RULES.

Books and periodicals may be used in the Reading-Room by members and friends, and by students recommended by the Boston Public Library.

Members may borrow books for home use, but no one shall have more than four books at any time, nor keep any book more than five weeks.

A member borrowing a book shall give a receipt therefor to a member of the Library Committee, to the Secretary, or to the regular attendant.

A fine of one cent per day per volume shall be charged for overtime, and must be paid before the delinquent can take any more books.

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Any person mutilating or losing a book shall pay for the damage, or replace the book.

Any one who violates the above rules shall, upon written request from the Librarian to the Board of Government, be debarred from the privileges of the library for such time, not less than three months, as the Board of Government may determine.

(Adopted Nov. 18, 1896.)

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FIRST ANNUAL MESSAGE

OF

JOHN WEAVER

MAYOR OF THE CITY OF PHILADELPHIA

WITH THE

ANNUAL REPORTS

OF

PETER E. COSTELLO

Director of the Department of Public Works

AND OF THE

CHIEFS OF BUREAUS

Constituting said Department

FOR THE

YEAR ENDING DECEMBER 31, 1903

ISSUED BY THE CITY OF PHILADELPHIA
1904

PHILADELPHIA
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1904

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PHILADELPHIA

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Secretary
ROBERT GRIER

Chief Clerk
GEORGE W. SEEDS

Contract and License Clerk
JOSEPH F. JONES

Stenographer
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Secretary Civil Service Board
ROLLA DANCE

Stenographer
JOSEPH MARCUS

Clerk
WILLIAM WEAVER

FIRST ANNUAL MESSAGE

OFFICE OF THE MAYOR, CITY HALL

Philadelphia, April 4, 1904.

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

GENTLEMEN:—In accordance with the provisions of the Act of Assembly of June 1, 1885, known as "The Bullitt Bill," I transmit to your Honorable Bodies my first annual message, with a statement of the finances and general condition of the affairs of the City.

FINANCES.

The finances of the City as shown by the report of the City Controller are in very good condition. There was in the City Treasury on January 1, 1903, $17,149,066.71, and the receipts for the year from all sources amounted to $28,366,389.72, making a total of $45,515,456.43. The total disbursements for the year amounted to $36,039,614.73, and the balance, amounting to a little over nine millions, is represented by appropriations that do not merge and outstanding warrants. The appropriations that do not merge are appropriated for contracts that are in process of execution.

The estimated receipts for 1904 are $28,033,544.13, to which will be added the $16,000,000.00 increase of the funded indebtedness of the City provided for by your Honorable Bodies by your Ordinance of December 17, 1903, and since ratified by the people—this $16,000,000.00 being for certain specified objects, but making a total amount for appropriations this year of $44,033,544.13. The funded debt of the City was reduced during 1903 by the sum of $3,071,300.00, so that the net funded debt on January 1, 1904, was..... $51,341,670 22
when the additional amount authorized of 16,000,000 00
shall have been borrowed,
The total indebtedness will be..... $67,341,670 22

This will be reduced during the present year by the payment of maturing obligations amounting to $1,497,400.00 through the Sinking Fund Commissioners.

A change has taken place during the year in the basis of assessing real estate for the purposes of taxation. In my address to Councils on April 6, 1903, I said, *inter alia,*

> "There has been for years much criticism in this City relative to the method of assessing real estate. I might report an instance that was brought at the time to my attention where a house that was bought for $8,000 was assessed at $4,000, and within a square of that house another house which was bought for $7,000 was assessed at $5,600. Such examples could be multiplied, not only in the case of small properties, but also in the case of large ones. The proper method and the only way to carry out the intent of the law would be to assess all property at its full market value."
>
> "This would remove the great multitude of inaccuracies that exist under the present method, and would insure that no owner of property would be required

to pay more than his just proportion of the burden of taxation. If the amount of taxes that this method would produce would amount to more than sufficient for the running expenses of the City government the tax rate could be reduced so as to bring down the gross amount of taxes to about the amount that is being paid. The system which I mention has been in use in the New England cities, and, I am informed, has lately been introduced in the city of New York. In the cities of England they have a different system. There the rate of taxation is based upon the annual rental value of the property. This latter method would be as fair as the system I have suggested, but at present it would be very much more difficult to change to the English system than it would to the system of assessing property at its full value."

It has been the custom to assess the real estate in the City of Philadelphia at values presumed to be eighty per cent. of its actual value. The Act of Assembly of May 15, 1841, P. L. 393, Sec. 4, provided that "it shall be the duty of the several assessors and assistant assessors to assess, rate and value all objects of taxation, whether for State, County, City, District, Ward, township or Borough purposes, according to the actual value thereof, and at such rates and prices for which the same would separately bona fide sell, * * *" and I am very glad to say that the Board of Revision took up the plan suggested and had the assessors re-assess the real estate of the entire City and make the new assessment in accordance with the law. The justice of the complaints of the inequality of assessment heretofore existing is shown by the bare statement that in some wards of the City the average increase in assessments was nearly fifty per cent., and in other wards only six per cent. This, however, will not prove to be the

permanent benefit it should be unless we can have a full publication of the lists very early in each year, so that each property owner may be advised of the assessment not only of his own property, but of every other property in the City of Philadelphia. I cannot put too much stress upon the importance of this publication and the efficacy of its publication will to a very great extent be lost if the publication is not made before a majority of the property owners have paid their taxes for the year. It seems to me the publication should be made early in the year without waiting for the action of the Board of Revision upon each assessment. The result of the new assessment was to raise the total value of assessed real estate from $911,968,674 to $1,162,074,023. This made it necessary to reduce the tax rate from $1.85 per hundred, which had obtained for a number of years, and your Honorable Bodies passed an Ordinance on September 26, 1903, fixing the tax rate for 1904 at $1.50 per hundred. This rate will yield a little over $500,000.00 more revenue for 1904 than we received in 1903 at the old rate under the method of assessment then in vogue. It seems to me that the affairs of the City should be so economically administered as to keep the tax rate down to this figure. I do not mean the economy that would cut down and pinch appropriations for essential purposes and which would perhaps force upon the City inferior materials and incompetent workmen (the City is entitled to the best and she should have the best), I mean the economy that will give the best at the lowest price for which the best can be obtained that will not make or tolerate unnecessary positions in the City Departments or the payment of money to any person unless it is for some proper municipal purpose and the City gets a fair return for her money so paid, and the economy that will throw wide open the doors of competition in every department in which it is necessary for the mu-

nicipality to enter into contractual relations with outside parties to furnish materials or to do work so that we can get the advantage of competent bidders to furnish the materials and do the work required, and I ask most earnestly your co-operation with the executive departments of the City in their efforts to so economically administer the affiairs of the municipality as to make it unnecessary to ever increase the tax rate.

It appears from the Controller's Report that the payments under mandamus executions during 1903 amounted to $1,891,403.47, or $391,403.47 more than had been appropriated for this purpose. There has been set aside for 1904 the sum of $1,500,000, but the prospects now are that the payments will far exceed this sum. With this great uncertainty your Honorable Bodies can realize how difficult it is for the financial officers of the City to make their calculations. I think perhaps over eighty per cent. of the amount thus paid out under mandamus executions has been paid upon awards by road jury in a great many instances after such awards have been cut down or revised upon appeal to the courts. This whole road jury system presents a problem that is well worth while considering. The policy of the law as it exists to-day when property is taken for municipal purposes is that there shall be some effort made between the owner and the City to agree upon a price at which the owner will sell and the City take before a bond is entered by the City to take under condemnation proceedings. As a matter of fact, in the majority of instances no real effort is made to agree; the property is taken and a road jury is appointed; they hold their meetings week after week and month after month—my recollection of the length of an average road jury meeting being that it lasts from thirty to ninety minutes, and in this way the meetings last for months and sometimes they are dragged into years at an immense cost not only to the City

but the owner, and all this time the owner is deprived of the use of his property. Then when the road jury finally makes the award, either one or the other takes an appeal, and sometimes both, and the same proceedings have to be gone through again, and again the parties are involved in heavy expense for expert testimony, etc. It has seemed to me that the duty ought to be rested on some one of the officers of the municipality to see to it that all reasonable efforts are exhausted to come to some agreement with the owner before condemnation proceedings are started. If such matters could be called to my attention before the ordinance to condemn is passed, I shall be very glad to have some one connected with one of the municipal departments endeavor to make terms with the owner, and thus obviate the delays and costs incident to condemnation proceedings and submit the result of such efforts to your Honorable Bodies for your approval. If efforts to settle should prove to be futile and condemnation proceedings become necessary, then it seems to me that if the law could be so amended that the proceedings should go right into court and be tried in the first place before a petit jury in one of the Common Pleas Courts, and thus save a vast amount of time and expense to both sides, it would be a great benefit. In the matter of the opening and widening of streets, this should only be done at the expense of the City where public necessity demands such opening or widening. If the opening or widening is requested only by property owners on the line of such street, and is for their benefit alone, they should be compelled to indemnify the City against all damages caused by such opening or widening. You may notice in the Controller's Report that of the payments under mandamus execution was the sum of $168,359.76 for Fairmount Park extension, and that "certain other amounts are pending through proceedings "instituted by the Park Commission for the condemna-

"tion of property for Park purposes unknown to this or "the Law Department prior to the filing of the claims." This seems such a startling statement on the face of it—that property is taken without any authority from your Honorable Bodies, and that there appears to be no limit to the quantity that may be taken or the cost of same, and while the people of our City have entire confidence in the gentlemen composing the Park Commission, appointed as they are, by the Board of Judges, and devoting so much of their time to these public duties, and the splendid work they have accomplished in bringing the Park up to its present good condition, yet it does seem an anomaly to have in a City two bodies, one—your Honorable Bodies—having the exclusive right to raise revenue, to fix the tax rate and to pass appropriation bills for the expenditure of such revenue, the law however restricting your right to appropriate within the lines of the revenue, and another body—the Park Commissioners—with no right to appropriate, yet with the apparent right to purchase and acquire property in the name of the City and for which the City is liable under mandamus proceedings absolutely regardless of the condition of the City Treasury and with no limitation on the amount they can make the City liable for. I say this because from the information I can get I believe the mandamuses this year for Park purposes alone will be upwards of half a million dollars.

It might be useful to call your attention to the legislation on the subject. The Act of March 26, 1867, P. L. 549, Section 6, reads:

> "The commissioners are hereby further empowered, whenever the Councils of the City of Philadelphia shall so declare by ordinance, to take such other land as may be deemed proper by said Councils for the extension of said Fairmount Park, between the

Spring Garden Water Works and the Columbia bridge, and between the Reading Railroad and the river Schuylkill, according to the value it shall be ascertained by a jury of (twelve) disinterested freeholders * * *."

The Act of April 14, 1868, P. L. 1087, Section 13, provides:

"It shall be lawful for said Park Commissioners to acquire title to the whole of any tract of land, part of which shall fall within the boundaries mentioned in the first section of this Act, and to take conveyance thereof in the name of the City of Philadelphia; and such part thereof as shall lie beyond or within the said Park limits, again to sell and convey in absolute fee simple to any purchaser or purchasers thereof, by deeds to be signed by the Mayor, under the seal of the City, to be affixed by direction of Councils, either for cash, or part cash and part to be secured by bond and mortgage to the City, paying all cash into the City Treasury: *Provided,* That the proceeds of such sales shall be paid into the Sinking Fund for the redemption of the loan created under the provisions of this Act: *Provided, also,* That no Commissioner, or any officer under the Park Commission, shall in any wise be directly or indirectly interested in any such sale of lands by the Commissioners as aforesaid; and if any Commissioner or officer aforesaid shall act in violation of this proviso, he shall, if a Commissioner, be subject to expulsion; if an officer, to be discharged, by a majority of votes of the Board of Park Commissioners, after an opportunity afforded of explanation and defence."

And Section 11 of the same Act provides:

> "The City of Philadelphia shall be authorized and required to raise by loans, from time to time, such sums of money as shall be necessary to make compensation for all grounds heretofore taken or to be taken for said Fairmount Park, and for the laying out and construction thereof for public use; for the permanent care and improvement thereof, and for all culverts and other means of preserving the Schuylkill water pure for the use of the citizens of said City; and shall annually assess taxes for keeping in repair and good order the said Park; and shall also provide for the payment of the interest on all said loans, and the usual sinking fund for the redemption thereof."

You will thus see that the legislature by the first Act only gave permission to the Commissioners to acquire "when the Councils of the City of Philadelphia shall so declare by ordinance" and under the Act of 1868 it was evidently the purpose of the legislature to have such lands paid for by a loan for that purpose, and this left a final check in the hands of the voters, for they must pass on the question of loans. There was an Act passed by the legislature last year, Act of April 24, 1903, P. L. 294, as follows:

> "Be it enacted, etc., that it shall be lawful for, and the right is hereby conferred upon, Commissioners of Public Parks within the cities of the first class of this Commonwealth, to purchase, acquire, enter upon, use and appropriate, for public park purposes, farm lands and woodlands adjoining and bounding land now used for park purposes within the corporate limits of said cities of the first class, in which the park or parks are located, where in the opinion of

said Commissioners the said land shall be necessary for the improvement of the said parks: *Provided, however,* That the total acreage of all lands so taken in pursuance of this act shall not exceed one thousand acres.

"In exercising the power aforesaid, all proceedings for ascertaining damages, and assessing the benefits incident thereto, shall be in accordance with the law authorizing cities of this Commonwealth to acquire, by purchase or otherwise, private property for public park purposes."

It will be seen that there is no provision in this Act providing for the payment for the property thus acquired, but it can scarcely be thought possible that the Legislature intended to give the Commissioners the right to buy 1,000 acres of land without any restriction as to price, or whether or not the money was in the Treasury to pay for it, especially when you take into consideration the clause of the Constitution of Pennsylvania of 1874, Article 15, Sec. 2, which provides:

"No debt shall be contracted or liability incurred by any municipal commission except in pursuance of an appropriation previously made therefor by the municipal government."

I have gone thus fully into these different matters to show you where the responsibility lies for the constantly increasing payments upon mandamuses, and to call to your attention the very serious financial problem the City will eventually face unless these mandamus payments are curtailed. The Park Commissioners control property held in the name of the City of Philadelphia, but which is outside of the Park limits on the east side of Thirty-third

street, which has not been used for Park purposes, and which has been unproductive for years, and which is worth several hundred thousand dollars. Surely this could be sold and the proceeds used to pay for the land that is constantly being added by the Commissioners to the Park, and thus stop to some extent this mandamus drain which now bids fair to exceed the Controller's estimate for this year by $500,000 to $1,000,000.

I was inaugurated Mayor of Philadelphia on Monday, April 6, 1903. On that day I appointed David J. Smyth, Esq., Director of Public Safety, and Peter E. Costello., Esq., Director of Public Warks.

DEPARTMENT OF SUPPLIES.

The General Assembly of Pennsylvania on April 4, 1903, passed an Act supplementary to the Bullitt Bill creating a Department of Supplies in Cities of the first class and specifying and limiting the functions of said Department. There was passed by your Honorable Bodies in April, 1903, an ordinance to carry into effect in this City the terms of this Act, which ordinance was signed by me on April 20th. I subsequently appointed Frederick J. Shoyer, Esq., Director of the Department of Supplies, which appointment was duly ratified. Mr. Shoyer's first annual report is submitted herewith, and your attention is specially called to it. Of course it is impossible to say what the result will be of the practical working of this Department until the close of this first year, but I am inclined to think that it will result in some very material advantages to the City. The difference in the lowest prices bid for materials used by the various bureaus in the City is most striking, and we feel that even this will be improved when we succeed in having all our tradespeople and

merchants realize that they have as good a chance to be the successful bidder for the City as any other person.

This first report of the Director necessarily deals in the most part with the organization of his Department. This was a work of no small magnitude, but was undertaken and prosecuted with such intelligence and perseverance by the Director and his assistants that long before the end of the year he had his department in good working order, and the splendid work that he is now doing in cutting down prices and holding contractors up to somewhere near the terms of their respective contracts augurs well for his Department.

DEPARTMENT OF PUBLIC HEALTH AND CHARITIES.

On April 8, 1903, the Governor signed an Act passed by the General Assembly of Pennsylvania supplementary to the Act of June 1, 1885, known as the "Bullitt Bill," and amending the same so as to change the Department of Charities and Correction under the charge of a President and four Directors to the Department of Public Health and Charities under the charge of a Director, thus transferring the Bureau of Health, which had heretofore been under the Department of Public Safety, to this Department, and transferred the Bureau of Correction to the Department of Public Safety.

On April 20, 1903, I signed an ordinance passed by your Honorable Bodies to carry into effect the terms of this Act, and subsequently appointed Dr. Edward Martin Director of this Department of Public Health and Charities. We were exceedingly fortunate in having a man of Dr. Martin's experience, ability and standing, accept this office, for the duties of the office, which have been most

faithfully attended to, must of necessity have interfered with his very large practice. Dr. Martin, however, is a man of great public spirit, and has been induced to accept the Directorship of this Department at a considerable sacrifice to his personal comfort, and we hope that he will in a short time see great public benefits resulting from the work he is doing in the Department that will more than compensate him for his personal loss. One of the first things accomplished by Dr. Martin was the selection and appointment of an advisory board, consisting of six of the most eminent physicians of the City—they are Dr. S. Weir Mitchell, Dr. John H. Musser, Dr. Hobart Hare, Dr. J. William White, Dr. Charles B. Penrose and Dr. J. M. Anders, and you will see by Dr. Martin's report herewith submitted that the services of the advisory board have been most helpful to the Department. In reorganizing the Board of Health, Dr. Martin appointed Dr. A. C. Abbott, a well-known authority in sanitary matters, Chief of the Bureau, and also President of the Board, with Dr. Chas. B. Penrose and Dr. Leonard Pearson as his associates on the Board.

I have had transferred from the Department of Public Safety to the Department of Public Health and Charities the Meat Inspectors, as it seemed to all of us that it would be more appropriate to have this work done under the supervision of the Board of Health. At Dr. Martin's request provision was made in your appropriation bills for 1904 for thirty-seven additional Medical Inspectors to do the work of the vaccine physicians, and more particularly for the systematic inspection of public school children.

The Philadelphia Hospital management has been entirely reorganized. The tubercular pavilions contracted for over a year ago have been completed, and Dr. Martin, since he went into office, has had built and put into successful operation a roof garden for consumptives. Dr. M. H.

Biggs has been appointed Chief Resident Physician and Dr. W. W. Hawkes Chief Resident Physician Insane Department, and Miss Margaret F. Donohue, Chief Nurse of the Philadelphia Hospital.

Ground was purchased by the City at Torresdale for the purpose of building a new hospital for the Insane, in order to relieve the present crowded conditions of Blockley, and over a year ago a contract was entered into for the building of the administration building of this hospital. Dr. Martin and his Advisory Board are of the opinion that it would not do to move the Insane Department to this place, as there is not sufficient ground to give them the proper surroundings, they believing that we should have a farm of at least 500 acres for this purpose, and it has been suggested that the Administration Building now erected at Torresdale be used for the Administration Building of a Hospital for the Indigent, and move the Indigent or Almshouse Department out to Torresdale, and secure another site for the Insane Department. The moving of the Almshouse or the Insane Departments would of course relieve the present crowded condition of Blockley, but it is a question whether the City can afford to acquire a site and build an Insane Hospital at the present time at the rate per acre we should have to pay for land in Philadelphia County. As it is a duty of the State to provide for indigent insane, perhaps the State can be prevailed upon to acquire a site within a reasonable distance of Philadelphia County, and build an Insane Asylum to take care of the insane. If this cannot be done I see no immediate prospect of taking both the Almshouse and Insane Departments from the Blockley Buildings. With the large number of cases of contagious diseases that the authorities have had to cope with, and the cramped quarters of the Municipal Hospital, it is really remarkable that they have done so well, but I am glad to say that the smallpox building of

the new Municipal Hospital is almost completed, and within a short time I hope the diphtheria and scarlet fever buildings will be erected, and we shall then have contagious disease hospitals where the patients who are compelled to go to them shall have all the comfort and care that modern science can give them. We should certainly try and make it as attractive and comfortable as possible for patients that the law compels to leave their own homes and go to a hospital, and we desire to make the grounds as attractive for convalescents as the buildings will be for the sick patients. While there has been some smallpox in Philadelphia during the past winter, yet considering that conditions last fall were favorable for a violent epidemic, to which attention was called by Dr. Martin late in the summer, and further considering the severity of the winter, which seems to aid smallpox conditions, it is little short of miraculous how this disease has been kept down, and we hope that very shortly it will be entirely effaced in our City.

In the ordinance passed by your Honorable Bodies recommending the increase of the indebtedness of the City to the extent of $16,000,000, there was an item of $900,000 for the erection of hospital buildings for contagious diseases, and I hope this will be sufficient to build, complete and equip the new hospitals on the ground already purchased by the City therefor, and we shall push this work forward as rapidly as possible.

DEPARTMENT OF PUBLIC WORKS.

A very large amount of work has been accomplished by this Department under the very capable management of the Director, Mr. Peter E. Costello. I call your attention to his report and especially to that part of it in which he

refers to the deficiency bills, and the manner in which the deficiencies arose. I might say here that this was the condition in all of the departments, so that it became necessary at the end of the year to not only float a temporary loan of $650,000, but also to pass a Deficiency Bill for the sum of $1,074,237.36, and in some instances it was necessary for us to make expenditures of money without any previous authorization in order to keep the various Bureaus and Departments of the City in running order. I might mention the instance of the City Ice Boat No. 2. During the summer of last year, when your Honorable Bodies were not in session, it was found that this ice boat was in such bad repair that she needed new boilers, and to be practically rebuilt, and I authorized this work to be done, as it took several months in which to complete it, the contractor agreeing to wait for his money until Councils appropriated the same. If this work had not been done, I am quite positive that the channel of the Delaware river would have been closed and kept closed the greater part of this very severe winter. In this connection, I call your attention to the Director's report referring to the report of the Superintendent of Ice Boats, who urges the building of a new Ice Boat at an approximate cost of from $250,000 to $300,000. This will probably have to come eventually, but we are in hopes we shall not have as severe a winter as this past one for some time to come.

Bureau of Highways.

This is a very important Bureau of the City Departments, as we cannot attach too much importance to the conditions of our roads and streets. At the time I came into office I was very much dissatisfied with the price paid for paving, especially the asphalt paving. There was an ordinance in existence which provided that streets should

be paved only with "Lake Asphalt," and a number of complaints were brought to me by prospective bidders—that is, they were prospective bidders if they could bid on anything besides *Lake* Asphalt. In listening to their complaints I was informed by them that there were a number of other asphalts on the market equal to the Lake Asphalts, and that inasmuch as all the lake asphalts were under the control of one body or combination, there could be no competition. I therefore informed them that they could bid, and that all bids would be received pending my investigation on the subject. This had the effect of reducing bids even for the lake asphalts about forty cents a yard from the previous contracts for this same material. Upon a thorough investigation of the matter I found that this question of lake asphalt had been before Common Pleas No. 2 of this County in an effort to enjoin the then Mayor of the City, Hon. Charles F. Warwick, and the Director of Public Works, Mr. Thomas M. Thompson, from awarding the contract for paving streets under the ordinance containing the provision that only lake asphalt should be used. The lower court ordered the injunction issued, but upon appeal to the Supreme Court this was reversed, and the judgment of the lower court set aside. (See the case reported in 183 Pa., page 55); thus the action of the Director in asking for bids and awarding contracts to lake asphalt dealers *only* under this ordinance was sustained, so that I felt that we were compelled to award the contracts to those contractors who could furnish *lake* asphalt. Some idea can be given to your Honorable Bodies of the difficulty the officers of the administration have in solving problems of this kind, when I say to you that an investigation of the case just cited revealed the fact that some of the very men who were before us complaining of the use of the word "lake" and the awarding of contracts for "lake" only, and urging upon us that land asphalt was

just as good as "lake," were some of the very men that had appeared before the Court in the case just cited, and had there testified that land asphalt did not compare in any way with lake asphalt. Your Honorable Bodies subsequently amended the ordinance so as to strike out the word "lake" and leave it to the department to select the best material that is bid upon, but we should surely now have the greatest possible competition, and I am in hopes that this will still further reduce the cost of paving to the City. The opening, grading and paving of streets is one of the most essential things in the building up and development of a City, and I find that it sometimes occurs that the City is without money either for grading or paving, and a builder is willing to do both the grading and the paving in order to put the houses that he has built on the market as speedily as possible. He is not permitted, however, under the law to do this, and I have thought that some relief should be given to our builders permitting them to do the grading or paving or both when the Department is without the necessary appropriation to do it, and of course all the work to be done after permission given by the Department, and subject both as to character of the work and materials used, to the supervision and control of the Department of Public Works. In this way I am inclined to think that we could have many more streets opened during the course of a year than we are having at the present time, and I ask your earnest consideration of this subject.

I also call your attention to the report of the Superintendent of Bridges, in which attention is called to the bad condition of a large number of the three hundred and thirty bridges owned by the City. In the ordinance passed by your Honorable Bodies to increase the indebtedness of the City by $16,000,000 is an item of $1,000,000 for the erection of new bridges. It seems to me, however, that

the old bridges—where it is necessary to practically reconstruct—should be attended to before any new bridges are built.

Bureau of Street Cleaning.

You will notice that the sum of over $600,000 was expended for cleaning streets and the removal of ashes last year. The bids and contracts for 1904 were very much larger than this; the original bidding being nearly twice the amount paid last year. I at once ordered all the bids rejected and new bids asked for, changing the specifications, and contracts were awarded amounting to $976,100. This, I believe, is very much more than should be paid for this work, and I have suggested that hereafter the bids shall be asked for in July for the street cleaning to be done the following year, so that unless we can get the contracts down by competitive bidding to what we think ought to be paid, we shall have time to make the necessary arrangements to do the work ourselves, and this will give other contractors time to prepare themselves if they are successful bidders.

In regard to the removal and disposal of garbage and dead animals, for which the City paid $516,340 in 1903, and for which they have contracted to pay $536,700 in 1904, I had the honor of forwarding to you some months ago a communication from Mr. John D. Pessano making a proposition which, if feasible, would relieve the City of this entire expense, and probably be a source of revenue to her. I have understood that this has been referred to one of the Committees of your Honorable Bodies, and may I ask that you take up the subject at the earliest possible moment, and have an investigation made of the proposed scheme, as, if anything is to be done, it should be done at once in order to relieve the City of this expense if possible by the first of January next.

The Director of Public Works also recommends the removal of household waste and rubbish separate and distinct from the garbage on the ground that it would be a source of revenue to the City instead of expense. I am inclined to think that this is correct, and that it would not be an additional burden on the housekeeper to have the paper and other rubbish put in one bundle distinct from the ashes, and it would also have the very distinct advantage of preventing it being blown around the streets after the ash gatherers have gone their rounds, and I think it would also be well to prevent by ordinance the indiscriminate collection of certain rubbish from the ash barrels by unauthorized and irresponsible parties, whose success in depositing a large amount of dirt on the streets throughout the City is second only to the success that attends the authorized ash gatherer when he undertakes to collect the ashes, paper and other household rubbish as it is now put out for collection. I ask your consideration of this matter and the passage of such legislation as to you shall seem proper.

Bureau of Surveys.

This Bureau is one of the most important Bureaus in the municipal government, and under the very able direction of its chief, Mr. Webster, has continued the good work that it has been doing for many years. In the ordinance passed by your Honorable Bodies for the increase of the City's indebtedness there is an item of $1,000,000 for the construction of main and branch sewers. I trust this will go a long way towards the work suggested in the reports of the Chief of the Bureau and the Director of Public Works.

In regard to the Northeast Boulevard, there has been a great diversity of opinion as to the utility and wisdom of building a boulevard three hundred feet wide through a

farming district, but it was placed upon the City plan by the action of your Honorable Bodies over a year ago and an appropriation made for commencing work thereon, and work was actually commenced early last year. I have insisted that the fifty thousand dollar unexpended balance of appropriations to this work should be held for the purpose of finishing the boulevard at the western end thereof where it was started, so that we could have a completed boulevard as far as it was able, thus accomplishing two objects: 1. The showing of our citizens what the boulevard will be by having a section of it entirely finished. 2. That if at any time your Honorable Bodies should consider that the expense of continuing the work was not justified, it could be stopped without leaving a considerable section of partly built roadway, which, instead of being a boulevard, would be a mud hole. I understand that the work of completing the western end of the boulevard in the way proposed by the plans prepared will be commenced as soon as the weather permits.

The parkway from City Hall to Fairmount Park is to my mind a very desirable improvement to the City, and one that will make Philadelphia most attractive. It appears, however, that the boulevard as at present laid out at the City Hall end would interfere very much with the proposed extensions and improvements at Broad Street Station, which are intended for the convenience of the travelling public, and I would suggest that in building this boulevard, which is entirely for the purpose of beautifying the City, we should hold constantly in mind the accommodations and convenience of our citizens, and I am informed that if we should make the northwest corner of Broad and Filbert Streets the center line of the boulevard that it would not then interfere with the proposed improvements of the Pennsylvania Railroad Company: I ask your earnest consideration of this matter.

The widening of South Broad Street to the width of 160 feet and the completion of League Island Park is one of the general schemes for the improvement of South Philadelphia. The widening of Broad Street and having it properly paved is an extremely important work, the Federal Government having the great League Island Navy Yard at the southern end of the City, and the main entrance into the Navy Yard from the land being over Broad Street, it should be a matter of pride to our City to have a good roadway running from the centre of the City to the Navy Yard. As this improvement, however, will cost considerable money and will very largely enhance the value of adjoining property it seems to me that such property should be assessed at full City rates, and pay their proportion of the cost of the improvement. I am also of the opinion that now at the time that we are widening this street and about to improve it permanently with a good pavement, that some provision should be made to abolish the two steam railroad grade crossings at present traversing Broad Street, the one over Oregon Street and the other between Pollock and Packer Streets, the first named being the Schuylkill River East Side Railroad and the other the Pennsylvania Railroad.

