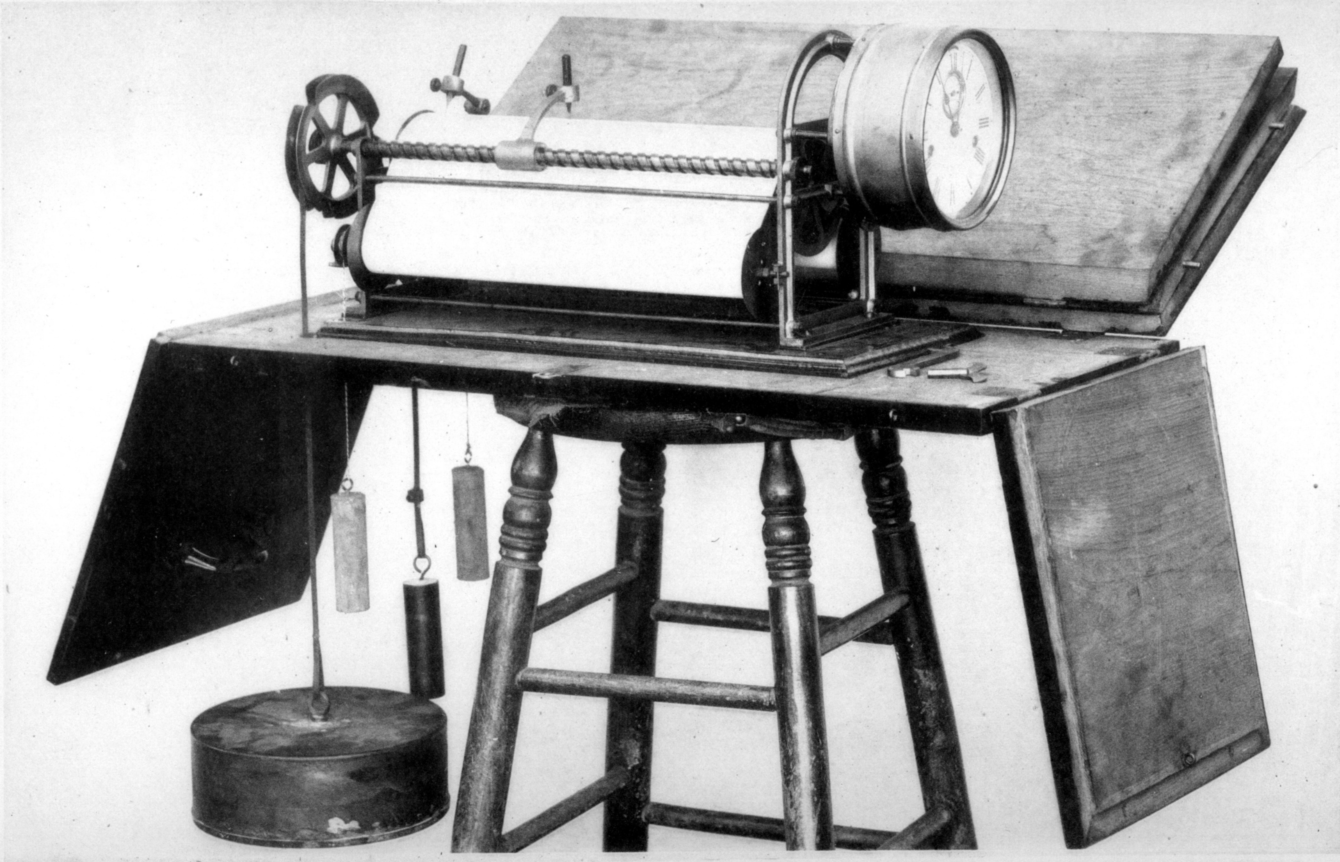


PHOTO-COLLOTYPE

WELLS & HOPE CO.

AUTOMATIC STREAM GAUGE.

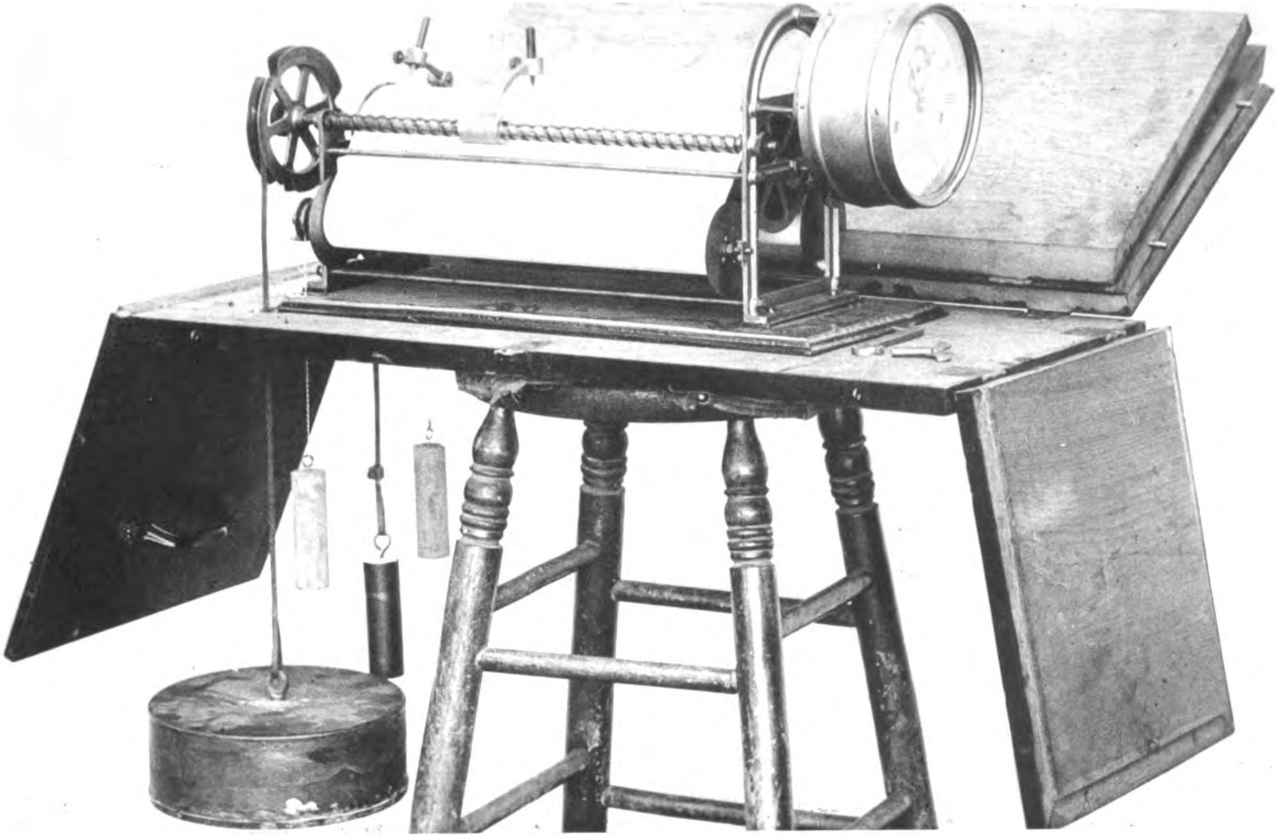


PHOTO-COLLOTYPE

WELLS & HOPE CO.

AUTOMATIC STREAM GAUGE.

CHART SHOWING THE QUANTITY OF WATER IN STORE AT THE END OF EACH MONTH FROM JAN. 1884 TO DEC. 1885, INCLUSIVE, IN PROPOSED STORAGE RESERVOIRS IN THE TOHICKON VALLEY, HAVING A CAPACITY OF 3 349 778 000 CUB. FT., THE AVERAGE DAILY WITHDRAWAL BEING 100 MILL. GALS.

E XIII

JU

CHART SHOWING THE QUANTITY OF WATER IN STORE AT THE END OF EACH MONTH FROM JAN. 1884 TO DEC. 1885, INCLUSIVE, IN PROPOSED STORAGE RESERVOIRS IN THE <u>TOHICKON VALLEY</u>, HAVING A CAPACITY OF 3,349,778,000 CUB. FT., THE AVERAGE DAILY WITHDRAWAL BEING 100 MILL. GALS.

XIV A.

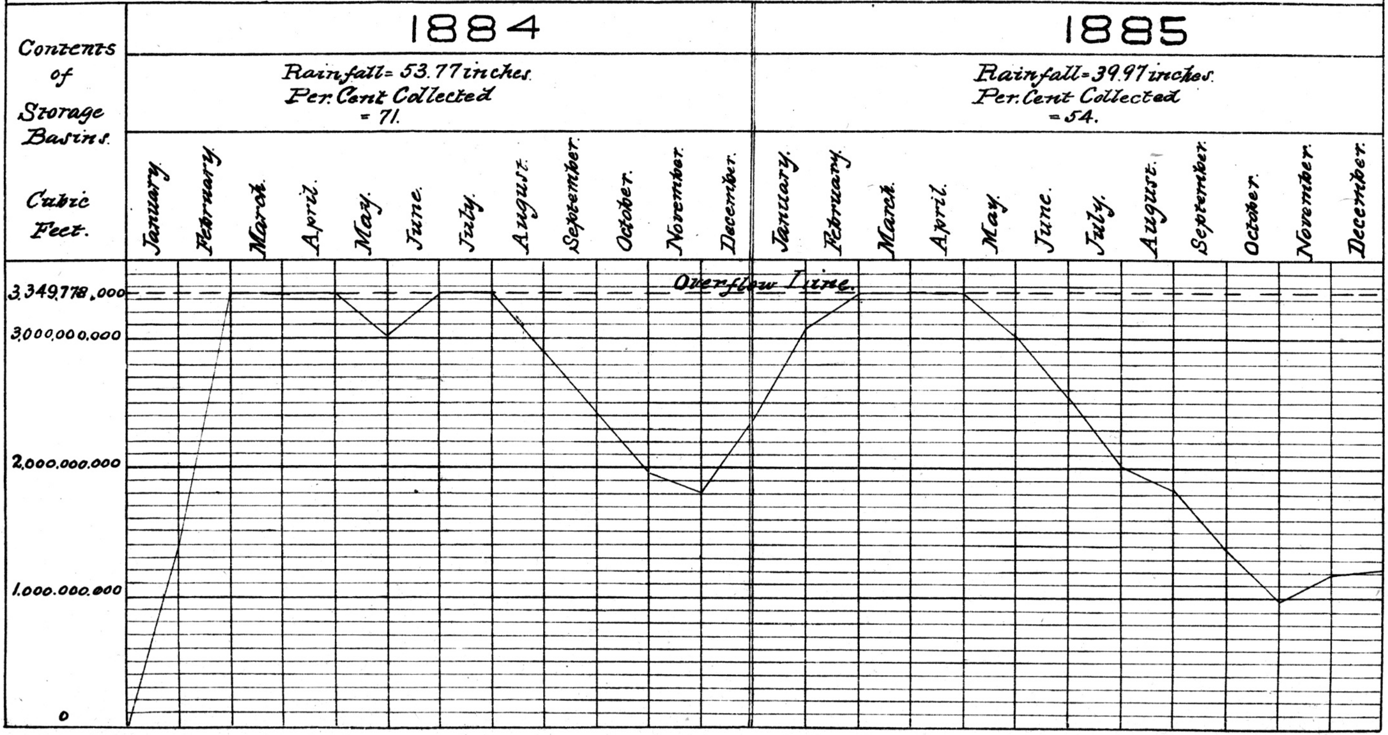


CHART SHOWING THE QUANTITY OF WATER IN STORE AT THE END OF EACH MONTH FROM JAN. 1884 TO DEC. 1885, INCLUSIVE, IN PROPOSED STORAGE RESERVOIRS IN THE TOHICKON VALLEY, HAVING A CAPACITY OF 3,349,778,000 CUB. FT., THE AVERAGE DAILY WITHDRAWAL BEING 100 MILL. GALS.

XIV A.

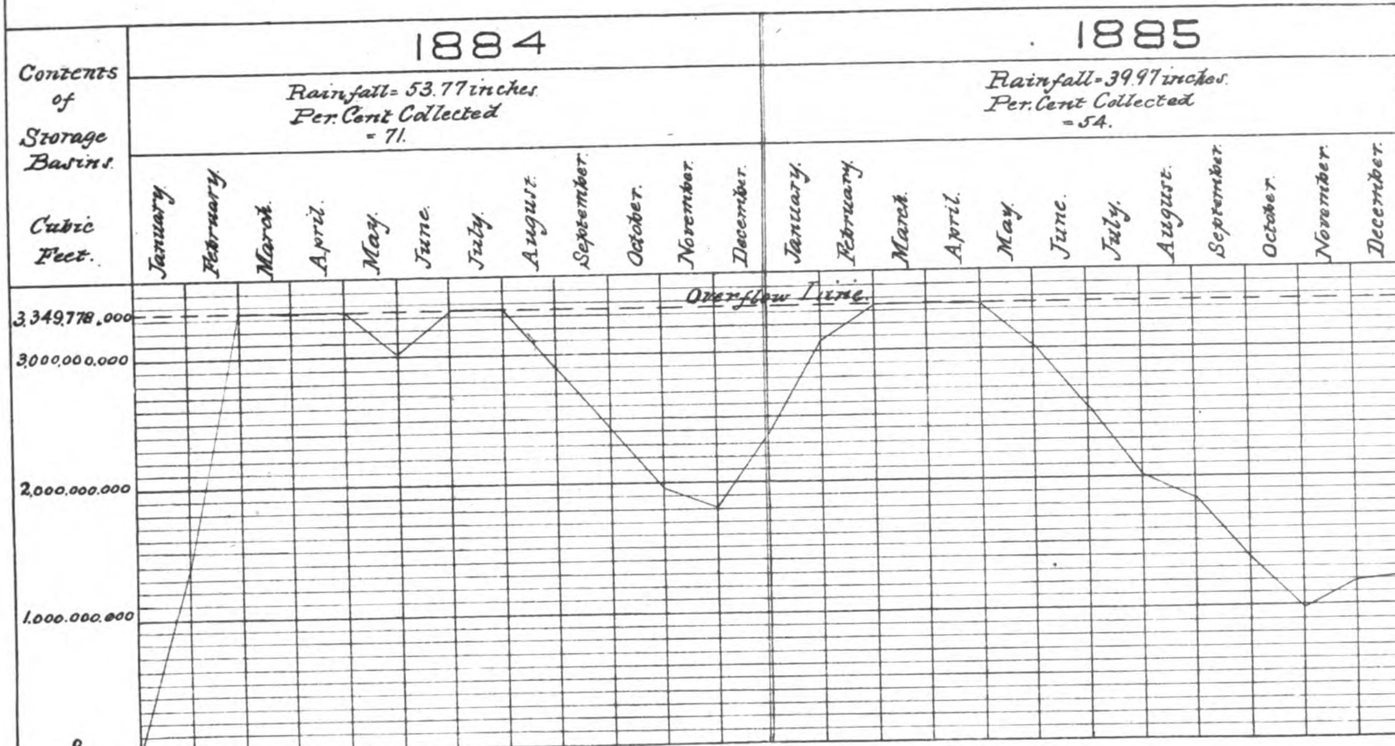


CHART SHOWING THE QUANTITY OF WATER IN STORE AT THE END OF EACH MONTH FROM JAN. 1884 TO DEC. 1885 INCLUSIVE, IN PROPOSED STORAGE RESERVOIRS IN THE NESHAMINY VALLEY, HAVING A CAPACITY OF 3.135.914.000 CUB. FT., THE AVERAGE DAILY WITHDRAWAL BEING 100 MILL. GALS.