Grade Crossings

In my address to your Honorable Bodies on April 6, 1903, I said:

> "You have probably noticed and been horrified, as I have, at the reports of the very large number of deaths caused at the grade crossings of the steam railroads in the City of Philadelphia during the last year. It is a great shame that, at this time, the opening of the twentieth century, there should exist any grade crossings in so large and great a city as this

is. Grade crossings should be speedily abolished, and the city engineers should at once confer with the engineers of the various railroad companies to ascertain the most feasible and economical way of abolishing them. These crossings have become so great a menace to life in the City of Philadelphia that they must be got rid of."

I had intended to take up this matter just as soon as I had become familiar with the duties of the Chief Executive of this City. I started an examination of the condition as soon as possible but during my investigation certain information came to me that prevented my starting negotiations with the Railroad Company, and this caused a delay of several months. We finally met at the offices of the Philadelphia and Reading Railway Company,—Mr. Baer, Mr. Voorhees, Mr. Welsh, Mr. Harris and some of the engineers of the Railroad Company being present for the Railroad, and Director Costello, of Public Works, Mr. Webster, Chief of the Bureau of Surveys, and myself, on behalf of the City. We had a long conference at which it appeared that the plan of the Railroad Company was to elevate the tracks on steel superstructure starting at Spring Garden Street and going to Girard Avenue. At the present time they have but two tracks between these points and their elevated plan proposes four tracks; they cannot get four tracks while running at grade on Ninth Street so that they must elevate to get two additional tracks. For this part of the elevation they wanted the City to pay one-half of the cost of construction. Surely with the great advantage of having two more tracks they could well afford to have built this small section themselves without any expense to the City. You can well see that if the City pays one-half of the cost of building the elevated superstructure for four tracks, when the railroad is now at

grade with only two tracks, the City would thus be paying the whole cost of abolishing the grade crossings between those two points, the Railroad Company by agreeing to pay one-half of this cost is merely agreeing to pay the cost of the two additional tracks and in addition to this they want the City to vacate a square of Ninth Street for them in this section. They then proposed to build retaining walls with earth embankments for the tracks up to Huntingdon Street. For this part of the elevation, i. e., from Girard Avenue up to Huntingdon Street, the Railroad Company wanted the City to pay three-fourths of the construction if they paid one-half of the other section; they finally put it that they would pay one-third of the cost of the construction of the entire elevated road from Spring Garden Street to Huntingdon Street if the City would pay two-thirds. This would be about the same to the City as the other proposition. We took the position for the City that the Railroad Company should pay two-thirds and that the City should not be asked to contribute over one-third. This would be about equivalent to paying one-half of the cost of construction between Girard Avenue and Huntingdon Street and allow the Railroad Company to bear the expense of construction between Girard Avenue and Spring Garden Street because of the immense benefit to the Company of the two additional tracks. The Railroad Company, however, would not agree to pay two-thirds, and gave their proposition to pay one-third of the entire cost as their ultimatum. I cannot recommend this nor can I see that the City should be called upon to do more than pay one-third. It is of immense benefit to the Railroad Company to have this elevation,—first, on account of the additional trackage above referred to; second, it would save the Company the expense of a large number of watchmen at the grade crossings to be kept there constantly; third, it would do away

with the large number of claims and suits for damages for personal injuries; fourth, inasmuch as the plans for elevation provide for all betterments, viz.: new and improved roadbed, the latest signal system, modern passenger and freight stations, &c., &c., it would give them a railroad equipped with more modern appliances than their present road is, and, lastly, they would be enabled to run their trains at much greater speed with absolute safety.

It is also of great importance to the City that either the grade crossings shall be abolished or that something shall be done to protect our citizens from danger who have to cross the tracks and, if the Railroad Company shall continue to refuse to meet the City upon equitable terms, it may be necessary to so regulate the speed of the trains within the City limits that there shall be no danger to pedestrians or vehicles crossing the tracks. This, of course would very seriously inconvenience the public travelling on the trains of the Railroad Company, but better this inconvenience than the constant killing of people at the grade crossings.

The Act of February 17, 1831, which incorporated the Philadelphia, Germantown & Norristown Railway Company, Section 16, is as follows:

> "And be it further enacted by the authority aforesaid, That the said railroad shall be so constructed by the said company, as not to obstruct or impede the free use and passage of any public road or roads which may cross or enter at the same, being now laid out or hereafter to be laid out; and in all places where the said railroad may cross, or in any way interfere with any public road, it shall be the duty of the said company to make or cause to be made, a good and sufficient causeway or causeways, to enable all persons passing or travelling such public road, to cross

and pass over or under the said railway, which causeway or causeways shall be made and maintained by the said company, and if the said company shall refuse or neglect to make such causeway or causeways, or when made, to keep the same in good repair, they shall be liable to pay a penalty of ten dollars for every day the same shall be neglected or refused to be made or repaired, after having been duly notified thereof, to be recovered by the supervisor of the township, with costs, for the use of the township, as debts of like amount are by law recoverable; and shall, moreover, be liable to an action or actions at the suit of any person who may be aggrieved thereby; and the service of process upon any officer or agent of said company shall be as good and available in law as if served upon the president thereof."

The cost of the elevated structure from Spring Garden Street to Huntingdon Street has been estimated by the Railroad Company to be five million four hundred and thirty-three thousand and twenty-six (5,433,026) dollars. This includes damages to property by reason of the change of grade of streets, but does not include consequential damages. The City's estimate for the entire work, including an approximate estimate for damages of all kinds, is five million six hundred and ten thousand (5,610,000) dollars. The City plan was to carry the steel superstructure to Jefferson street before commencing the stone wall and earth filling structure, so as to leave Ninth street open to public use instead of closing it between Girard avenue and Jefferson street as contemplated by the Railroad plan. This would only make a small difference in cost.

One million (1,000,000) dollars is provided in the recent loan bill for the abolition of grade crossings. In the

eleven million two hundred thousand (11,200,000) dollar loan of 1898 was an item of nine hundred thousand (900,000) dollars for abolition of grade crossings. This, I understand, was for the grade crossings on the Philadelphia & Trenton Railroad. Seven hundred thousand (700,000) dollars of this nine hundred thousand (900,000) dollars has been negotiated, leaving two hundred thousand (200,000) dollars to be negotiated, but no part of it has been used, and there seems to be no immediate prospect of it being used; it is just lying idle, with the City paying interest on it. If this could be transferred to the abolition of the Ninth street crossings we would have the necessary amount to pay one-third, and if the Railroad Company would agree to this, work could be commenced forthwith, and we could provide by another loan bill for the Philadelphia & Trenton grade crossings. I sincerely hope that the railroad officials will come to see it as we do.

It has been suggested to me that it might be possible to elevate and depress the streets in such a way as to leave the Railroad as it is—change the grades of the streets. I have had this gone into carefully by Mr. Webster and he reports to me that it would cost more than the elevated structure would cost, would make very heavy grades causing great inconvenience, and when completed would be an eyesore. I therefore believe that the elevation is the proper remedy and while I have thought that the elevation should be continued up to Wayne Junction, the funds available compel us to confine our efforts to the section between Huntingdon and Spring Garden Streets.

Bureau of Water and Bureau of Filtration.

These two bureaus are inseparably connected with each other. The functions, however, of the Bureau of Water being to furnish the entire City with water, and that of

the Bureau of Filtration to build and equip the system of filtration already devised and planned whereby we hope to give the City an abundant supply of pure water when they are completed. While we have the Roxborough plant in operation and I am informed that the Belmont plant will be completed so as to give West Philadelphia filtered water before the first of July this year, I do not see much possibility of having the entire filtration plant at Torresdale completed within two years. I believe that it is being hurried all that it possibly can but it is a work of such magnitude that it is simply impossible to drive the work more rapidly than it is being done to-day. The total capacity of the three filtration plants is estimated to be about three hundred and forty-two million (342,000,000) gallons per day, and of this total amount two hundred and fifty million (250,000,000) gallons per day is to be filtered at Torresdale. I refer you to the Director's report and to the report of Chief Hill, of the Bureau of Filtration, for a more specific statement as to the present conditions of the various contracts now being completed. Other contracts must be made as soon as the money is available for the completion of the work. I wish every one of our citizens could see and understand the great work that is going forward in the efforts to obtain for them a clean and pure water in exchange for that which they get after a very heavy freshet in the rivers. The plant at Torresdale with the capacity of two hundred and fifty million (250,000,000) gallons a day will have fifty-five (55) filtration beds, besides the preliminary filtration and the fresh water basin, and then the fresh water will be carried in a conduit that has now been practically completed—three miles long and twelve feet in diameter—from the Torresdale Filtration Beds to Lardner's Point Pumping Station. Here it will be pumped into the immense water mains for

distribution all over the City. It is the largest filtration plant in the world and the greatest work of its kind ever undertaken.

It is perhaps interesting to know that with the one exception of the City of Buffalo in the State of New York, Philadelphia has the largest consumption of water per capita of population of any city in the world. London, I am informed, with her immense population, only uses about two hundred and twenty million (220,000,000) gallons of water daily, while we use over three hundred million (300,000,000) gallons daily. In London they started sand filtration of her water about seventy years ago, and to-day they filter with the sand filtration system all their water with the exception of about thirty million (30,000,000) gallons daily, which comes from the Kent district. I understand that Liverpool and Edinburgh also have sand filtration for their water, but of course the quantity filtered is very much smaller than London. Other European towns having sand filtration for their water supply are Berlin, Hamburg, Bremen and Altoona, in Germany; St. Petersburg in Russia; Zurich, in Switzerland, and Warsaw, in Poland.

In the United States, as far as I can learn, the first sand filtration plant was built in Poughkeepsie, N. Y., between thirty and forty years ago; then followed a plant at Hudson, N. Y., and then one at Lawrence, Mass.

It might be well to note that Lawrence takes her water from the Merrimac River about nine miles below the City of Lowell, whose sewer is emptied into this river. The next city to start sand filtration was Albany, N. Y.; then came Philadelphia, and since Philadelphia started her plant, the City of Washington, D. C., Pittsburg, Pa., and Reading, Pa., have started like projects and the cities of Cleveland, Ohio; Chicago, New York, Louisville, Cincinnati, Buffalo, St. Louis, Wilmington, Del., and Denver

have been investigating our work with a view of treating their water supply in the same way. There are also about two hundred smaller towns in the United States that filter their water supply by the use of mechanical filtration systems and there seems to be no doubt that modern science points to filtration as being the proper method of getting pure water.

I call your special attention to the report of the Director of Public Works on the condition of the machinery in the Water Department. It is extremely important that we should have sufficient money to see to it that our engines and machinery are kept in proper condition to keep the reservoirs filled and a proper pressure in the water mains so as to give our citizens in every locality all the water they desire.

The meter system also presents a problem that I have asked the Director of Public Works to take up with the Chiefs of the Bureaus of Water and Filtration and determine on some course to recommend to your Honorable Bodies. It was working most unsatisfactorily to large manufacturers. We had over one hundred and thirty thousand (130,000) dollars of unpaid water bills—all of them meter bills—that we have been compelled to send to the City Solicitor for suit. We have temporarily suspended the installation of further meters until we can determine on some policy that will be equitable and fair to all.

DEPARTMENT OF PUBLIC SAFETY.

This department with its manifold duties and the number of bureaus connected therewith has been very ably administered by the Director, Mr. David J. Smyth.

I call your especial attention to his report of the work of the Bureau of Police. After the commencement of the

present administration of the City affairs it was announced so that everyone could understand it that speak-easies, gambling establishments and slot machines must go, and that policy playing must be stopped. It was not our purpose to persecute wrong doers, but merely to prosecute those who were guilty of a breach of the law. Our object was to break up the illegal practices, and in hundreds and thousands of instances this was accomplished without any prosecution as soon as it was known that it had to be done. Those who persisted in the violation of the law were prosecuted and it will be the duty of this administration to continue this policy throughout its term. I am reliably informed by gentlemen who have been spending a greater part of their lives in the lowest parts of the City in noble and self-sacrificing efforts to uplift fallen humanity that speak-easies, gambling establishments and slot machines have been very largely suppressed, and that the worst form of gambling—policy—which took the pennies, nickles and dimes of the poor to such an extent that it has been stated that a million dollars in one year has changed hands in this form of gambling—has been entirely obliterated. If we can continue to do this during the balance of the term of this administration, we shall feel that the work of this administration has not been altogether in vain. A number of efforts have been made to reintroduce policy playing into the City but thus far without success. It makes spasmodic appearances, but the police are on the alert and soon stop it. It is astonishing that poor dupes can still be found who are willing to throw their hard earned money away in this manner, with absolutely no chance of return, but you may be assured that the whole power of the administration will be used to prevent its reintroduction into this City and to arrest now not only the tools but the men who are known as backers, should any attempt be again made.

The large textile strike in our City during last summer was one of those unfortunate things that will occur from time to time in the contest between capital and labor, but as you will see by the Director's report, there was little trouble and few arrests. I think this was due to a very great extent to the law abiding character of the men who were involved in the strike.

Bureau of Fire.

The Fire Department of the City of Philadelphia still holds the high position to which its very efficient but modest chief, James C. Baxter, has raised it, and I refer you to his excellent report.

The high pressure pumping station at Delaware avenue and Race street has been completed by the Bureau of Water, Department of Public Works, and turned over to this Bureau.

Electrical Bureau.

This Bureau is becoming a most important Bureau of the City Government, as electricity is becoming more and more used in all branches. The great ability and splendid work of its chief, Mr. John C. Sager, on the theatrical commission (hereafter referred to) was of great assistance to the commission. His experience as an electrician enabled him to at once recognize danger from defective or improper wiring and all electrical arrangements.

Bureau of Building Inspection.

This Department has been kept busy throughout the year. The calamity at the Philadelphia Baseball Park on August 8th, when an overhanging platform fell into the street, injuring a number of people, shows the importance of the most constant vigilance not only of places in which large numbers of people collect, and which do not

have the appearance of being any too safe, but also in regard to those places that are considered to be absolutely safe. We had all been led to believe that this was one of the soundest and safest structures in the City of Philadelphia, and yet it collapsed without a second's warning, and an investigation after the accident showed not only defective construction originally, but also a condition of unsafeness that must have lasted a considerable time, but which, under the method of construction, was so concealed within a brick wall that a break was necessary to show its instability.

The dreadful calamity at the Iriquois Theatre, in Chicago, the end of December of last year, sounded a note of warning to all large cities of the possibilities of danger to the public by a disregard of regulation and law, or the careless management of the playhouse. I at once appointed a commission consisting of Chief Hill, of the Bureau of Building Inspection; Chief Sager, of the Electrical Bureau; Chief Baxter, of the Bureau of Fire; Fire Marshal Lattimer, and three of the best experts I could get in the City of Philadelphia—George F. Payne and A. Raymond Raff, builders, and Howard S. Richards, a well-known engineer and architect, of the firm of Wilson, Harris & Richards. These three gentlemen immediately accepted my invitation to act as members of the commission, and in a most commendable public spirit offered to give their services to the City without compensation. They immediately commenced their work, and have carefully inspected thirty-four theatres and halls in the City. They found the condition in some of the theatres most deplorable, their being great danger of fire from defective electric wiring, and the facilities for the audiences getting out of the theatre in case of fire were so poor that in some instances we closed the theatre entirely until changes were made, and in others we closed some parts, and in all the

commission suggested changes. I understand that the management of nearly all the places visited most cheerfully fell into the views of the commission for the safety of their patrons, and the work of changing has been going forward rapidly. If I shall find any of the managers refusing to adopt the suggestions made by the commission for the purpose of providing for the safety of the public I shall not hesitate to revoke the license of the house thus refusing or to take some other means of compelling obedience to the orders. A number of rules have been suggested to me by the commission, and after going over them very carefully with the commissioners, it is my purpose to publish them, and have a copy delivered to the proprietor or manager of each theatre, and it will be the purpose of the administration to carefully watch these places of entertainment to see that the rules thus made for the safety of their patrons are carefully carried out.

I shall probably have some further communication to make to you on this subject in the near future.

THE CITIZENS' PERMANENT RELIEF COMMITTEE.

The Citizens' Permanent Relief Committee of Philadelphia, composed of the following well-known citizens:

John Weaver (*Chairman*), Francis B. Reeves (*Vice-Chairman*), Rudolph Blankenburg, John H. Converse, Hon. George D. McCreary, Hon. John Field, Charles J. Harrah, W. W. Foulkrod, Daniel Baugh, Hon. William Potter, Morris Newburger, Theodore C. Search, Alexander Van Rensselaer, Theodore V. Warne; Robert C. Ogden (Honorary Member); M. S. French, M. D., *Secretary;* Drexel & Co., *Treasurer,* was called upon several times during the year.

About the end of May or the beginning of June, 1903, the floods of the Mississippi caused great destruction of property and other damage to the town of Topeka, Kansas, and other towns in the Mississippi Valley. The Citizens' Permanent Relief Committee met immediately, made an appeal to the people of Philadelphia, who responded nobly, as they always do when they are called upon to relieve the distress of their fellowmen, and we were thus enabled to relieve in a very substantial manner with money the sufferings of the people of the Mississippi Valley. We were again called upon late in the year by the people of Butler, Penna., there being a most violent epidemic of typhoid fever, which had been caused by the temporary breaking down of their filtration plant and the necessity of using water direct from a stream without filtering it. In this instance the Citizens' Permanent Relief Committee sent to Butler a corps of twenty-five trained nurses and three doctors, all under the charge of Dr. French, the Secretary of the Relief Committee, and they there opened a hospital known as the "Hospital of Brotherly Love." They remained there nursing the sick that were brought to them until the epidemic had been relieved. The Citizens' Permanent Relief Committee were especially grateful to the Jefferson Hospital, the Presbyterian Hospital, and the University Hospital, who, together with the Philadelphia Hospital, supplied the twenty-five trained nurses to go to Butler. It is a most encouraging thing that these busy men of affairs who are on this Committee will drop their business affairs at a moment's notice to attend a call of this Committee. It is only indicative, however, of the manner in which the people of the City so promptly and generously respond to the call of distress from whatever part of the world it may come.

LAW DEPARTMENT.

The law business of the City has been very materially increased, but has been attended to most satisfactorily by the very able City Solicitor, Mr. John L. Kinsey.

The full report of his Department is sent herewith, but it is perhaps not out of place to give here a short summary of some of the important work of his Department.

The Department collected in 1903 three hundred and twenty-seven thousand one hundred and thirty-six (327,136) dollars and seventy-five (75) cents. This, of course, does not include the payment recently made of five hundred and sixty thousand (560,000) dollars by the Reading Railroad Company, as that will appear in this year's report.

There was collected as delinquent taxes and water rent one hundred and thirty-five thousand seven hundred and twenty-one (135,721) dollars and fifty-six (56) cents, and of personal taxes ten thousand (10,000) dollars. Tax liens to the number of fourteen thousand and seventeen (14,017) were filed, amounting to six hundred and twelve thousand and thirty-five (612,035) dollars. Of municipal claims other than taxes there were filed one thousand one hundred and thirty-eight (1,138) in number; three thousand two hundred and ninety-nine (3,299) writs of scire facias, and one thousand four hundred and ninety-seven (1,497) writs of alias scire facias were issued to revive judgments on municipal claims. Amicable actions were entered into in one hundred and sixty-five (165) cases of scire facias to revive, three thousand one hundred and ninety-three (3,193) judgments upon tax liens, amounting to one hundred and twenty-six thousand one hundred and eighty-one (126,181) dollars and eleven (11) cents were recovered. There was collected from the Prothonotary twelve thou-

sand nine hundred and twenty-seven (12,927) dollars and sixty-five (65) cents as costs on tax liens.

Seven hundred (700) violations of the building laws were considered by the Department and thirteen (13) bills in equity filed, and numerous actions for penalties brought before Magistrates.

Fifty-six deeds of real estate were prepared and settlements made, the total consideration involved being one million one hundred and twenty thousand one hundred and thirty-two (1,120,132) dollars and eighty-three (83) cents.

The Department continued the preparation of the data in reference to the title papers, leases, &c., concerning the real estate owned by the City, and it is expected that within a short time the Department will be able to furnish upon request, complete information relative to the various properties owned by the City.

The business of the Road Department has increased enormously, and on December 31, 1903, one hundred and forty-one (141) cases were pending before road juries, for the opening and widening of streets, changes of grades, construction of sewers, vacation of streets, condemnation for park purposes other than ground taken for Fairmount Park, for school properties, for water supply, freeing of turnpikes from toll, and during the year one hundred and fifty-two (152) separate proceedings before road juries were disposed of.

The claims in these proceedings amounted to four million six hundred and eighty-five thousand six hundred and thirty (4,685,630) dollars and ninety-one (91) cents, and the juries awarded two million five hundred and twenty-eight thousand three hundred and thirteen (2,528,313) dollars and twenty-one (21) cents. This amount was considerably reduced by appeals taken by the City.

In the Bond and Contract room two thousand nine hun-

dred and forty (2,940) proposal bonds were prepared and filed, and fees to the amount of five thousand eight hundred and eighty (5,880) dollars were received; one hundred and twenty-two (122) other bonds and agreements were prepared and fees collected of six hundred and ten (610) dollars; nine hundred and ninety-two (992) contracts and bonds were prepared and fees received amounting to thirteen thousand eight hundred and ninety-eight (13,898) dollars; one hundred and four (104) judgments were satisfied on which attorneys fees amounting to three hundred and twelve (312) dollars were paid. From the various departments one thousand three hundred and fifty (1,350) communications were received.

The cases in which the City was either plaintiff or defendant were very numerous, and were conducted in the various Courts,—the Supreme Court, Superior Court, Circuit Court of the United States, the United States Court of Appeals, the United States Supreme Court, the Courts of Common Pleas and Quarter Sessions, and in the latter court, desertion cases to the number of two thousand and twenty-nine (2,029) were disposed of.

LIBERTY BELL.

On June 17th of last year—the anniversary of the Battle of Bunker Hill—there was a celebration in Boston commemorative of the battle, at which, under the direction of your Honorable Bodies, we took the old Liberty Bell from its resting place in Independence Hall. It was the first and only time that the Bell had been taken to Boston, and it seemed so very appropriate that the two cities who had fought shoulder to shoulder, and who had gone through such desperate struggles together a hundred and twenty-eight years ago should again be brought closer together by

taking there from the City of Philadelphia, at the request of the City of Boston, the old Liberty Bell that had heralded the events of the great revolutionary struggle. I am very glad to say that the Bell was safely restored to its resting place in Independence Hall on the twentieth of June.

For the past several months I have been receiving protests from patriotic societies and individuals protesting against ever again removing the Bell from Independence Hall, and I shall have the honor of transmitting to you in the course of a few days all these papers and others bearing upon the subject of the removal of the Bell.

I send herewith the annual reports of the Directors of Public Safety, Public Works, Public Health and Charities, and Supplies, being the four departments immediately under my supervision and direction.

I also send herewith the annual reports of the Receiver of Taxes, City Treasurer, City Controller, City Solicitor, Board of Public Education, Sinking Fund Commissioners and the Board of Revision of Taxes.

May I ask that your Honorable Bodies will unite with the officers of the administration in doing all that is possible during the coming year for the promotion of the best interests of our City.

Yours truly,

JOHN WEAVER,

Mayor.

ANNUAL REPORT

OF THE

DEPARTMENT OF PUBLIC WORKS

FOR THE

YEAR ENDING DECEMBER 31, 1903

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OFFICERS

OF THE

DEPARTMENT OF PUBLIC WORKS

Director:
PETER E. COSTELLO.

Assistant Director:
WILLIAM H. BAKER.

CHIEF CLERK—WILLIS SHEBLE.
CLERK—ERNEST T. HANEFELD.
ASSISTANT CLERK—ANDREW L. TEAMER.
STENOGRAPHER AND CLERK—HARRY A. STOY.
STENOGRAPHER AND TYPEWRITER—ROSCOE C. LOCKWOOD.
GENERAL INSPECTOR—ROBERT C. HICKS.
OFFICIAL PHOTOGRAPHER—LEWIS R. SNOW.
MESSENGER—J. J. JOHNSON.

Chiefs of Bureaus:

SURVEYS—GEORGE S. WEBSTER.
HIGHWAYS—WILLIAM H. BROOKS.
FILTRATION—JOHN W. HILL.
WATER—FRANK L. HAND.
STREET CLEANING—SAMUEL SUTCLIFFE.
GAS—DR. N. WILEY THOMAS.
LIGHTING—JOHN J. KIRK.
CITY ICE BOATS—JAMES S. JEFFERSON.

SEVENTEENTH ANNUAL REPORT

OF THE

DEPARTMENT OF PUBLIC WORKS

PETER E. COSTELLO, Director

Philadelphia, January 2, 1904.

HON. JOHN WEAVER,
Mayor of Philadelphia.

DEAR SIR:—In compliance with the Act of Assembly creating the Department of Public Works, I have the honor to submit the report of the operations of this Department for the year ending December 31, 1903—The Seventeenth Annual Report of the Department.

This report will not enter into details unnecessarily, as they may be found in the comprehensive reports of the Chiefs of the several Bureaus herewith transmitted and which will interest those desirous of familiarizing themselves with the work of this Department.

The expenditures during the past year for maintenance were $3,975,289.19, and for permanent improvements and extensions, $9,240,653.56, making the total expenditures for the year $13,215,942.75. Of the amount expended for extensions and improvements the sum of $7,493,895.63 was derived from loans authorized in previous years and not appropriated from direct taxation. The receipts amounted to $3,929,266.57, which was $169,961.95 greater than the previous year.

Upon assuming the office of Director of the Department of Public Works, I found that bills for a large sum of money had been contracted, with no provision made for their payment. I deemed it advisable to ask for an additional appropriation to pay these bills, and Councils now have before them an ordinance to appropriate the sum of $638,432.18 to this Department to pay deficiency bills of 1903. These bills were due in a measure first, to insufficient appropriations, and second, to the fact that we were compelled to pay bills for coal furnished to the Bureau of Water during 1902 out of the appropriation for 1903, without an additional appropriation having been made to the item for the purchase of coal.

City Ice Boats.

The total expenditures of the City Ice Boats for the year 1903, were $41,662.26, which was divided as follows: For current expenses, $22,662.26, and $19,000 for extensions.

The receipts for the year amounted to $810, which was for towage and the sale of old material.

The winter of 1902-03 was one of ordinary severity, and the City Ice Boats were not called upon to open a channel in the Delaware river until January 13, 1903, when Boat No. 2 was placed in active commission, followed two days later by Boat No. 1. These boats were actively engaged until January 31, 1903, in keeping the channel free of ice.

Contract was awarded during the summer to the Neafie & Levy Ship and Engine Building Company for installing new boilers and rebuilding Boat No. 2. This work is now in progress, and will be completed in a few days. The work, when finished, will materially strengthen the Department, during ice times, in keeping the river open to navigation and bring to our aid practically a new boat.

Boats Nos. 1 and 3 were put in excellent condition during the summer of 1903 for the rough work of combatting the ice during the winter season. They were thoroughly overhauled and necessary repairs given attention.

From present indications, the winter of 1903-4 will be of unusual severity. Boats Nos. 1 and 3 were placed in commission on December 30, 1903, and proceeded down the river to cut out the ice at the Horseshoe, which was seriously impeding navigation, and to open the river to incoming and outgoing vessels.

At the time of writing this report they are busily engaged in the work of keeping an open channel to the sea.

In his report, the Superintendent of the City Ice Boats urges the building of a new ice boat at an approximate cost of from $250,000 to $300,000. This boat should be equipped with modern appliances and be able to navigate the harbor during the severest winter weather.

The following tables give a summary of the receipts and expenditures of the City Ice Boats for the year 1903:

	1903.
Amount received for sale of old material	$810 00
Total paid to City Treasurer	$810 00

	1903.
Total amount of warrants drawn	$41,662 26
Deduct cash paid City Treasurer	810 00
Total	$40,852 26

Bureau of Gas.

The amount appropriated for the use of the Bureau of Gas, $10,000, was expended during the year.

When the Philadelphia Gas Works were leased to The United Gas Improvement Company, there was a provision contained in the lease that said company was to pay into the City Treasury the sum of $10,000 annually for the salaries and expenses of the re-organized Bureau of Gas. The money is then appropriated by Councils for the benefit of said Bureau.

The main duties of the Bureau are to see that the quality of gas and its illuminating value are maintained, and to make tests of such meters as consumers consider are registering fast.

The following table gives the monthly average candle power of the gas furnished to the citizens of the City of Philadelphia:

	Candle Power.
January	23.07
February	22.94
March	22.99
April	22.99
May	22.88
June	23.21
July	23.00
August	22.89
September	22.97
October	23.05
November	22.90
December	23.15
Maximum monthly average	23.21
Minimum monthly average	22.88

The chemical composition of the gas is indicated by the following results:

Nitrogen	4.80 per cent.
Carbon di-oxide	2.50 per cent.
Illuminants	11.50 per cent.

Oxygen	0.75 per cent.
Hydrogen	32.60 per cent.
Carbon mon-oxide	21.65 per cent.
Methane	26.20 per cent.

During the year eighty-one meters were inspected, of which sixty-eight proved fast and thirteen registered slow.

When application is made for the examination of meter, the provision of the lease requires that a deposit of one (1) dollar be made with the Bureau of Gas, before test is made. Should the meter register fast, the deposit is returned to the consumer and correction made in bill. Should the meter prove slow or correct, the deposit of one (1) dollar is turned into the City Treasury.

The Chief Inspector of Meters reports that the requirements of the contract between the City and the United Gas Improvement Company relative to the candle power of gas have been complied with and the standard fully maintained, and that prompt attention has been given in all cases where meter inspection has been made.

Bureau of Highways.

The expenditures of the Bureau of Highways for the year were $2,234,462.89, of which $647,082.61 were for current expenses and $1,587,380.28 for extensions. The receipts for the same period were $179,188.49, which exceeded those of the previous year by $5,571.30.

At the close of the year 1903 many marked improvements had been made by the Bureau of Highways.

There were opened and graded 25 miles of streets, which aggregated 1,097,522 cubic yards. There were 17.50 miles of new streets paved, the materials used being sheet asphalt, granite block and vitrified block upon a cement concrete foundation. The cost of this improvement approximated $850,000.

Owing to the meagre sum available for repaving, the

amount of work done during the past year was only 4.88 miles.

At the close of the year 1903, the unpaved and macadamized roads in the City were in excellent condition, due to the thorough manner in which they were cared for throughout the year.

The City acquired, during the year, the Bustleton and Somerton turnpike. Owing to the poor condition in which it was found by the Bureau of Highways, it was resurfaced for its entire length—about nine miles—and is now in excellent condition. The Bensalem pike was also secured by the City and placed in fair condition, the work being halted because of the lack of funds.

There were resurfaced with broken stone 25.15 miles of macadam roads, making them practically new roads. Dirt roads to the extent of 26.87 miles were macadamized and large stretches of new roads built.

During the year the paved streets of the City were kept in good repair. The work was done for a lump sum ($145,600), and included all character of pavements excepting sheet asphalt and granolithic, which were repaired under separate contracts.

Very little resurfacing with sheet asphalt was done, owing to the lack of appropriation. From the unexpended balance remaining to the credit of the item from 1902, we resurfaced 10,672 square yards on streets which had disintegrated and were dangerous.

The work of cleaning and repairing sewers, manholes and inlets, was done in a satisfactory manner. There were a number of serious breaks in sewers, all of which were promptly repaired by the contractors of the Bureau of Highways, with the least possible inconvenience to the public.

There are 330 bridges in the City under the care of the Bureau of Highways, of an estimated value of $20,-

500,000. There are a number of them in a very precarious condition. Several important structures are in danger of collapsing and others have been closed to travel. In the report of the Superintendent of Bridges will be found a statement in detail, giving the amounts required to place the various bridges in good condition, which aggregates $204,150. Permanent repairs and renewals cannot be made until Councils provide funds with greater freedom than heretofore, as the appropriations for the past few years have been totally inadequate and, in this connection I desire to add that the appropriation for 1904 will soon be exhausted.

Work done by the passenger railway companies has been capably performed under the supervision of the officials of the Bureau of Highways.

A detailed account of the work done during the past year by the Bureau, will be found in the report of the Chief, hereto appended.

The following statement is a classification of the street pavements laid during the year and their mileage; also total mileage of the various street pavements to December 31, 1903:

Kinds of Pavements	Laid During 1903.		Making Total in City, Dec. 31, 1903.	
	Sq. Yards	Miles.	Sq. Yards.	Miles.
Sheet asphalt	257,041	16.05	5,166,463	337.69
Asphalt block			180,702	19.30
Granite block	62,797	3.02	6,169,984	367.80
Cobble or rubble			2,049,183	73.12
Vitrified brick	38,858	3.11	2,230,789	141.73
Granolithic			72,726	12.77
Slag block			71,280	9.82
Macadam	269,197	26.87	2,722,976	262.66
Total	627,893	49.05	18,673,103	1,224.89

In addition to the paved and macadam streets, there are 437 miles of unpaved streets or dirt roads.

The following tables give a summary of work done during 1903 and of the receipts and expenditures of the Bureau of Highways for the same period:

Statement of Work Done.

	1903.	
New paving	117,009	Linear feet,
Macadamizing (new)	141,888	Linear feet.
Grading	1,097,522	Cubic yards.
New footway paving	57,433	Square yards.
Repairs to paved streets	891,064	Square yards
Footways repaved	18,491	Square yards.
Ditches repaved	50,329	Square yards
Gutter stone laid	4,930	Linear feet.
Crossing stone laid	8,394	Linear feet.
Curbstone reset	106,244	Linear feet.
Wooden trunks	12,467	Linear feet.
Brick and stone drains	1,981	Linear feet.
Hand railings	4,900	Linear feet.
Curved curb corners	10,247	Linear feet.
New curbstone set	175,921	Linear feet.
Vitrified brick and stone gutters	5,670	Linear feet.
Resurfacing sheet asphalt	10,672	Square yards.
Resurfacing broken stone	132,869	Linear feet.
Footway, curb and railroad notices served	25,732	

Summary of Work Done in Improved Pavements.—New Streets, 1903.

	Square yards.	Linear feet.
Granite blocks	19,594	4,725
Sheet asphalt	228,930	74,453
Vitrified bricks	34,047	13,196
Macadamizing	269,197	141,888
Total	551,768	*234,262

Replacing Cobblestones with Improved Pavements.—Old Streets, 1903.

	Square yards.	Linear feet.
Granite blocks	43,203	11,198
Sheet asphalt	28,111	10,291
Vitrified bricks	4,811	3,236
Total	76,125	*24,725

*1903. Total amount of new paving 258,987 linear feet, equal to 49 miles 267 linear feet.

In addition to the work done by the City in the paving and repaving of streets with improved pavement, the following statement shows in detail the amount of work done by the passenger railway companies during the year 1903:

	Linear feet
Resurfacing sheet asphalt	7,200
Granite Block Repaving between tracks	52,001
Total	59,201

Equal to 11 miles, 1,121 linear feet, at an estimated cost of $150,000.

Receipts and Expenditures.

The receipts of the Bureau of Highways during the past year were $179,188.49, an increase of $5,571.30 over the previous year.

Statement of Expenditures.

	1903.
Current expenses	$647,082 61
For extensions	1,587,380 28
Total	$2,234,462 89

Board of Highway Supervisors.

The total amount of money earned by the draughtsmen of the Board of Highway Supervisors during the past year was $24,098.56, and the expenses for the same time were $11,369.83, the excess of receipts over expenditures being $12,728.73.

During the year eighty-five plans of substructures have been added to the records of the Board, making a total of three hundred and seven miles of finished plans on file.

These plans are of inestimable value to the City Departments and the several companies maintaining underground structures. The engineers of the Market Street Subway have found them especially valuable in locating the underground structures on its route.

The records of this Board are the most complete of their kind of any City in the country, and the recommendation of the Chief Draughtsman for an increase in the number of draughtsmen has my approval, and I would respectfully suggest that the matter be brought to the attention of Councils, as the present force is totally inadequate to record and plot the underground structures sufficiently fast to keep pace with their accumulation.

The total number of permits authorized to be issued by the Board during the year 1903, to the companies maintaining underground structures, was one thousand and eight.

The following is a summary of the transactions of the Board of Highway Supervisors and of the work of the draughting department, also receipts and expenditures for the year 1903:

Transactions of the Board of Highway Supervisors.

For vaults	8
For railroad tracks, curves, and turnouts	149
For underground pipes	559
For electrical conduits	458
For erecting bridges	7
For tunnels	1
For drinking fountain	2
For subway	1
For connection to sewers	1

Work done by the Draughtsmen of the Board of Highway Supervisors.

New street record plans prepared	85
Blue print plans placed on file	402

Receipts and Expenditures.

Receipts	$24,098 56
Expenditures	11,369 83
Excess of receipts	$12,728 73

Recapitulation.

Amount of earnings	$18,382 98
Amount outstanding from previous years	19,372 97
	$37,755 95
Amount received and deposited with City Treasurer	24,098 56
Amount outstanding	$13,657 39

Bureau of Lighting.

The expenditures of the Bureau of Lighting for the past year were $328,922.44.

The lighting of the City with gas and gasoline lamps is under the care of this Bureau, electric lighting being under the supervision of the Electrical Bureau, which is connected with the Department of Public Safety.

The total number of lamps lighted and under the care of the Bureau of Lighting on December 31, 1903, was 34,129, divided as follows:

Gas lamps maintained by The United Gas Improvement Company	21,021
Gasoline lamps furnished by Pennsylvania Globe Gas Light Company	13,034
Gas lamps supplied by the Northern Liberties Gas Company	74

In addition to the above there were 123 gas lamps maintained by the Department of Charities and Correction.

Since the lease of the Philadelphia Gas Works to The United Gas Improvement Company, this Bureau has had a general supervision of the work to be performed by said company, in so far as relates to the erection, discontinuance and relocation of gas lamps. The work done by the United Gas Improvement Company, which bears any relation to this Bureau, has been performed satisfactorily. The lamps have received careful attention and very few complaints have been noted.

During the year there were added 1,054 gas lamps, of which 302 were new gas lamps and 752 were relocations, the latter having been discontinued at other locations because of their proximity to electric lights.

Under the terms of the lease of the gas works, The United Gas Improvement Company is required to erect annually 300 additional new gas lamps. This number is woefully insufficient and were it not for the fact that the erection of new electric lights makes it possible to discontinue a large number of gas lamps, the Department would be absolutely unable to satisfy the demands made on

it for the erection of gas lamps on streets to be paved and newly built upon by operative builders.

During the year we discontinued because of their nearness to electric lights, 597 gas lamps, which were relocated in various locations and enabled the Department to satisfy the pressing demands made upon it.

On November 25, 1903, bids were opened for the furnishing and lighting of naphtha lamps for the year 1904. The only bid received was that from the Pennsylvania Globe Gas Light Company, the contractors for the year 1904, and was as follows:

For naphtha lamps of 20 candle power, guaranteed, per lamp per year	**$21 00**
For lamps of 60 candle power, guaranteed, per lamp per year	**29 50**

The contract was awarded to said company for the year 1904.

During the past year there were discontinued 482 gasoline lamps due to the erection of gas lamps and electric lights, all of which were relocated, as well as two that were left over from the previous year. By resolution of Councils, 503 gasoline lamps were located, all of which were erected with the exception of five that could not be placed in position for various causes.

On December 31, 1903, there were in service 7,352 plate burner gasoline lamps and 5,682 Welsbach gasoline lamps.

The plate burner lamps are erected in alleys, while the Welsbach gasoline lamps are located in streets where there are no gas mains.

The work performed by the Pennsylvania Globe Gas Light Company has been satisfactory, all lamps having been kept in good order and lighted regularly.

The following statement shows the number of gas and

gasoline lamps, also the expenditures of the Bureau of Lighting during the year 1903:

	Number of Lamps.	Cost during the year.
Gas lamps maintained by the United Gas Improvement Company	21,142	
Gasoline lamps	13,034	$315,650 35
Gas lamps supplied by the Northern Liberties Gas Company	74	1,509 96
Gas lamps maintained by the Bureau of Correction	231	
Salaries and office expenses		11,762 13
Total	34,481	$328,922 44

Of the gas lamps maintained by the United Gas Improvement Company during 1903, there were not lighted because of their proximity to electric lights	121
Of the gas lamps maintained by the Department of Charities and Correction during 1903, there were not lighted because of their proximity to electric lights	108
	229

Bureau of Street Cleaning.

The work of this Bureau during the year 1903 has been performed in a satisfactory manner.

On April 24, 1903, Mr. Sylvester H. Martin resigned his position as Chief of Bureau of Street Cleaning, and on April 27, 1903, Mr. Samuel Sutcliffe was appointed to the place. Under the vigorous policy pursued by Mr. Sutcliffe, Philadelphia, to-day, has cleaner streets than ever before in her history.

During the year $666,233.45 were expended for the cleaning of streets, inlets and alleys, removal of ashes, etc., and for the collection and disposal of garbage $516,340, a total of $1,182,573.45. Of this sum, the amount of $40,640.50 reverted back to the City Treasury, being penalties inflicted upon the contractors of the City for violation of their contracts.

There were cleaned during the year 230,239.45 miles of streets, 1,083,759 sewer inlets, and 158,074 private

alleys, from which were removed 218,928 cart loads of dirt. There were removed from buildings 630,593 cart loads of ashes and 27,949 cart loads of dry waste.

There were also removed and disposed of 301,643 cart loads of kitchen garbage and 17,513 dead animals.

From the footways of the bridges crossing the Schuylkill river, there were removed 1,472 single cart loads and 790 double cart loads of snow, and from the streets surrounding the City Hall 1,070 single cart loads and 589 double cart loads, at a cost of $2,445.47.

When it is considered that in the entire City are 308,230 buildings, 962.23 miles of streets and 20,688 inlets, a faint idea of the stupendous amount of work required to be done by the contractors for the collection and disposal of garbage, cleaning streets, etc., can be obtained.

The removal of snow from the streets in the heart of the City is a difficult problem, due primarily to a lack of sufficient funds with which to carry on the work. By experiments successfully conducted and on a large enough scale to prove its worth, it has been demonstrated that snow can be removed from the streets immediately after the fall of snow, at a much less cost than by the price per load now paid.

An interesting item is presented in the report of the Chief of the Bureau, wherein he recites that while the cost per running mile for cleaning streets, alleys and inlets and removal of ashes and household waste in 1902 was $3.74, in 1903 it was but $2.83 per running mile, the reduction being pricipally due to the largely increased amount of work performed.

On December 16, 1903, bids were received for cleaning streets, alleys, etc., for the year 1904, and the collection and disposal of garbage. The former work was under new specifications, which required much additional work upon the part of the contractor and necessitated the perform-

ance of nearly twice as much cleaning as heretofore. Under these specifications, much night work was to have been done in all the districts, in addition to the regular day cleaning. These bids, however, were all rejected, with the exception of that of the American Product Company for the removal of garbage, etc., and new proposals were asked for under the specifications for 1903. These proposals were opened on December 30, 1903, and contracts amounting to $976,100 were awarded to the lowest bidders. For the removal and disposal of garbage and dead animals, contract was awarded to the American Product Company for $536,700.

The Chief of Bureau of Street Cleaning, in his report, recommends that an increased amount of cleaning be done in the Third, Fourth and Fifth Districts and should be embodied in our specifications for next year. This has my earnest endorsement.

Recommendation is also made for the removal of household waste and rubbish separate and distinct from the ashes and garbage, it being the conviction of the Chief that it would ultimately result in a source of revenue to the City instead of expense, as is the case with our present specifications.

The following is a statement in detail of the operations of the Bureau of Street Cleaning during the year 1903:

Total Work During the Year 1903.

DISTRICTS.	CLEANED.						REMOVED.					Number of Complaints of all Kinds.
	Squares.	Alleys.	Inlets	Crossings.	Market Houses.	Snow from Fire Plugs.	Number of Dead Animals.	NUMBER OF LOADS.				
								Dirt.	Ashes	Dry Waste.	Garbage.	
First	468,992	26,519	190,211	51,216	624	804	3,098	45,265	111,185	5,540	46,141	665
Second	367,441	26,226	196,590	56,100	1,217	922	3,391	48,323	108,789	6,555	48,531	1,263
Third	306,558	17,810	88,311	36,553	303	1,372	3,646	13,056	65,616	3,782	69,326	690
Fourth	701,362	46,971	423,065	42,127	.....	1,031	3,729	79,172	194,338	5,604	75,156	781
Fifth	433,985	40,548	157,548	29,184	.....	840	3,649	22,065	150,665	6,468	62,489	698
Sixth	24,060	.....	28,034	4,462	.....	1,131	.....	11,047	.....	.....	.....	72
Total, 1903	2,302,398	158,074	1,083,759	219,642	2,144	6,100	17,513	218,928	630,593	27,949	301,643	4,169

Bureau of Surveys.

During the year 1903, the total expenditures of the Bureau of Surveys were $1,835,704.88, of which $275,701.08 were current expenses and $1,560,003.80 were for extensions. The receipts of the Bureau were $130,402.55, which were $4,306.64 greater than the previous year.

The proceedings of the commission appointed in 1902 under authority of Act of Assembly of June 14, 1897, to fix the location of the line dividing Philadelphia and Delaware Counties in the vicinities of Cobb's creek at Market street, west of Sixty-third street, as well as other portions of said dividing lines, are progressing satisfactorily.

The following amounts were appropriated for the construction of main sewers during the year 1903:

Main sewers (annual appropriation)	$100,000 00
McKean street relief system	25,000 00
Cohocksink Relief	100,000 00
Sewer in Market street	100,000 00
Sewer in Shunk street	40,869 83
Extension of Cresheim Creek Intercepting System	27,000 00
Main sewers (Ordinance December 11, 1903)	46,000 00
	$438,869 83

With the exception of the Market street sewer all of the main sewers for which appropriations named above were made, have been placed under contract. The Orthodox street sewer has been completed and the others are in a fair way of early completion.

Until the Philadelphia Rapid Transit Company is in a position to submit complete details of its proposed subway in Market street, east of Broad street, the work of constructing the Market street sewer is temporarily held in abeyance.

The Intercepting System of sewers along the Schuylkill water shed was much improved during the past year by the extension of certain sewers. This system should be

constantly extended in order that the Schuylkill river may be kept free from pollution and to meet requirements for additional drainage in developing sections.

Liberal appropriations should be made to the Bureau of Health to compel property owners to make correct connections with the Intercepting Sewer.

The Wingohocking creek system contains the largest area in the City to be drained by a sewer and work has been carried on for a number of years at such places as the development of the land demanded.

Attention is called to the construction of sewer that is tributary to the Wingohocking creek, extending along Luzerne street, with terminus east of Second street, in order to properly drain the property recently acquired by the City for Municipal Hospital site.

Drainage of First, Twenty-sixth, Thirty-sixth and Thirty-ninth Wards.—Work on the McKean street relief sewer commenced in 1902, was continued and completed to Ninth street. A new contract for a further extension of this sewer was entered into and this enabled the City to carry on the work to great advantage and without interruption. Additional funds, however, should be provided to extend this relief sewer to its objective terminus.

Work was also continued on the extension of the Shunk street system, contracted for and commenced during 1902, and is now nearing completion.

The sewer in Jackson street, from Schuylkill river eastwardly, contracted for in 1902, was commenced and completed as far as the limited appropriation would permit.

Frankford Intercepting System.—The work was commenced on the contract for sewer in Wakeling street, from Frankford creek northwestwardly, in 1902, and fair progress has been made, promising an early completion as far as the available funds will permit. This sewer is remarkable in that it is the largest concrete sewer in the City.

Contract was also made and work carried to completion on the main sewer extension in Pratt street, from Frankford avenue northwestwardly. This sewer enabled the development of a large tract of land upon which the Philadelphia Rapid Transit Company has erected large car barns.

Aramingo System.—The only new work in the Aramingo system consisted in the extension of sewer in York street, from Tulip to Emerald street, and from American to Fifth street, and on Fifth street, from York to Cumberland street. This completes the York street relief system. Since its completion the effectiveness of this improvement has been several times severely tested by extraordinary rainfalls and found entirely adequate. Formerly, during times of heavy rainfall, streets were flooded and water backed into cellars, entailing large losses to properties.

Cohocksink System.—Two breaks occurred in the old Cohocksink sewer—one on Dauphin street, east of Broad street, and the other on Montgomery avenue, east of Eighth street. Both breaks were repaired in a substantial manner.

The systematic reconstruction of the old Cohocksink sewer was continued under the annual contract for repairs, reconstruction and improvement of old sewers. There are still some sections of this sewer which were found, upon examination, to be in dangerous condition. These should be rebuilt at the earliest opportunity to prevent accidents and damage to property.

Cohocksink Relief Sewer.—The construction of this system was undertaken to relieve the old sewer, which, traversing a closely built up area paved with impermeable pavements, was largely overtaxed and overflowed after every heavy rainfall, resulting in frequent breaks and much damage to property.

Rapid progress has been made in the work of construc-

tion, and before the heavy rains of the coming summer are upon us, it is probable the sewer will be in operation. The total amount appropriated for this work was $460,000.

This system presents some novel features, chief among which is the method of automatically securing a separation of sewage and storm water, to avoid pollution of the Shackamaxon street ferry slip; the four chambers at the intersection of Mascher and Thompson streets also gave rise to some interesting engineering problems.

The construction of the Market Street Subway of the Philadelphia Rapid Transit Company, immediately east of the Schuylkill river, early in the year 1903, involved the relocation and reconstruction of a number of old sewers on Market street and intersecting streets, between Fifteenth street and the Schuylkill river. This work has been done without any expenditure upon the part of the City for construction or inspection.

In the detailed report of the Chief Engineer of the Bureau of Surveys will be found a very interesting and valuable history of the development of the present drainage system of the City.

The following main sewers are urgently needed and appropriation for their construction should be made as early as possible:

Extension of Sixty-third and Market streets to Cobb's Creek.
Extension of Shunk street system, on Porter street, to Broad street.
Extension of Ogontz street, North of Olney avenue.
Extension of Frankford Intercepting System (Wakeling street and Torresdale avenue).
Extension of Courtland street to North Penna. R. R.
Extension of McKean street relief sewer.
Extension of Jackson street, east of Twenty-ninth street.
Extension of Wissahickon High Level Sewer to Rex avenue.
Reconstruction of Front and Girard avenue sewer.
Wissahickon High Level Cut-off.
Indiana avenue relief to Broad and Allegheny avenue.

Rock Run System, on Ashdale street, west of Philadelphia and Newtown R. R.

Reconstruction of Christian street, from Taney to Twenty-first street.

Branch Sewers and Inlets.—During the year just closed there were constructed 15.64 miles of branch sewers at a total cost of $339,755.01. For the reconstruction of inlets the sum of $5,000 was appropriated and placed under contract. Contracts were also entered into for the construction of new inlets, curved curbing, etc., to the amount of $15,000.

Most of this work was done preparatory to the paving and repaving of streets. A detailed statement of the work performed will be found in the report of the Chief Engineer of the Bureau.

The total length of all sewers built and inspected during the year 1903 was 27.924 miles, divided as follows:

Main sewers	8.225	miles.
Branch sewers	15.642	"
Sewers built at private expense	4.057	"

at a total cost of $1,368,620.89.

The total length of sewers constructed to January 1, 1904, is as follows:

Main sewers	160.407	miles.
Branch sewers	818.576	"
	978.983	

Northeast Boulevard.—Ordinance of Councils approved December 24, 1902, authorized the Board of Surveyors to place on the City plan an avenue 300 feet wide, commencing at Broad and Cayuga streets, and extending in a northeasterly direction, to Torresdale, on the Delaware river, a distance of about 10½ miles. Provision was made for a connection with Fairmount Park by way of Hunting Park avenue, and with Germantown by way of Belfield

avenue. The ordinance also authorized the revision of lines and grades on streets along and adjacent to the route of the proposed avenue.

When this Boulevard is completed it will open up for improvement a territory including approximately one-third of the area of the City, a large part of which at the present time has no direct or convenient method of transit to the centre of the City.

Six lines of steam railroads will be crossed, either by overhead or undergrade bridges. Viaducts will be required to cross the valleys of the Tacony and Pennypack creeks. It is proposed that the valleys of both these streams shall be acquired by the City for Park purposes, in which event the proposed avenue will afford convenient means of access to them from all parts of the City.

Work was commenced on the plans of the avenue immediately upon the approval of the ordinance, and has been steadily carried on during the year. The revision carried on in connection with this work involves some radical changes in the former projected street systems, the widening of many streets and the laying out of wide avenues connecting Torresdale, Bustleton, Fox Chase, Holmesburg, Tacony, Wissinoming, Frankford and Lawndale with the 300 feet wide avenue.

Parkway.—In 1891, Councils, by resolution, requested that preliminary plans and estimates of cost be prepared for a Boulevard from City Hall to Fairmount Park. Several studies were submitted to Councils, and the Park boulevard was placed upon the City plan June 12, 1893, under authority of ordinance approved April 12, 1892. In 1895 this Boulevard was stricken from the City plan, but the project to secure an appropriate entrance to Fairmount Park was not abandoned. After many plans had been prepared, an ordinance was passed by Councils and approved March 28, 1903, authorizing the placing of the

Parkway upon the City plan. The plans were given a public hearing on December 7 and are now ready for confirmation.

As projected, the Parkway extends in a direct line from City Hall to Fairmount Reservoir, a distance of approximately 1¼ miles. Upon the completion of the filtration system, it is proposed to abandon the reservoir and erect upon the site a Museum of Art.

The width of the Parkway from City Hall to Logan Square is 160 feet, with ample space provided at the City Hall end for an imposing entrance and plaza; from Logan Square to Twenty-second street, the width is 300 feet; at Twenty-second street the width is about 560 feet, gradually increasing to Twenty-fourth street, from which point to the Park, its northern boundary is Fairmount avenue, and its southern boundary Callowhill street.

The cross section from City Hall to Twenty-third street will be similar to that of the Avenue of the Champs Elysees; beyond Twenty-third street no surface development has yet been decided upon.

The plan includes and utilizes what was once the bed of a railroad, between Twenty-second and Twenty-fifth streets, improved as a boulevard under the work of abolishing grade crossings on Pennsylvania avenue, completed in 1900.

League Island Park.—With a view to raising the grade of League Island Park, a tract of 300 acres, immediately north of League Island Navy Yard, both east and west of Broad street, the present contract for dredging in the Schuylkill river provides that all dredged material shall be placed within the limits of League Island Park. Under the present contract about 800,000 cubic yards of material can be placed and as upwards of 900,000 cubic yards were placed there under a prior contract, the grade of the Park

will be raised so as to permit of future development, at a great saving to the City.

The widening of Broad street to the width of 160 feet, south of Johnson street, was done so as to provide a fitting approach to the Park.

In various parts of the City, wide avenues have been projected to connect smaller parks with each other or to furnish fitting connections from the more populous outlying districts to the new Boulevard.

Pennypack Park.—The Pennypack creek traverses the northeastern section of the City, through a country which, for picturesqueness, is second only to that along the banks of the Wissahickon creek. To preserve this territory in its original state and that the populous northeastern section of the City may be provided with park advantages, it is proposed to acquire about 1,000 acres along this creek, lay out drives and develop it in a similar manner to that portion of Fairmount Park along the Wissahickon creek.

Plans were prepared and visits made to the tract by the Board of Surveyors and a report has been submitted to Councils.

Railroad Projects.—During the year a number of railroad projects have been contemplated, mainly looking to the abolishment of existing grade crossings. In the report of the Chief Engineer of the Bureau of Surveys, will be found an explicit report, in detail, of the various projects under consideration.

Railroad Improvements.—During the year just closed, there were various improvements made by the railroad companies in order to handle their business expeditiously and economically and vast sums of money were expended on the work.

Among the improvements resulting from the work of the railroad companies, is the construction of a bridge by the Philadelphia and Reading Railway Company on the

line of Clarissa street, over its Richmond branch, which complies with the condition imposed by Councils when Pulaski avenue, below the Midvale Steel Works, was vacated.

Market Street Subway.—In connection with the work of constructing this subway, Councils by ordinance authorized the raising of the grade of Twenty-third street, between Chestnut and Filbert streets, and of Market street, between Twenty-second street and the Schuylkill river; also all streets affected by this change in order to permit of the construction of the subway under Twenty-third street and the widening of Market street.

To provide for the physical changes as provided by the plans prepared by the Bureau of Surveys, Councils made an appropriation of $80,000. Contract was awarded for the work and it is being carried on in connection with the other work upon the subway in that vicinity.

Testing Laboratory.—The demands upon the laboratory have been greater than in any other year, owing to the large amount of public work under way. The value of the material tested amounts to more than $1,000,000.

The actual value to the City by reason of securing high grade material in its public works, is represented by many times the cost of maintenance of the laboratory. It is of grave importance to the City in its influence, since the knowledge that all material must pass rigid tests, causes the manufacturers to use the utmost care to maintain standards.

The equipment of the laboratory during the past year has been materially increased by the introduction of new machinery.

Bridges.—There was available for the construction of bridges at the beginning of the past year, the sum of $343,301.99, and there was expended during the year the sum of $145,893.09; the sum of $5,000 was appropriated

to Item 34 to pay one-half the cost of constructing a foot-walk tunnel under the tracks of the Philadelphia and Reading Railway at Tioga station, the railroad company to pay a like amount.

The following is a list of bridges commenced in 1902 and all were completed during 1903, with the exception of the Passyunk avenue bridge over the Schuylkill river:

Frankford avenue and Old Front street over Frankford creek.
Lehigh avenue under Connecting Railway.
Dauphin street under Connecting Railway.
Fifty-second street over West Chester and Philadelphia R. R.
Passyunk avenue over Schuylkill river.

The contracts entered into during the past year for bridges are as follows:

Stokley street over Richmond Branch, P. & R. R. W.
Seventeenth street and Indiana avenue, over Philadelphia, Germantown and Norristown R. R.
Tioga tunnel (one-half cost to be paid by P. & R. R. W. Co.).
Frankford avenue and Poquessing creek (one-half cost to be paid by Bucks County).

Satisfactory work has been progressing on all the above bridges during the year.

During the year an extension was made to the west end of Spring Garden street bridge, by the Pennsylvania Railroad Company, which had been authorized by ordinance of Councils approved December 24, 1902. The cost of this work was borne by the railroad company.

A footbridge over Pennsylvania avenue and subway at Twenty-seventh and Aspen streets was constructed by Burnham, Williams & Company, authorized by ordinance of Councils approved May 20, 1903.