XIV B.

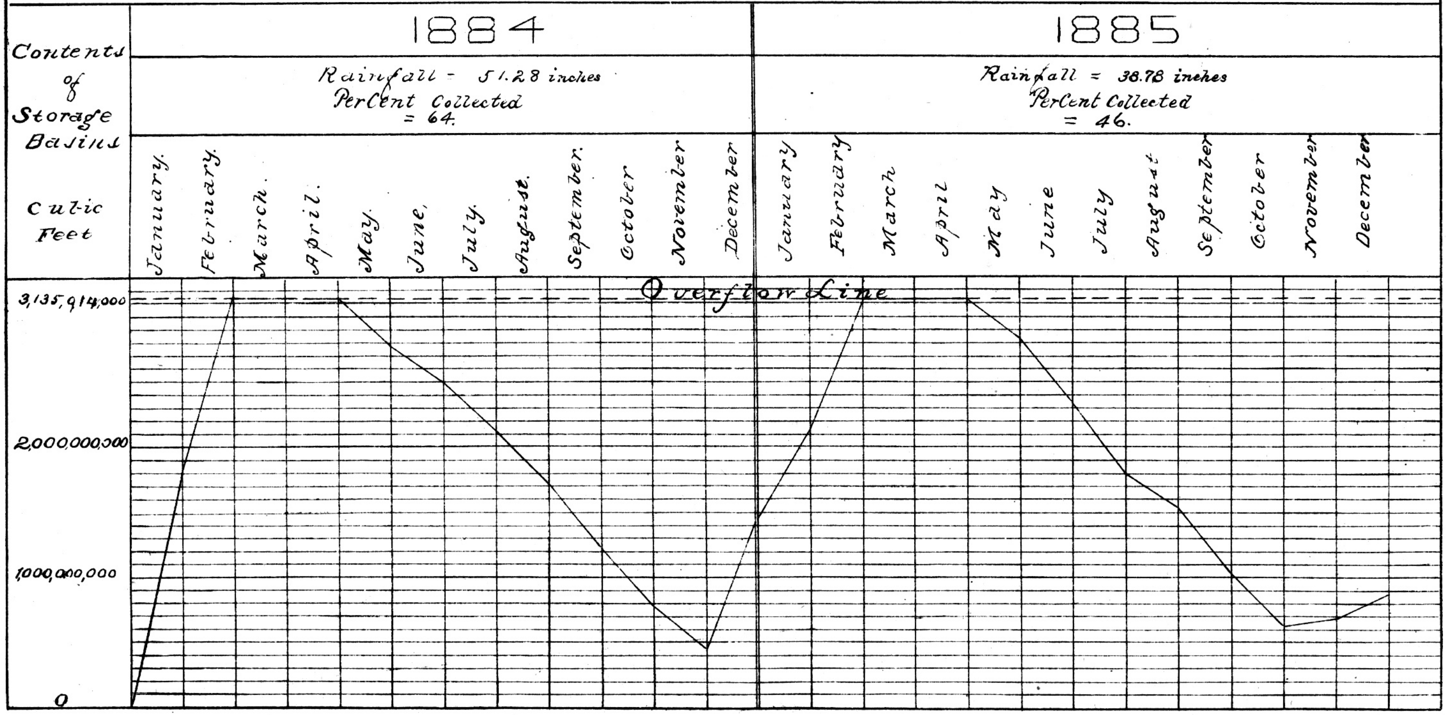


CHART SHOWING THE QUANTITY OF WATER IN STORE AT THE END OF EACH MONTH FROM JAN. 1884 TO DEC. 1885 INCLUSIVE, IN PROPOSED STORAGE RESERVOIRS IN THE NESHAMINY VALLEY, HAVING A CAPACITY OF 3.135.914.000 CUB. FT., THE AVERAGE DAILY WITHDRAWAL BEING 100 MILL. GALS.

XIV B.

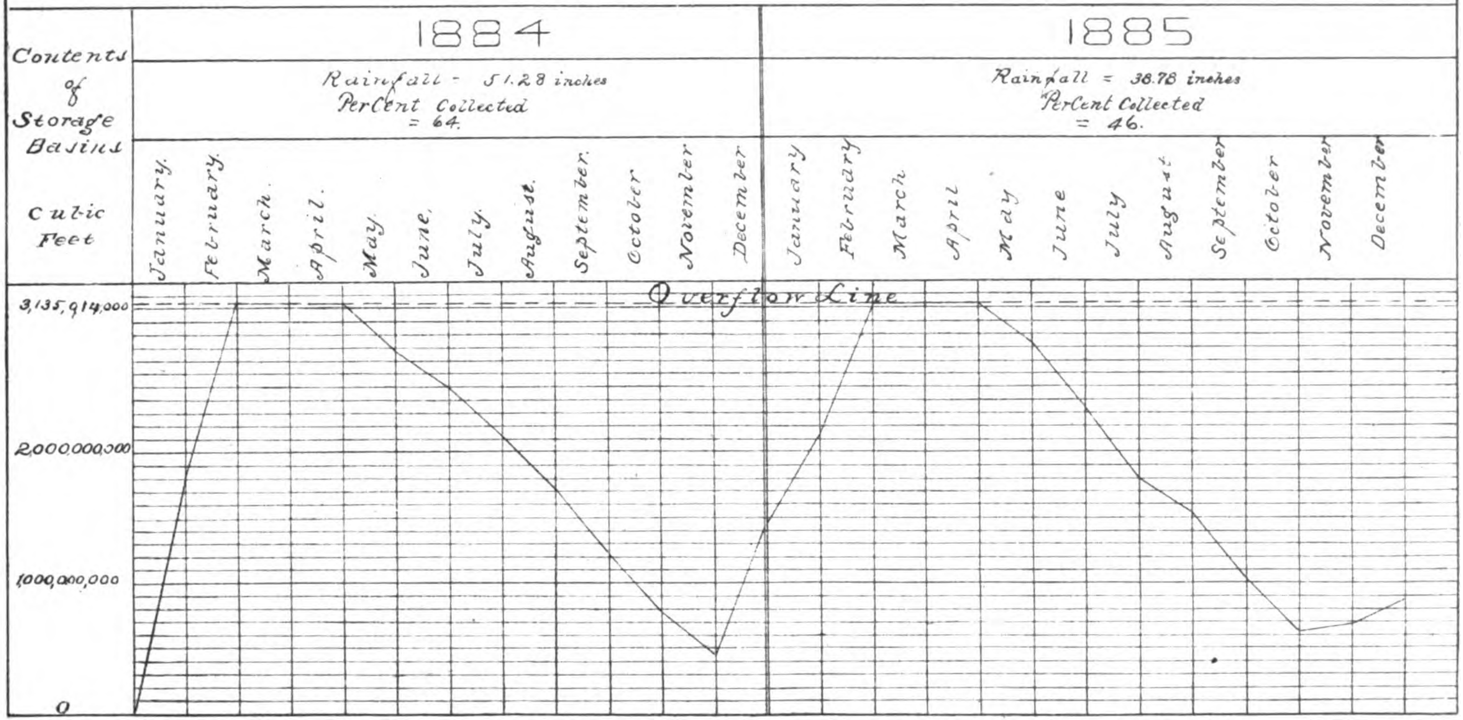


CHART SHOWING THE QUANTITY OF WATER IN STORE AT THE END OF EACH MONTH FROM JAN. 1884 TO DEC. 1885 IN PROPOSED STORAGE RESERVOIRS IN PERKIOMEN VALLEY ABOVE GREEN LANE, HAVING A CAPACITY OF 3.089.854.000 CUB. FT. THE AVERAGE DAILY WITHDRAWAL BEING 60 MILL. GALS.

NOTE. STREAM FLOW FOR 1885 WAS COMPUTED ON BASIS OF ESTIMATED AVERAGE RAINFALL AND AVERAGE QUANTITY OF RAIN FALLING OFF.

XIV C.

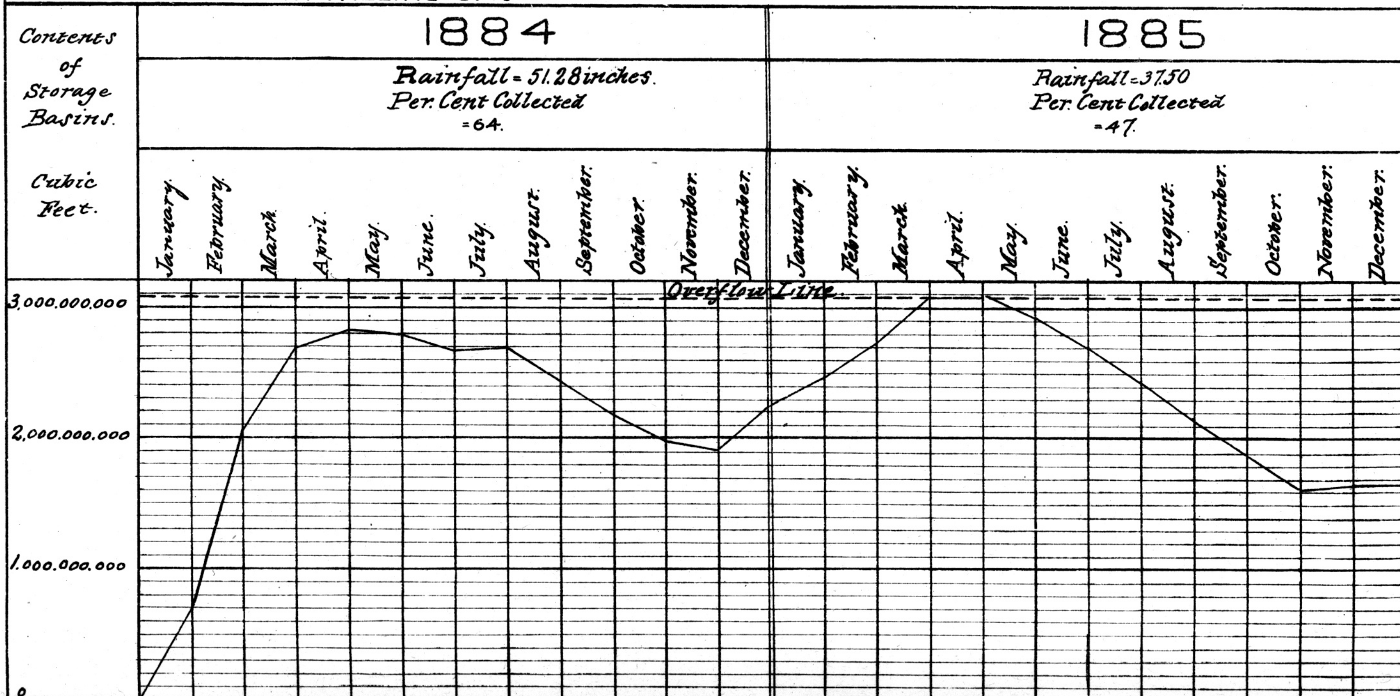


CHART SHOWING THE QUANTITY OF WATER IN STORE AT THE END OF EACH MONTH FROM JAN. 1884 TO DEC. 1885 IN PROPOSED STORAGE RESERVOIRS IN PERKIOMEN VALLEY ABOVE GREEN LANE, HAVING A CAPACITY OF 3.089.854.000 CUB. FT. THE AVERAGE DAILY WITHDRAWAL BEING 60 MILL. GALS.

NOTE. STREAM FLOW FOR 1885 WAS COMPUTED ON BASIS OF ESTIMATED AVERAGE RAINFALL AND AVERAGE QUANTITY OF RAIN FALLING OFF.

XIV C.

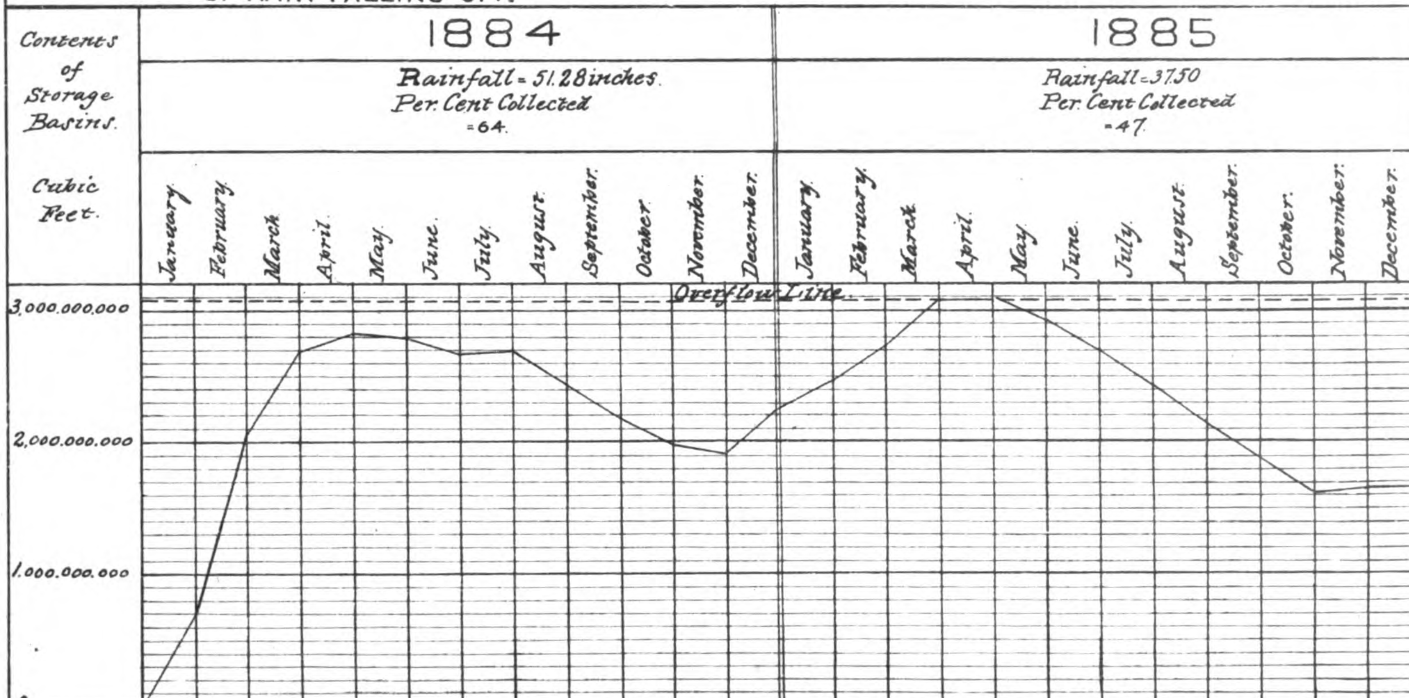


CHART SHOWING THE QUANTITY OF WATER IN STORE AT THE END OF EACH MONTH, FROM JAN. 1884 TO DEC. 1885 IN PROPOSED STORAGE RESERVOIRS IN THE EAST SWAMP AND RICH VALLEYS HAVING A CAPACITY OF 1,595,808,000 CUB. FT. THE AVERAGE DAILY WITHDRAWAL BEING 40 MILL GALS.

NOTE | STREAM FLOW FOR 1885 WAS COMPUTED ON BASIS OF ESTIMATED AVERAGE RAINFALL AND AVERAGE QUANTITY OF RAIN FALLING OFF.