Plans were advertised for Allegheny avenue bridge under the Connecting Railway and proposals received July 30, but contract has not been awarded. The Pennsylvania

Railroad Company is to contribute at least $20,000 towards the construction of this bridge.

Passyunk Avenue Bridge over Schuylkill River.—This bridge, which was authorized by ordinance of December 12, 1900, is intended to connect sections on both sides of the Schuylkill river, which must, at the present time, depend upon circuitous route for communication.

Contract for the western approach, abutments and four piers of the viaduct approach, has been awarded and the work is now in progress.

The Chief Engineer in his report, calls attention to the necessity of constructing a number of bridges which would assist materially in the development of large and promising territories.

Widening Delaware Avenue.—In the matter of the continuation of the work of widening Delaware avenue, between Vine and Green streets, after negotiations with the owners of property to fix the amount of damages had been brought to a satisfactory conclusion, the result of these negotiations were messaged to Councils by the Mayor on April 14, 1902. No action has yet been taken to provide an appropriation and the accomplishment of the work is therefore delayed.

Improvement of Channel of Schuylkill River.—The formation of a 30-foot channel in the Delaware river having been undertaken and put under contract by the Federal authorities, rendered it unnecessary for the City to make provision for said river and the entire sum appropriated by Councils on June 27, 1902, for the improvement of the channels of the Delaware and Schuylkill rivers of $400,000 was diverted for the purpose of bettering the conditions of the Schuylkill river, northward from Penrose Ferry bridge. Plans and specifications for the work were drawn up and bids received and contract awarded to the lowest bidder, the American Dredging Company.

District Surveyors.—The Board of Surveyors held twenty-three regular sessions and twelve special sessions. On five of the stated meetings, road days were held, at which time opportunity was given to property owners to voice their opinions upon proposed plans or changes in plans. On road days, hearings were given on 160 plans, fifteen of these being sectional plans of the Northeast or Torresdale Boulevard and three of the Parkway, from City Hall to Fairmount Park.

The Board finally confirmed 113 plans and rejected four. It has also considered numerous plans for improvements to street passenger railways during the year.

Work amounting to $150,593.33 was performed for the various Departments and Bureaus of the City, the combined cash receipts and credits being $67,993.84 more than the expenses of the entire Survey Districts.

The following is a summary of the receipts and expenses of the District Surveyors for the year 1903:

Summary of Receipts and Expenses of District Surveyors.

Districts.	Surveyors.	Cash Receipts.	Credit for work done for the City.	Total Credit.	EXPENSES.				Balance profit to the City.	Profit to the city in 1902.	Increase.	Decrease.
					Salaries.	Pay of assistants.	Miscellaneous.	Total.				
1	John M. Nobre.....	$7,783 82	$6,011 66	$13,795 48	$3,000 00	$7,286 00	$1,914 34	$12,200 34	$1,595 14	$3,267 47	.....	$1,672 33
2	Chas. W. Close.....	4,124 85	7,300 72	11,425 07	3,000 00	5,620 00	1,564 36	10,184 36	1,240 71	813 14	$427 57	
3	W. C. Cranmer.....	6,324 81	8,910 59	15,235 40	3,000 00	7,437 49	1,440 73	11,878 22	3,357 18	2,881 25	475 93	
4	F Bloch.....	2,318 58	8,149 17	10,467 75	3,000 00	4,607 00	1,294 52	8,901 52	1,566 23	907 04	659 19	
5	Walter Brinton.....	14,451 27	11,409 72	25,860 99	3,000 00	10,268 59	2,058 06	15,326 65	10,534 34	3,760 98	6,773 36	
6	Joseph Mercer.....	10,642 92	18,746 04	29,388 96	3,000 00	9,427 74	2,556 30	14,984 04	14,404 92	14 820 21	.....	415 29
7	W. K. Carlile.....	1,872 92	7,192 84	9,065 76	3,000 00	4,255 96	1,484 44	8,740 40	325 36	721 79	.....	396 43
8	C. A. Sundstrom....	2,509 44	13,819 03	16,328 47	3,000 00	10,406 20	2,685 24	16,091 53	236 94	637 27	.....	400 33
9	Joseph C. Wagner..	6,787 52	11,104 54	17,892 06	3,000 00	11,274 96	1,798 84	16,073 80	1,818 26	3,360 75	.....	1,542 49
10	John H. Webster, Jr.	6,896 98	12,284 63	19,181 61	3,000 00	3,074 25	1,945 06	13,019 31	6,162 30	3,327 41	2,834 89	
11	Joseph Johnson....	14,037 20	9,410 70	23,447 99	3,000 00	10,231 34	2,705 80	15,937 14	7,510 85	10,056 55	.....	2,545 70
12	J. H. Gillingham....	11,867 17	11,866 92	23,734 09	3,000 00	7,746 33	2,087 17	12,833 50	10,900 59	9,035 73	1,864 86	
13	H. M. Fuller.....	7,491 75	9,074 74	16,566 49	3,000 00	9,916 00	2,094 30	15,010 30	1,556 19	2,612 79	.....	1,056 60
14	C. B. Webster.....	5,287 79	15,312 03	20,599 82	3,000 00	8,444 45	2,370 54	13,814 99	6,784 83	2,320 15	4,464 68	
	Total.....	$102,396 61	$150,593 33	$252,989 94	$42,000 00	$114,996 40	$27,999 70	$184,996 10	$67,993 84	$58,522 53	$17,500 48	$8,029 17

The following tables give a summary of the operations of the Bureau of Surveys in the actual construction of work and the receipts and expenditures during the year 1903:

Summary of Main, Branch and Private Sewers built during the year 1903.

	1903.	
	No.	Linear feet.
Intercepting sewer connections	3	12,497,48
Main sewers	29	30,933.93
Branch sewers	103	82,588.89
Private sewers	58	21,421.00
Total	193	*147,441.30

* Equal to 27.92 miles.

Statement of Work upon Bridges during year 1903.

	1903.
Finished	6
Begun	5
Authorized	3
Planned	5

Statement of Receipts.

Year.	Receipts of Bureau.	Receipts of District Surveyors.	Total.
1903	$28,005 94	$102,396 61	$130,402 55

Statement of Expenditures.

	1903.
Current expenses	$275,701 08
For extensions	1,560,003 80
Total	$1,835,704 88

Registry Division.

The following is a summary of the operations of the Registry Division of the Bureau of Surveys during the year 1903:

	1903.
Number of certificates of registered owners issued	4,223
Number issued for use of Law Department	547
Receipts from certificates of registered owners	$1,054 02
Receipts from miscellaneous sources	$216 60
Number of original lots plotted	10,171
Number of transfers registered	35,369
Number of plans made for use of City Departments, Bureaus, etc.	501
Number of examinations of registry plan books made by the public	54,883
Number of descriptions of property filed for registry	45,540
Number of titles perfected	2,361
Number of certificates of legal opening of streets issued to Bureaus, etc	2,078
Number of certificates of registered owners in municipal lien cases for Law Department	1,181

Bureau of Water.

The total expenditures of the Bureau of Water for the year were $7,537,334.62, of which $1,463,065.14 were current expenses and $6,074,269.48 were for extensions, the greater part of the latter sum having been expended in

connection with the Improvement, Extension and Filtration of the Water Supply.

The receipts for the year were $3,594,753.97, an increase of $135,663.25 over the year 1902.

Since the water works have been in operation, they have brought to the City in net revenue $19,970,166.80.

Attention is called to the increase in consumption of water throughout the section of the City east of the Schuylkill river, and in some instances to the inability of the pumping facilities to meet the demands.

Appropriation should be made to enable the Department to enter into contracts for new engines, boilers and other appurtenances, so the Bureau of Water could, at all seasons of the year, be in a position to furnish an unlimited supply of water to the citizens of this City.

During the years 1902 and 1903, no appropriations were made for extensions, and in the annual appropriation for the year 1904 the same condition exists. This delay in caring for our present pumping plant can only lead to evil results, the chief among which is the crippling of the machinery by overwork, inconvenience and annoyance to water takers and retarding enterprises throughout those sections of the City most affected. This, eventually, will impair the revenues derived by the City from its water service.

It was only through the fortunate circumstance of having numerous and heavy falls of rain during the past summer that prevented a serious condition insomuch as pertains to the supply of water to our citizens. We were enabled, by the high water in the Schuylkill river to keep the turbine wheels at the Fairmount Pumping Station in operation to a much greater extent than usual, which resulted in the pumpage at this station averaging 8,000,000 gallons daily more than in 1902. Even with this help,

there was a considerable shortage of water in the section of City west of Broad street and south of Market street.

To afford temporary relief to this section of the City, an ordinance was presented in Councils to make an appropriation of $158,000 to lay additional mains, so that the Frankford system could be tapped, pending the completion of the Torresdale Filter Plant, from which the business section of the City will ultimately receive its supply.

The following work should be provided for at once, as a further delay may result in serious complications:

Shawmont Pumping Station:

Two 15,000,000 gallon pumping engines.....	$75,000	
Eight steam boilers	48,000	
Boiler house and stack.....	35,000	
		$158,000

Belmont High Service Station:

One 5,000,000 gallon pumping engine.....	26,000

Frankford Pumping Station:

Three steam boilers	$18,500	
Addition to boiler house.....	7,500	
		26,000
		$210,000

In addition to the above, I also recommend the immediate construction of new boiler house and stack and the installing of ten new boilers for the Belmont Station, which, it is estimated, will cost $105,000.

At the latter station the pumpage is greater than the boiler capacity, and additional boilers should be provided at once. Three of the pumps were constructed in 1869, and if we replaced them with engines of modern construction, it would effect a saving of about $25,000 annually in the amount of coal consumed at this station.

Other improvements, amounting to $70,000 are re-

quired, and a description of them will be found in the report of the Chief of Bureau of Water.

The total consumption of water in 1903 was 119,456,525,979 gallons, making a daily average of 327,278,153 gallons, an increase over the year 1902 of 13,285,511 gallons per day.

The average per capita consumption daily was 237.5 gallons, an increase of 4.8 gallons over that of the previous year.

The total pumpage during the year was 124,015,934,669 gallons, an increase over 1902 of 7,217,510,169 gallons.

The average cost of pumping 1,000,000 gallons of water to a height of 100 feet was $5.20, an increase of 40 cents per million gallons over the preceding year. This was due to the greater consumption of coal and its increased price, as well as the advanced prices of other materials entering into the operation of the pumping machinery; there was also a greater amount of money expended for repairs.

There are at present laid in the City, 1,445.69 miles of water mains, of which 25 miles 4,391 linear feet were laid during the year 1903. There are in service 13,647 fire hydrants, 348 of which were installed during the past year. There were 5,637 new water attachments made during the year.

High Pressure Fire System.—The new building for the High Pressure Fire System, at Delaware avenue and Race streets, Henderson & Company, Ltd., contractors, is now completed, and the engines and pumps connected and ready for service. The station has been turned over to the Bureau of Fire, Department of Public Safety.

Great difficulty was encountered in the construction of this building, in securing suitable foundations.

When the excavation had reached a depth of five feet below the sidewalk on Delaware avenue, a mass of old oak timbers was encountered, together with caissons built

of oak timbers and filled with stone. A corduroy road built of oak saplings extended across the entire width of the building on the Water street front. The discovery of these obstacles caused a discussion as to the character of the foundations to be adopted, and soundings were taken over the entire site from Delaware avenue to Water street. In view of the existing conditions, a concrete foundation, reinforced with steel rods, was decided upon as a means of avoiding any settlement. Over 1,700 cubic yards of concrete and 5,000 pounds of steel rods were used in the foundations.

The difficulties encountered in constructing the foundations of the buildings were also met in the building of the stop house near the bulkhead of the river, and also in laying the 30-inch suction main from the river across Delaware avenue to the pumping station. The difficulty in the latter instance was met by sawing off the piles to the grade of the main and forming caps on their heads for the pipe to rest on.

Building operations were seriously interfered with by labor troubles and by a fire in the plant of the Dauphin Bridge Company, which twisted all the roof trusses, necessitating new ones being made, causing a delay of two months.

The pumping plant in the building, including foundations therefor, were furnished by Messrs. M. R. Muckle, Jr., & Company, of Philadelphia, and consists of nine three-cylinder four-cycle gas engines made by the Westinghouse Company of East Pittsburg, Pa., nine triplex double-acting pumps made by the Deane Steam Pump Company, of Holyoke, Mass., two air compressors, two 220-volt dynamos, nine 15-inch diameter air tanks, gas and air pipes; suction and discharge mains, one large steel plate air chamber on the discharge main, ignition batteries for each engine and relief, safety and suction valves on

each of the pumps. The relief valves are of ample capacity and can be adjusted to any pressure from 150 to 300 pounds per square inch.

The construction of the engines was completed on May 28, 1903, when a satisfactory running test of two of them was made in the machine shops of the Westinghouse Company.

All of the engines were held on storage until July 17, pending the completion of the building. The last one was placed on its foundation on October 15, 1903.

The engines and pumps have been operated under water pressure trial tests of from 150 to 300 pounds per square inch for from three to five hours nearly every day since they were erected upon their foundations. The trial tests were made for each engine separately and for four and five engines running at one time.

Gas for the engines is supplied by the United Gas Improvement Company and is of the ordinary illuminating quality used throughout the City.

The pumps have a total capacity of 9,100 gallons per minute, or 1,211 cubic feet per minute, with provision for increasing this quantity to 12,700 gallons per minute, with a pressure of 300 pounds per square inch.

On December 10, 1903, a test was made at the Race street wharf by the Chief of Bureau of Fire, of the capacity and power of the engines and pumps. Four lines of 3½-inch rubber lined hose was attached to the fire boat connection at the river front, with one 2-inch diameter nozzle on each line of hose and the stream directed into the river. Four pumps were put in operation, with a pressure of 150 pounds to the square inch, which was increased gradually to 200 pounds, when it was seen that any further increase would be dangerous for the men holding the nozzles, as one of them had already slipped

from its position and severely injured the fireman holding it.

The four streams were thrown to an estimated height of from 150 to 200 feet. The volume of water passing through the four nozzles was somewhat less than 5,000 gallons per minute, as the relief valves on the pumps were entirely closed.

The completion of the work on the high pressure fire system will provide this City with a method of protection from fire second to none in any City of the Union.

Pumping Stations.

Fairmount Station.—At this station during the past year were pumped 113,899,184 gallons more than in 1902. In February, 1903, the main shaft of No. 5 wheel broke and before it could be shut down, the broken machinery did much damage. Substantial repairs were made at once.

An appropriation should be made to cover much needed repairs to the roof at this station.

Spring Garden Station.—A number of repairs to the engines have been made during the past year, greatly improving the efficiency of the engines at this station. They are now in fairly good condition.

Belmont Station.—The pumpage at this station increased nearly 29 per cent. and during the present year it is anticipated there will be still a further increase. Additional pumping facilities should be installed at once.

On September 3, the first water was pumped to the Belmont Filters and has since continued without interruption.

Queen Lane Pumping Station.—The engines at this station have been in service a greater length of time than ordinarily is the case, caused by less breakage of the machinery and in consequence the pumpage has increased

at the rate of 7,491,000 gallons daily, equal to 10.41 per cent. No. 3 pump should have new pump chambers and the main shaft of No. 1 engine is out of line, which causes the shutting down of the engine every two or three days.

The foundations of engines Nos. 3 and 4 need repairing but no opportunity has been presented to shut down the pumps long enough to accomplish this result.

Roxborough Station.—The engines at this station have been operated to the fullest extent during the year and so great was the demand for water that we had to erect and put in service an old 4,000,000 gallon pump which had been discarded. Even with this addition it was almost impossible to furnish all the water required for the Germantown, Manayunk and Roxborough districts and for the sponge and sand washing at the Upper and Lower Roxborough filter plants.

There are a number of repairs needed to be made to the several pumps at the station, but from present indications it will be impossible to make same owing to the great demand upon the resources of the station.

Frankford Station.—At this station there have been numerous accidents to the pumping machinery during the past year, which necessitated extensive repairs. All the engines but No. 1 are in a very unsatisfactory condition.

There have been several serious breaks in the pumping main connections at this station, caused by excavation and settlement of the ground and shoring adjacent to the pipes during the construction of the new Lardner's Point Pumping Station and Intake.

High Service Stations.

The pumpage at Belmont High Service Station increased 35.7 per cent. during the past year. This was principally due to the fact that water was supplied for testing the filter basins at Belmont.

The boilers and engines are in good condition, but the pumpage is in a precarious condition, there being but one engine capable of pumping its maximum capacity.

The pumps, engines and boilers from which the Roxborough High Service district obtains its supply are in good condition.

The Wentz farm station is in excellent condition. The Bureau is now engaged in installing an old pump at this plant and operating it as a low duty pump.

The Chestnut Hill station is out of service and the Mt. Airy station is only used for emergency, in case of accident to the mains which supply the high levels of Germantown and Chestnut Hill.

Meters.—During the past year we asked Councils to pass an ordinance prohibiting the introduction of meters, because we find, that under present arrangements, they do not work equitably.

The matter of proper water charges for both meter rating and by schedule rates should be the subject of thorough inquiry; for instance, the Chief of the Bureau calls attention to the fact that the total revenue on 259 metered residences would have been $4,106.50; the meter rents, estimated from the quantity of water registered, were $663.49, to which should be added the excess of the minimum charges for each meter where they exceed the cost of water actually metered, amounted to $756.53, making the total receipts from these metered properties $1,482.73, or $2,623.77 less than the water rents by schedule rates.

On these residential properties the total consumption during the year was 16,582,500 gallons, the average was 45,404 gallons per day, and if we assume a population of four persons at each house, the average daily consumption was 43.8 gallons per capita.

This shows how small a quantity of water is required

for all household purposes and in many cases a large percentage of the residences throughout the City where no meters are now used there is doubtless an equally small consumption of water. Only from 17 to 20 per cent. of the total number of properties are chargeable with the great waste of water which is unnecessary and useless and so desirable to check, but there is no way to accomplish this purpose except by arbitrarily selecting locations and applying the meter, a method which is objectionable because of its lack of uniform treatment of the water consumers.

From the above statement it can be gleaned how inequitable is the present system. When the entire water supply of the City is filtered, an ordinance should be passed based on the result of a thorough investigation of the conditions, so that equitable charges can be made for both schedule and meter ratings.

Under the present meter arrangements, the City of Philadelphia is not reimbursed for the money expended, much less receiving a return on same.

The following tables give the numbers and types of engines, locations and capacities of reservoirs and a summary of the operations of the Bureau of Water; also receipts and expenditures for the year 1903:

Statement of the Number and Type of Engines and their Several Aggregate Capacities, at the Various Stations.

Pumping Station.	Designated Number of Engine or Turbine.	Type of Engine.	Designed Capacity in Million Gallons per Day.	Total.
Spring Garden. Old Station	5	Compound Rotary	20,000,000	
Old Station	6	Simpson's Compound Rotary	10,000,000	
Old Station	7	Marine Compound Rotary	20,000,000	
Old Station	8	Worthington Duplex	10,000,000	
Old Station	11	Gaskill	20,000,000	
New Station	9	Worthington Duplex	15,000,000	
New Station	10	Worthington Duplex	15,000,000	
New Station	2	Holly	30,000,000	
New Station	3	Holly	30,000,000	170,000,000
Queen Lane	1	Southwark	20,000,000	
Queen Lane	2	Southwark	20,000,000	
Queen Lane	3	Southwark	20,000,000	
Queen Lane	4	Southwark	20,000,000	80,000,000
Belmont	1	Worthington Duplex	5,000,000	
Belmont	2	Worthington Duplex	5,000,000	
Belmont	3	Worthington Duplex	8,000,000	
Belmont	4	Worthington Duplex	20,000,000	
Belmont	5	Holly Horizontal Compound	10,000,000	
Belmont	6	Holly Horizontal Compound	10,000,000	
Belmont	7	Holly Horizontal Compound	10,000,000	68,000,000

Statement of the Number and Type of Engines, etc.—Continued.

Pumping Station.	Designated Number of Engine or Turbine.	Type of Engine.	Designed Capacity in Million Gallons per Day.	Total.
Belmont High Service	1	Worthington	2,000,000	
Belmont High Service	1	Worthington	5,000,000	7,000,000
Roxborough Old House	1	Worthington Duplex	4,000,000	
Roxborough Old House	2	Worthington Duplex	5,000,000	
Roxborough Old House	3	Worthington Duplex	6,500,000	
Roxborough New House	4	Worthington Horizontal Compound	5,000,000	
Roxborough New House	5	Worthington Horizontal Compound	5,000,000	
Roxborough New House	6	Worthington Horizontal Compound	5,000,000	
Roxborough New House	7	Worthington Horizontal Compound	5,000,000	35,500,000
Roxborough High Service	1	Worthington	5,000,000	
Roxborough High Service	2	Worthington	5,000,000	
Roxborough High Service	3	Worthington Centrifugal	10,000,000	
Roxborough High Service	4	Worthington Centrifugal	10,000,000	
Roxborough High Service	5	Worthington Centrifugal	10,000,000	40,000,000
Mt. Airy	1	Davidson	1,000,000	
Mt. Airy	2	Davidson	1,000,000	
Mt. Airy	3	Knowles	1,000,000	3,000,000
Chestnut Hill	1	Knowles	250,000	
Chestnut Hill	2	Worthington Duplex	500,000	750,000

Statement of the Number and Type of Engines, etc.—Continued.

Pumping Station.	Designated Number of Engine or Turbine.	Type of Engine.	Designed Capacity in Million Gallons per Day.	Total.
Frankford	1	Marine Compound Rotary	10,000,000	
Frankford	2	Corliss Compound Rotary	10,000,000	
Frankford	3	Southwark Rotary	22,000,000	
Frankford	4	Southwark Foundry Quarter Crank Flywheel	15,000,000	57,000,000
Frankford High Service	1	Holly Horizontal Compound	3,000,000	
Frankford High Service	2	D'Auria Compound Duplex	4,000,000	7,000,000
Fairmount. New House	1	Turbine Wheels	2,000,000	
New House	3	Turbine Wheels	5,330,000	
New House	4	Turbine Wheels	5,330,000	
New House	5	Turbine Wheels	5,330,000	
Old House	7	Turbine Wheels	5,100,000	
Old House	8	Turbine Wheels	5,100,000	
Old House	9	Turbine Wheels	5,100,000	33,200,000
Total				501,540,000

Statement of the Location, Date of Completion, Elevation and Capacity of the City's Reservoirs.

Name of Reservoir.	Location.	Date of Completion.	Height ab've City Datum.	Capacity in Gallons.
Fairmount. Reservoir No. 1	East Fairmount Park	1815	94 feet...	26,350,000
Fairmount. Reservoir No. 2		1821		
Fairmount. Reservoir No. 3		1827		
Fairmount. Reservoir No. 4, Section 1		1835		
Fairmount. Reservoir No. 4, Section 2		1836		
Fairmount. Reservior No. 4, Section 3		1836		
Lehigh..... Section 1	Sixth and Lehigh avenue	1852	114 " ...	11,440,000
Lehigh..... Section 2		1871		
Spring Garden	Twenty-sixth and Master streets	1844	120 " ...	12,950,000
Corinthian	Corinthian avenue and Poplar street	1852	120 " ...	37,341,000
East Park.. Section 1	East Fairmount Park	1887	133 " ...	62,738,000
East Park.. Section 2		1888		306,400,000
East Park.. Section 3		1889		319,480,000
Queen Lane North Basin	Thirty-third street and Queen lane	1894	238 " ...	205,620,000
Queen Lane South Basin				177,480,000
Frankford	Oxford turnpike and Comly street	1877	167 " ...	36,046,000
Belmont	West Fairmount Park	1870	212 " ...	39,758,000
Belmont	Belmont and City avenues	1903	279 " ...	72,000,000
Belmont Clear Water Basin	Monument avenue and Ford road	1903	239 " ...	16,500,000
Mount Airy	Allen's lane and Mower street, Germantown	1851	363 " ...	4,546,000
Roxborough	Ridge and Shawmont avenues	1866	366 " ...	12,838,000
Roxborough Clear Water Basin	Dearnley and Fowler streets	1903	325.75 " ...	3,000,000
New Roxborough. North Basin	Port Royal avenue and Ann street	1893	414 " ...	71,594,000
New Roxborough. South Basin				75,438,000
New Roxborough Clear Water Basin	Port Royal avenue and Hagy street	1903	410 " ...	8,000,000
Chestnut Hill Tank	Hartwell avenue and Chestnut Hill R. R., Chest. Hill	1860	481 " ...	52,000
Belmont Stand Pipe	West Fairmount Park	1895	364 " ...	106,000
Roxborough Stand Pipe	Port Royal avenue and Ann street	1895	491 " ...	106,000
Frankford Stand Pipe	Oxford turnpike and Comly street	1900	300 " ...	106,000
Total				1,499,889,000

Statement of Pumpage for the year 1903.

	1903. Gallons.
Pumped to reservoirs	124,015,934,669
Equal to gallons pumped 100 feet high	248,768,806,094

NOTE.—The "pumped to reservoirs" etc, includes 4,415,315,469 gallons of repumpage to higher levels at Belmont, Roxborough, Roxborough Annex Mt. Airy, Chestnut Hill, and Frankford High Service Stations, which deducted from the total pumped gives a total pumpage from rivers of 119,600,619,200 gallons.

The quantity stored in reservoirs on December 31, 1903, was 144,093,221 gallons more than that stored on December 31, 1902. This quantity deducted from the total pumpage from rivers makes the total consumption for 1903, 119,456,525,979 gallons. The cost of pumpage is based on the total pumpage. The consumption per capita is computed from the average consumption during 1903 of 327,278,153 gallons per day.

	1903. Gallons.
Pumped by water-power	7,736,381,403
Pumped by steam-power	116,279,553,266
Largest quantity pumped in twenty-four hours	384,393,464
Smallest quantity pumped in twenty-four hours	213,150,635

Year.	Average daily consumption.	Average consumption in gallons per capita per day, estimating the population at.*	Cost of one million gallons pumped one hundred feet high.
	Gallons.	Gallons.	
1903	327,278,153	237.5	$5 20

*1903: 1,378,298 estimated.

The cost of pumping 1,000,000 gallons 100 feet high during 1903 was $5.20, or 40 cents in excess of that during the previous year. The increased cost of pumpage is due entirely to the increased price and consumption of coal, and to a slight increase in the items of repairs to machinery corresponding with the additional pumpage and work performed.

About six and one-quarter per cent. of the total pumpage was by water power, the turbine wheels using 232,091,442,090 gallons to pump 7,736,381,403 gallons.

Year.	PIPE LAID.			*PIPE RELAID.	FIRE HYDRANTS PLACED IN POSITION.			SUBSTITUTED FOR DEFECTIVE HYDRANTS.			Fire Hydrants in Use.	New Water Attachments.
	Feet.	EQUAL TO			New Style.	Old Style.	Total.	New Style.	Old Style.	Total.		
		Miles.	Feet	Feet.								
1903	136,391	25	4,391	†15,254	348	.....	348	100	.....	190	13,647	5,637

Total pipe laid, 1,445.69 miles.

* Adds nothing to feet in ground.

† 1903. Pipe taken up is less than quantity relaid, 1,382 feet.

Statement of Receipts and Expenditures for the year 1903.

	Receipts, 1903.
Receipts from water rents	$3,275,997 53
Receipts from fractional rent	68,992 21
Receipts from water pipes	128,265 82
Receipts from City Solicitor's office	43,555 88
Receipts from penalties	31,512 60
Receipts from delinquent rent	31,041 32
Receipts from Chief Engineer's office	7,709 19
Receipts from searches	3,021 75
Receipts from delinquent penalties	4,657 72
Total	$3.594,753 97

	Exp'nditures, 1903.
Current expenses	$1,463,065 14
For extensions	6,074,269 48
Total	$7,537,334 62

Bureau of Fillration.

While the work in connection with the Improvement, Extension and Filtration of the Water Supply is of the greatest magnitude and importance, the space we must give it is necessarily limited. In the report of the Chief Engineer of the Bureau of Filtration will be found an interesting and exhaustive account of this work, together with a more or less technical description of the contracts being performed. It is a very thorough paper and contains much valuable information.

In his report is also enumerated the work that has been completed prior to 1903 and what is essential to complete the system of filtration. These matters I have not dwelt

upon in my report, which is confined chiefly to the work done during the past year.

In this connection I desire to call particular attention to the vast amount of work done during the past six months—in fact, more work has been performed in that time than for any equal period since the inception of this great undertaking.

The total amount of money appropriated by Councils for the Improvement, Extension and Filtration of the Water Supply since its inception in 1898, is $17,500,000. Of this amount there has been expended on completed contracts $2,433,177.47; on uncompleted contracts, $7,863,932.89; limits of uncompleted contracts, $4,402,764.11; paid by the Bureau of Water for work done in connection with the improvement of the water supply, $1,013,149.89; for land damages there has been expended $843,738.06, and for the salaries and wages of engineering staff there has been paid out $497,394.05. There is still available a balance of $205,781.13. The remainder of the money has been expended for supplies, advertising, inspection, repaving over pipe trenches and other minor matters.

The land appropriated for filters and other works comprises 465.302 acres, divided as follows:

Upper Roxborough	34.518	acres
Shawmont Pumping Station	2.800	"
Belmont	60.572	"
Torresdale	343.500	"
Lardner's Point	3.089	"
Oak Lane	20.823	"

As at present laid out, the total capacity of the filter plants when completed will be 40,000,000 gallons in excess of the probable average daily present consumption.

Contract No. 37, Lower Roxborough Preliminary Filters.—This contract embraces a system of filters for treatment of the subsided water taken from the Lower Rox-

borough Reservoir. It comprises eleven filters, arranged as compartments of a unit tank of steel reinforced concrete. The water is introduced into the bottom of the tanks through perforated tile pipes and percolates upwards through the gravel, crushed slag and sponge and is drawn off at the top of the filters.

The water enters the filters at the rear end and is drawn off at the front end into galvanized iron boxes, from which it flows into the collecting pipe and is thence conducted to the plain sand filters.

Each preliminary filter has a filtering capacity of 1,024 square feet and when all are in service will deliver 12,000,000 gallons per day.

This contract is of an experimental character and no payment is made to the contractor until he has completed one year's operation and complied with the guarantees of removal of turbidity in the applied subsided water and of cost per million gallons for operation.

These filters have not all been started but it is expected that all will be found in full service by December 31, 1904.

Contract No. 37-A, Foundation and Superstructure for the Lower Roxborough Preliminary Filters.—This contract embraces foundation, puddle lining, granolithic floors and part of the concrete gullets in the filter house, the frame superstructure for an office and shelter house, the filter house and Administration building.

This work was completed on December 31, 1903.

Sand Ejector.—This apparatus is for the removal of scraped sand by means of a water jet from the filters to the sand washers in the court and is provided with handles and broad feet to make it portable, so that it can be set up and connected with the water supply and discharge pipes at convenient places in the filters. This ejector is modelled

after those in successful use in the works of the East London Water Company.

Ejector Pipes.—In addition to the regular contracts, a special contract was made for the ejector pipes for the supply of water under pressure to the portable ejector and for the conveyance of the mixed sand and water to the washers in the court.

Contract No. 12, Upper Roxborough Filters.—This contract embraced eight filters and a clear water basin of 8,000,000 gallons capacity. The filters will be supplied with subsided water from the Upper Roxborough Reservoir and with these filters working at a rate of 15,000,000 gallons, the water will usually have been subsided ten days before going to the filters. It is anticipated that with the use of the subsided water, it will permit the working of the filters up to 20,000,000 gallons per day when the Purvey District has been enlarged to take the water.

These filters were started in service July 3, 1903.

Contract No. 24, Filtering Materials and Underdrains for Upper and Lower Roxborough Filters.—This contract embraced the filtering materials and collectors for the Upper and Lower Roxborough Filters and the sand washers and houses at Lower Roxborough.

The contract was completed during July and all filters were operated by August 6, 1903.

Contract No. 18, Low Service Pumping Machinery for Upper Roxborough Filters.—This contract comprises three centrifugal pumps and vertical driving engines to supply water from the Upper Roxborough Reservoirs to the Upper Roxborough Filters. The water is supplied to the pumps by gravity and the difference between the elevation of the water in the filters and the elevation of the water in the reservoirs is overcome by the action of the pumps.

The machinery was completed during the year and subjected to the tests required by the contract.

Contract No. 20, Triplex Pumps and Gasoline Driving Engines.—This contract includes two sets of driving engines and pumps. The tests made of these engines have been satisfactory in every respect and the machinery placed in service about July 1, 1903.

Contract No. 33, Sand Washers.—This contract was for four complete sand washers, set in the court at the Roxborough filters, each washer to serve two filters. The contract was completed July 1, 1903.

Contract No. 44, Electric Lighting System for Upper and Lower Roxborough Filters.—This contract was for a complete electric lighting system for the lighting of said stations and has been in satisfactory operation since October 1, 1903. It has been found very efficient in permitting the scraping and washing of sand to proceed after darkness has set in.

Contract No. 16, Belmont Filters, Sedimentation Reservoir and Clear Water Basin.—In the district to be supplied from the Belmont plant is an estimated population of 170,000 people. The plant comprises a sedimentation and clear water basin, plain sand and preliminary filters. There is sufficient land available for the construction of eight additional filters, should there be any necessity for their use in future.

This contract is now completed, lacking only the tests for water-tightness of the sedimentation reservoir, clear water basin and four of the filters. These tests are now progressing and it is expected will be completed within a few weeks.

An elaborate detail report of the work done at this plant will be found in the attached report of the Chief Engineer of the Bureau of Filtration.

Contract No. 40-A, Centrifugal Pumping Machinery,

Belmont.—This contract embraces two sets of pumps and driving engines to pump wash water to the preliminary filters, and if required, to pump pre-filtered water from above the sand bed of low level filters to filters at high level.

Each pump has a capacity of 5,000,000 gallons per day against a head of 45 feet.

No payment has been made on account of this contract.

Contract No. 40-B, Duplex Direct Acting Pumps.—This contract calls for three duplex direct acting pumps to supply filtered water under pressure to the sand washers and sand ejectors; also four internally fired tubular marine type boilers.

This machinery is completed in the shops of the contractor and will be erected as soon as the engine and pump room have reached a satisfactory stage.

No payments have been made on account of this contract.

Contract No. 42, Administration Building and Pumping Station for Belmont.—This contract is rapidly approaching completion and had there not been interruptions caused by unfavorable weather, the engine and boiler rooms would have been in condition to receive machinery before now.

Contract No. 46, Electric Lighting System for the Belmont Filters, etc.—Work on this contract is progressing but there has not been any payment made on account of same.

Contract No. 49, Filtering Materials and Underdrains, for Belmont.—The requirements for collectors, sand, gravel and placing sand is practically the same as those for the Roxborough Filters. Three filters have been supplied with the filtering materials and are ready for service and two others are nearly finished, and as soon as six filters are finished the operation of filtering water will be commenced

at Belmont. By midsummer the whole supply of water for the West Philadelphia district will be filtered.

Contract No. 63, Sand Washers, Belmont.—This contract is for eight sets of sand washers of the same general design as those now in use at Upper Roxborough. The work was completed November 11, 1903, and the washers are ready for service.

Contract No. 65, Hand Traveling Crane, Belmont.—This contract is for a six ton hand traveling crane for the engines and pumps to facilitate the work of handling heavy pieces of machinery, when repairs or adjustments become necessary.

The crane is completed and ready for erection as soon as the room in which it is to be placed is finished.

Contract No. 19, extension of Pipe System, West Philadelphia, Upper Roxborough Connecting Pipes, etc.—All the work embraced under this contract was completed January 31, 1903, and excepting lines "K" and "L," Belmont, and lines "M," "N" and "O," Roxborough, has been in operation since that date. Line "L," Belmont Filters, was put in operation October 4, 1903, and lines "M," "N" and "O," Upper Roxborough Filters, were put in service July 3, 1903.

Contract No. 25, Filters and Clear Water Basin, Torresdale.—This contract embraces fifty-five plain sand filters and clear water basin of 50,000,000 gallons capacity; each filter has a net sand area of 0.75 acre, and in many respects similar to the filters at Belmont and Upper Roxborough. At the present time nearly 80 per cent. of the work has been completed on this contract.

This project is the largest of its kind ever conceived. At this station, unless some unforeseen condition arises, there will be filtered a volume of water larger than the entire consumption of London and two and one-half times the combined capacity of the filtration work at Berlin and

Hamburg. This plant will supply a population of nearly 1,100,000. As projected it will represent nearly five-sixths of the entire water supply of the City, and it is not unreasonable to expect that when this, the largest filtration works in the world, are in successful operation, they will be visited by people interested in the filtration of public water supplies from all parts of the world.

The filtered water from this station will flow by gravity to the pumping station at Lardner's Point, about three miles south of the Torresdale Station.

A great story could be written of the operations at this plant could space be spared. In the report of the Chief Engineer of the Bureau of Filtration will be found a more comprehensive treatment of this subject.

Contract No. 50, Filtering Materials and Collectors, Torresdale.—This contract includes the furnishing and distribution of the collectors and filtering materials in the Torresdale Filters. The amount appropriated by ordinance for this work will only be sufficient to do about one-half what is needed. No part of this contract has yet been performed.

Contract No. 14, Torresdale Conduit.—This contract is ninety-five per cent. completed. It embraces a gravity conduit about 14,015 feet long, including end shafts, for the conveyance of filtered water from the Torresdale Filters to the pumping station at Lardner's Point. The conduit, with the exception of about fifty feet, is uniformly 10 feet 7 inches in diameter inside the brick lining.

An excellent description of this really wonderful piece of work will be found in detail in the report of the Chief Engineer of the Bureau.

Contract No. 29, Lardner's Point Pumping Station No. 2.—This contract comprises an engine house, boiler house, dynamo room, pump room for the boiler feeders, toilet rooms and two Custodis brick chimneys. The river

work in connection with the construction of this station, has greatly retarded the progress of the work, which is now about 66 per cent. completed. The contractors, however, have overcome the difficulties encountered and are now devoting much energy in pushing the work to completion.

Contract No. 11, Pumping Engines and Boilers and Traveling Crane, Lardner's Point Pumping Station.—This contract embraces three 20,000,000 gallons high duty pumping engines, three batteries of four marine fire box boilers each and one 30-ton electric traveling crane. Two of the engines are completed at the shops of the contractors at Lockport, New York, and the third is well advanced towards completion. All the boilers are completed and orders have been issued to forward the setting of these in the boiler house constructed under contract No. 29.

The electric traveling crane has been completed in the engine room for some time, and is ready for the electric current.

Contract No. 28, Lardner's Point Pipe Distribution System.—This contract includes the furnishing and laying of various sized pipes required about the engine house of Lardner's Point Pumping Station No. 2; the furnishing and placing of all stop valves and special castings in the valve chambers and elsewhere in the distribution system; the construction of valve chambers; sewer chambers where the lines of pipe on Tacony street intersects large sewers; the crossing of Frankford creek on the line of Torresdale avenue, between Frankford and Kensington avenues, and for all labor and materials required for the construction of the work.

This work is now in progress.

Under this contract was performed the extremely hazardous feat of moving the 48-inch main supplying the Frankford district while under pressure and in service, in

order that room could be provided for laying the 60-inch main, maintaining during the entire operation the regular supply of water for the citizens of the northeastern section. The difficult operation was completed without a single serious interruption.

This particular piece of work is given a full description in the report of the Chief Engineer of the Bureau.

Contract No. 27, Oak Lane Reservoir.—The total work completed to January 1, 1904, equals 66.38 per cent. This work has not progressed as satisfactorily as the Department desired; but efforts are now being made by the contractors to improve the conditions, and at present work is proceeding to our satisfaction.

There are many interesting items contained in the report of the Chief Engineer, which it is regretted cannot be set forth in my report because of limited space, dealing with the following subjects of much interest not only to the layman but to the engineering body: Water Tightness of Structures; Asphalt Reservoir Lining; Concrete Cubes; Roxborough Filter Operation; Lower Roxborough Filters; Upper Roxborough Filters; Summary of Operations of Roxborough Filters; Turbidity of Filter Effluents; Filter Scrapings and Cost of Cleaning Filters; Description of the Operation of the Filters at Upper and Lower Roxborough; Testing Stations; Experiments with Floats to Determine the Action of the Tides on Sewage Matters Entering the Delaware River at and Below the Lardner's Point Pumping Station, and a History of the Typhoid Epidemic in the Twenty-first Ward.

These subjects will prove interesting reading to every one wishing to secure a greater knowledge on the question of filtration by the slow sand process and a perusal of the report of the Chief Engineer will be of much benefit to those who desire to become better acquainted with the immensity of the work in connection with the Improvement,

Item.	Description.	Quantity.	Lower Roxborough.	Upper Roxborough.	Torresdale Conduit.	Belmont Filters.	Torresdale Filters.	Oak Lane Reservoir.	Lardner's Point. Con'ct No. 29.	Contract No. 17.	Contract No. 19.	Contracts Nos. 28 and 72.	Contract No. 66.	Contract No. 70.	Total when work is completed.	Work during 1903.
1	Excavation	Cubic yards.	66,000	134,157	89,302	567,010	936,030	372,110	32,750	115,473	70,760.9	265,000	8,690	164,262.4	2,821,545.3	752,313.7
2	Embankment	Cubic yards.	22,000	59,500	.....	314,000	297,300	42,000	.....	.....	.....	.....	.....	.....	734,800	103,804
3	Puddle	Cubic yards.	8,750	17,060	.....	69,613	117,850	33,600	786	.....	.....	.....	.....	.....	247,659	117,029
4	Concrete	Cubic yards.	12,959	24,336	23,900	71,775	169,377	14,681	12,245	1,278	1,581	2,700	50	1,421	336,303	191,299.3
5	Brick masonry	Cubic yards.	105	302	19,402	288	325	80	*1,449	107	132	210	62	116	22,578	18,777
6	Rubble masonry	Cubic yards.	.....	.....	.....	2,230	.....	.....	15	716	275	150	50	792	4,228	62.4
7	Cast iron pipe	Tons.	220	1,005	.....	3,068.3	7,000	94	210	15,221.5	7,386.1	38,000	1,151.9	36,007.6	109,364.1	6,994.51
8	Special castings	Tons.	50	170	.....	878	480	43.2	51.25	593	270.7	650	31	1,404.3	4,621.45	517
9	Stop valves, 4 inch to 72 inch	Each.	55	{ 1 sluice, 63 valves }	.....	{ 7 sluices, 215 valves }	{ 4 sluices, 585 valves }	4	{ 25 sluices, 16 valves }	210	79	91	28	233	1,616	449
10	Cast iron fixtures	Pounds.	42,271	52,860	117,640	386,994	423,250	2,000	144,900	104,253	22,394	20,000	9,300	45,920	1,361,772	238,710
11	Structural steel	Pounds.	70,040	131,512	346,374	537,500	961,520	7,500	1,960,400	3,790	16,200	151,000	1,000	4,200	3,327,036	1,611,298
12	Filter drains	Linear feet.	6,885	15,875	.....	33,806	103,290	.....	.....	.....	.....	.....	.....	.....	159,856	30,203
13	Filter gravel	Cubic yards.	4,298	9,490	.....	22,554	68,915	.....	.....	.....	.....	.....	.....	.....	105,257	14,755
14	Filter sand	Cubic yards.	13,247	26,367	.....	63,023	192,555	.....	.....	.....	.....	.....	.....	.....	295,192	39,926
	Pumping Station	.....	1	1	.....	1	1	.....	1							
	Administration Building	.....	1	1	.....	1	1									

*This item does not include 422,500 face and fire brick.

Extension and Filtration of the Water Supply of the City of Philadelphia.

The work on the Improvement of the Water Supply is shown by reference to the following table, which gives quantities of more important items under construction during the year 1903:

List of Contracts for the Improvement, Extension and Filtration of the Water Supply.

Contract No.	Description of Contract.	Contractor.	Date of Letting.	Date of Contract.	Limit of Contract.	Payment.	Date of Final Payment.
1 1 Sup.	A Testing Station..... Extension to Testing Station.	Thomas Parker..... Thomas Parker.....	Feb. 27, 1900..	Mar. 6, 1900... May 7, 1900...	$9,000 00 5,000 00	$11,653 54	July 13, 1900.
2	Ice Refrigerating Machine....	Newburg Ice Machine & Eng. Co...	July 20, 1900..	Aug. 20, 1900..	800 00	800 00	Nov. 19, 1900.
3	Filtering Sand and Gravel for Testing Station.....	Norcross & Edmunds.....	July 20, 1900..	Sept. 4, 1900...	2,500 00	1,016 54	Nov. 2, 1900.
4	Platinum Ware for Testing Station.....	Chas. Lentz & Sons.	July 20, 1900..	July 27, 1900..	674 50	649 50	Oct. 31, 1900.
5	Test Borings.....	Flaghouse & Beeson	Aug. 7, 1900...	Sept. 6, 1900...	9,750 00	8,833 30	March 9, 1901.
6	Platinum Ware for Testing Station.....	Arthur H. Thomas Co.....	Dec. 12, 1900...	.....	444 95	444 95	Feb. 6, 1901.
7	Lower Roxborough Filters....	.....	Dec. 12, 1900...	No award made. Readvertised as Contract No. 10.			
8	Sand Ejector.....	Patrick Gormly.....	April 17, 1901.	May 6, 1901...	1,800 00	1,712 03	August 7, 1901.

List of Contracts for the Improvement, Extension and Filtration of the Water Supply.

Contract No.	Description of Contract.	Contractor.	Date of Letting.	Date of Contract.	Limit of Contract.	Payment.	Date of Final Payment.
9	Cast Iron Water Pipe, Special Castings, Stop Valve, Pipe-laying, etc.....	Bids rejected on Pipe Lines "A" to "J" inclusive. See Contracts "9 A," "9 B" and "9 C" for rest of contract,					
9A	Cast Iron Stop Boxes.....	J. Alfred Clark.....	Feb. 11, 1901..	May 14, 1901..	$2,100 00	$1,563 80	Dec. 21, 1901
9B	Stop Valves.....	Eddy Valve Co.....	Feb. 11, 1901..	May 3, 1901...	17,000 00	14,403 06	Dec. 21, 1901.
9C	Cast Iron Water Pipe and Special Castings for Lower Roxborough Filters.....	Daniel J. McNichol.	Feb 11, 1901..	May 8, 1901...	7,500 00	7,468 14	Dec. 20, 1901.
10	Lower Roxborough Filters...	Daniel J. McNichol.	Feb. 11, 1901..	Mar 20, 1901..	250,000 00	230,880 20	Mar. 1, 1902.
11	Pumping Engines and Boilers and Electric Traveling Crane for Lardner's Point Pumping Station.....	Holly Mfg. Co.....	May 1, 1901...	June 6, 1901...	360,000 00	100,152 04	Not completed.
12	Upper Roxborough Filters...	Daniel J. McNichol.	Apr. 17, 1901..	May 8, 1901...	540,000 00	550,911 59	Nov. 11, 1903.
13	Rotary Stop Valves, Patterns and Core Boxes.....	Eddy Valve Co.....	Apr. 17, 1901..	June 1, 1901...	13,000 00	12,825 00	Nov. 22, 1902.

List of Contracts for the Improvement, Extension and Filtration of the Water Supply.—Continued.

Contract No.	Description of Contract.	Contractor.	Date of Letting.	Date of Contract.	Limit of Contract.	Payment.	Date of Final Payment.
15	A Test Pit at Lardner's Point	Contract abandoned. Work done by Water Bureau.					
16	Belmont Sedimentation Reservoir, Filters and Clear Water Basin.....	Ryan & Kelley.....	May 28, 1901..	Aug. 7, 1901...	$2,000,000 00	$1,758,007 44	Not completed.
17	Extension of Distribution Pipe System.....	Daniel J. McNichol.	April 17,1901.	June 4, 1901...	750,000 00	749,455 01	Oct. 24, 1902.
18	Low Service Pumping Machinery for Upper Roxborough Filters.....	Henry R. Worthington, Inc.....	July 29, 1901..	Aug. 22, 1901..	23,500 00	20,982 09	Not completed.
19	Belmont Rising Mains, Upper Roxborough Connection Pipes and Extension of Distribution Pipe System	Daniel J. McNichol.	Dec. 18, 1901	Jan. 30, 1902..	500,000 00	499,805 18	Feb. 7, 1903.
20	Triplex Pumps and Gasoline Driving Engines for Upper Roxborough Filters.....	Fairbanks, Morse & Co.....	Dec. 18, 1901..	Mar. 1, 1902...	10,800 00	8,916 50	Not completed.

List of Contracts for the Improvement, Extension and Filtration of the Water Supply—Continued.

Contract No.	Description of Contract.	Contractor.	Date of Letting.	Date of Contract.	Limit of Contract.	Payment.	Date of Final Payment.
21	Low Service Pumping Station for Upper Roxborough Filters	Henderson & Co, Ltd	Sept. 25, 1901.	Oct. 21, 1901.	$21,000 00	$18,636 42	Not completed.
22	Hand Traveling Crane for Low Service Pumping Station, Upper Roxborough Filters	Alfred Box & Co.	July 29, 1901.	Dec. 19, 1901.	2,900 00	2,800 00	Aug 14, 1902.
23A	Administration Building and Pumping Station, Upper Roxborough Filters	Daniel J McNichol.	June 25, 1902.	Aug. 6, 1902.	43,000 00	38,440 60	Aug. 19, 1903
24	Filtering Materials and Collectors for Upper and Lower Roxborough Filters and Sand Washers for Lower Roxborough Filters	Daniel J McNichol.	Dec. 18, 1901.	Jan 30, 1902.	290,000 00	280,358 53	Aug. 24, 1903.
25	Torresdale Filters and Clear Water Basin	Daniel J. McNichol.	Dec. 18, 1901.	Jan. 18, 1902.	5,000,000 00	3,555,346 42	Not completed.
26	Torresdale Testing Station	Patrick Gormly	July 29, 1901.	Aug. 20, 1901.	9,000 00	8,643 00	Dec. 19, 1901.

List of Contracts for the Improvement, Extension and Filtration of the Water Supply—Continued.

Contract No.	Description of Contract.	Contractor.	Date of Letting.	Date of Contract.	Limit of Contract.	Payment.	Date of Final Payment.
27	Oak Lane Reservoir.....	R. A. Malone & Co..	Dec. 18, 1901..	Mar 14, 1902..	$550,000 00	$282,740 02	Not comp'eted.
28	Lardner's Point Distribution.	Daniel J. McNichol.	Feb 16, 1903..	Mar. 4, 1903...	1,300,000 00	452,373 36	Not completed.
29	Lardner's Point Pumping Station, No. 2.....	Geo. C. Deitrich.....	Sept. 17, 1902.	Oct. 4, 1902....	565,000 00	14,515 62	Not completed.
30	Lardner's Point Pumping Station, No. 2.....	.....	Feb. 26, 1902..	Readvertised as Contract No. 29.			
32	Addition to Testing Station at Spring Garden Pumping Station.....	.....	Sept. 25, 1901 .	No Award Made.			
33	Sand Washers for Upper Roxborough Filters.....	E. M. Nichols.....	Mar. 24, 1903..	Apr. 4, 1903...	4,000 00	3,849 00	Sept. 4, 1903.
37	Preliminary Filters, Lower Roxborough.....	Maignen Filtration Co	Sept. 23, 1902..	Oct. 27, 1902..	49,800 00	.....	No payments made.

List of Contracts for the Improvement, Extension and Filtration of the Water Supply.—Continued.

Contract No.	Description of Contract.	Contractor.	Date of Letting.	Date of Contract.	Limit of Contract.	Payment.	Date of Final Payment.
37A	Foundation and Superstructure for the Lower Roxborough Preliminary Filters...	Daniel J. McNichol.	Feb. 16, 1903..	Mar. 4, 1903..	$50,000 00	$39,714 96	Not completed.
40A	Low Service Drainage for the Belmont Filters.....	Camden Iron Wks..	June 30, 1903.	July 27, 1903..	7,000 00	.....	No payments made.
40B	Sand Washer, Pumps and Boilers for Belmont Filters....	I. P. Morris Co.....	June 30, 1903.	July 24, 1903..	29,000 00	.....	No payments made.
42	Administration Building and Pumping Station at Belmont Filters.....	H. B. Shoemaker & Co.....	June 30, 1903.	July 17, 1903..	55,000 00	24,150 74	Not completed.
44	Electric Lighting System for the Upper and Lower Roxborough Filters.....	Pa. Equipment Co..	Mar. 24, 1903..	Apr. 22, 1903..	15,500 00	8,356 99	Not completed.
46	Electric Lighting System for the Belmont Filters.....	Pa. Equipment Co..	June 30, 1903.	July 21, 1903..	20,000 00	.....	No payments made.

List of Contracts for the Improvement, Extension and Filtration of the Water Supply.—Concluded.

Contract No.	Description of Contract.	Contractor.	Date of Letting.	Date of Contract.	Limit of Contract.	Payment.	Date of Final Payment.
49	Filtering Materials and Underdrains for the Belmont Filters.....	Daniel J. McNichol.	Feb. 16, 1903..	Mar. 4, 1903...	$365,000 00	$84,677 26	Not completed.
50	Filtering Materials and Underdrains for the Torresdale Filters.....	Daniel J. McNichol.	Feb, 16, 1903..	Mar. 4, 1903...	500,000 00	.....	No payments made.
62	Baffles for the Lower Roxborough Reservoir.....	.....	June 25, 1902.	No award made.			
63	Sand Washers for the Belmont Filters.....	Patrick Gormley...	June 30, 1903.	July 16, 1903..	6,800 00	6,595 00	Dec. 8, 1903.
65	Hand Travelling Crane for the Low Service Pumping Station, Belmont Filters.....	Alfred Fox Co.....	June 30, 1903.	July 16, 1903..	2,700 00	.....	No payments made.
66	Pipe Line "U"—Extension of the Roxborough Distribution System.	....	Sept. 4, 1903...	No award made.			

Director's Office.

The past year witnessed the greatest volume of work yet performed by the employes of this office, and I am pleased to say it was well done.

The following is a summary of the expenditures of the Director's office for the year 1903:

Item.		1903.
1.	Salaries	$22,720 00
2	Keep of horses	1,399 98
3	Printing, stationery, etc	3,299 87
4	Fitting up room for official photographer	2,498 75
	Total	$29,918 60

The appropriations, receipts and expenditures of the Department of Public Works for the year 1903 are set forth in the accompanying table in detail by Bureaus.

In closing this report I wish to express my appreciation for the valuable assistance rendered me by my Assistant and the employees of this office, as well as the Chiefs of the several Bureaus of this Department; and to acknowledge the aid and courtesy shown me by you at all times in seconding my efforts to administer the office to the best interest of the public.

Respectfully submitted,

PETER E. COSTELLO,
Director.

SUMMARY OF APPROPRIATIONS, EXPENDITURES, RECEIPTS, ETC., OF THE DEPARTMENT OF PUBLIC WORKS DURING THE YEAR 1903.

Bureaus.	Appropriations for 1903.	Balance available from previous years.	Additional Appropriations and Transfers.	Total.	Number of Warrants drawn.	Amount of Warrants Drawn.			Transfers from.	Balance available 1904.	Total.	Amount merging.	Receipts.	Number of Employes Dec. 31, 1903.
						Current Expenses.	Extensions.	Total.						
Director's Office	$26,620 00	.....	$3,378 00	$29,998 00	232	$29 918 60	.....	$29,918 60	.....	.....	$29,918 60	$79 40	.....	10
City Ice Boats	51,680 00	.....	150 00	51,830 00	127	22,662 26	$19,000 00	41,662 26	$150 00	$9,500 00	51,312 26	517 74	$810 00	58
Gas	10,000 00	.....	.....	10,000 00	107	10,000 00	.....	10,000 00	.....	.....	10,000 00	.....	13 00	6
Highways	1,201,603 07	$917,107 13	680,928 70	2,799,638 90	3,540	647,082 61	1,587,380 28	2,234,462 89	149,306 30	414,361 44	2,798,130 63	1,508 27	179,188 49	128
Board of Highway Supervisors	*	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	24,098 56	12
Lighting	330,216 00	.....	.....	330,216 00	230	328,922 44	.....	328,922 44	64 00	.....	328,986 44	1,229 56	.....	8
Street Cleaning	1,242,470 00	.....	.....	1,242,470 00	505	1,197,937 06	.....	1,197,937 06	16,558 95	.....	1,214,491 01	27,978 99	.....	17
Surveys	885,160 00	2,378,911 58	286,910 83	3,550,982 41	4,355	275,701 08	1,560,003 80	1,835,704 88	151,714 83	1,562,094 31	3,549,514 02	1,468 39	130,402 55	273
District Surveyors	†	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	14
Water	1,712,713 00	10,220,182 84	363,837 68	12,296,733 52	5,443	1,463,065 14	6,074,269 48	7,537,334 62	13,104 00	4,714,282 99	12,264,721 61	32,011 91	3,594,753 97	1,100
Filtration	‡	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	181
Total 1903	$5,460,462 07	$13,516,201 55	$1,935,205 21	$20,311,868 83	14,539	$3,975,289 19	$9,240,653 56	$13,215,942 75	$330,893 08	$6,700,238 74	$20,247,074 57	$64,794 26	$3,929,266 57	1,807

* Included in the appropriation and in the expenditures of the Bureau of Highways. † Included in the appropriation and in the expenditures of the Bureau of Surveys. ‡ Included in the appropriation and in the expenditures of the Bureau of Water.

ANNUAL REPORT

OF THE

BUREAU OF WATER

FOR THE YEAR 1903.

OFFICERS

OF THE

BUREAU OF WATER

Chief,

FRANK L. HAND.

General Superintendent,

ALLEN J. FULLER.

Chief Clerk,

J. T. HICKMAN.

Assistants to Chief,

WILLIAM WHITBY, H. J. JOHNSON.

Correspondence Clerk—P. DEHAVEN.

Chief Draughtsman,

JOHN E. CODMAN.

Draughtsmen,

Martin Murphy, James H. Hand, Jr.,
John R. Gorman, Charles B. F. Waller,
Andrew P. Peterson, Joseph D. Austin.

Assistants to Chief Clerk,

Thomas Spence, A. H. Raven.

Time Clerk—Walter R. Timby.
Clerk—George G. Whitby.
Assistant Clerk—Kennedy McNeal.
Search Clerk—John S. Todd.
Assistant Search Clerk—John J. Maxwell.
Assistant Clerk—John J. Barney.
Pipe Inspector—Max. M. Segel.
Pipe Clerk—Charles H. Pyrah.
Messenger—Haines Lewis.
Janitor—David Richards.
Watchman—James Robinson.
Watchman—George Harper.

Telephone Operators,

Jennie M. Hannings, Calvin Craner.

Permit Clerk—Charles H. Russell.

Assistant Permit Clerk—James S. Van Vranken.

Chief Inspector—Edward Harshaw.