XIV D.

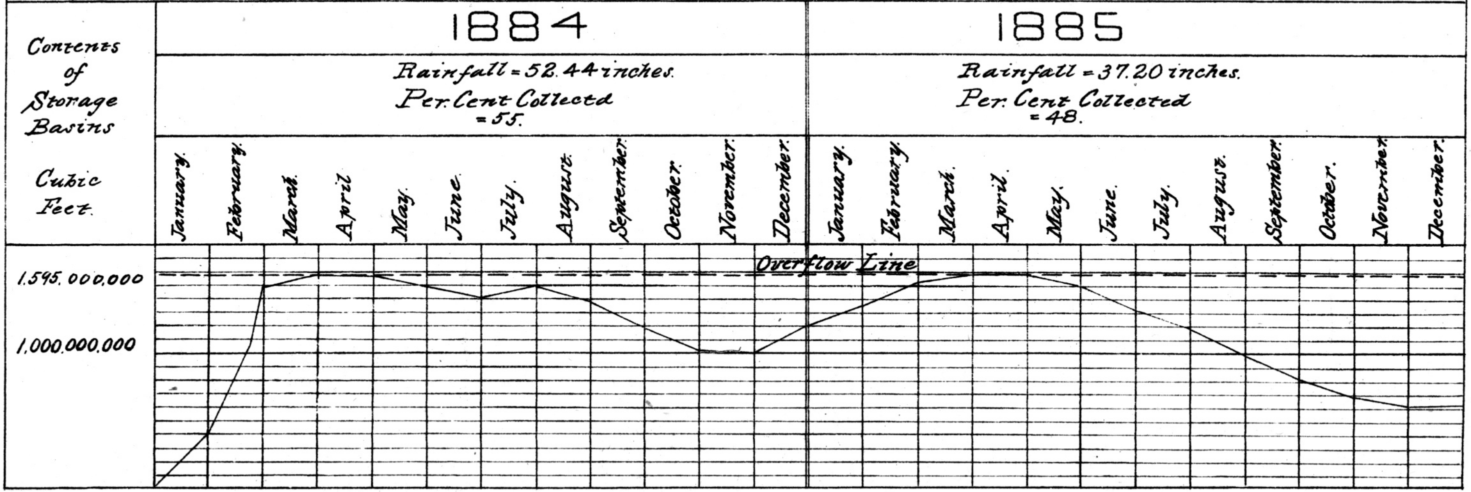
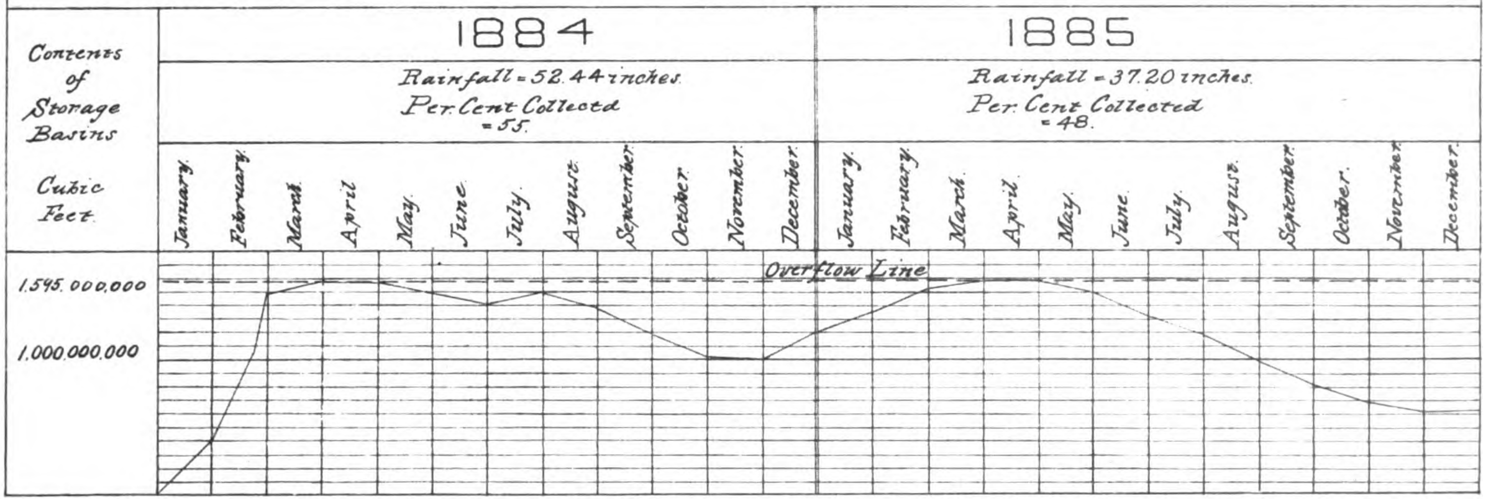
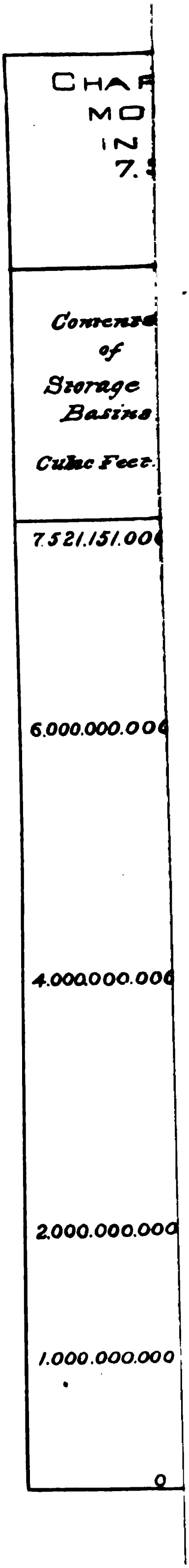


CHART SHOWING THE QUANTITY OF WATER IN STORE AT THE END OF EACH MONTH, FROM JAN. 1884 TO DEC. 1885 IN PROPOSED STORAGE RESERVOIRS IN THE EAST SWAMP AND RICH VALLEYS HAVING A CAPACITY OF 1,595,808,000 CUB. FT. THE AVERAGE DAILY WITHDRAWAL BEING 40 MILL GALS.

NOTE | STREAM FLOW FOR 1885 WAS COMPUTED ON BASIS OF ESTIMATED AVERAGE RAINFALL AND AVERAGE QUANTITY OF RAIN FALLING OFF.

XIVD.

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Contents
of
Storage
Basins
Cubic Feet.
7.521.151.00
6.000.000.00
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2.000.000.000
1.000.000.000
0

CHART SHOWING THE QUANTITY OF WATER IN STORE AT THE END OF EACH MONTH, FROM JAN. 1884 TO DEC. 1885 IN PROPOSED STORAGE RESERVOIRS IN THE PERKIOMEN VALLEY ABOVE SCHWENKSVILLE, HAVING A CAPACITY OF 7.521.151.000 CUB. FT. THE AVERAGE DAILY WITHDRAWAL BEING 150 MILL. GALS.

NOTE | STREAM FLOW BEFORE SEPT. 1ST 1884 WAS COMPUTED ON BASIS OF ESTIMATED AVERAGE RAINFALL AND AVERAGE QUANTITY OF RAIN FLOWING OFF.

XIV E.

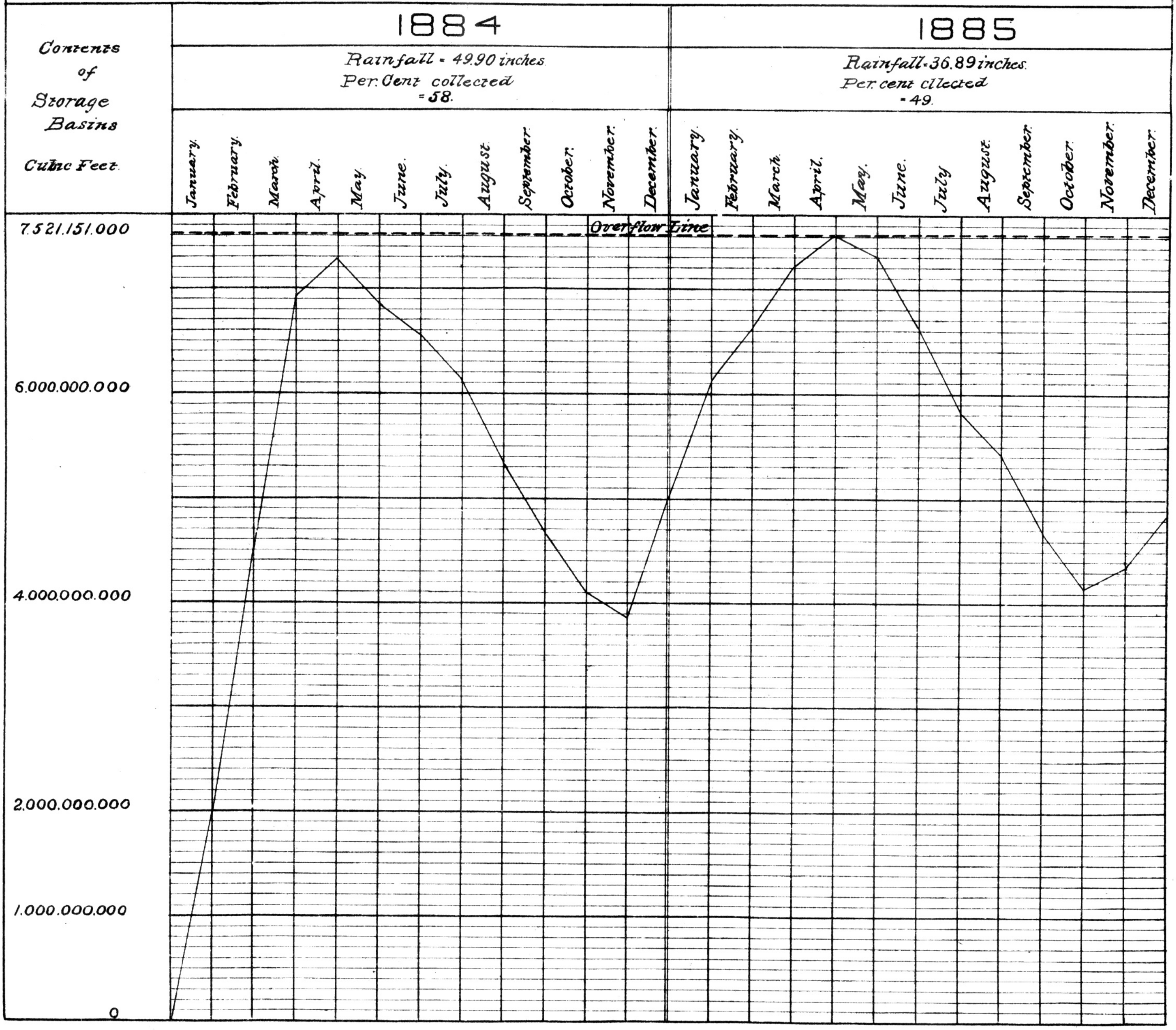

CHART SHOWING THE QUANTITY OF WATER IN STORE AT THE END OF EACH MONTH FROM JAN. 1884 TO DEC. 1885 IN PROPOSED STORAGE RESERVOIRS IN THE N.E. BRANCH VALLEY, HAVING A CAPACITY OF 1,896,000,000 CUB. FT. THE AVERAGE DAILY WITHDRAWAL BEING 50 MILL. GALS.

XIV F.

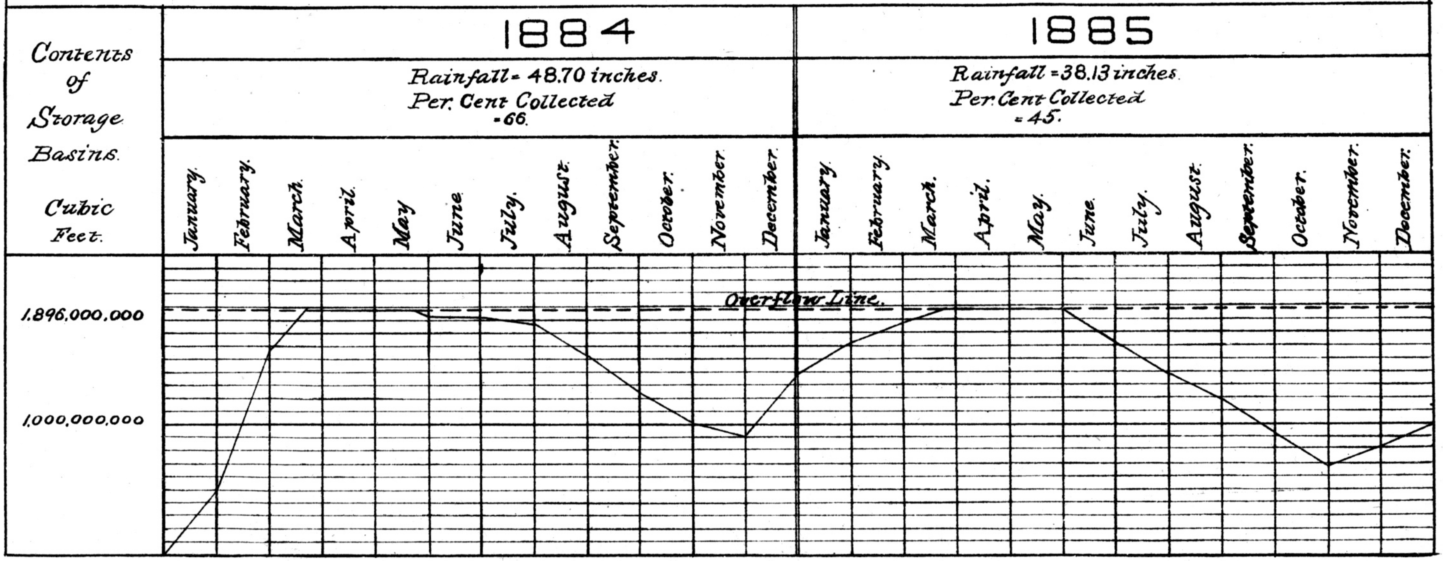

PHOTO-COLLOTYPE WELLS & HOPE CO.

AUTOMATIC STREAM GAUGE AND GAUGING BRIDGE,

Perkiomen Creek, at Frederick.

PLATE XVI.

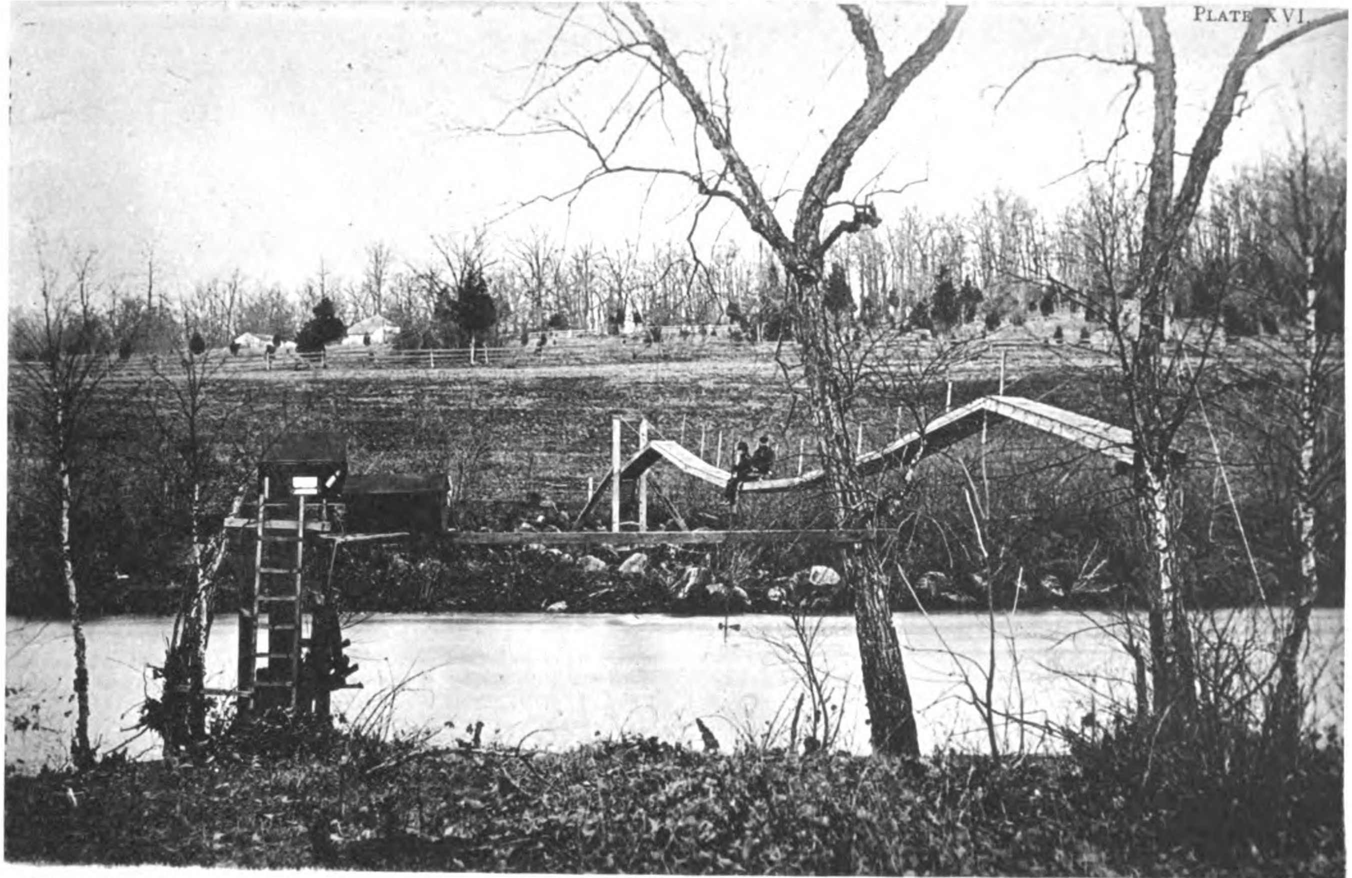

PHOTO-COLLOTYPE

WELLS & HOPE CO.

AUTOMATIC STREAM GAUGE AND GAUGING BRIDGE.

APPENDIX I.

ADDRESS

ON THE

SCHUYLKILL RIVER

AS A

SOURCE OF WATER SUPPLY

FOR THE

CITY OF PHILADELPHIA.

BY

CHARLES W. DULLES, M. D.

MR. CHAIRMAN AND GENTLEMEN:

The whole argument for going to another source for the water supply of Philadelphia rests upon certain objections to the Schuylkill river. The objections are of two kinds: *First*, that the quantity of water flowing down the Schuylkill river is now inadequate or will shortly become inadequate; and, *second*, that the quality of the water is now such as to make it unfit for drinking, or that it will soon become unfit to drink.

In order to study these assertions properly they must be considered separately.

The first assertion, namely, that the quantity of water in the Schuylkill river is now inadequate, or will shortly become so, has been strongly urged by the representatives of the South Mountain Water Company. For example, I find it stated by Mr. Maris, President of this Company, on page 4 of his Memorial: *

* Memorial. To the Chairman and members of the Water Committee. Signed by John M. Maris, President South Mountain Water Company. 8°, pp. 7, January 3, 1887.

"It has been demonstrated that this minimum flow" (the minimum flow of the Schuylkill river past Fairmount) "has decreased in the course of years from 500,000,000 gallons in 1816 to 250,000,000 gallons in 1874, and 170,000,000 gallons in 1881."†

The first thing that struck me in going over this statement was the astonishing apparent diminution in the flow of the water, which led me to make a calculation as to how long the water in the Schuylkill would last, if this statement were true: and the calculation shows that, if the statement be true, there will be no water at all in the Schuylkill river in 1897. It will be all gone. The figures in the memorial of Mr. Maris show a falling off of 80,000,000 gallons of water in seven years, or more than 11,000,000 gallons a year. At this rate, if the figures given for 1881 are accurate, in sixteen years from that date there would not be a drop of water flowing down the Schuylkill river, but in 1897 it would be absolutely dry!

In order to ascertain whether or not these figures were correct, as I suspected they could not be, I put myself in communication with Mr. Edwin F. Smith, Superintendent and Engineer of Canals of the Philadelphia and Reading Railroad Company (and undoubtedly the best authority on the amount of water in the Schuylkill river), in order to ascertain exactly what amount of water the Schuylkill could furnish. I asked him in regard to the maximum, the minimum, and the average flow, and, in a letter dated January 13, 1887, he informs me that the maximum flow of the Schuylkill river at Philadelphia amounts to 1,112,348,100,000 cubic feet, or about 8,899,784,800,000 gallons in a year, which equals about 24,383,000,000 gallons a day. The minimum flow of the river at Flat Rock, as made in the report of the Commission of Engineers to Councils, in 1885, is 245,000,000 gallons daily. The average flow of the river at Flat Rock is 570,000,000 gallons in every twenty-four hours.

† This statement is quoted from the report of the Philadelphia Water Department for 1884, made by Colonel Ludlow, page 52. The figures for 1874 are incorrectly quoted, but I give them as Mr. Maris puts them.

Mr. Smith further says:

"The figures of 170,000,000 gallons per day in 1881, and quoted in the Water Department reports as my measurement of the minimum flow in that year, are incorrect. I never made any such statement, and Mr. ' , Assistant Engineer of the Water Department at that time, who quoted the figures as my measurement, understood the matter very well, and knew that they were the result of about three minutes' calculation between us, and that they represented approximately the flow on a certain day, when we, the Schuylkill Navigation Company, were manipulating the river. It was unfair to make such a statement in the Water Department report."

The present consumption of water in the City of Philadelphia is 70,000,000 gallons a day, allowing nearly 73 gallons per head daily. The consumption of water in 1910, with an estimated population of 1,615,837 would be 161,000,000 gallons a day, allowing 100 gallons per head each day.

When we compare these figures with those of Mr. Smith, we see that, at its minimum, the Schuylkill river furnishes more than three times the quantity of water now used by the City of Philadelphia, and at its average eight times as much, while, at its minimum, it furnishes 74,000,000 gallons more than the estimated need for 1910, and at its average it furnishes more than three times as much as will be needed at that day.

This conclusion harmonizes completely with the opinion expressed in 1883, by a Board of experts appointed by Mayor King in 1882, consisting of Messrs. J. Vaughan Merrick, Frederick Graff, E. S. Chesbrough, and Col. William Ludlow, who declared (Report of Philadelphia Water Department for 1883, p. 336):

"It is evident that so far as quantity is concerned, an abundant supply can be obtained from the Schuylkill for a long time to come."

The present pumping capacity of the city station, as furnished me in a letter from John L. Ogden, Esq., Chief Engineer of the Philadelphia Water Department, dated January 13, 1887, is more than 163,000,000 gallons daily, as follows:

PUMPING CAPACITY.

	Gallons.	Gallons.
Fairmount, by water	35,500,000	
Spring Garden, by steam	70,000,000	
Belmont, by steam	18,000,000	
Roxborough, by steam (half in reserve)	12,500,000	
Frankford, by steam (half in reserve	20,000,000	
Kensington, by steam	6,000,000	
		160,000,000

Auxiliary or high service stations:

Roxborough basin	1,000,000	
Mt. Airy basin	2,000,000	
Chestnut Hill basin	750,000	
		3,750,000

From these figures we see that the present pumping capacity of the city stations is more than twice as great as the present need of the city, and that it is almost as great as will be required in 1910, the difference being only 1,000,000 gallons daily.

The storage capacity of the various reservoirs (as stated in the Report of the Philadelphia Water Department for 1885, p. 27), is now over 191,000,000 gallons, and with the completion of the East Park and Cambria reservoirs it will be over 1,100,000,000 gallons, as follows:

STORAGE CAPACITY.

	Gallons.	Gallons.
Fairmount	26,443,140	
Spring Garden	9,800,000	
Corinthian	37,312,000	
Lehigh (or Fairhill)	25,757,720	
Belmont	40,000,000	
Wentz Farm	35,750,000	
Roxborough	11,771,700	
Mount Airy	4,390,000	
		191,224,560

With the completion of the East Park and Cambria reservoirs the storage capacity will be increased as follows:

East Park	700,000,000	
Cambria	210,000,000	
		910,000,000
Total		1,101,224,560

It will be seen from this statement that, with half the present pumping capacity, no storage whatever would be needed at present to prevent a water famine, even if the river fell to its minimum, or even if that minimum were less than one-third as much as it is. With the present storage capacity the whole city could be supplied for 2½ days, without drawing a drop from the river, and with the East Park and Cambria reservoirs completed, it could be supplied for 14 days, without taking a drop from the river.

As to the future, the consumption in 1910, with a population estimated at 1,615,837, is estimated at 161,000,000 gallons, at 100 gallons per capita daily,* (Report Philadelphia Water Department for 1885, p. 69). With the present pumping capacity no reservoirs would be needed to prevent a scarcity of water in 1910, if the river touched its present minimum, while, if the minimum fell to 100,000,000 gallons the present storage capacity would supply the deficiency for 3 days, and, with the East Park and Cambria reservoirs completed, it would supply the deficiency for 18 days.

Now, as to the use of the River Schuylkill and the question of the minimum flow, we must not forget that, even were it possible that the river would fall materially below its present minimum flow,† it is the natural right of all those who live on the banks of the river—a common law right as old as

* At the present time London, with a population of 4,000,000 is supplied with only 37½ gallons per capita daily.

† But there is no likelihood that the flow of the Schuylkill river will in the future be much less than it is now. As has been pointed out by Dr. J. Cheston Morris, in an address to the Water Committee of Councils on January 13, 1887, this is not the usual history of rivers.

the Romans—to drink the river dry, if they can. The City of Philadelphia is entitled to drink all it can out of the river. There are no rights which conflict with the rights of the city to use the river, except those of the Schuylkill Navigation Company; that is, the inhabitants of Philadelphia have a right to drain the Schuylkill to its last drop for ordinary uses, but they have no right to use the water for the purpose of driving machinery, if in so using it they impair its navigability. It will be remembered that when a conflict arose in 1869 between the City of Philadelphia and the Schuylkill Navigation Company, it was not in regard to the right of the city to use the water of the Schuylkill for drinking purposes, but for pumping,* and as the city will probably have no need for using water pumps in the future, such a contingency is not likely to occur again. As I have said, every inhabitant of this city, or of any other city along the banks of the Schuylkill river, has a right to use *every drop* of the water in that river for drinking purposes, if he can.

The second assertion, to which I have alluded, namely, that the quality of the water of the Schuylkill river is now such as to make it unfit for drinking, or that it will soon become unfit to drink, must also be divided, in order that it may be properly considered; that is, it must be decided, first, whether or not, the water supply of Philadelphia is now unfit to drink; and second, whether, or not, it is likely to become so soon.

First, then, is the water supply of Philadelphia now unfit to drink? There are many who think it is. Some think this because its appearance is sometimes disagreeable, and because it sometimes has a disagreeable taste or odor. These grounds for the opinion mentioned may be dismissed with the statement that while they may justify an objection to the water on the score of æsthetic preferences, they cannot be considered as evidences that the water is unwholesome, since some of the most wholesome waters in the world have an unfortunate appearance, and unfortunate taste or odor. As illustrations of

* "The Legal Protection of the Present Water Supply for Philadelphia." By Wm. Wilkins Carr, of the Philadelphia Bar. 8°, pp. 46, Phila., 1886. Pages 7 and 8.

the former I may cite the waters of the Ganges, of the Nile, of the Amazon, of the Mississippi, and of the Delaware. As illustrations of the latter, I may cite all limestone waters, all chalybeate waters, all alkaline waters, peat waters, and the cedar water so common on the New Jersey coast, as well as most rain water. But the fact that the Schuylkill water has sometimes a disagreeable appearance, and very rarely a disagreeable taste or odor is due wholly to remediable causes. The muddiness which marks it at certain seasons depends solely upon the want of sufficient subsiding reservoirs, and will cease to annoy our citizens as soon as this want is supplied. The taste of the water is almost always excellent, and I think it has never been objected to except when the river has been covered with ice. The cure for this is also easy, and consists simply in breaking up the ice in the Fairmount pool as fast as it forms. The same is true in regard to the exceedingly rare occurrence of a disagreeable odor in the water.

More serious objections have been made to the Schuylkill water, founded upon chemical analysis. These objections are entitled to great respect, because of the character and standing of those who make them. When such gentlemen as Dr. Cresson, of this city, and Professor Leeds, of Hoboken, criticise the water supply, their criticisms should receive the most careful consideration, and full inquiry should be made in order to determine whether, or not, as has been charged, the Schuylkill water is unwholesome and dangerous to the health of the community.

Dr. Cresson, in his report to the Water Department of March 3, 1875, says (Report of Philadelphia Water Department for 1884, p. 45):

"The pollution of the Schuylkill river has been increased to such an extent as occasionally to class the water as unwholesome."

Professor Leeds is more outspoken in his criticism. He says (Report of Philadelphia Water Department for 1883, p. 372) in his report of February 27, 1883, to the Board of Experts appointed by Mayor King:

"At present it is more important to note that the water in Fairmount and Spring Garden pools often deteriorates to a point below the maximum limit of admissible impurity."

Two years later he says (Report of Philadelphia Water Department for 1885, pp. 387, 388):

"There is no point on the Schuylkill river, from Phœnixville down to Fairmount, where incompletely oxidized sewage, that is to say, sewage in a more or less decomposed and noxious condition, is not revealed by analysis to be ordinarily present in the water."

And in a letter to S. S. Hollingsworth, Esq., one of the attorneys for the South Mountain Water Company, dated December 18, 1886, Professor Leeds says: *

"On each day of ordinary flow of the Schuylkill river, there goes past the intake of the Spring Garden Pumping Station nearly one-half ton of sewage. The amount of this sewage which finds its way into the reservoirs depends simply on the amount of water pumped. This is the average amount, the quantity of sewage flowing past the intake sometimes being as high as a ton."

These are certainly very alarming statements, and, if they were confirmed, would justify serious concern. But, before making up our minds to condemn the Schuylkill river, it will be proper to investigate the grounds for them. I have not at present access to Dr. Cresson's analyses; but I have to those of Professor Leeds, whose objection to the Schuylkill is much more strongly stated.

I have taken the trouble to go over these analyses of Professor Leeds with a great deal of care, and with such skill as I could bring to bear on the work, and I have come to conclusions diametrically opposed to those of Professor Leeds.