Inspectors,

Wm. A. Agnew,
Lewis Obermiller,
Theo. Yeager,
Jas. Buchanan,
George Crooks,
Henry Homiller,
Wm. J. Reed,
Conrad L. Eagle,
George Hoffman,
John McGrory,
Harry J. Stone,
John A. Brown,
George W. Eckert,
Frank Sloan,
George Spence,
Hillary Connor,
Harrison D. Bates,
Owen Jones,
Thos. G. Morris,
John T. Gault,
Robert M. Snyder,
Chas. W. Wells.

Works--General

Assistant to General Superintendent—Wm. Laumaster.

Clerk and Paymaster—Frank Hohlfeld.

Assistant Clerk—John B. Wright.

Foreman Machinist—Robert Bromiley.
Foreman Bricklayer—Lewis Myers.
Foreman Carpenter—Henry Guest.
Foreman Plumber—Chas. H. Green.
Foreman Stonemason—Michael Farrell.
Foreman Painter—Joseph Work.
Foreman Rigger—Lewis Pederson.
Foreman Laborer—Wm. Calhoun.

Foremen of Repairs,

D. H. Rose, E. N. Sampson.

General Storekeeper—John A. Acker.

Storekeepers,

Daniel D. Todd, Wm. F. Glenn.

Electrician—Henry F. Morgan.

Lineman—Edw. J. Cavanaugh.

CONSTRUCTION AND REPAIR SHOP, Twelfth and Reed Sts.

Superintendent of Shop—James H. Dean.
Clerk—Morris P. Getz.
Watchman—John W. Watkins.

Purveyors' Districts

First District Office, 1120 Wharton Street.

Purveyor—Charles T. Erichson.

Clerk—Wm. J. Mackey.
Assistant Clerk—James McCracken.
General Foreman—Martin Kelley.
Foreman of Repairs—W. W. Wellington.
Hydrant Inspector—James Preston.
Watchman—John H. Peterson.

Second District Office, 918 Cherry Street.

Purveyor—David A. Craig.

Clerk—William J. McKee.
Assistant Clerk—Fred J. Gheen.
General Foreman—J. M. Paullin.
Foreman of Repairs—Edw. Homan.
Hydrant Inspector—Robert S. Hughes.
Watchman—J. D. Kirkpatrick.

Third District Office, Beach Street and Susquehanna avenue.

Purveyor—Charles J. Lowry.

Clerk—Vacant.
Assistant Clerk—Milton Fredericks.
General Foreman—Robert Glenn.
General Foreman—James Hutchinson.
Foreman of Repairs—Wm. P. Yetter.
Hydrant Inspector—Thos. P. Cowden.
Hydrant Inspector—Henry Flake.
Hydrant Inspector—Wm. Gerstner.
Hydrant Inspector—Jno. R. Horn.
Watchman—Jas. H. Jebbs.

Fourth District Office, Twenty-sixth and Master Streets.

Purveyor—John Montgomery.

Clerk—Philip S. Thomas.
Assistant Clerk—Jay T. Wilson.
Assistant Clerk—Wm. W. Davis.
General Foreman—George W. Showaker.
Foreman of Repairs—John Richards.
Yardman—Thos. F. Kelley.
Hydrant Inspector—Wilson Lancaster.
Hydrant Inspector—John C. Smith.
Watchman—Henry S. Martin.

Fifth District Office, 4377 Manayunk avenue.

Purveyor—H. A. Markley.

Clerk—F. J. Cornman.
General Foreman—Wm. H. Dawson.
Foreman of Repairs—George Rittenhouse.
Hydrant Inspector—Jos. R. Gardy.

Sixth District Office, Town Hall, Germantown.

Purveyor—George W. Bardens.

Clerk—R. M. J. Livezey.
Assistant Clerk—Godfrey Dieter.
General Foreman—Jos. B. Fowler.
Foreman of Repairs—John L. Cameron.
Hydrant Inspector—Samuel Atmore.

Seventh District Office, Thirtieth and South Streets.

Purveyor—Michael Young.

Clerk—John F. Mahaun.
Assistant Clerk—Jas. S. Ashworth.
General Foreman—Jas. H. Tawney.
Watchman—John C. Bishop.
Watchman—Jacob H. Boon.

ANNUAL REPORT

OF THE

BUREAU OF WATER

FOR THE YEAR 1903

SEVENTEENTH ANNUAL REPORT

OF THE

BUREAU OF WATER

ONE HUNDRED AND SECOND ANNUAL REPORT

OF

OPERATIONS CONNECTED WITH THE CITY WATER SUPPLY

Philadelphia, December 31, 1903.

PETER E. COSTELLO, ESQ.,
Director Department of Public Works.

DEAR SIR:—I have the honor to present herewith my annual report of the general conditions and work performed by the Bureau of Water for the year ending December 31, 1903.

In my last report reference was made to the great increase in the consumption of water throughout all sections of the city east of the Schuylkill river, and, in some instances, to the inability of the present pumping facilities to meet the demands for water.

Urgent recommendations were made for appropriations with which to purchase new engines, boilers and other appurtenances necessary to furnish a sufficient supply of water during the heated term and during extremely cold weather, but, I regret to say, that no provision has yet been made for these important purposes.

No appropriations whatever were made for extensions during 1902 nor 1903, and no such provision has since been made for 1904.

The delay in making important additions to the pumpage systems, necessitated, from time to time, by the growth of the city and the proportionate increased requirements of its water supply, can only lead to additional crippling of the service by overworking the machinery, with a corresponding inadaquate water supply, thus inconveniencing and annoying water takers and retarding, instead of stimulating, enterprise throughout the several localities most affected.

This undesirable condition of affairs was prevented during the past summer only by frequent rainfalls, particularly from June to September, inclusive, during which period the high water in the river permitted the operation of the turbine wheels at Fairmount to a much greater extent than usual, and pumpage at these works correspondingly exceeded that of the preceding year by an average of eight million gallons daily.

Even with this assistance, and notwithstanding the earnest efforts made by the employees at the several pumping stations, there was a considerable shortage of water in the old city proper, particularly west of Broad street and south of Market street.

So important was this matter to the residents of that section that an ordinance was introduced in Councils to make an appropriation of $158,000 to lay additional mains, in order to tap the Frankford system, and thus give tempo-

rary relief pending the completion of the Torresdale Filter Plant, from which point this section is eventually to be supplied.

I therefore most earnestly beg to repeat my recommendations of last year, "that immediate provision be made for the following urgent requirements.

Roxborough Station.		
Two five-million gallon engines	$75,000	
Eight (8) steam boilers	48,000	
Boiler-house and stack	35,000	
		$158,000
Belmont High Service.		
One (1) five-million gallon engine		$26,000
Frankford Station.		
Three (3) steam boilers	$18,500	
Addition to boiler house	7,500	
		$26,000
		$210,000

In addition to the above I also recommend the immediate construction of a new boiler house, stack, and ten (10) new boilers for the Belmont works, estimated to cost $105,000.

At this station the pumpage is greater than the boiler capacity, and additional boilers are required to operate a sufficient number of pumps to meet the increased demands for water.

Three of the pumps at this station were constructed in 1869, and their long service and ancient pattern fully warrant their replacing with engines of modern construction, with a guaranteed economy that will result in a saving of from $20,000 to $25,000 in the amount of the annual coal bills at this station.

I therefore recommend that an addition be made to the Belmont engine house, and three (3) 10-million gallon engines be purchased therefor, to cost, approximately, $200,000.

Among other requirements needed for the improvement and benefit of the service, named in my former reports, are the following:

Repairs to the roof of mill house, Fairmount Works...	$4,000
New coal shed, Roxborough Works.....	55,000
Building and fence, Seventh District Yard.....	11,000
	$70,000

While all the above-named items are needed, and perhaps may be subjected to the delays usual in prosecuting such work, I would call attention to the fact that it takes from one to two years to construct large pumping engines, and those specified for the Roxborough and the Belmont High Service Stations are required now. Also, the additional boilers at the Spring Garden, the Belmont, the Roxborough and the Frankford Pumping Stations. Any delay, therefore, in making immediate provision for these boilers and engines means a serious crippling of the service during the present Mayoralty term, and it is a question whether such a condition can even now be averted by the most strenuous efforts possible.

Revenue Collected.

The total collections during the year 1903 and the increased amount, as compared with that for 1902, were as follows:

Water rents	$3,087,661 59
Meter rents	276,575 47
Frontage	128,265 82
Amount collected by City Solicitor.....	43,555 83
Penalties	36,170 32
New connections	11,794 00
Searches	3,021 75
Miscellaneous	7,709 19
Total collections 1903.....	$3,594,753 97
Total collections 1902.....	3,459,090 72
Net increase 1903.....	$135,663 25

Expenditures.

The expenditures for maintenance, service mains, etc., were	$1,463,165 14
Expenditures for improvements and extensions	5,866,448 73
Total expenditures during 1903	$7,329,613 87
Total expenditures during 1902	6,511,934 83
Total increase of 1903	$817,679 04

In addition to the above, $207,720.75 were expended on the construction of the High Pressure Fire Main Service, which is not an item that is properly chargeable to the Water Bureau, and is therefore not included in the expenses of that branch of the service.

For several years past unpaid bills have been carried over and included in the items paid in the succeeding year, some of which were greatly increased by the additional cost of coal during the strike of the anthracite coal miners, and during the past year by the increased price of coal, and also other items which have been included in a deficiency bill to be paid during the current year. This, in a measure, accounts for a reduction of expenditures during 1903 for maintenance, amounting to $205,036.62.

Net Earnings of the Water Bureau.

The total revenue from water rents, etc.,

The total revenue from water rents, etc., from the installation of the water works up to December 31, 1903, was	$83,798,650 26

The total expenditures for maintenance,

The total expenditures for maintenance and construction, including the amounts paid for the improvement, extension and filtration of the water supply, were	$63,828,483 46

Net profit earned by the Water Bureau

Net profit earned by the Water Bureau from the installation of the water works up to December 31, 1903, was $19,970,166 80

Increased Consumption.

The total consumption during 1903 was 119,456,525,979 gallons, or, at an average rate of 327,278,153 gallons per day, an increase, as compared with that of 1902, of 13,285,511 gallons per day.

The average per capita consumption was 237.5 gallons, an increase, as compared with that of 1902, of 4.8 gallons.

The following table shows the average daily consumption of water in the several distribution systems named, and the average increase and decrease in each section:

Distribution Systems.	Average daily consumption in million gallons.	Average increase or decrease in million gallons per day.	Percentage of increase or decrease.
East Park.....	156,329,290	— 5.026	— 3.11
Belmont	38,950,428	+ 7.491	+ 23 81
Queen Lane.....	78,573,582	+ 7.406	+ 10.41
Roxborough.....	23.206,954	+ 3.371	+ 16.98
Frankford.....	30,194,817	+ .040	+ 0 13

By the aid of the additional pumpage of 8,000,000 gallons of water per day at the Fairmount Station during the summer and fall seasons, as previously stated, an unusual opportunity was presented to make many repairs to the pumping machinery at the Spring Garden Station, and the apparent decrease of a little over 5,000,000 gallons in the daily consumption in the East Park system, shown above, is due to the better condition and more effective work performed by the pumps at these works—in other words, more water was pumped for each revolution registered by the engine counter.

In the Belmont system, a considerable increase of nearly 7,500,000 gallons in the consumption is shown by the pumpage records, but while there can be no doubt that the demands for water in this section were considerably in excess of those of the preceding year, necessitating the constant service of one or more of the old pumps, in addition to the three new Holly engines at this station, a greater part of this increase, as registered by the old pumps, is chargeable to "slip" and to "short stroke" of the old engines, and another part to the large quantity of water consumed during the construction and testing of the Belmont filter basins.

In the Queen Lane system there has also been a considerable increase of more than 7,000,000 gallons per day, and inasmuch as the pumps supplying this section were in better condition than during 1902, the additional consumption is fairly chargeable to increased use and waste of water, the latter being due to a better filled reservoir and corresponding greater head on all appliances wasting water.

In the Roxborough system there was an increase in the consumption of twenty-eight (28) per cent., or nearly three and four-tenths (3.4) million gallons per day, which is partly chargeable to the water used at the Upper and Lower Roxborough filtration plants for sand and sponge washing, and to the water overflowing and being permitted to run to waste from the filtered water basins. The latter practice has been discontinued, but since the inception of the filter plants it has been found possible to filter more water than was anticipated, and in the desire to utilize this additional capacity of the filter basins, the boundaries of both the Upper and the Lower Roxborough filter districts have been extended far beyond their original lines, and the pumping facilities at the Roxborough station are now inadequate to

meet the demands of this extended district during the seasons of maximum consumption.

The same conditions in reference to using old and antiquated pumps exist at this station as at the Belmont Works.

The three low-duty engines, Nos. 1, 2 and 3, are great coal consumers, but their worst feature is that while they are rated as having a total pumping capacity of 16.5 million gallons, the most effective result that can be obtained from them, as ascertained by measurement with a Venturi meter, is 10,725,000 gallons per day.

These engines should be discarded and replaced with new pumps of the best modern construction.

I have already referred to the necessity of providing additional boilers at this station. Prompt action in this matter will provide steam power for operating all four of the new high-duty pumps, instead of three, as is now the case, and thus assist materially in meeting the demands for water from this station.

In the meantime, two new engines can be constructed, and possibly be ready for service in 1905.

All of this work, however, must be completed before the three old pumps mentioned above can be removed and replaced with three new engines. The latter should be ready for erection immediately upon the completion of the two new pumps referred to early in this report.

I cannot too earnestly state the importance and urgency for providing all the additional pumping facilities named above, and which are absolutely requisite to meet the present and the immediate future demands for water from this station.

In the Frankford system there was practically no difference, as shown by the pumpage records, in the quantity of water consumed as compared with that of the preceding year, indicating a more effective operation of the pumping machinery at this station during the past year.

The following table shows the per capita consumption in the several water systems for the years 1902 and 1903.

These data are compiled in the usual way from the pumpage records and the estimated population.

The results obtained include consumption and waste of water, and while the consumption, or water used, increases little from year to year, the quantity wasted not only becomes greater rapidly, but fluctuates considerably during the quarterly season. It also varies with the height of the water in the reservoirs, for with full basins the head is greater and more water distributed, and wasted from leaky fixtures and others turned on for no useful purpose.

Per Capita Consumption.

Distribution Systems.	Gallons. 1902.	1903.
East Park	243	231
Belmont	203	246
Queen Lane	233	251
Roxborough	197	225
Frankford	244	239

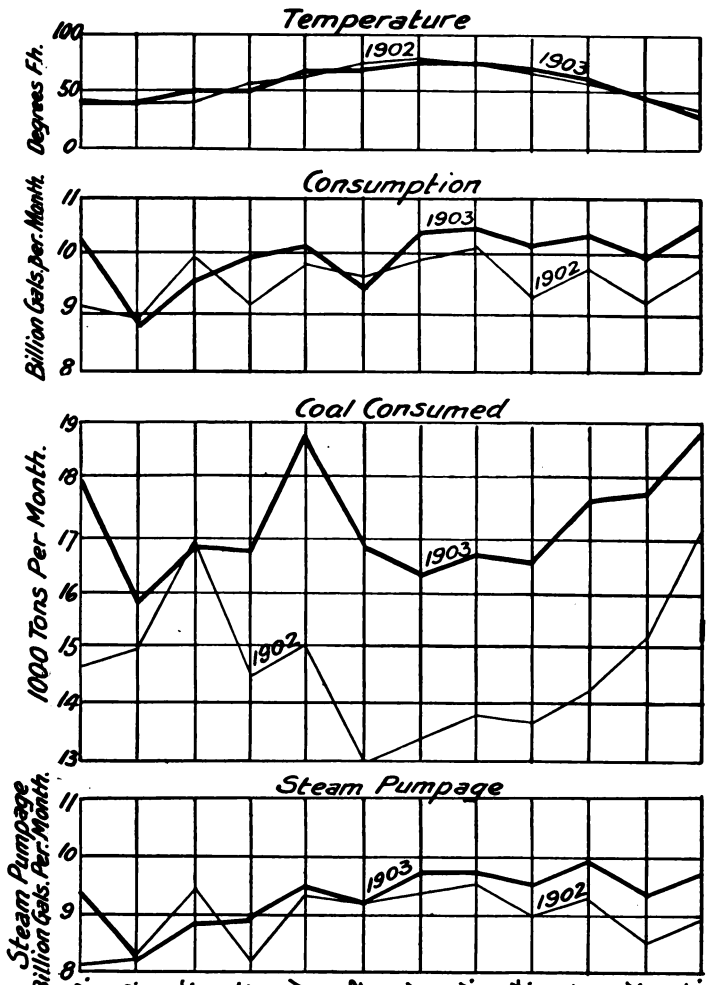
Pumpage.

The total pumpage from rivers and the supplementary pumpage to the high level districts was 124,015,934,669 gallons, an increase of 7,217,510,169 gallons over that of the preceding year.

Ninety-four (94) per cent. of the total pumpage was by steam power, and the other six (6) per cent. by water power.

The average cost of pumping one million gallons one hundred feet high was $5.20, an increase of 40 cents per million gallons, due to a greater consumption of coal and its increased price, as well as that of other materials used in operating pumping machinery, also to the greater amount expended for repairs.

The following diagram shows the temperature, consumption, coal consumed and steam pumpage for each month, in comparison with that of 1902:



Meters.

In many respects the present condition of the meter service is extremely unsatisfactory, and, in a measure, it seriously affects the proper adjustment of the water rent charges.

The Bureau is hampered by the lack of funds necessary to comply with the requirements and conditions stated in the ordinances of Councils, as, for instance, whenever there is an alleged excessive charge for water rents, the ordinances are mandatory to place meters on all connections "where the source of supply is both public and private." Also, in all cases "where there is an alleged non-use of existing appliances," but this Bureau, having no meters, cannot comply with the ordinances governing these matters.

There are also cases where water-takers are engaged in manufacturing business and have numerous water appliances, or a reserve boiler and engine power, which are necessary in case of accident, etc., to insure the continued operation of their business, and they prefer to pay by meter rates, as is done by numerous others under similar circumstances, but, for the reason stated above, the Bureau is obliged to deny them this privilege, and to charge full rates for reserve fixtures.

It is furthermore highly desirable to place meters on all private fire connections in order to check their use for any purpose other than the extinguishment of fires, for which the city furnishes the water free of charge.

In many other respects the meter service is unsatisfactory to the consumer and to the interests of the city, and either sufficient means should be provided to make a proper and just application of the meters, or this service should be abolished and all water rents charged at schedule rates.

A reduction, approximating about 20 per cent., should be made for deficiency in the quantity of water actually

pumped during 1903, due to the age, slip and wear and tear of the machinery. To this should be added about 5 per cent. for water used for municipal purposes, which would leave a balance approximating 89.6 billion gallons of water actually furnished to consumers for use and waste.

On this basis the total revenue received by the Bureau during 1903 amounted to 4 1/100 cents for each one thousand gallons, and on the same basis the cost of pumpage, including all expenses for the maintenance of the Bureau amounted to 1.633 cents for each one thousand gallons. The net profit, therefore, amounted to 2.377 cents per one thousand gallons.

It is not to be supposed, however, that if the water were furnished to consumers through meters that they would willingly pay to any considerable extent for water wasted, and the latter would soon be reduced to within reasonable limits, which probably would bring the consumption down to fifty billion gallons, which, at the present meter rate, would only produce a revenue of about $2,000,000, as against $3,422,932.32, the amount received during 1903.

It thus appears that if meters were in general use the city could not afford to furnish water at 4 cents per each one thousand gallons without incurring considerable loss of revenue, which should be large enough to provide for all extensions as needed from year to year, and I am of opinion that the meter rate should be increased to at least 8 cents for each one thousand gallons of water supplied to consumers by meter.

I am also of opinion that for manufacturers and other large consumers of water (not including private dwellings) a reduction should be made in the rates, as is now done in many cities as well as in all commercial and business transactions, in proportion to the quantity of water consumed; or, in other words, there should be a sliding scale of prices, graded according to the consumption, which

would give the large consumer the advantage always expected in extensive business enterprises.

As previously stated, this Bureau was unable to furnish meters to all applicants, and in many instances meters were purchased by the consumers, and, after approval, were set in place by city employees. In many cases advantage was taken of the provisions of ordinance of 1901, by owners of private dwellings, to have meters placed on the connections supplying their premises.

During 1903 the city purchased and placed 22 meters on the connections supplying private residences, and owners of similar properties purchased, at their own expense, 237 meters, which were tested and installed by city employees.

As a matter of course the desire of the purchasers was to save water rent, and the following results show that they were exceedingly successful:

The total revenue that would have been collected by schedule rates on the 259 metered residences would have been $4,106.50. The meter rents, estimated from the quantity of water registered, were $663.49, to which should be added the excess of the minimum charges for each meter, where they exceed the cost of water actually consumed, amounting to $756.53, making the total receipts from these metered properties $1,482.73, or $2,623.77 less than the water rents by schedule rates.

On these residential properties the total consumption during the year was 16,582,500 gallons; the average was 45,404 gallons per day, and if we assume a population of four persons at each house, the average daily consumption was 43.8 gallons per capita.

This shows how small a quantity of water is required for all household purposes, and in many cases a large percentage of the residences throughout the city where no meters are now used there is doubtless an equally small consumption of water. Only from 17 to 20 per cent. of the total

number of properties are chargeable with the great waste of water which is so unnecessary and useless and so desirable to check, but there is no way to accomplish this purpose except by arbitrarily selecting locations and applying the meter, a method which is objectionable because of its lack of uniform treatment of the water consumers.

The whole question of the use or non-use of meters is a legislative matter, and the above statements are given to show the present condition of the service.

The increase in the number of meters installed in 1903 was 315, making the total number in use at the end of the year 1775.

High Pressure Fire Service.

The practical completion of the High Service Fire System within the limits of the business section of the city makes a distinct advance in the problem of extinguishing fires.

Half a century ago great progress was made in this respect over the old "hand-power machines" by the advent of the "steam fire engine," and this beautiful and almost perfect mechanism, limited in power only by its size, has most effectually performed its work; but the rapid growth of the city, and a corresponding increase of the business interests of individuals and corporations has made it necessary to erect great buildings that tower far above the older structures and beyond the reach of the limited streams of steam fire engines.

It has thus become necessary to provide a service for fighting fires within these high buildings, and to more effectually extinguish them in adjoining structures, which, owing to their inflammable construction, are a source of great danger.

A radical departure was therefore made in the designing of the new fire system by making the engines stationary and

of great power, in order to force water through mains to any point within the district covered by the fire main distribution system.

These stationary engines are well housed and ready to start immediately and effectively upon the first sound of the alarm, which is a great advantage over the steam fire engine, which is liable to accident, delay by storms, loss of time in transit over long distances, and exposed to winter weather. Furthermore, the new fire main system has the advantage of being under a constant pressure of seventy (70) pounds to the square inch, so that at any time a hose stream can be turned on during the important early stages of a fire. In fact, the whole arrangement is almost automatic up to the point of attaching the hose and directing the streams on to the fire.

The following is a description in detail of the engines and engine house:

The new building for the High Pressure Fire System, at the corner of Delaware avenue and Race streets, is now completed and all the engines and pumps are connected and ready for service.

The contractors for the foundation and building were Messrs. Henderson & Co., Limited.

The work of tearing down the old building occupying the site was begun on November 10, 1902, and completed on November 29, 1902, at which time the excavations for the foundation were begun.

The excavation over the entire area of the building was first carried down to elevation —5.5 C. D., and the pump well to elevation —7.5 C. D.

When a level of —5.0 C. D. (which corresponds to a depth of 5 feet below the present sidewalk on Delaware avenue) was reached, a mass of old oak timbers, 24 x 26 inches, was encountered, together with caissons built of oak timbers and filled with stone.

A corduroy road built of oak saplings, remarkably well preserved, extended across the entire width of the building on the Water street front.

The party wall of the adjoining building was found to be built upon what may be called a combination foundation. On the Delaware avenue front the wall was of capped piling; further back, or about half way to Water street, cribs filled with stone were found, and from Water street to a point 105 feet from Delaware avenue, the party wall was founded on gravel. At the peak this wall was 60 feet above the foundation of the new station.

The discovery of these obstacles opened a discussion as to the character of the foundation to be adopted, and soundings were taken over the entire area from Delaware avenue to Water street, and a profile made showing the underlying conditions. Gravel was found at elevation —2 C. D. at Water street, and at —12 C. D. at about half way to Delaware avenue, and at Delaware avenue gravel was found at elevation —20 C. D.

It was impossible to take soundings in regular lines, as the drill struck the timber caissons, old piles, etc., in every direction.

In view of the existing conditions a pile foundation was considered impracticable, and a concrete foundation, reinforced with steel rods, was decided upon as a means of avoiding any possible settlement.

The weight on the foundation is that of the four building walls with steel roof trusses, 7 large gas engines, each weighing 90,000 pounds; 2 small gas engines, each weighing 35,000 pounds; 7 large pumps, each weighing 49,000 pounds; 2 small pumps, each weighing 25,000 pounds; the brick work and large granite cap stones, each 1 foot thick, forming the foundations for the engines and pumps, or a total estimated weight of about 800 tons to be distributed

over an area of about 6,500 square feet, or not quite $\frac{1}{10}$ ton for each square foot.

Over 1,700 cubic yards of concrete and 5,000 pounds of steel rods were used in the foundation, which was deposited in layers of 9 inches, a large force of men being employed in order to complete a layer of this thickness over the entire area of the building, 72 x 138 feet, in one day. The work was started in February, 1903, and carried on continuously until completed, levels being constantly taken in order to detect any possible settlement. Levels were also taken during the erection of the engines and pumps and until the final completion of the plant, and no sign of settlement found.

The difficulties encountered in constructing the foundation of the building were also to be contended with in the building of the stop house near the bulkhead at the river, also in laying the 36-inch suction main from the river across Delaware avenue to the station. Here the difficulty was met by sawing off the piles to the grade of the main and forming caps on the heads of them for the pipe to rest upon.

Owing to the heavy traffic on Delaware avenue during both day and night, not more than 20 feet of ditch could be opened at one time.

Building operations were seriously interfered with by labor dissensions, and by a fire in the plant of the Dauphin Bridge Company, which twisted all the roof trusses, necessitating new ones being made, involving a delay of two months.

The building above the foundation is of an Italian style of architecture. The exterior walls are of dark red pressed stretcher brick, made in Philadelphia, with cornices of terra cotta matching in color. The roof covering is of slate and copper, supported by steel trusses.

The interior walls are lined with buff brick, with a dado

of dark brown enamel to a height of 7 feet above the floor level.

The floor is of cement, with an 18 inch border of red tile. At the water street end of the building there is a vestibule, a waiting room, an office and a bath room.

The building is heated by steam, there being 20 radiators distributed throughout it. The heating system was put in by the Bureau of Water.

At the Water street end is a vault for the storage of coal for heating purposes and oil and grease for use on the machinery.

The building is remarkably light during the day, there being large plate glass windows along the Water and Race street and Delaware avenue fronts.

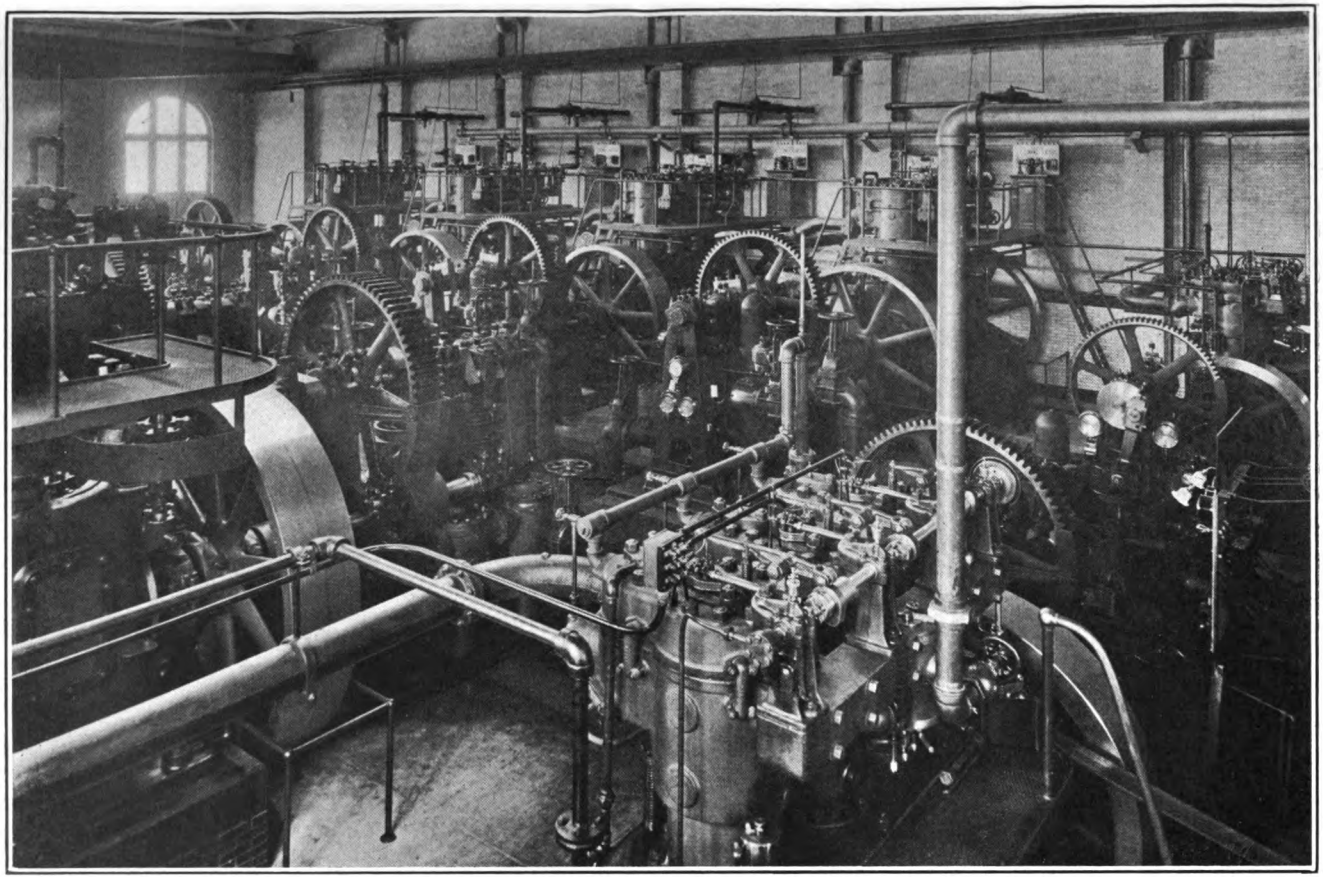
For lighting at night there are combination gas and electric light fixtures with 170 incandescent electric lights and 30 gas jets on the combination fixtures on the pilasters, affording ample light at all times, the entire system being controlled from one switchboard.