When I examine these analyses I do not find that the Schuylkill water makes such a bad showing, when judged by two standards which can hardly be objected to by Professor Leeds. One of these is his own "General standard of purity

* Pamphlet entitled "The Water Supply of Philadelphia," dated January, 1887, p. 10.

for river water in the United States" (Report of Philadelphia Water Department for 1883, p. 243), and the other is the condition of the Delaware river water at Point Pleasant and at the Delaware Water Gap.

In order to demonstrate this, I call attention to a comparison of some of the analyses of the Schuylkill water with both of the standards mentioned.

I have prepared a series of tables, five in number, which I will place at the disposition of the Committee, which will illustrate my meaning.

Table I. shows a comparison of the Delaware water at Point Pleasant with that of the Schuylkill, and of both with Professor Leeds' standard of purity, from which it will be seen that according to analysis made by Professor Leeds in 1883, the Schuylkill river water at Spring Garden forebay was superior (except as to nitric acid) to the Delaware water, and to Professor Leeds' standard of purity without exception, while the Delaware river water was not only inferior to Professor Leeds' standard of purity as to free ammonia, but also inferior to the Schuylkill water at Spring Garden Basin, except as to nitric acid.

TABLE I.

In parts per 100,000.	* Delaware, Point Pleasant.	* Schuylkill, Spring Garden Forebay.	Prof. Leeds' Standard.
Free ammonia	0.015	0.0005	0.012
Albuminoid ammonia	0.017	0.009	0.028
Nitric acid	0.190	0.370	0.500
Oxygen required (permanganate process)	0.320	0.180	0.500

Table II. shows a comparison of analyses, made by Professor Leeds, of the Schuylkill water in January, 1883—at a time when the river had been for a long time covered with ice, and when it had attracted unfavorable attention by reason of a disagreeable taste and smell—with his standard of purity.

* Report of the Philadelphia Water Department for 1883, p. 259.

TABLE II.

Parts in 100,000.	* Prof. Leeds' Standard of Purity. Maximum.	†Schuylkill, Fairmount Forebay, January 9, 1883.	†Schuylkill, Fairmount Forebay, January 13, 1883.	‡Fairmount Basin Surface, January 19, 1883.	‡Spring Garden Basin Surface, January 19, 1883.
Free ammonia	0.012	0.019	0.020	0.016	0.013
Albuminoid ammonia	0.028	0.023	0.014	0.012	0.011
Required oxygen (permanganate process)	0.500	0.370	0.300	0.180	0.180
Nitrous acid	0.001	0.005	0.006	0.008	0.010
Nitric acid	0.500	0.369	0.355	0.364	0.374
Chlorine	1.000	0.659	0.700	0.650	0.650
Total solids	20.000	18.500	18.500	18.500	19.000

* Report of Philadelphia Water Department for 1883, page 243. General standard of purity. (For river water in the United States. Highest upper limits.)
† Same report, page 351.
‡ Same report, page 352.

From this table it will be seen that the Schuylkill, at this unpropitious time, was superior to Professor Leeds' standard of purity in every respect, except as to free ammonia and nitrous acid, and in respect to these ingredients it was not much inferior to the standard.

It must be acknowledged that free ammonia and nitrous acid (or nitrites) are important elements in determining the relative purity of drinking water according to the generally-accepted standards for water analysis. But I shall show, at a later period, that the accepted standards are acknowledged by all students of water analysis, and by Dr. Leeds among them, to be unreliable as absolute tests of the fitness or unfitness of a water for drinking purposes; and I now call attention to the remarkable fact that Professor Leeds states (Report of Philadelphia Water Department for 1883, p. 367) that "letters addressed to eminent physicians in Philadelphia elicited the uniform response that no connection could be established between the character of the Schuylkill water supply in the

month of January (1883) and any case of disease within their practice."

This is an exceedingly interesting fact, and goes further to vindicate the Schuylkill water, at its worst, from the charge of being unwholesome, than the estimated excess of free ammonia and nitrous acid does to convict it on this charge.

Furthermore, whatever apparent impurity there was in the Schuylkill water at this unfortunate time was wholly due to a cause which, as I have already said, is easily remediable, namely, the persistence of a coating of ice on the river, which prevented the escape of free ammonia and the change of nitrites into nitrates, which would take place constantly if the ice were kept broken up by steam tugs or otherwise.

Table III. is constructed so as to show in graphic form, by lines drawn to a given scale, the relative proportions of the various constituents, from which the impurity of drinking water is usually calculated, in the water of the Schuylkill at Phœnixville, at Roxborough, at Spring Garden, and at Fairmount, in the water of the Perkiomen, at Green lane, and in the water of the Delaware at Point Pleasant and at the Water Gap, as compared with each other and with the standard of purity given by Professor Leeds.

From Table III it will be seen that in respect to free ammonia, the Schuylkill water at Roxborough and Spring Garden, and (with the exception of one analysis) at Fairmount is better than the Perkiomen water, or the Delaware water at Point Pleasant or the Water Gap, and than Professor Leeds' standard for pure river water.

In regard to Albuminoid Ammonia, the Schuylkill water at these points is also better than the Perkiomen or Delaware water and than the standard for pure river water.

In regard to Nitrous Acid, it is as good as the Perkiomen and better than the standard for pure river water.

In regard to Nitric Acid, it is as good as the Perkiomen water and better than the standard for pure river water.

In regard to required Oxygen, it is better than the Perkiomen or the Delaware and than the standard for pure river water.

In regard to Chlorine, it does not differ materially from the Perkiomen or Delaware water, and is better than the standard for pure river water.

Table IV shows a comparison of analyses made by Prof. Leeds, of the Schuylkill water above Phœnixville, at Roxborough and at Spring Garden, with those of the Delaware water at Point Pleasant, and above the Water Gap, and of all with Prof. Leeds' standard of purity. In making up this table I have selected for each locality the date at which the water contained the largest amount of each ingredient.

From Table IV it will be seen that in respect to free and Albuminoid Ammonia the Schuylkill water is better than that of the Delaware at Point Pleasant, and than the standard for pure river water.

In respect to Nitric Acid, it differs very little from the Delaware water, while one sample (No. 2) falls a little below the standard for pure river water.

In respect to oxygen required to oxidize organic matter, the Schuylkill water is better than the Delaware water at Point Pleasant or the Water Gap, and the latter falls much below the standard for pure river water.

In respect to chlorine, the Schuylkill water is about as good as the Delaware water at Point Pleasant, and better than the standard for pure river water; while the Delaware at the Water Gap is a little better than the Schuylkill water anywhere.

It will be noticed that no mention of nitrous acid (nitrites) is made in this table. This is due to the fact that they are not found in the diagram from which it has been constructed, but an examination of the table (Report of Philadelphia Water Department for 1884, opposite page 362) from which Professor Leeds constructed his diagram, discloses the fact that no sample of the Schuylkill water within the city limits contained more

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than one-fifth of the quantity of nitrites (.001 parts in 100,000) admitted in Professor Leeds' standard for pure water, while the Schuylkill at Phoenixville and the Perkiomen contained at times more than twice as much (.0005 parts in 100,000) as the largest quantity found at any time (included in the analyses) in the Schuylkill at Roxborough, Spring Garden, and Fairmount (.0002 parts in 100,000). On looking over the table carefully, it will be observed that the Schuylkill water is better at Spring Garden than at Roxborough or Phoenixville, except as to free ammonia and chlorine; as to chlorine it is just as good at Spring Garden as it is at Phoenixville. This interesting fact seems to flatly contradict the often repeated assertion that the Schuylkill becomes progressively more polluted as it approaches and passes through the City of Philadelphia.

Table V is constructed from the analyses of Professor Leeds, as given in the reports of the Philadelphia Water Department for 1883 and 1884, and shows the comparative worth (as far as chemical analysis can show this) of the waters of the Schuylkill and the Delaware, at points from which the supply is now drawn and at points from which it has been proposed to draw it.

In this table I have simply gone straight down Professor Leeds' tables, taking the figures in their order, as they bore on this subject, and I stopped when I had taken twenty-eight analyses, simply because I did not think it would throw any better light on the subject to go on multiplying analyses, as I think twenty-eight is sufficient for the purpose. A careful examination of all the analyses given by Professor Leeds will show, I think, that those included in Table V do no injustice to any of the rivals of the Schuylkill river.

TABLE V.

	Parts in 100,000.	Free ammonia.	Albuminoid ammonia.	Nitrous acid or nitrites.	Nitric acid or nitrates.	Oxygen required.	Chlorine.
1	Schuylkill, above Phœnixville, May 2	.0005	.0065	.00005	.410	.20	.45
2	Schuylkill, Spring Garden (surface), January 19	.0130	.0117	.01000	.374	.18	.65
3	Schuylkill, Spring Garden (surface), July 21.	.0005	.0090	none.	.370	.18	.60
4	Schuylkill, Spring Garden (bottom) January 19	.0177	.0137	.00830	.212	.18	.60
5	Delaware, Water Gap, September 9	.0110	.0200	none.	.190	.19	.30
6	Delaware, Water Gap, October 9	.0030	.0115	none.	.300	.12	.30
7	Delaware, above Water Gap, November 10.	.0020	.0140	none.	.270	.15	.20
8	Delaware, Point Pleasant, July 21	.0015	.0170	none.	.190	.32	.30
9	Delaware, Point Pleasant, September 12	.0035	.0113	....	.190	.10	.40
10	Delaware, Kensington wharf, flood tide, July 21	.0020	.0230	trace.	.570	.28	.45
11	Delaware, same, 3 feet below surface, June 8–9	.0012	.0080	trace.	.480	.28	.55
12	Delaware, same, 3 feet above bottom, June 8–9	.0015	.0085	trace.	.490	.30	.57
13	Delaware, same (200 feet out), 3 feet below surface, June 8–9	.0010	.0075	trace.	.450	.27	.60
14	Delaware, same (200 feet out), 3 feet above bottom, June 8–9	.0012	.0085	trace.	.470	.26	.60
15	Schuylkill, Fairmount—average (excluding January)	.0046	.0079	.0005	.440	.22	.46
16	Perkiomen—average	.0106	.0218	....	.410	.31	.53
17	Lower Delaware—average	.0019	.0128	none.	.480	.28	.46
18	Schuylkill, above Phœnixville, April 17	.0025	.0100	.00005	.920	.19	.25
19	Schuylkill, Roxborough, April 17	.0015	.0100	....	.800	.15	.20
20	Delaware, Point Pleasant, April 17	.0025	.0100	none.	.860	.30	.20
21	Perkiomen, Green lane, April 23	.0080	.0160	.00005	.430	.26	.25
22	Delaware, Point Pleasant, April 23	.0030	.0110	none.	.420	.24	.20
23	Delaware, Point Pleasant, April 30	.0030	.0150	none.	.410	.30	.20
24	Delaware, Water Gap, April 30	.0025	.0120	none.	.380	.35	.20
25	Delaware, Frankford, April 30	.0040	.0150	none.	.439	.33	.25
26	Schuylkill, above Phœnixville, May 14	.0045	.0125	.00008	.375	.15	.30
27	Schuylkill, Roxborough, May 14	.0010	.0155	none.	.375	.17	.30
28	Delaware, Point Pleasant, May 14	.0035	.0189	none.	.350	.45	.20

Nos. 1–17 are taken from Rep. of Phila. Water Dep. for 1883. Table II, opposite page 252.
Nos. 18–20 are taken from Rep. of Phila. Water Dep. for 1884. Table I, opposite page 356.
Nos. 21–28 are taken from Rep. of Phila. Water Dep. for 1884. Table II, opposite page 362.

When we study table V. we see that in the matter of free ammonia the analyses show in three figures a decimal of four figures only four times, as follows: In the Schuylkill river, at Spring Garden (taken from the bottom) it is .0177 parts in 100,000; in the Schuylkill river, at the same place, taken from the surface, it is .0130 parts in 100,000; in the Delaware, at the Water Gap, it is .0110 parts in 100,000; and in the average of the Perkiomen water it is .0106.

The difference is immaterial. The lowest figures are:—

No. 1.	Schuylkill, above Phœnixville	.0005
2.	" at Spring Garden	.0005
37.	" at Roxborough	.0010
13.	Delaware, Kensington, *flood tide*	.0010
11.	" " "	.0012
14.	" " "	.0012
12.	" " "	.0015
8.	" Point Pleasant, "	.0015
19.	Schuylkill, at Roxborough	.0015

Now, when it is borne in mind that the Delaware at flood tide sweeps by the Kensington wharf the sewerage of a city having nearly a million inhabitants, we may wonder to find that the water taken there shows less free ammonia than is found at any time in the upper waters of this stream, and may see how true it is that free ammonia cannot be taken as an indication of sewage pollution.

In the matter of albuminoid ammonia, we find that the analyses show three figures in a decimal of four figures twenty-one times. The highest figures are as follows:—

No. 10.	Delaware, Kensington, flood tide	.0230
16.	Perkiomen	.0218
5.	Delaware Water Gap	.0200

The lowest figures are as follows:—

No. 1.	Schuylkill, above Phœnixville	.0065
13.	Delaware, Kensington, flood tide	.0075
15.	Schuylkill, Fairmount, *average*	.0079
11.	Delaware, Kensington, flood tide.	.0080
12.	" " "	.0085
14.	" " "	.0085
3.	Schuylkill, Spring Garden	.0090

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The whole column shows a decided superiority in the Schuylkill water as compared with the Delaware water at Point Pleasant or the Water Gap, while the Delaware water at Kensington wharf, when the sewage of the whole city is sweeping by at the flood tide, is actually *very much* better in regard to albuminoid ammonia, than it is far up at the Water Gap.

In the matter of nitrous acid (or nitrites) we find in one sample from the Schuylkill at Spring Garden (No. 2), taken January 19, when the river was covered with ice, the enormous quantity of .01000 parts in 100,000 (or 1 in 10,000-000). I have found nothing to compare with this in any other analysis except another taken from the bottom of the river at the same time and place which shows .00830 parts in 100,000. All the other analyses show quantities from nothing to a bare trace at Phœnixville, (Nos. 1, 18, and 26), Kensington (Nos. 10–14) at flood tide, Schuylkill at Fairmount (*average*) (No. 15), Perkiomen at Green Lane (No. 21).

In order that we may not misunderstand the significance of the quantity of nitrous acid (or nitrites) found in the Schuylkill on January 19, 1883 (apart from the possibility of an error in the analysis), we must bear in mind that the river was covered with ice at the time, and that the condition of the water had no evil effect upon the health of the city, as determined by the correspondence of Professor Leeds with eminent physicians in Philadelphia, before referred to (Report of Philadelphia Water Department for 1883, page 367).

In regard to the nitrates, the highest figures are as follows:

No. 18.	Schuylkill above Phœnixville	.920
20.	Delaware at Point Pleasant	.860
19.	Schuylkill at Roxborough	.800
10.	Delaware, Kensington (flood-tide)	.570

The lowest figures are as follows:

No. 5.	Delaware, Water Gap	.190
8.	" Point Pleasant	.190
9.	" "	.190

The whole column shows that the Schuylkill water at Spring Garden was never quite so good or quite so bad as the Delaware water at the Water Gap, or at Point Pleasant, while it was always better than that of the Perkiomen. It was never quite so good or quite so bad as the Delaware at Point Pleasant.

Another important matter for chemical analysis is the amount of oxygen required to oxidize organic matter. This is one of the means of testing for organic impurity. The figures in regard to that show the worst for the Delaware at Point Pleasant, and next for the Delaware at the Water Gap,

and, in detail, those figures are as follows:

No. 28.	Delaware at Point Pleasant	.45
24.	" " Water Gap	.35
25.	" " Frankford	.33
8.	" " Point Pleasant	.32
16.	Perkiomen (average)	.31
12.	Delaware at Kensington (flood tide)	.30
20.	" " Point Pleasant	.30
23.	" " "	.30

The lowest figures are as follows:

No. 9.	Delaware at Point Pleasant	.10
6.	" " Water Gap	.12
7.	" above Water Gap	.15
19.	Schuylkill at Roxborough	.15
26.	" above Phœnixville	.15
27.	" at Roxborough	.17
2.	" at Spring Garden	.18
3.	" " "	.18
4.	" " "	.18
18.	" above Phœnixville	.19
5.	Delaware at Water Gap	.19

The whole column shows the Schuylkill water to be better at Spring Garden than the Delaware water at Point Pleasant or the Water Gap.

In regard to chlorine, the highest figures are as follows:

No. 2.	Schuylkill at Spring Garden	.65
3.	" " "	.60
4.	" " "	.60
13.	Delaware at Kensington (flood tide)	.60
14.	" " "	.60
12.	" " "	.57
11.	" " "	.55
16.	Perkiomen (average)	.53
15.	Schuylkill, Fairmount (average)	.46
1.	" above Phœnixville	.45
10.	Delaware, Kensington (flood tide)	.45
9.	" Point Pleasant	.40
27.	Schuylkill at Roxborough	.30

The lowest figures are as follows:

No. 7.	Delaware above Water Gap	.20
19.	Schuylkill at Roxborough	.20
20.	Delaware at Point Pleasant	.20
22.	" " "	.20
23.	" " "	.20
24.	" Water Gap	.20
28.	" Point Pleasant	.20

In regard to chlorine it will be seen that the Delaware at Point Pleasant and at the Water Gap makes a better showing than the Schuylkill or the Perkiomen. This fact might be seized upon by one who wished to condemn the Schuylkill; but it is offset by two other facts of great importance. The first is the fact that the excess of chlorine in the Schuylkill water is probably due to the large quantity of innocent chlorides discharged into the river by manufactories on its banks, and it is not due at all to organic impurity, as may also be inferred from the good showing of the water in other respects. The second fact is that in no case does the Schuylkill contain much more than one-half the proportion of chlorine allowed for good water in Professor Leeds' standard of purity for river water in the United States, namely, one part in one hundred thousand.

After studying these analyses, I do not hesitate to ask you to accept with me the opinions of the Citizens' Committee on the future water supply of the City of Philadelphia, who, in a memorial to the Select and Common Councils of Philadelphia, dated November 30, 1886, says: "We are satisfied * * * that, although objections have been made to the water of the Schuylkill, it is chemically as pure as those which may be brought to the city from other points which are advocated as sources of supply, etc."

I also quote the opinion of Dr. Henry M. Chance, Civil Engineer (who examined the subject at the request of the Citizens' Committee of 1886, on the future water supply of Philadelphia), who, in a private letter to a member of the Citizens' Committee, dated July 27, 1886, says: "In regard to the analyses, etc., I can only say, that as a whole they are quite favorable to the Schuylkill water, and this I think would be the judgment of any unbiased person.* In fact, the opponents of the Schuylkill find it necessary to repeatedly state that the analyses very curiously have failed to show the objectionable impurities, or words to that effect."

As an illustration of the way in which these analyses have been used to make the Schuylkill water seem dangerous, let me call your attention to a feature in the argument of one of its most serious opponents. The principal criteria of impurity in chemical analysis of drinking water have been, as stated by Professor Leeds (Report of Philadelphia Water Department for 1885, page 388), the percentages of albuminoid ammonia,

* It is hard to understand how Professor Leeds could say, in a letter dated December 18, 1886, to Mr. Hollingsworth, attorney for the South Mountain Water Company, and which was read before the Water Committee of Councils on January 4, 1887:

"The upper waters of the Delaware do not contain sewage in amount sufficient to be detected by analysis, and in this respect differ entirely from the Spring Garden and Fairmount and Roxborough water."

of nitrous and nitric acid (or nitrites and nitrates), and of chlorine.

The Schuylkill water at Phœnixville is admitted to be an exceptionally pure water; the water at the Roxborough and Spring Garden pumping stations is said to be dangerously impure. Professor Leeds, in a report dated March 15, 1886 (Report of Philadelphia Water Department for 1885, page 388), states that the latter are about of the same quality and (same report, page 384) places the increase of albuminoid ammonia at the Roxborough station over that at Phœnixville at forty-four per cent., that of nitrous acid at four hundred per cent., and that of chlorine at seven per cent. This sounds startling at first, but loses some of its effect when we find that these percentages are erroneously calculated upon the last figures of a very small decimal. As a matter of fact the amount of albuminoid ammonia at Phœnixville, according to Professor Leeds' analyses is 0.0097 parts per 100,000, or *a little less than one part in ten millions*, while at Roxborough it is 0.014 parts per 100,000, or a little less than *one and a half parts in ten millions!* The figures at Phœnixville represent a percentage of one hundred thousandth ($\frac{1}{100000}$) of one per cent., and those at at Roxborough only one and a half hundred thousandth ($\frac{1\frac{1}{2}}{100000}$) of one per cent., an increase of only one half of a hundred thousandth part ($\frac{\frac{1}{2}}{100000}$) of one per cent., or a half a part in ten millions. This is a very different way of stating the case, a much less alarming way, and, I believe, the fair way. Studying the figures for nitrous acid, we find that, at Phœnixville, the water contains 0.00012 parts per 100,000 or a little more than one part in 100,000,000, while at Roxborough it is 0.0006 per 100,000, or six parts in 100,000,000. This represents a percentage of one millionth part ($\frac{1}{1000000}$) of one per cent. of nitrous acid at Phœnixville, and six millionth parts ($\frac{6}{1000000}$) of one per cent. at Roxborough; an increase of only five millionth parts ($\frac{5}{1000000}$) of one per cent., or five parts in a hundred millions. Of chlorine there are found at Phœnixville a little over three tenth

($\frac{3}{10}$) parts per 100,000, or three ten-thousandths ($\frac{3}{10000}$) of one per cent., while at Roxborough there are a little over five-tenth ($\frac{5}{10}$) parts per hundred thousand, or five ten-thousandth ($\frac{5}{10000}$) of one per cent., an increase of only two ten-thonsandth ($\frac{2}{10000}$) of one per cent.

I have gone over all the comparisons of Professor Leeds in his reports, and find similar enormous differences between the way he calculates his percentages and what seems to me the just way to do it.

I will give you another illustration in regard to this matter. If we were to suppose that albuminoid ammonia were as deadly a poison as prussic acid, or that the Schuylkill water actually contained as much prussic acid as it does albuminoid ammonia, namely, one part in ten millions at Phœnixville, and one and a half parts in ten millions at Roxborough, the first figures would represent the presence of one grain of prussic acid, or fifty grains of the officinal (two per cent.) dilute prussic acid in 143 gallons of water. As the dose of the latter is two or three minims, it will be seen that, in order to get an ordinary medicinal dose of prussic acid a man would have to drink 8½ gallons of Schuylkill water at Phœnixville, and 5.7 gallons at Roxborough, at one time. As this medicinal dose is recommended by Professor Alfred Stillé, in his work on "Therapeutics," to be taken several times a day, we can see that, if the Schuylkill water contained as much strong prussic acid as it does albuminoid ammonia, a patient would have to drink 25 gallons of it a day at Phœnixville, or 17 gallons a day at Roxborough, before he could expect to get any *good* from it.

I may go further, and state that, if the total amount of albuminoid ammonia, nitrous acid (nitrites), and chlorine found in the Schuylkill water at Roxborough were strong prussic acid, one might with impunity drink a quart of it several times a day. This is putting the matter extremely; for there is no evidence whatever that these substances are in themselves injurious to health. On the contrary, whether found in drinking water or in beef tea, they are in themselves perfectly harmless.

But this suggests an objection which may be raised by those who see danger in Professor Leeds' figures. They will say that it is not the absolute quantity of these ingredients which is dangerous, but the fact that they indicate the presence of other dangerous matters. This is a pure assumption. Take albuminoid ammonia, which is often cited as an evidence of the presence of unoxidized sewage; it is not reliable at all; for (as has been well shown by Charles Elkin in his book on "Potable Water," London, 1880), "it has been found in certain selected deep springs of undoubted purity as regards freedom from animal contamination, that at certain seasons, such as late autumn, and then especially when grass is abundant, the organic matter accompanied by ammonia has largely increased," &c. And, again: "The organic matter of sewage is of an albuminoid nature * * * * so, too, is much of the soluble matter of vegetation albuminous, the composition of both albumens, animal and vegetable, being identical. Ordinary herbage contains a considerable per centage of albuminoids,"—and we must remember the fact that the Schuylkill river is lined by wooded banks for a considerable extensive territory, and that there is annually a deposit of a very large number of leaves which leach, and the result of their chemical changes comes down into the water.

And, again, speaking of the figures of Dr. Frankland, Professor Wanklyn, and Dr. Tidy, Mr. Ekin says: "As giving any indication, however, of the wholesomeness of a water, they are useless, because both vegetable and animal organic matter * * * yield organic carbon and nitrogen and albuminoid ammonia, and in proportions so nearly alike as to be practically indistinguishable. An excess of organic matter is not necessarily an objectionable feature in a drinking water, for many of what are confessed to be our best and purest supplies frequently contain an excess of organic matter," etc.

To come to this side of the water, Professor William Ripley Nichols,* of Boston, a student of this subject, says: "The amount of nitrogen as nitrites and nitrates does not bear any direct ratio to the amount of organic matter originally present in the water, although their compounds are generally taken as indications of its previous existence," etc.

As to the reliability of chemical analysis, in determining the wholesomeness or unwholesomeness of drinking water, let me quote the opinion of Professor Nichols: "In the majority of cases, chemical examination cannot be relied upon as giving conclusive evidence as to the suitability of a water for drinking. * * * If the water is grossly polluted, or is of exceptional purity, chemical examination can determine these facts; but, in a vast majority of cases, while chemistry may teach something and aid in the decision, it cannot teach everything, and it cannot *decide*." (*Op. cit.*, page 303.) "Various students of the matter of water-supply have formulated 'standards' which a water may not overpass. They are, however, only of relative value. Moreover, different kinds of water cannot be judged by the same standard—a fact that is often lost sight of." (*Op. cit.*, pages 303, 304.) And in another place he says: "Chemistry does not give us the means of determining the amount of organic matter in water, or even of determining, in all cases, whether it is of animal or vegetable origin." (*Op. cit.*, page 299.) Similar conservative opinions have been expressed by Professor Parkes in his Manual of Practical Hygiene.*

Professors Mallet, Wormley, and Greene say (Report of Water Department of Philadelphia for 1885, page 152): "In the present state of chemical knowledge, it is only possible, and will probably always remain but possible, to say after

* A Treatise on Hygiene and Public Health. Edited by Albert H. Buck, M. D. New York, 1879. Vol. I, Art. "On Drinking Water and Public Water Supplies," page 297.

* Parkes, Edmund A., M. D., F. R. S., etc. A Manual of Practical Hygiene. Edited by F. S. B. François de Chaumont, M. D., F. R. S., etc. With an Appendix, etc., by Frederick N. Owen, Civil and Sanitary Engineer. 2 vols. New York, 1884. Vol. I. Chap. I.

an examination, that it (a water of intermediate character as to purity) is *comparatively* more or less open to suspicion, more or less likely to prove wholesome in use than some other water which has been examined in the same way." And, again, "We cannot at present, on the basis of the most elaborate chemical, microscopical, and biological examination, pronounce *absolutely* upon the wholesomeness or unwholesomeness of a sample of such water as is actually used by large city populations."

Again, Dr. Sell, Imperial Councillor in Berlin, in the report of the Imperial Board of Health for 1881, presents a masterly study of the methods of analysis of drinking water all over the world, and calls attention to a number of sources of error in them. The first is in regard to the solid residue after evaporation. He gives the results for forty-one different waters at temperatures of 100°, 140°, and 180° (Centigrade), and states, as is apparent, that "the figures differ so much, that a comparison of the residue after evaporation, as obtained at the different temperatures, is utterly worthless." He rejects also the determination of the quantity of organic substances by the difference in weight beween the evaporated residue before and after incineration, for the good reason that many inorganic substances (as ammonia salts, alkaline chlorides, carbonates, etc.) are driven off or destroyed by incineration. And he plainly says, "at the present day there does not exist a single practicable method for a complete and reliable quantitative determination of the organic constituents of water." (Page 363). And, again, after speaking of the generally-used methods of Wanklyn, Chapman, and Smith, for determining the presence of dangerous organic matter, and an improvement upon it by Fleck, Sell says we must hesitate to draw conclusions from them, "because our knowledge concerning the nature of those substances which render the use of a water dangerous to health, is still greatly in need of extension and confirmation." Finally, Professor Leeds himself is perfectly aware of this fact, for he distinctly states (Report of Philadelphia Water Department for 1883, page 243):

"It may be supposed that the chemist should be able to establish a natural and absolute standard of purity for drinking water. But this is not possible."

And, as an indication of his own opinion of the impossibility of attributing variation in the chemical analysis of drinking water to recognize sources of pollution, I would quote his statement (Report of Philadelphia Water Department for 1883, p. 241) in regard to the Schuylkill river, that, "While the volume of polluting matter thrown into the river Schuylkill does not vary greatly from season to season, the components of the water vary immensely." (Report of Philadelphia Water Department for 1883, page 241).

In other words, although the same quantities of polluting material are thrown into the water from season to season, when the analyses are made, they do not show up, on the contrary the analyses present great discrepancies.

Before leaving this part of the subject I would like to refer you again to the able report of Professors Mallet, Wormley, and Greene, contained in the annual report of Colonel Ludlow for the year 1885, as indicating the conclusions to be drawn from a careful chemical analysis of the Schuylkill water. These gentlemen say, that in their analysis, "There has been found no inorganic or mineral substance, which, of itself and in the quantity present, can be considered in any way harmful or seriously objectionable. And, as regards organic matter * * * this examination does not show the presence in any of the samples of Philadelphia water of so large a proportion of such matter as to be incompatible with the water being normal and wholesome."

So much in regard to the chemical analysis of the Schuylkill water, in regard to which I willingly quote the words of Professor Leeds, in the report already referred to: "Were the character of the Spring Garden water sought to be established by the favorable analyses, it would rank very high, whilst if the desire were to vilify it, abundant damaging testimony would be gathered from the list of maximum figures." (Page 137.)

I trust I have not labored in vain in the attempt to show how unjust it would be to admit that chemical analysis alone could be used to condemn a given drinking water, but even if we were to grant this unfair assumption to any one who might be tempted to "vilify" the Schuylkill water, we need not fear that the concession would prove disastrous, for a careful study of the various analyses available indicates, as I have shown above, that the Schuylkill river at what is assumed to be its worst point, is in some important respects better than the Delaware river at Point Pleasant, and even at the Water Gap, and that in no respect does it fall below a proper standard of wholesomeness.

As bearing upon the comparisons instituted between the waters of the Schuylkill and Delaware rivers, the following letter published in the *Public Ledger*, in December, 1885, is of interest. Some of the gentlemen of the Committee have probably seen it before:

"UPPER DELAWARE WATER NOT SO VERY PURE.