The building is wired for 210 16-inch c. p. 110 volt lamps. The system is a three wire Edison system, with an eight wire branch circuit tablet board placed in the office.

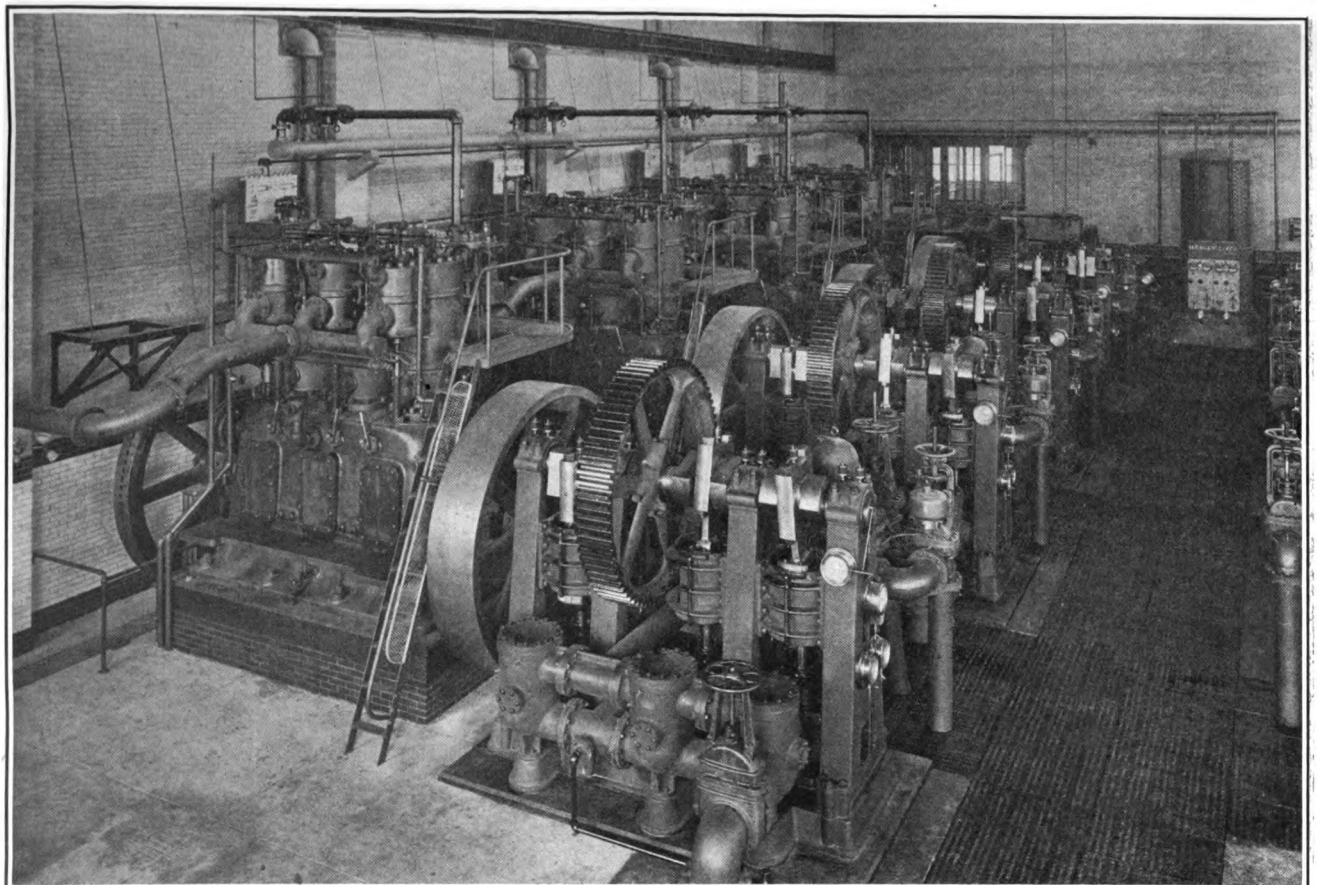
Each branch circuit has 24 16-inch c. p. volt lamps. These lamps are distributed throughout the building as follows: 140 on the ceiling, 28 on 14 columns, 12 on the side wall, 8 under the office and 22 in the office.

All wires are run in lorricated pipes concealed in the side walls, with a bossett box at each terminal. Each circuit is controlled by a 25 A. T. P. knife blade switch and cartridge fuse placed on the tablet board.

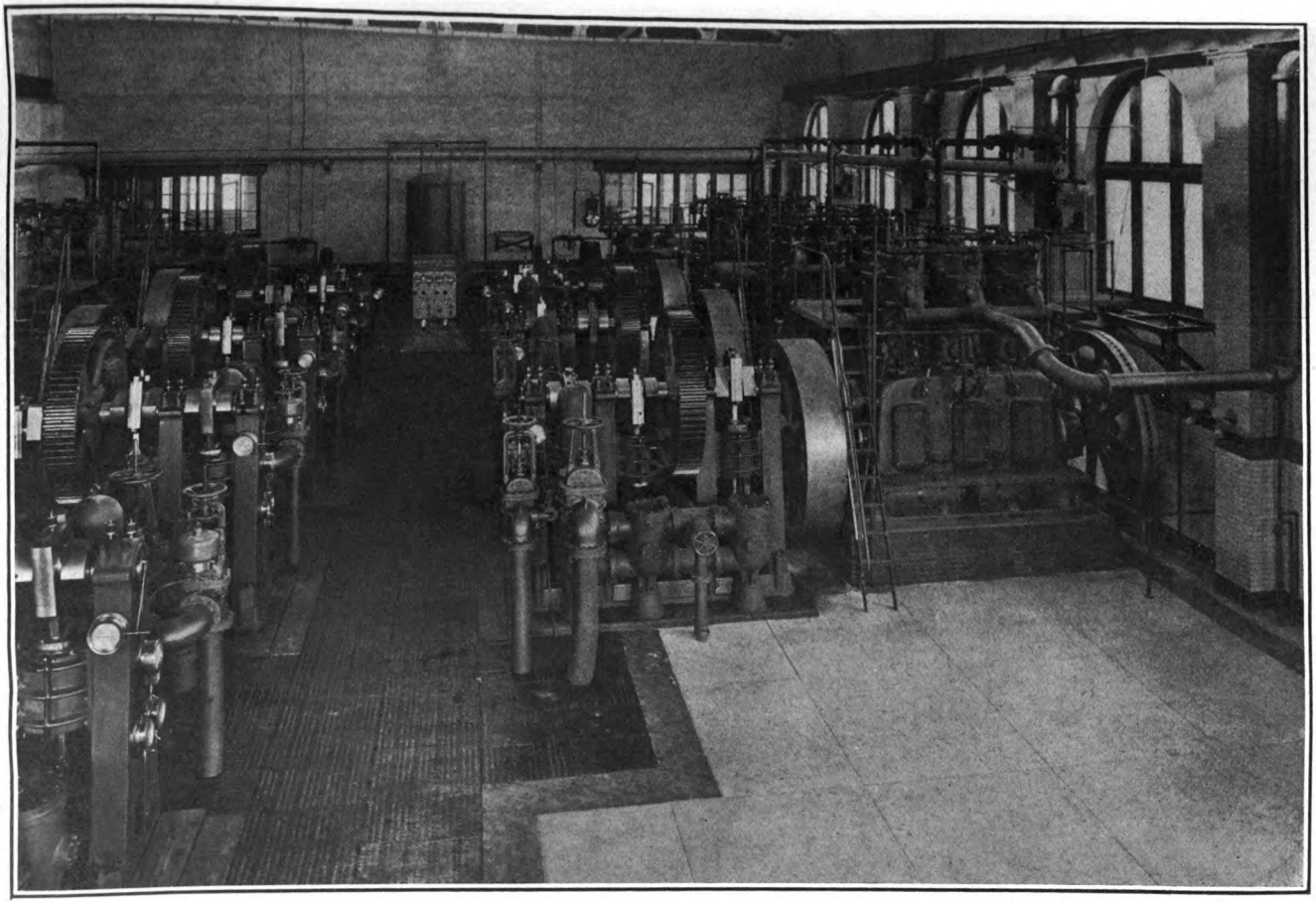
The mains are connected to the tablet board with a 300 ampere T. P. knife blade switch and fuse. A main fuse block is placed where the service enters the building.



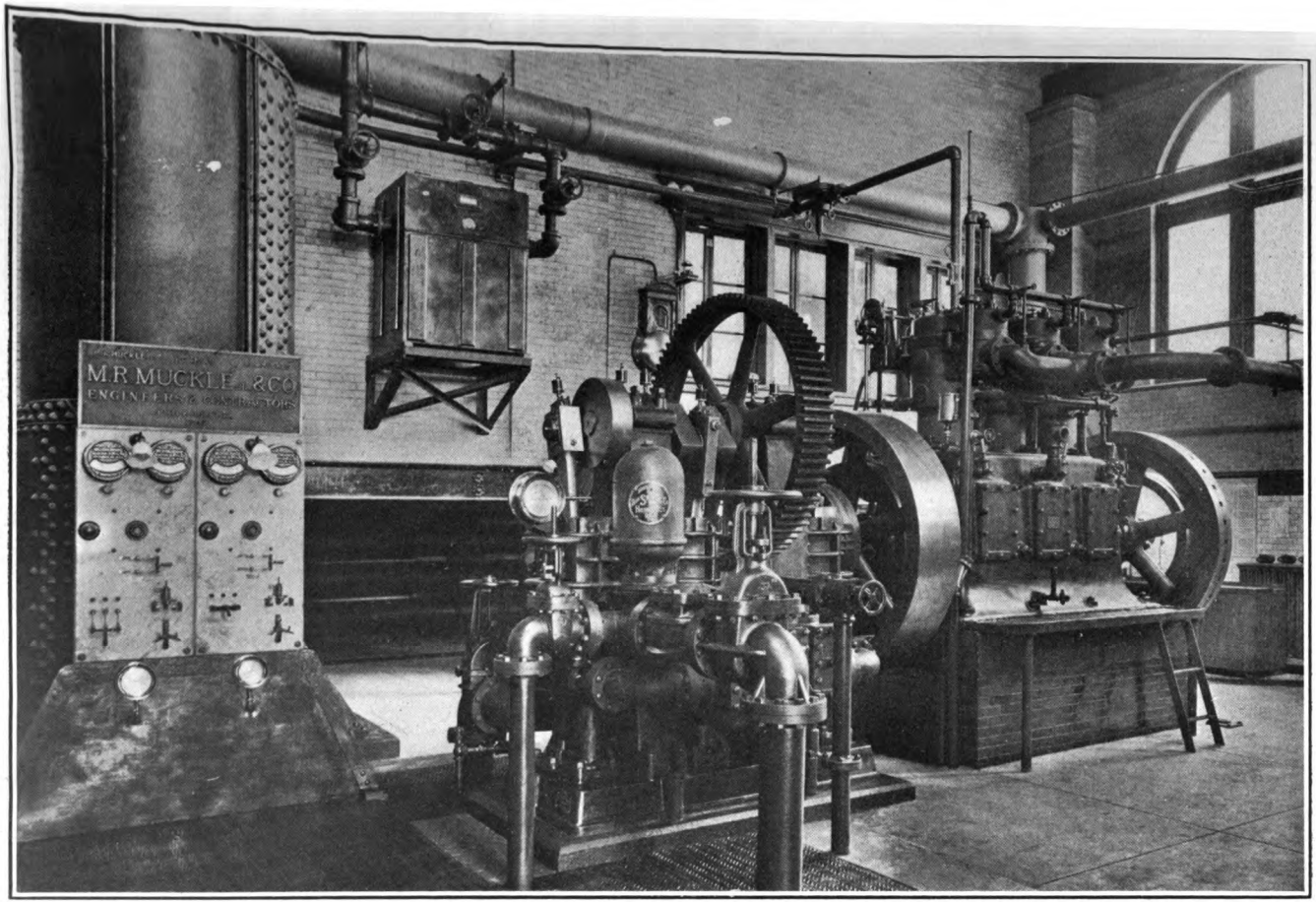
View in Engine Room from Gallery



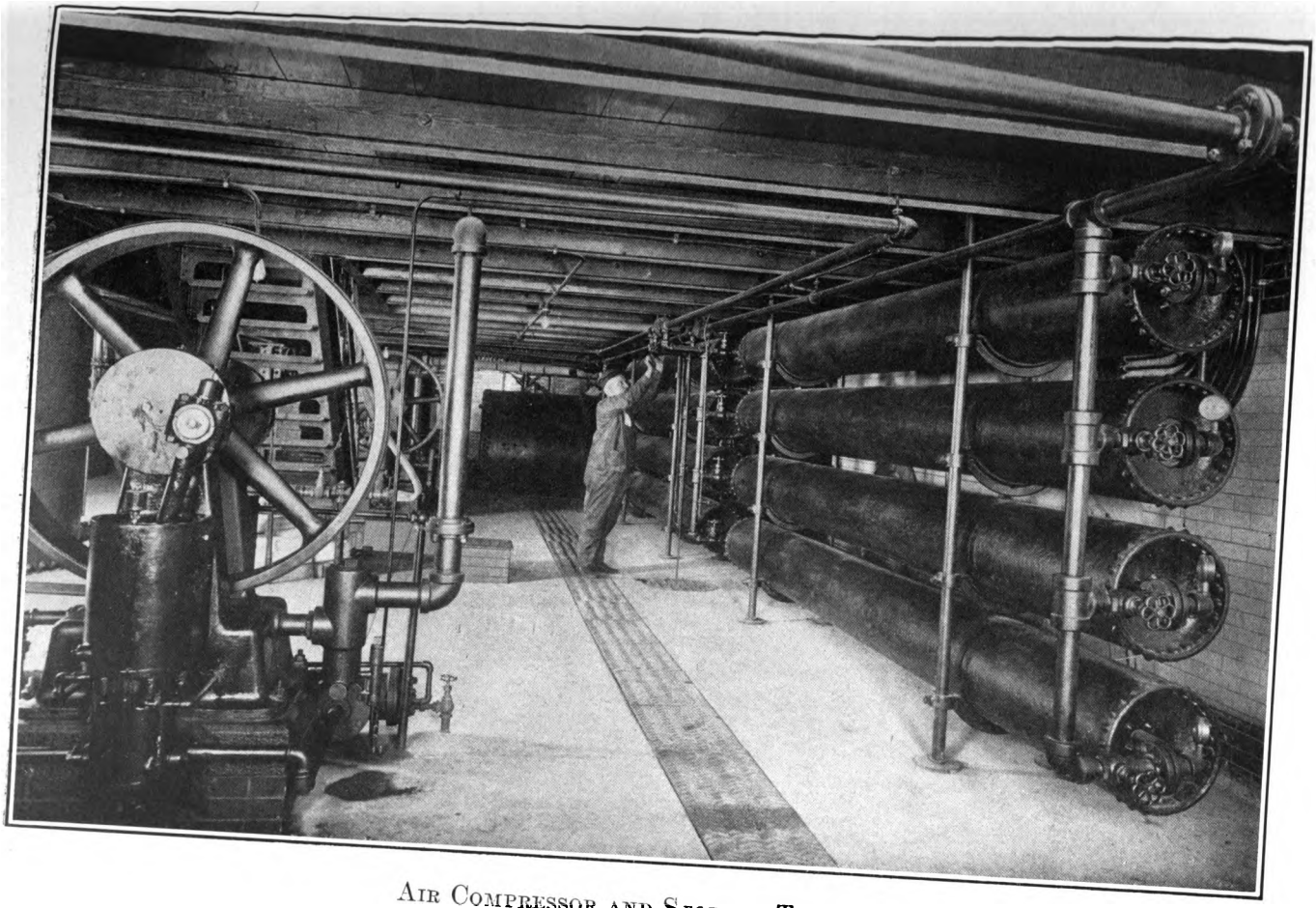
View in Engine Room from Entrance, Showing South Line of Engines.



View in Engine Room from Entrance.



ONE OF THE SMALL GAS ENGINES AND PUMP, SWITCHBOARD AND GAS METER.



Air Compressor and Storage Tanks.

Machinery.

The pumping plant in the building, including foundations, etc., was contracted for by Messrs. M. R. Muckle, Jr., & Co., of Philadelphia, and consists of 9 three cylinder 4 cycle gas engines, made by the Westinghouse Co., East Pittsburg, Pa.; 9 triplex double acting pumps made by the Deane Steam Pump Co., of Holyoke, Mass.; two air compressors, two 220 volt dynamos, 9-15 inch diameter, air tanks, gas and air pipes, suction and discharge mains, one large steel plate air chamber on the discharge main, ignition batteries for each engine, and relief, safety and suction valves on each of the pumps. The relief valves are of ample capacity and can be adjusted to any pressure from 150 to 300 pounds per square inch.

The construction of the engines was completed on May 28, 1903, when a satisfactory running test of two of them was made in my presence in the machine shops of the Westinghouse Co. I was accompanied by Mr. John E. Codman, Chief Draughtsman of this Bureau, and Messrs. M. R. Muckle, Jr., and T. C. Smith, representing M. R. Muckle, Jr., & Co.

The engines were erected upon temporary foundations and connected, for fuel, to the natural gas supply from the wells on the Company's property.

To produce the required resistance a Prony brake was arranged on the end of the main shaft of each engine, the brake H. P. varying from no load to 140 H. P., which was one-half the full load, to 280 H. P., full load, to 300 H. P., over load, and 310 H. P., excessive over load.

The last trial was to test the governors for control of the speed, the load of 300 H. P. being instantly thrown off. The engine was under control without any very perceptible increase of speed.

All the tests were perfectly satisfactory. A careful in-

spection of the other engines was also made at the same time.

All of the engines were held on storage until July 17, pending the completion of the building. The last one was on the foundation on October 15, 1903.

The engines are started with compressed air admitted to the first cylinder, and they can be started and made to develop the full speed and pressure on the pumps (300 pounds per square inch) in less than one minute. The pumps can be put in operation by an engineer and two helpers in less than one minute for each engine.

The engines and pumps have been operated under water pressure trial tests of from 150 to 300 pounds per square inch for from 3 to 5 hours nearly every day since they were erected upon the foundations, discharging water into the overflow pipe through the relief valves operated by electric motors on each pump.

The trial tests were made for each engine separately and for four and five engines running at one time. Careful observations were made at these times of all fittings on the 20 inch steel discharge main, including the steel plate air chamber and connections to the stop valve in the 20 inch main outside the air chamber connections. All work was found to be satisfactory and no indication of weakness or of defective parts was found in the pumps or the fittings and connections.

Gas for the engines is furnished by The United Gas Improvement Company, and is the ordinary illuminating gas used by the city. It is brought from the 30 inch main on Front street by a 16 inch main on Race street and enters the building at the Race and Water street corner.

The quantity of gas consumed by the large engines is at present computed from the pressure recorded on the Bristol automatic recording gauge placed on the pumps by the Gas

Company. The small engines have gas meters placed on the supply pipes.

Each large engine is computed to consume from 0.617 cubic foot of United Gas Improvement gas containing 675 B. T. U. per cubic foot per revolution of the pump when working with only the suction pressure, to 1.79 cubic feet when working against a pressure of 300 pounds per square inch.

This computation is approximate, being dependent upon experimental data obtained under different circumstances with the use of gas containing 1000 B. T. U. per cubic foot. As a more satisfactory method of measuring the amount of gas consumed, the United Gas Improvement Company intends to place meters of its own design and construction upon each engine as soon as they can be finished.

Ignition.

The ignition system for the engines is supplied with current from three sources, the first being a primary battery, the second a small dynamo for 220 volts, and the third the regular Edison 220 volt current, taken from the street and put through a rotary transformer. Of the small dynamos there are two, each driven by one of the small engines. These two dynamos deliver their current to a main switchboard, from which lines are taken around the walls of the building to the igniter cabinets, of which there are nine, one for each engine. On this switchboard are also placed two switches connected to the Edison 220 volt main, one supplying current to the igniter cabinets and the other to the nine motor operated overflow valves, as will be explained later. The nine igniter cabinets are all alike, and a description of one will suffice for all.

The cabinet contains, in the first place, six cells of Edison-Lalande primary battery. These are connected to one end of a double throw switch, the center connections of

which switch are taken respectively through a spark coil to the igniters on the engine and to the metal of engine so as to form a grounded return through the igniter when this is closed.

By placing the switch in the downward position the engines are thus run from the primary battery direct. When the switch is thrown into the upward position it is connected to the middle point of a second double throw switch, one side of which is marked "emergency" ignition and the other side the "regular" ignition. The emergency ignition side is operated by current taken directly from the 220 volt dynamo through a bank of 220 volt 32 c. p. lamps, three of these lamps in multiple being ordinarily used so as to give about one and a half amperes of spark current. In the "regular" ignition position the switch receives current at 110 volts from the secondary side of a small motor generator which is set upon the top of the cabinet, the current passing through a similar bank of 110 volt c. p. lamps, three of these giving one and one-half amperes.

The motor end of this motor-generator is operated through the usual starting box from the center of a third double throw switch which has its two ends connected, one to the 220 volt station dynamo, the other to the 220 volt Edison mains. Thus these motor-generators take current at 220 volts and deliver it at 110 volts, this having been found to give the best general results as regards certainty of firing the gases with the minimum of wear upon the igniter points and of leakage through the insulation of the igniters.

The interposition of the double winding of the motor-generator also keeps all grounds from the Edison circuit when this is used, and also prevents one unit interfering with another. The connections of all the cabinets are so arranged that when running in the emergency position and taking current from the small station dynamos, the same

pole of the circuit will always be connected to ground or to igniter, no matter how the switch may be placed or how many engines may be running.

Everything about the igniter cabinets is so arranged that the attendant cannot by any combination of the switches get the Edison current and the station current thrown together or either of these into the primary battery. The wrong position of a switch may stop or affect the working of that particular engine, but cannot interfere with any other.

For operating the motors on the overflow valves, current is taken only from the Edison 220 volt circuit through the second switch already referred to on the switchboard. From this switch the current is led to each of the seven large pumps, and there is taken through a reversing switch to a small half horse power series wound motor connected by a train of gears to the overflow valves. These motors are so arranged that when it is desired to close the valve, by throwing the switch into one set of contacts the motor will start up and close the valve when the motor will be pulled up, but current may be left flowing without injury to the motor. On placing the switch in the other set of contacts the motor will start up in the reverse direction and open the valve. To provide for the extra effort required to open the valve when it has been shut tight, the last gear in the train, or the one which operates the nut which permits the motor to start up and get full speed before it has any work to do, so that when the lost motion has all been taken up, the inertia of the armature under full speed is used to start the valve. The lost motion similarly takes care of the valve in starting it from the open position to the closed.

Capacity of the Station.

Two of the pumps are of 350 gallons capacity and 7 are of 1,200 gallons capacity each per minute, making the

total capacity 9,100 gallons per minute, or 1,211 cubic feet per minute, or 32 cubic feet per second, with provision for increasing this quantity to 12,700 gallons per minute, with a pressure of 300 pounds per square inch.

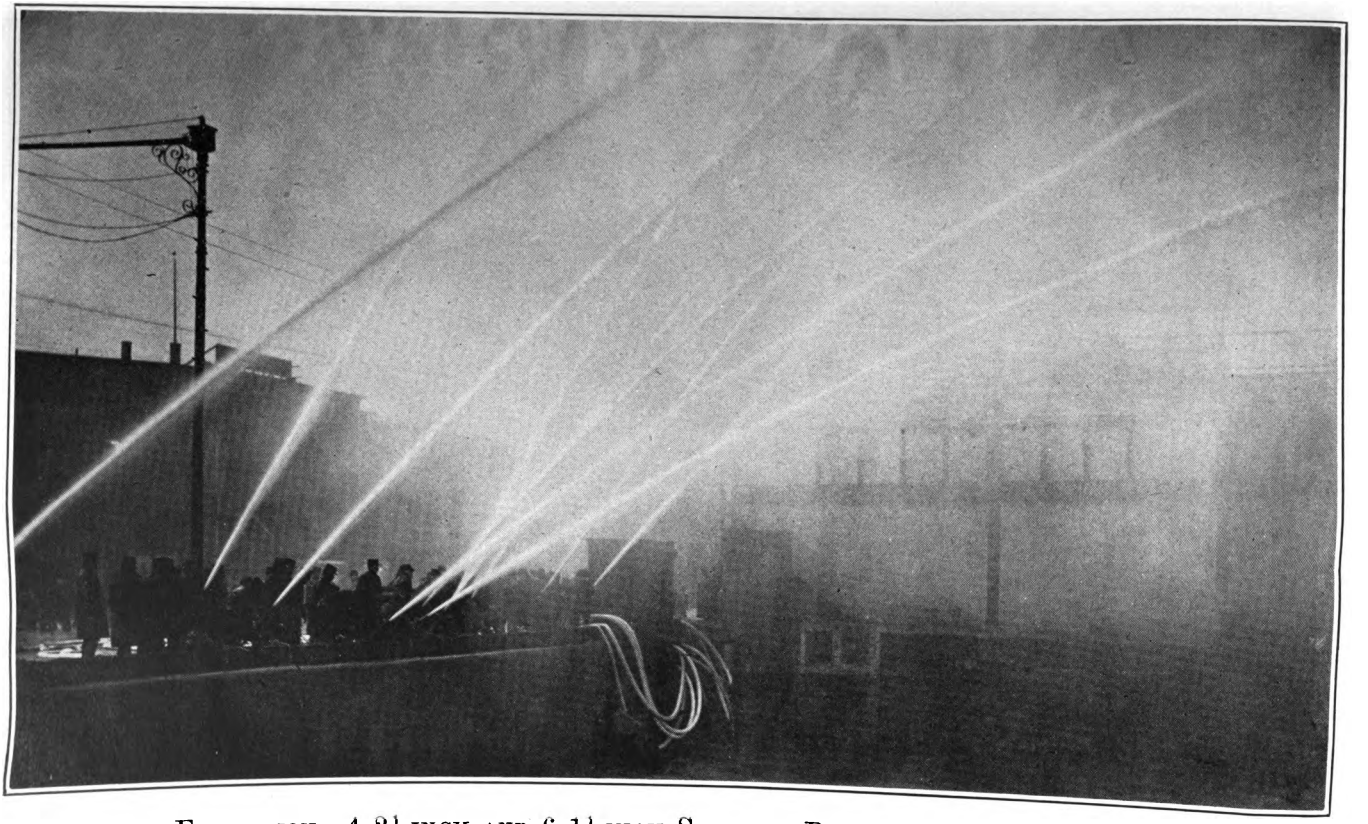
On December 10, 1903, a test of the capacity and power of the engines and pumps was made at the Race street wharf by Mr. J. C. Baxter, Jr., Chief of the Bureau of Fire. Four lines of 3½ inch rubber lined hose were attached to the fire boat connection at the river front, with one 2 inch diameter nozzle on each line of hose, and the streams directed into the river. Four pumps were put in operation, with a pressure of 150 pounds per square inch, which was gradually increased to 200 pounds, when it was seen that any further increase would be dangerous for the men holding the nozzles, as one of them had already slipped from its position and severely injured the fireman holding it.

The four streams were thrown to an estimated height of from 150 to 200 feet. The volume of water passing through the four nozzles was somewhat less than 5,600 gallons per minute, as the relief valves on the pumps were not entirely closed.