"MR. EDITOR.—It is generally supposed that the water of the Upper Delaware is pure and free from the adulteration of other streams of less magnitude, from which it is proposed to draw the future supply for this city.

"From personal observations, made between Stroudsburg and Port Jervis, at intervals during the past fifteen years, I find that there is a noticeable change in the condition of the water, it being less pure than formerly.

"There are fifteen towns and villages along the Delaware above the Water Gap, the most populous place being the City of Port Jervis, where the drainage from not less than two thousand dwelling-houses and industrial establishments passes into the river The water is unpalatable, and is not used by those having access to it. The route for a railroad along the river between Port Jervis and Stroudsburg has been surveyed, and in all probability will be built in the near future. With it would come an increase in the number of industrial establishments and other sources of pollution to the river, which the City of Philadelphia could not prevent. During the months of July and August thousands of female shad, which expire after spawning, float down the river, and during the past summer I saw the shores in places lined with their bodies in various stages of decomposition.

"Although to the eye the water of the upper Delaware is usually quite clear and transparent, it is, perhaps, not much purer than other proposed sources of supply nearer home. J. A. F.

"PHILADELPHIA, December 9, 1886."

Now, having gone somewhat over the matter of chemical analysis, I want to call your attention to another test of the wholesomeness of the water, which is of much more consequence, and which may enable one to decide whether he will join himself to those who have a good opinion of the water of the Schuylkill river, or whether he will join himself to those who will vilify it. And this is the test of experience. This, after all, is the crucial test. When it is applied to the water supply of Philadelphia, we find that, in spite of many obvious defects in regard to sewerage and surface cleansing in Philadelphia, in spite of great vicissitudes of climate, this city is the healthiest in the whole world. Colonel George E. Waring, in the eighteenth volume of the United States Census Report for 1880, says: "*The salubrity of Philadelphia is exceptional*, the mortality being one to every thousand persons less than that of London, two to every thousand persons less than that of Paris, and seven to every thousand persons less than that of New York."

And he adds later: "If a proper system for the removal of household wastes could be extended to all parts of the City of Philadelphia, it might reasonably be hoped that there would thereby be secured a lower death rate, even much lower than that of any other city of the world."

The authority on which I make that statement is an editorial in the Philadelphia *Ledger* of November 15, 1886.

I have myself made some tables in regard to the health of Philadelphia as compared with other large cities, and the result has been to confirm entirely the opinion of Colonel Waring, and I believe now that he was justified in saying that Philadelphia is the best in healthfulness of any city in the world that approaches it in size. It is a curious fact that London, that is supposed to be the only city that is any more healthy than Philadelphia, is a city in which the complaints in regard to the water supply are more serious and more frequent than they are in Philadelphia.

I have prepared a table of the death rates in a number of large cities, taking three weeks which happened to be reported in a medical journal which has just come to hand as I am writing, and not selecting them from a larger number for any reason whatever.

This report (in the *British Medical Journal* of November 27, 1886) I have had to supplement from the report of the Board of Health of Philadelphia, because it contains the death rate for only one of the three weeks. With this completed, we find the following to be the order of healthfulness as deduced from the death rates:

Death rates for weeks ending at dates stated:

City.	Nov. 6.	Nov. 13.	Nov. 20.	Average.
London	16.7	17.9	17.4	17.3
Belfast	17.4	20.9	19.7	19.3
Philadelphia	21.2	19.2	18.9	19.8
* Vienna	18.9	22.5	....	20.7
Liverpool	19.8	23.8	20.5	21.4
Edinburg	24.7	21.0	19.4	21.7
* Paris	21.1	22.1	22.3	21.8
* Berlin	22.8	22.9	21.2	22.3
* St. Petersburg	22.9	23.4	22.2	22.8
Dublin	21.4	25.4	22.9	23.2
Glasgow	24.0	23.3	23.7	23.7
† Leeds	23.2	21.7	27.1	24.0
Manchester	24.5	23.1	24.4	24.0
* New York	26.1	24.7	24.3	25.0

* Dates not exact; said to be "recently" in the report quoted.

† Leeds has been put in because Professor Leeds has recently cited it as having a water supply which was up to his standard.

From this table it will be seen that the death rate in Philadelphia is lower than that of any city of its size in the world, except London.*

* The *Public Ledger* (of Philadelphia), January 8, 1887, contains the following editorial: "MUCH IT IS TO BE REGRETTED that people who might be of service to Philadelphia

Those who argue that the water supplied to Philadelphia is unwholesome ought to be able to demonstrate that its damage to health is more than compensated by Philadelphia's superiority (over Paris, for example) in the salubrity of its climate, the cleanliness of its streets, the perfectness of its system of sewerage, but I have never seen this attempted.

Another interesting point in regard to the health of the city, which I have had in view for some time, is that of the relative ages at which deaths occur in Philadelphia; and as bearing upon the question we are discussing, I find, on investigation, that there were:

In 1884,	deaths over sixty years, 3,852.	Total deaths, 19,999.	Ratio, 1 : 5.
In 1885,	" " " " 4,221.	" " 21,392.	" 1 : 5.
In 1886,	" " " " 4,008.	" " 20,005.	" 1 : 5.

We find from this table a remarkable evenness in the number of deaths in the City of Philadelphia, and that one out of every five, or twenty per cent., is of those who live to the age of sixty and over, which is certainly a most remarkable longevity.

In conclusion, then, I venture to assert that there is no good evidence whatever that the water of the Schuylkill is unfit for drinking purposes, whether we consider the question from a theoretical or from a practical standpoint. The test of chemistry, and the test of experience—the crucial test—both seem to demonstrate that it is perfectly wholesome.

There remains, of the questions proposed for discussion in the beginning of this paper, only that of the likelihood that the Schuylkill water will soon become dangerous to the health of the citizens of Philadelphia. We have already seen that there is no good ground for asserting that this water is now

in improving our water system will persist in treating the present supply from the Schuylkill as though it was so polluted by sewage as to be dangerous to health. That is not the fact, as the health reports prove. The case in favor of the healthfulness of the Schuylkill water, as made out by the general returns of mortality and of the diseases which cause death, is strengthened by the special report, which shows that the district where typhoid fever lately prevailed is supplied from the Delaware river. Nobody is likely to object to improvements in our water system, but unwarranted statements at the outset of the argument provoke dispute that retards consideration of the main issue."

unwholesome, and it may be confidently believed that with the completion of the intercepting sewer from Manayunk to below Fairmount dam, and the enforcement of the rights of the city against pollution of the river beyond the city limits, there need be no fear that the Schuylkill water will ever become unfit to drink. The duty of the city to minimize the quantity of objectionable matter which might find its way into the river within the city limits, by the construction of proper sewers, is one which should be, and doubtless will be, speedily performed;* and no less should it enforce its rights against all who would wantonly or carelessly pollute the river above the city. The first of these duties, the protection of the river,

* The *Public Ledger* (of PHILADELPHIA), March 3, 1886, contains the following interesting letter from Col. Charles H. Banes:

INTERCEPTING SEWER DISCUSSION.

For the Public Ledger.

MR. EDITOR:—The controversy about the intercepting sewer leads me to offer for the information of your readers a few thoughts in reference to the origin and purpose of its construction.

When I introduced the ordinance in Councils to commence the intercepting sewer it was after full consideration of the various recommendations of the ten years preceding by the Park Commission and Board of Experts, and after personal consultation with scientific men and engineers. Action was not based upon the principle that a sewer of moderate size would remedy all the evils of our present water supply, but that it should constitute a vital part of a comprehensive plan, incomplete except upon its adoption as an entirety.

1. Prevent pollution of the Schuylkill from sewage at all times, except during periods of freshet and turbid water, by a moderate sized sewer.

2. Complete storage reservoirs at Cambria and East Park, capable of holding twelve days' supply for the entire city.

3. As in times of freshet no sewer could preserve the River Schuylkill from the contaminations of surface drainage and freshets, stop all pumping and draw from the storage basins.

4. After having prevented the pollution of the stream by our own citizens, the city, as the sole owner of the river within its corporate limits, should proceed to enforce its riparian rights in the courts against those offenders in localities above Flat Rock dam. There are a number of precedents for such action, and quite recently by an individual against Rochester.

This general plan faithfully carried out will give the city a sufficient supply of good water for fifty years. With reference to other sources of supply, unless from lakes, the same contingencies in reference to pollution may arise. If, after the expenditure of a large sum, the water is brought from the Upper Delaware, what guarantee would the city have that enterprise and population would avoid lining the banks of the river with towns and factories? To-day, with engineering skill, a moderate sum of money and the enforcement of riparian rights, the city would be in a better position for a good supply of pure water than it can attain through any plan thus far presented.

CHARLES H. BANES.

will be, to a great extent, accomplished when the intercepting sewer is finished, and this work ought to be pushed energetically to completion. The second duty is not impossible of performance, as was asserted on January 13, 1887, before the Water Committee of Councils, by Furman Sheppard, Esq., Attorney for the South Mountain Water Company. Nor do I believe that it will be at all difficult whenever the city makes up its mind to it.

You will understand that I speak with great deference on this subject. I give a layman's opinion, but I have been at some pains to make up my mind in regard to it, especially after hearing the positive statement that there was no law which the City of Philadelphia could invoke to protect the Schuylkill river from pollution. The City of Philadelphia will find natural allies in the inhabitants of the Schuylkill valley everywhere, because the nearer they are to any source of pollution the greater will be their own danger from it. And, even if the dictates of common sense do not compel them to keep their own part of the stream pure, the dictates of common law will.

In spite of assertions to the contrary, I believe that there need be no doubt at all in regard to this matter.

I have conferred with some friends of mine versed in the law, and they have assured me that that is a safe statement to make. I have also had the pleasure of going over the very able charge of Judge Thayer to a jury trying the case of the Commonwealth of Pennsylvania against Soulas *et al.* for polluting the Schuylkill river (Report of Philadelphia Water Department for 1884, pages 59–60). On this occasion Judge Thayer said: "Now, it is very old and well-settled law, that to pollute a public stream is to maintain a common nuisance. It is not only a public injury, but it is a crime, a crime for which those who perpetrate it are answerable in a tribunal of criminal jurisdiction. An Act of Assembly forbids and punishes as crimes all common or public nuisances; and I know of no public nuisance more serious in its evil effects, and more obnoxious to the denunciation of the law, than to corrupt and poison a public stream from which large numbers of people obtain their drinking water."

After hearing Judge Thayer's charge in the case referred to, the jury found the defendants guilty without leaving the jury-box.

The whole subject of legal protection of drinking water against pollution has been elaborately discussed in a pamphlet by Wm. Wilkins Carr, Esq., of the Philadelphia Bar,* who, as Master appointed by the Court to decide in the case of the City of Philadelphia *vs.* Carmany, *et al.*, ordered the abatement of a nuisance, consisting in the emptying of mill refuse in Gorgas Run, a small tributary of the Wissahickon creek. The mill was situated about five miles above the Belmont Pumping Station, six miles above the Spring Garden Pumping Station, and about eight miles above the Fairmount Pumping Station.

From these documents, it is easy to see that the city has abundant legal protection against pollution of the river within or above the city limits, which will be enforced by the Courts upon proper action being brought by the city. In some cases heretofore the city authorities have shown an unwillingness to prosecute offenders against the rights of the city, but, whenever they choose, they can obtain the conviction of any or all of them.

The case of the City *vs.* Carmany, *et. al.*, is a striking illustration of the extent to which a mere suspicion of pollution may be used to prevent the admission to the drinking water of anything which could injure its wholesomeness.

This comprises, I think, the reasons why the Schuylkill river is a proper source of water supply for the City of Philadelphia for the present, and for any reasonable time in the future, and if you can recall the points of the argument I think you will agree with me. In the first place, the argument

* The Legal Protection of the Present Water Supply for Philadelphia. Philadelphia, 1886.

is that there is plenty of water in the river now, and there is every reason to believe there will be plenty of water in the river for a long time to come to supply all the needs of the city, and that there is sufficient pumping capacity to supply the city now and in 1910. I have also shown that, as to the storage capacity of the city, the reservoirs now in use, and those not completed, but which should be and I trust will be shortly completed, will furnish abundant storage capacity for the city at present, and if others are needed before 1910 they can be constructed.

In the second place, with regard to the quality of the water, I have tried to show that the objections founded upon chemical analyses are not well founded, and for two reasons. First, chemical analyses are not reliable, as is, I think, frankly admitted by all students of the subject; and again, if it be conceded that chemical analysis is the true and reliable means of testing drinking water, then, by the very analyses which have been made in this case, I have shown that the Schuylkill river makes a good showing and the Delaware river makes a bad showing, and that the water of the Schuylkill is not exceeded in purity by the water of the Delaware river either at Point Pleasant or at the Delaware Water Gap.

So much for the present. As to the future, I say, with great deference to the opinions of the other side, having heard those opinions, and attaching to them all the importance they deserve, that putting them alongside of other opinions of gentlemen of equal ability and responsibility, I have come to the conclusion that there is no difficulty in preventing any pollution of the Schuylkill river either within or without the city limits. For all these reasons I think I am justified in saying that the Schuylkill river is the proper source of the Future Water Supply of the City of Philadelphia.

APPENDIX K.

Extract from proceedings of the Water Committee at a meeting held in Select Council Chamber on the evening of January 13, 1887.

ADDRESS OF DR. J. CHESTON MORRIS.

MR. CHAIRMAN AND GENTLEMEN:—I feel very awkward at being placed in the position of responding to this invitation. I fully expected that the Chairman of our Committee, Mr. P. C. Garrett, would have been here this evening to state more fully the feeling of our Committee than I can possibly do. I may say, however, that our position is simply this: A meeting of some of the citizens of Philadelphia was held in Parlor C of the Continental Hotel last spring, to consider the question of the water supply of the City of Philadelphia; and at that meeting a Committee was appointed to investigate the whole subject, and report to a future meeting of citizens. That Committee drew up a memorial, which they presented to Councils, asking that they might be heard before anything further was done in regard to the future water supply of the City of Philadelphia; and in consequence there are some of us here to-night ready to state what we think and to give some reasons for the faith that is in us.

At the last meeting of this Committee, Mr. Hollingsworth stated the position of the South Mountain Water Company; and he handed in a Citizens' Memorial to the Select and Common Councils of the City of Philadelphia—on which occasion I said that the memorial was such, in the main, as I thought most of us could sign without any difficulty, and that there were only some little expressions in it which we would rather have qualified before putting our signatures to it. I also said that I had no doubt at all but that a large majority of those who had signed it were of just the same views as those which I express now. For instance, this memorial says. "the water supply is not satisfactory and such as the citizens have a right to receive." That is what we feel. We feel that the water supply can be, and ought to be, improved; and that this is necessary to the best interests of the City of Philadelphia.

Then the memorial goes on: "We are not satisfied to accept the opinions of those who deem the present source all-sufficient for our needs, and we desire to express our views on the subject." The language used there is "the present *source*." I think that language ought to be corrected, so as to read "the present *sources*," because we are deriving our present water supply not only from the Schuylkill, but also from the Delaware, and we have thus an opportunity of comparing the results of their use; and the consequence is that the complaints in the newspapers, as to the quality of the water supplied, come mainly from those whose source of supply is the river Delaware.

Then the memorial goes on to say: "We recognize the value of the extensive surveys just completed in behalf of the city. Information so impartially compiled from such high authority, and the subject so exhaustively and carefully considered, undoubtedly furnish data for prompt action." But these surveys, and the information so impartially compiled. and from such high authority, when we come to examine the whole subject, amount to nothing. You will find that even Colonel Ludlow does not express himself unqualifiedly as to the abandonment of the Schuylkill. On the contrary, he maintains that the Schuylkill, at Phœnixville, is a phenomenally pure stream; that it is originally a good water, and that it can, and ought to, be kept so.

Then this memorial says: "No city should cling to a source of water supply that of necessity cannot be protected from polluting agencies." I shall refer to this later on.

Again: "The effects of sewage, chemicals, dye stuffs, wool-washings, cemeteries, etc., do not require comment." Of course they do not; they ought all to be kept out, and there is law enough to keep them out now. All that is necessary is the enforcement of the law. In order to enforce it we must go into court. But if we go into court to enforce the law, we must do so with clean hands. We must show first that we have done all that we can do as a city to keep the water clean. The right of the city to a pure and abundant water supply has been well asserted, and I need not go into that any more than into the financial part of the question, of which others are better qualified than I to speak. The final sentence of the memorial is this: "We respectfully urge that the recommendation of the final survey now before you be promptly *considered*, and such action taken as will give the desired relief." I do not know whether I would not be willing to sign that, as I have no doubt many of the gentlemen have done, with the understanding that the recommendations of the final surveys should be promptly *considered*. It does not say that such recommendations should necessarily be adopted. I would sign that paper for the *consideration* of those recommendations myself. And I also know that Colonel Ludlow says that the Schuylkill is a very good source of supply, and, in his last report, that it is an open question as to what we shall do about that.

We only desire that the City of Philadelphia should have the best possible supply, and we honestly think that the plan which we recommend is a better one than that which has been offered to this Committee by the South Mountain Water Company.

Mr. Hollingsworth made one statement at the last meeting, to which I desire to present a counter statement. This statement was that the *supply* of water in the Schuylkill is diminishing. I have it from the authority of Mr. Edwin F. Smith, the chief engineer in charge of the Schuylkill Navigation Company for the Philadelphia and Reading Railroad Company, that the water supply of the Schuylkill river has not diminished; that there is as much water there now as there was at any other time; and I think it eminently natural that there should be. Whether there are more or fewer persons living on a stream does not make that stream any greater or less in its flow of water. The processes of civilization have gone on in the valley of the river Seine for fifteen hundred years without any diminution in its supply. The processes of civilization have gone on in the valley of the Tiber for twenty-five hundred years without lessening its quantity. Therefore, I do not think the river Schuylkill is likely to fail us, especially as Mr. Smith, who has watched the river carefully for many years, and is *the* authority on the subject, tells us there is no diminution whatever.

Now, then, as to the *quality* of this Schuylkill water. The statement was also made by Mr. Hollingsworth, at the last meeting of this Committee, on the authority of Dr. Albert R. Leeds (and Mr. Hollingsworth read a letter from Dr. Leeds to that effect), that the upper waters of the Delaware do not contain sewage in amount sufficient to be detected by analysis, and in this respect differ entirely from the Spring Garden and Fairmount and Roxborough water. In response to that, I would refer to Professor Leeds' own statement in the Report of the Water Department for 1884, in which he gives the results of his own analyses, showing that the Delaware river at Byram is very little, if any, better than the Schuylkill at Roxborough, and the difference between the Delaware at Byram and at the Water Gap is very little more, so that he has clearly stated in this letter read by Mr. Hollingsworth, a very different thing from the figures published in his report for 1884.

With regard to the other tables submitted in a letter from Dr. Cresson, as to the presence of ammonia in the Schuylkill water, am I right in saying that the first contains free ammonia, and the second albuminoid ammonia, or the nitrites?

Mr. Hollingsworth. The first contains free ammonia, and the second chlorine.

Dr. Morris. The tables were not so headed in the copy I had. I could not, therefore, compare them with others as if they had been. One thing is plain to anybody who glances over the tables published in the reports of the Department, and that is, that at times this water of the Schuylkill has been what Colonel Ludlow calls it, a phenomenally pure water, and that at times the water has been foul. In other words, the river is pure, is good, but is liable, as other streams would be, to pollution, and should be protected against that pollution. Can it be so protected? The law is abundant for it. The decisions that have been rendered say so, and all that is necessary is to enforce the law. I do not wish to trench on the legal branch of the subject, which is out of my province, but would only refer to the pamphlet of Mr. Wilkins Carr, showing the condition of the law and the rights of riparian owners.

Mr. Hollingsworth. The only natural conclusion from that pamphlet was, that there were no adequate means of protection from contamination.

Dr. Morris. I read that very differently: that, on the contrary, the only thing necessary is *to enforce the law.*

I advocate the Schuylkill as a better *original* source of supply than the Delaware from the *quality* of the water in the first place. This Schuylkill water, as Professor Cresson has so eloquently described in his pamphlet, has gone through a process of purification which renders it, at Phœnixville and at Flat Rock Dam, a phenomenally pure stream. Further on it is liable to more or less pollution. That pollution should be prevented, and can be prevented, and I think it lies with you, gentlemen, as representing the power of the City of Philadelphia, to prevent it. I advocate the Schuylkill, as a source of supply, for the reasons given in a paper read by me before the State Board of Health in May last, and printed in the Annals of Health for December, copies of which have been sent to the Chief Engineer of the Water Department for the use of this Committee. I also advocate it from a comparison of the analyses of both the Schuylkill and Delaware, so frequently made and published in the Department Reports.

In prosecuting the study of the improvement of the water supply of Philadelphia, two points are to be considered. The first, is *immediate* need, and the second, the *future* need of the City. They should be considered first, separately, then together. Our present supply is sometimes deficient in quantity in the summer months, and its quality is below what it might and should be. The immediate construction of large subsiding reservoirs will remedy the quality to a great extent, and also insure a somewhat better supply. This statement has been controverted by Mr. Hollingsworth, but there is no doubt, to my mind, that a large proportion of the impurity in the water is of a more or less solid character, and that subsidence will correct that. There is a large amount of foul sewage which is allowed to escape into it in the neighborhood of the Wissahickon and along the Fairmount pool, which might very easily be kept out, and ought to be kept out. That can be done.

By the way, I want to call attention to one statement of Professor Leeds, viz.: "That every day during the ordinary flow of the Schuylkill river there passes the intake of the Spring Garden Pumping Station nearly one-half ton of sewage." I am glad it *passes by*. I hope it does not all go in there.

That amount is taken, I suppose, as the whole amount represented by the figures of the analysis of the river at that point; and unless we take in the whole of it, we should not be able to get that amount in there. However, we ought not to get any of it in there. I have no hesitation in saying that. It can be kept out, and should be kept out.

Immediate construction of large subsiding reservoirs will then remedy the quality to a great extent. I do not say wholly; and also insure a somewhat better water supply as to quantity.

But experience has shown that with the water used for the purposes of navigation there is not sufficient, at times of very low water, to use extensively for pumping by water power and for navigation, especially if this pumping be done from the Fairmount pool, and for navigation. The continual increase of pumping by steam, as shown by the reports, is made at a great increase of expense, probably, of at least five to one. In comparing the cost of different plans this important element should be borne in mind. We are told that only one-tenth of the whole supply of 200,000,000 per diem, which will be needed 40 or 50 years hence, can be raised by water power as used at present, and the rest must be raised by steam or gravity. We are more concerned with what can be done *now*, or in the course of a few years; and more than this, I submit, can be accomplished by the use of the Schuylkill Navigation Company's rights to water power, namely: by constructing a canal (as proposed by Mr. E. F. Smith) to take water above Flat Rock dam to a point near the Wissahickon Park drive, and erecting there suitable turbines. A large part of the present daily needed supply can thus be raised at a minimum cost. This work would not take long to accomplish, and would give water free from any contamination affecting Fairmount pool. If this contamination was gotten rid of the water could again be used there as at present, effecting thus another saving in the amount which would have to be pumped by steam or possibly obtained by gravity from another source. I would, therefore, advocate such a step from motives of economy. There is no hesitation, doubt, or discordance in the testimony as to the natural and usual purity of the water supply from the Schuylkill as at Phœnixville or Flat Rock dam. There is no doubt that pumping works, and a short canal or aqueduct could be erected as indicated as soon as the reservoirs (East Park and Cambria) could possibly be ready for use. These latter are now in process of construction and needful at any rate under any system, and need not therefore be discussed. But how to get possession of the works of the Schuylkill Navigation Company—what will they cost, and what will they be worth to the city? The present market value of the $13,000,000 securities of the Schuylkill Navigation Company is less than $6,000,000. Among its properties are reservoirs containing, alone, water enough for six weeks' supply of the City of Philadelphia. That is to say, suppose there was not a drop of water flowing over the dam at Fairmount, there would be water enough which could be brought down from the reservoirs now in possession of the Schuylkill Navigation Company to supply the city for six weeks—pure water and good water. Has a drought ever been known to last anything like that length of time? What doubt, therefore, can there be that these reservoirs even, as now constructed, besides others, the sites for which are controlled by them, would be capable of supplying all our needs?

I have no doubt the objection will be made by Mr. Hollingsworth that we should get water soiled by impurities from the towns above us. But this is not the fact. When the water from these reservoirs is now let down for the purposes of navigation, you can immediately *see* the change produced by the flow, as the pure water comes down from above, and displaces the less pure water below. The towns above, too, are naturally interested most vitally in keeping the stream from which they must obtain their supply pure, and would co-operate with us. Sewage has been utilized and made profitable elsewhere, and there is no reason why it should not be done here. Even the manufacturing interests, at first opposed to such movements, have found from their own increased profits resulting from the enforcement of legislation compelling them to utilize their waste products, good reason to acquiesce in and sustain such enforcement. I noticed this the other day in reading the life of the late Sir Robert Christison, of Edinburgh, Scotland. Then, again, we must remember that the very freshets, which bring down so much mud, and spoil the appearance of the water tor the time being, are in reality beneficial. They scour out and cleanse, and remove from the river much of the refuse and offal and objectionable matter which Mr. Hollingsworth refers to as coming from the valley of the Schuylkill, but which comes mainly from the mills near Manayunk—leaving the dams and reaches of the river clean, fresh, and sweet. What we want is to have a sufficient amount of water stored in the reservoirs of the city and elsewhere to enable us to use that stored water during the time that the river is undergoing this scouring process. After that we can use the river, and obtain from it a perfectly good water supply for the city.

All these dams, reservoirs, and other property of the Schuylkill Navigation Company could then be had for $6,000,000. The alteration required to adapt them better for purposes of a water conduit, including construction of new reaches of canal, paving and lining the sides, could be made, I am informed by competent engineering authority, for $2,500,000 more, making a total cost to the city of $8,500,000. The annual expenses of maintenance, obtained from official sources, are about $75,000. It will thus be seen, therefore, at a glance, how favorably this scheme would compare financially with the Delaware aqueduct schemes.

If it was wise policy for the City, in 1819, to pay the Schuylkill Navigation Company $150,000, and to erect and maintain for the latter the Fairmount dam, for the sake of the rights thus acquired, and I have never heard its wisdom questioned, it is admitted, although we have not taken the best possible care, or made the best possible use of them, would it not be equally wise policy now to obtain control of all the dams, reservoirs, water-rights and privileges of the company at far less than the cost of their construction to-day? Nor would their usefulness diminish as time rolls on. They could be, and would become forever, an integral and useful part of our water system, whatever unforseen changes time may bring.

If we compare the above cost with that of the Perkiomen gravity supply, as given in Colonel Ludlow's report, we find that an aqueduct from Schwenksville would cost $6,500,000 for a gravity supply of 210,000,000 gallons daily. But this water is not so good as that from the Upper Perkiomen, to obtain which by gravity from Green Lane would cost a little over $7,000,000. A very good supply by gravity could thus be had; if found insufficient, it could be supplemented by a short extension into the Upper Tohickon region at a cost of $1,500,000 more. Or, if thought better, the aqueduct could be continued so as to bring water from the Aquanchicola and Upper Lehigh, at a further expense of $5,000,000. Either of these plans, looking to the ultimate supply of the City, are far less expensive, in the first place, than the Delaware Byram mixed pumping and gravity scheme, to say nothing of its extension to the Upper Delaware, and to say nothing of the quality, as shown by the analyses of these sources. Another question is raised as to the probable pollution of these sources of supply, and which can be best protected from them. We hear much of the 250,000 persons living in the Schuylkill Valley, and the sparse population of that of the Delaware. Is the country there so bad that there is no likelihood of the hum of industry being heard there? Which of us can go along the valley of the Lehigh and see the improvements going on there—can see the life and stir without being convinced of the contrary? Then, again, the coal mining industries in the Schuylkill Valley have reached their probable maximum, the acid water which results passes, as Dr. Cresson describes, over the limestone bed of the Schuylkill, at and near Reading, is there neutralized and freed from its impurities. The mining industries of the Lehigh are comparatively in their infancy, and where is the bed of limestone to purify the Delaware in its flow over it?

Then again we have heard much, and often, of the legal difficulties in the way of policing the Schuylkill and preventing its contamination by sewage or other pollution. Well, how much easier is this going to be in the case of the much longer Delaware? And how about the towns there? And if this would be so difficult when the whole stream lies under the control of one State, how much less would the difficulty be when the rights and jealousies of three sovereign States are involved? I think this latter part of the problem has not been sufficiently noticed.

And now I want to call your attention to another point. We have our rights, as riparian owners, to take our water supply from the Schuylkill, and as long as we do so, we can maintain those rights as against any one who might soil or make foul that water supply. But what will become of those rights if we abandon such use? Will not the Schuylkill become "an open sewer?" And which of us can calmly contemplate such a result? Which of us would like to walk, ride, or drive in our beautiful Park to inhale pestilential vapors from Fairmount Dam? Or which of us can estimate the effect of such miasmata on the health of the City at large? London allowed the fouling of the Thames to go on until it became wellnigh impossible to remedy it. Let us beware how we allow a similar fate to overtake our beautiful Schuylkill.

But, says Mr. Hollingsworth, "the river is the natural drain of the Schuylkill valley." Certainly, that is true; most rivers are the natural drain of their valleys. I do not know of any river that is not. But there is no occasion or necessity whatever to allow sewage and garbage and manufacturing refuse, or anything of that sort, to flow into it any more than into any other river—the Delaware for instance, and I have just shown which of the two can be more easily protected. Steps should, I think, be immediately taken to accomplish this before it becomes too late, as in the case of the Thames.

Another point is the disadvantage of deep reservoirs and long aqueduct systems. The impounded water is liable to become loaded with low forms of growth, and the waters of the Croton and the Cochituate have not improved under the process. If you draw water from the spigots in Boston you will find that there is "an ancient and a fish-like smell" about it. If you try the water in New York, you will find that it is not as good as our much abused but sweet Schuylkill water. If, however, you go to St. Louis, you will find that the water is white, almost milky, but pure and wholesome. It is obtained from what? Not deep reservoirs and long aqueducts, but from the stream of the Mississippi. A large stream is, as Colonel Ludlow acknowledged, the best source of supply for a city.

I would therefore, on behalf of our Citizens' Committee, urge the continued use of the Schuylkill as our main source of water supply, and suggest the above means by which its quality and availability may be improved.

I also submit a plan of the canals and reservoirs of the Schuylkill Navigation Company, prepared by, and belonging to, Mr. E. F. Smith, who has kindly permitted its use by our Committee. This shows the six weeks' supply contained in the reservoirs, etc., of the Company.