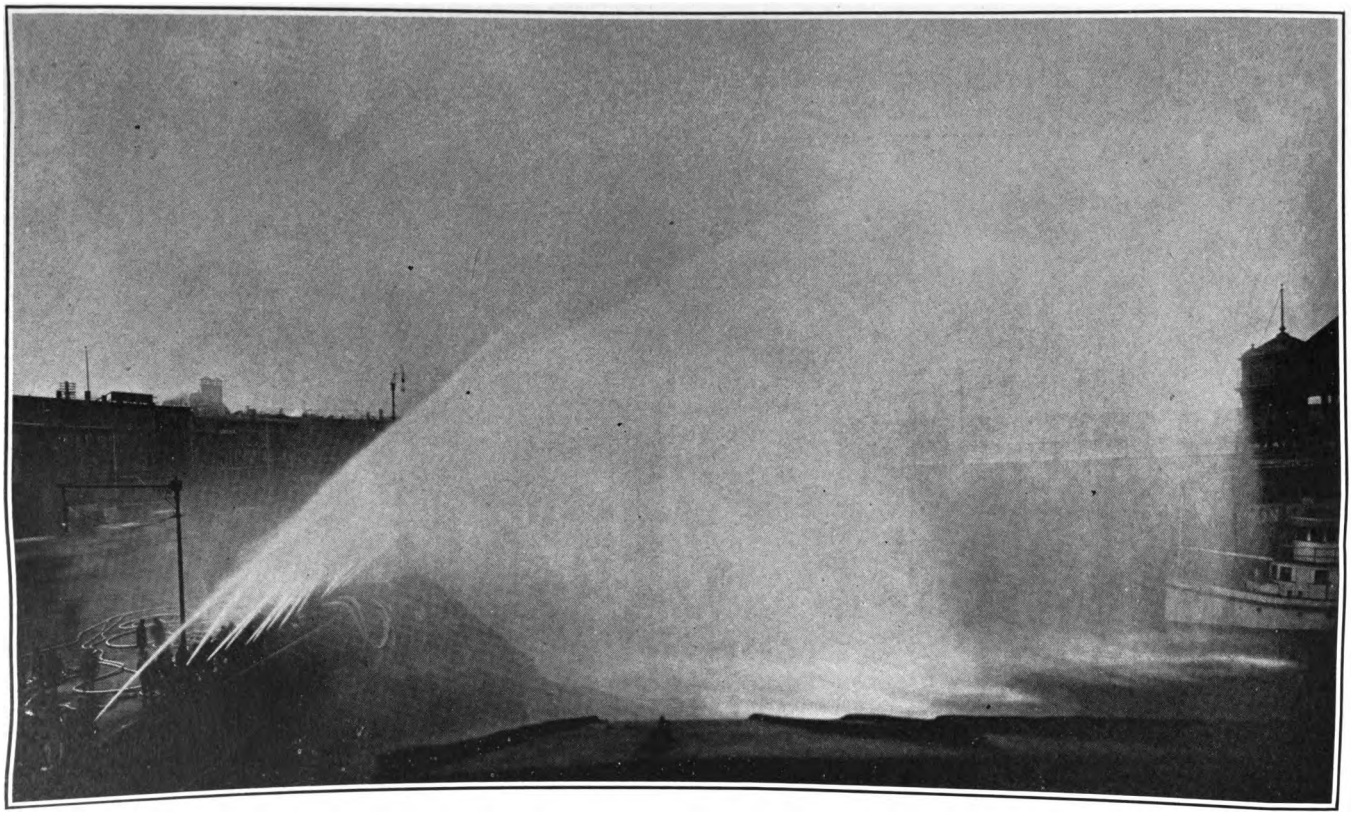
Fairmount and Flat Rock Dams.

The repairs to Fairmount dam have been limited to replacing such fender logs as were loosened and washed away by the action of the water, and to such other minor work as could be done with the limited force and materials available for the purpose.

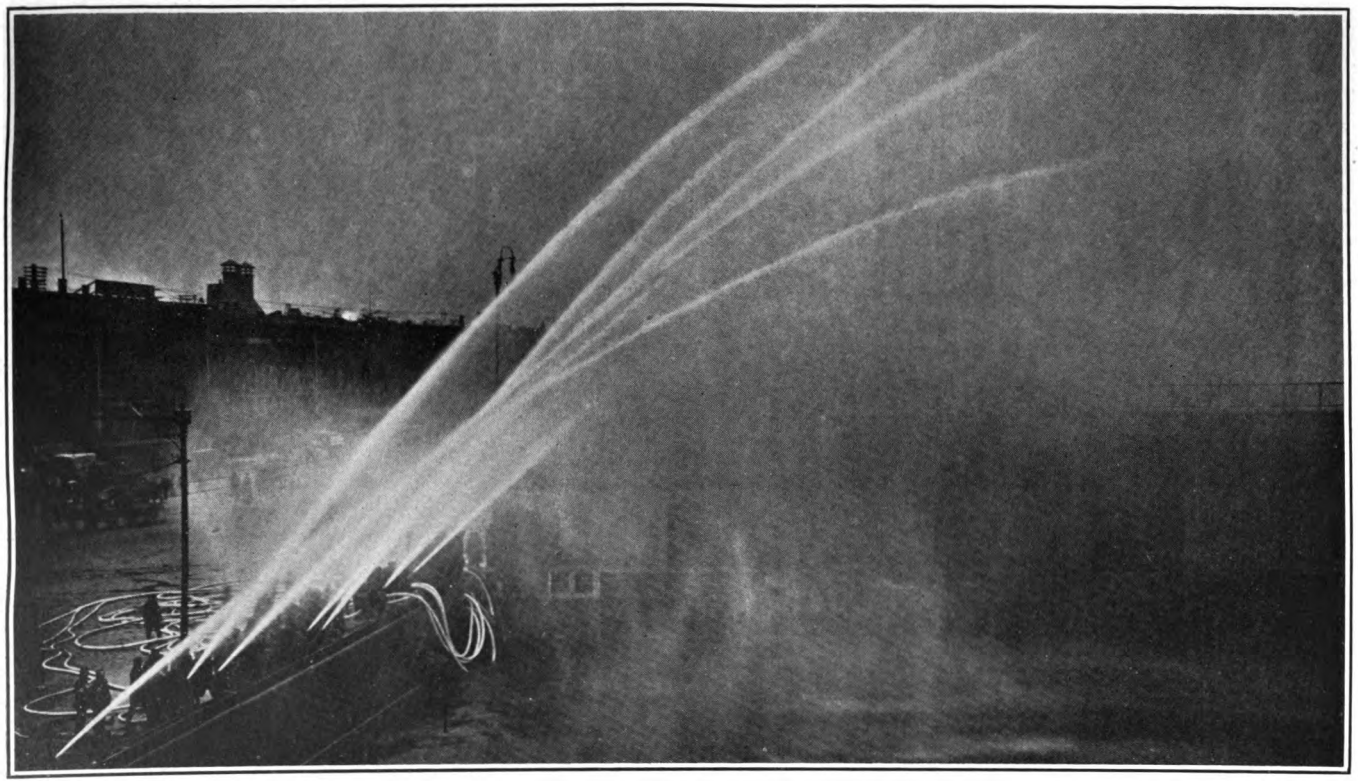
In my previous reports I have frequently referred to the necessity for making extensive repairs to this important structure, which at no time can receive too much attention, and which, in its present condition, endangers 83 per cent. of the City's water supply.



EXHIBITION—4 2½-INCH AND 6 1½-INCH STREAMS, DELAWARE AVENUE, APRIL 6.



EXHIBITION—4 2-INCH AND 12 1½-INCH STREAMS, DELAWARE AVENUE, APRIL 6.



EXHIBITION—4 2½-INCH AND 4 1½-INCH STREAMS, DELAWARE AVENUE, APRIL 6.

EXHIBITION—BROAD AND SANSOM STREETS, APRIL 20.

The repairs made by the Schuylkill Navigation Company to the Flat Rock dam, which broke in 1902, have successfully withstood the wear and tear of several freshets during the past year, but this dam is in too precarious a condition to allow it to remain as it is without taking some action to safe-guard the water supply to the northwest section of the city.

Both these structures should receive immediate attention, with a view to placing them in a strong and durable condition.

Fairmount Station.

The total pumpage at Fairmount station was 7,736,381,403 gallons, or 113,899,184 gallons in excess of the quantity pumped during 1902.

The cost of pumpage was $3.12 per million gallons, an increase of $1.19, due to the unusually extensive repairs to machinery, with corresponding expense therefor, at these works.

In February last the main shaft of No. 5 wheel broke, and before it could be shut down the broken shaft fractured the wheel chamber and twisted the pedestals and bearings.

A new cast iron shaft was purchased, with which to replace the old one, and the wheel chamber was repaired with boiler plate in a very substantial and satisfactory manner.

All the wheels are now in good condition and ready for service, but the old pump house, from defects in construction of the roof and leakage presents a most unsatisfactory appearance, and an appropriation sufficient for the purpose should be made to cover the needed repairs.

Spring Garden Pumping Station.

Since my last report all the engines at this station have been placed in fairly good condition.

The broken pump chamber on No. 3 engine has been re-

placed with a new one; the leaky joints between the pump barrel and suction chamber of No. 7 engine were caulked with copper, and many other like repairs have been made, greatly improving the efficiency of most of the engines at this station.

Belmont Pumping Station.

The engines, boilers and buildings at this station are in excellent condition. The grounds have been well cared for, and it is pleasing to note the interest taken on the part of the employees to keep this station in good order.

There have been a number of break-downs to the machinery, but these have all been repaired.

The left-hand low pressure cylinder of No. 4 engine was badly cut, and was re-bored; the low pressure rods of the right-hand cylinder were bent and were taken out and straightened; the air pumps were thoroughly overhauled and many minor repairs were made, greatly improving its condition.

The pumpage at this station has increased nearly 29 per cent., and during 1904, when the supply is to be taken at a higher level from the new filter basin, the demand for water will be considerably increased, as well as the work to be performed by the engines when pumping to the new raw water basin at the Belmont filter plant, which is 67 feet higher in elevation than the old reservoirs at George's Hill.

On September 3 the first water was pumped to the Belmont filter plant by engines Nos. 5, 6 and 7, and No. 4 engine has since performed a similar duty.

All of these engines worked easily and smoothly, but, as above stated, additional steam power will be required at this station to meet the demands for more water and to operate the pumps against the increased head.

Queen Lane Pumping Station.

The engines at this station have been in a far better condition than for a number of years past. There has been less trouble from the breaking of the intermediate pump chambers, while those of the new pattern have given no trouble. The pumps have therefore been in service a greater length of time, and the pumpage has increased 10.41 per cent., or at the rate of 7,491,000 gallons per day.

The machinery at the station is not, however, in a satisfactory condition. There are two cracked discharge chambers in No. 3 pump which should be replaced with new chambers; the main shaft of No. 1 engine is out of line and the intermediate crank is wearing at the pin so rapidly that the engine has to be shut down every two or three days to put in a new liner.

In order to repair this pump satisfactorily it will be necessary to shut it down for two or three weeks, re-babbit the bearings and bore them out in place.

The foundations of Nos. 3 and 4 engines need repairing, but no opportunity has presented to shut down the pumps long enough to accomplish this work, and for the same reason, several cracked breeches pipes on the pumping mains, which have been temporarily repaired with iron bands, are awaiting permanent repairs.

Roxborough Pumping Station.

The engines at this station have been operated during the past year to the fullest extent, and so great were the demands for water that it became necessary to erect and put into service the old 4,000,000 gallon engine which was purchased in 1899, and discarded after the construction of the four new Worthington High Duty engines, Nos. 4, 5, 6 and 7.

Even with this additional assistance it was difficult to furnish all the water required for the Germantown, Manayunk and Roxborough districts, and the "sponge and sand washing" at the Upper and Lower Filter Plants.

By measurements taken with the Venturi and Ferris meters, the four Worthington High Duty pumps, Nos. 4, 5, 6 and 7, were found to pump within from 2 to 4 per cent of the quantity recorded by the pump registers, while the Low Duty engines, notwithstanding every possible effort was made to obtain better results, did not pump within about 30 to 35 per cent. of the quantity registered.

The decrease in the expense of operating modern engines in place of those three old pumps, Nos. 1, 2 and 3, would almost be sufficient to purchase a new engine each year, so that in about from three to four years the amount saved would pay for the new pumps, and thereafter the savings could be used for other purposes.

Three new pump chambers for engines Nos. 4, 5, 6 and 7 have been furnished by the engine builders, and five more are under construction to replace a number in which the valve decks are cracked. In the meantime some of the valve seats, which could not be held in place, have been removed and the openings filled with hard metal and clamped with plates, top and bottom, held by through bolts, which unsatisfactory arrangement must continue until an opportunity presents to shut the engines down to install the new chambers. From all indications so great is the demand for water, this cannot be done until an additional engine is erected to take the place of the one to be repaired.

Frankford Station.

The pumping machinery at this station has given considerable trouble throughout the entire year.

There have been numerous accidents, necessitating ex-

tensive repairs, and, in general, all the pumps, with the exception of No. 1, are in a very unsatisfactory condition.

No. 2 pump was given a thorough overhauling and the foundations were partly rebuilt, but the flywheel still runs unsteadily, and this defect cannot be remedied except by placing heavy cast iron bed plates under the pedestals, or by using an independent air pump, which would relieve one side of the engine of the additional load of driving the present air pump.

The pump end of No. 3 engine is in a very leaky condition. Joints have blown out and new valves and valve seats are required in all the chambers. To do this work will require the dismantling of the entire pump, removal of the chambers to the shop, and, after machining, the reassembling of all the parts.

No. 4 engine requires a number of minor repairs, and we are awaiting an opportunity to shut it down to give it this attention.

There have been several serious breaks in the pumping main connections at this station, caused by excavation and settlement of the ground and shoring adjacent to the pipes during the construction of the new Lardner's Point pumping station and intake. At the present time two of the 30-inch connections are blanked off and are awaiting the completion of the intake before restoring them to their former condition.

High Service Stations.

The pumpage at the Belmont High Service station increased 35.7 per cent. during the past year. This was due principally to the greater demands for water for testing the filter basins at the Belmont filter plant.

The boilers and engines are in good order, but the pumpage is in a precarious condition, for only one of the engines is capable of pumping the quantity needed during seasons of maximum draught.

The pumps, boilers and engines from which the Roxborough High Service district obtains its supply are in good condition, and the boilers are furnishing steam for the Annex, or Upper Roxborough pumping station, in a very satisfactory manner.

The Wentz Farm is in most excellent condition. The d'Auria pump has been erected and operated as a low duty pump. Air pumps and a condenser have been made for this engine, and they will soon be placed in position. This engine will then be complete.

The Chestnut Hill station is out of service.

The Mt. Airy station is only used in emergency, in case of accident to the mains which supply the high levels of Germantown and Chestnut Hill.

Distribution.

The total quantity of new pipe laid for the distribution of water was 136,391 feet, an increase of 23,370 feet in excess of that laid in 1902.

There are many streets in which pipe should have been laid, but, owing to lack of materials, the Bureau could not do the work.

This delay is not only detrimental to builders, but it is a monetary loss to the city in water rents and in pipe frontages, which would otherwise have been collected.

Very respectfully yours,

F. L. HAND,
Chief of Bureau.

Comparison of Pumpage for the Delaware and Schuylkill Rivers for 1902 and 1903.

	GALLONS.		GALLONS.	
	1902.	1903.	Increase.	Decrease.
Annual pumpage:				
From rivers	114,460,164,379	119,600,619,200	5,140,454,821	
High service	2,338,260,121	4,415,315,469	2,077,055,348	
Total	116,798,424,500	124,015,934,669	7,217,510,169	
Maximum daily pumpage:				
From rivers	360,040,744	376,550,938	16,510,194	
High service	6,078,645	7,842,526	1,763,881	
Total	366,119,389	384,393,464	18,274,075	
Average daily pumpage:				
From rivers	313,589,491	327,672,929	14,083,438	
High service	6,406,192	12,096,755	5,690,563	
Total	319,995,683	339,769,684	19,774,001	
Average daily pumpage:				
From rivers, per capita	232	238	6	

Volume and Cost of Pumpage for the Years 1893 and 1903, Inclusive.

Year.	Number of gallons pumped.‡	Number of gallons pumped 100 feet high.‡	Cost per million gallons pumped 100 feet high.	Gallons pumped per capita per day.	Population estimated.
1893.....	65,352,736,978	110,590,708,479	$3 22	150	1,190,493
1894.....	72,073,724,238	121,190,588,387	3 48	159	1,238,112
1895.....	78,775,849,104	132,040,954,195	3 69	162	1,329,957
1896.....	87,693,642,529	161,776,711,713	3 43	172	1,367,815
1897.....	95,667,466,871	187, .71,927,277	3 16	185	1,385,784
1898.....	102,241,835,372	210,828,629,625	2 97	196	1,400,000
1899.....	107,991,371,604	231,813,686,728	2 90	199	1,425,843
1900.....	106,822,576,055	218,119,532,621	3 71	221	*1,293,697
1901.....	103,805,457,224	210,456,847,513	4 14	211	1,321,304
1902.....	116,798,424,500	239,693,545,013	4 80	232	1,349,500
1903.....	124,015,934,669	248,768,806,094	5 20	238	1,378,298

* United States Census.
‡ Including repumpage or high service.

Cost of Raising 1,000,000 Gallons 100 Feet during 1902 and 1903.

Pumping Stations.	1902.	1903.	Increase.	Decrease.
Fairmount	$1 93	$2 48	$0 55	
Spring Garden	4 46	5 16	70	
Belmont	5 70	5 40	.....	$0 30
Queen Lane	3 64	3 83	19	
Roxborough	6 29	6 70	41	
Frankford	6 50	6 93	43	
Average	$4 64	$5 04	$0 40	
High Service Stations.				
Belmont	$16 71	$12 72	.....	$3 99
Roxborough	8 69	9 17	$0 48	
Roxborough Annex	.....	8 63	8 63	
Mount Airy	111 75	221 76	110 01	
*Chestnut Hill	483 64	18,520 65	18,037 01	
Frankford	187 46	216 67	29 21	
Average	$18 02	$15 56	.....	$2 46
Total average	$4 80	$5 20	$0 40	

* This station is practically out of service.

Comparison of the Nominal, Maximum, Minimum and Average Daily Pumpage for 1902 and 1903.

Pumping Stations.	Nominal.		Maximum.		Minimum.		Average.	
	1902.	1903.	1902.	1903.	1902.	1903.	1902.	1903.
Fairmount	33,290,000	33,290,000	38,099,645	35,039,521	555,776	886,937	20,883,513	21,195,565
Spring Garden	170,000,000	170,000,000	160,922,400	159,402,160	35,401,620	82,518,740	140,373,758	139,393,260
Belmont	68,000,000	68,000,000	47,312,964	50,110,920	4,968,980	15,818,040	31,423,979	39,050,428
Queen Lane	80,000,000	80,000,000	81,713,800	80,990,750	22,545,100	17,527,800	71,152,173	74,361,253
Roxborough	31,500,000	35,500,000	29,190,930	30,702,720	209,595	5,278,755	19,595,946	23,330,099
Totals from Schuylkill	382,790,000	386,790,000	357,239,739	356,246,071	63,681,071	122,030,272	283,429,369	297,335,605
Increase		4,000,000				58,349,201		13,906,236
Decrease				993,668				
Frankford	57,000,000	57,000,000	42,050,635	43,920,980	19,754,270	5,627,190	30,160,122	30,337,324
Totals from Delaware	57,000,000	57,000,000	42,050,635	43,920,980	19,754,270	5,627,190	30,160,122	30,337,324
Increase				1,870,345				177,202
Decrease						14,127,080		
Totals from Delaware and Schuylkill	439,790,000	443,790,000	399,290,374	400,167,051	83,435,341	127,657,462	313,589,491	327,672,929
Increase		4,000,000		876,677		44,222,121		14,083,438
Decrease								

Comparison of the Nominal, Maximum, Minimum and Average Daily Pumpage, etc.—Continued.

High Service Stations.	Nominal.		Maximum.		Minimum.		Average.	
	1902.	1903.	1902.	1903.	1902.	1903.	1902.	1903.
Belmont	7,000,000	7,000,000	3,520,600	3,341,440	720,900	1,891,200	1,750,756	2,375,674
Roxborough	10,000,000	10,000,000	5,411,340	5,096,520	2,799,495	3,817,495	4,348,044	4,235,425
Roxborough Annex	.....	30,000,000	.....	11,361,666	.....	9,583,548	.....	5,289,535
Mount Airy	3,000,000	3,000,000	1,700,000	1,618,750	48,650	48,750	192,766	100,584
Chestnut Hill	750,000	750,000	600,248	78,720	73,800	36,900	19,134	519
Frankford	7,000,000	7,000,000	337,176	173,228	57,616	85,104	95,492	95,018
Total High Service	27,750,000	57,750,000	11,569,364	21,670,324	3,700,461	15,462,997	6,406,192	12,096,755
Total Daily	467,540,000	501,540,000	410,859,739	421,837,375	87,135,802	143,120,459	319,995,683	339,769,684
Increase	.....	34,000,000	.....	10,977,637	.....	55,984,657	.....	19,774,001
Decrease	.....	.....	.....	.....	.....	.....	.....	.....

The following appendices accompany this report:

A. Report of Chief Clerk.

B. Report of General Superintendent.

C. Report of Assistant in charge of Distribution.

D. Report of Superintendent of Construction and Repair Shop.

E. Report of Chief Draughtsman.

APPENDIX A.

REPORT OF CHIEF CLERK

Philadelphia, January 25, 1904.

MR. F. L. HAND,
Chief, Bureau of Water.

DEAR SIR:—I have the honor to transmit herewith a detailed statement of the expenditures of the Bureau, an itemized list of miscellaneous receipts, and a table of the revenues derived from the operations of the Bureau during the year 1903.

Yours respectfully,

J. T. HICKMAN,
Chief Clerk.

Detailed Expenditures of the Bureau for 1903.

General Appropriation.	Amount appropriated.	Amount expended.	Amount merging.	Amount not merging.
An Ordinance to make an appropriation to the Bureau of Water, approved December 20, 1902	$1,712,713 00			
Balance from books of 1902	10,220,182 84			
Additional appropriations and transfers	363,837 68			
	$12,296,733 52			
Diminished by transfers	13,104 00			
	$12,283,629 52			
Net appropriation		12,283,629 52		
Item 1. Salaries	$369,913 00			
Diminished by transfer	9,305 00			
Net appropriation to item		$360,608 00		
Chief of Bureau		6,000 00	$6,000 00	
Chief clerk		2,000 00	2,000 00	
Assistant clerk		1,200 00	1,200 00	
Correspondence clerk		900 00	900 00	
Time clerk		1,000 00	970 48	
Messenger		720 00	720 00	
Draughtsmen		7,200 00	7,200 00	
General superintendent		3,500 00	3,500 00	
Assistant to general superintendent		1,000 00	1,000 00	
Clerk and paymaster		1,100 00	1,100 00	
Assistant clerk		900 00	900 00	
Assistants to Chief		3,600 00	3,600 00	
Pipe inspector and clerk		2,200 00	2,200 00	
Search clerks		2,200 00	2,200 00	
Assistant clerks		3,650 00	3,650 00	
Chief inspector		1,200 00	1,200 00	
Inspectors		22,000 00	21,878 41	
Permit clerks		2,300 00	2,300 00	
Purveyors		10,680 00	10,680 00	
Clerks to purveyors		5,600 00	5,133 30	
Purveyors' assistant clerks		5,250 00	5,250 00	
Hydrant inspectors		7,050 00	7,020 63	
General foremen		7,573 00	7,559 96	
Foremen of repairs		7,020 00	7,020 00	
Superintendent of shop		1,500 00	1,500 00	
Clerk to superintendent of shop		900 00	900 00	
Watchmen, office and yards		6,075 00	6,009 68	
Storekeepers		1,400 00	1,400 00	
Foreman machinist		1,800 00	1,800 00	
Foreman bricklayer		1,100 00	1,100 00	
Foreman carpenter		1,100 00	1,100 00	
Foreman stonemason		900 00	900 00	
Foreman painter		900 00	900 00	
Foreman rigger		900 00	9 0 00	
Foreman laborer		840 00	840 00	
Foreman plumber		1,000 00	1,000 00	
Janitor Main Office		720 00	720 00	
Lineman		1,000 00	1,000 00	
Telephone operators		1,320 00	1,320 00	
Electrician		1,200 00	1,200 00	
General storekeeper		1,000 00	1,000 00	
Yard keeper (4th District)		915 00	915 00	

Detailed Expenditures of the Bureau—Continued.

General Appropriation.		Amount appropriated.	Amount expended.	Amount merging	Amount not merging.
Item 1—Continued.					
SALARIES AT PUMPING STATIONS.					
Fairmount		$12,790 00	$12,474 41		
Spring Garden		81,780 00	79,096 33		
Belmont		28,060 00	26,390 17		
Belmont High Service		7,150 00	7,096 86		
Queen Lane		38,680 00	36,486 25		
Roxborough		29,480 00	27,372 49		
Roxborough High Service		8,720 00	8,330 47		
Mt. Airy		4,950 00	4,269 55		
Chestnut Hill		2,950 00	2,008 76		
Frankford		18,940 00	18,210 21		
Frankford High Service		7,500 00	7,482 25		
Totals		.....	$358,905 66	$1.702 34	
Item 2. For the purchase and hauling of coal		$400,000 00			
DEFICIENCIES OF 1902.					
Car service	$15 00				
Freight on coal	23,907 16				
Coal for stations	97,056 76				
		.....	$120,978 92		
COAL FOR OFFICES AND SHOP.					
2 tons nut, @ $6.90	$13 80				
4 tons bit., @ $6.00	24 00				
4 tons nut, @ $8.50	34 00				
6 tons bit., @ $6.50	39 00				
29 tons stove, @ $7.50	217 50				
45 tons bit. @ $5.50	247 50				
67 tons stove, @ $6.75	452 25				
392.08 tons pea, @ $4.90	1,922 85				
		.....	2,950 90		
COAL FOR STATIONS.					
142 tons egg, Fairmount, at $6.75	$958 50				
27.09 tons buck., Queen Lane, at $3.08	84 55				
28 tons pea, Chestnut Hill, at $3.85	107 80				
24.07 tons nut, Spring Garden, at $5.48	133 44				
154.08 tons pea, Frankford High Service, at $4.10	633 05				
186.06 tons pea, Frankford, at $4.24	789 91				
373.03 tons buck., Mount Airy, at $4	1,492 60				
2,194.13 tons pea, Spring Garden, at $3.56	7,812 95				
4,428 tons pea, Belmont, at $3.55	15,719 41				
6,749.06 tons buck., Fkd., at $3.11	20,990 33				

Detailed Expenditures of the Bureau—Continued.

General Appropriation.		Amount appropriated.	Amount expended.	Amount merging.	Amount not merging.
Item 2—Continued.					
11,761.19 tons buck., Belmont, at $2.81	33,051 08				
15,157 tons pea, Roxborough, at $3.56	53,958 91				
16,995.18 tons pea, Queen Lane, at $3.81	64,754 38				
25,146.07 tons buck., Spr'g Garden, at $2.83	71,164 18				
		.....	$271,651 09		
Hauling coal from Roxborough to Roxborough High Service Station, 2,696.04 tons, at 40c		.....	1,078 48		
Wood		.....	69 00		
			396,728 39	$3,271 61	
Item 3. For the purchase of oil, lubricants, paints, brushes, wood, coke	$10,000 00				
Increased by transfer	7,607 62				
Net appropriation to item		$17,607 62			
Deficiencies of 1902:					
Gasoline	$5 94				
Black oil	6 30				
Wood	27 00				
Paints	49 63				
Lard oil	62 40				
Headlight oil	214 26				
Coke	333 60				
Paints	376 31				
Grease, lubricating	949 20				
Engine oil	2,109 46				
Cylinder oil	3,473 52				
		.....	7,607 62		
Coke		.....	454 77		
Grease, lubricating, 786 pounds, at 9¼c	$72 71				
Grease, lubricating, 9,964 pounds, at 10c	996 40				
		.....	1,069 11		
OIL.					
107 gals. gasoline at 16c		.....	$17 12		
5 gals. lard, at $1	$5 00				
10 gals. lard, at 60c	6 00				
53 gals. lard, at 80c	42 40	.....	53 40		
209 gals. electric, at 35c		.....	73 16		
430 gals. headlight, at 10½c	$45 16				
3,295½ gals. headlight, at 11¾c	387 19	.....	432 35		
1,028½ gals. cylinder, at 55c	565 68				
6,279½ gals. cylinder, at 45c	2,825 79	.....	3,391 47		
5,685½ gals. engine, at 35c		.....	1,989 93		
Tallow		.....	32 24		
Soda		.....	7 76		
Paints		.....	2,449 63		
			$17,578 56	$29 06	

Detailed Expenditures of the Bureau—Continued.

General Appropriation.	Amount appropriated.	Amount expended.	Amount merging.	Amount not merging.
Item 4. For the wages of mechanics, laborers and other workmen employed upon repairs to machinery, and the maintenance of buildings, grounds and reservoirs, and the transportation of workmen incident thereto. $80,000 00				
Increased by transfer and additional appropriation..... 122,000 00				
Net appropriation to item.....	$202,000 00			
Transportation.....	.....	$2,779 10		
Wages:				
Fourth District.....	.....	389 74		
Clerk and assistant paymaster	.....	435 00		
Stop attendant.....	.....	503 25		
Fifth District.....	.....	885 94		
Bricklayers.....	.....	15,231 64		
Carpenters.....	.....	9,036 60		
Helpers.....	.....	7,069 05		
Horses, carts and drivers.....	.....	2,449 11		
Laborers.....	.....	112,331 68		
Machinists.....	.....	34,497 90		
Painters.....	.....	5,247 70		
Stone masons.....	.....	6,104 93		
Totals.....	.....	$196,911 64	$5,083 36	
Item 5. For the wages of mechanics, drillers, laborers and other workmen connected with repairs to, and the improvement of, the distribution and the laying of service mains, the transportation of workmen engaged in repairs, and the travelling expenses of pipe inspectors..... $125,000 00				
Increased by transfer and additional appropriation..... 168,000 00				
Net appropriation to item.....	$293,000 00			
Transportation.....	.....	$1,360 30		
Traveling expenses (pipe inspectors).....	.....	504 09		
Wages:				
Buildings, grounds and reservoirs.....	.....	170 12		
Improvement.....	.....	26,289 83		
First District.....	.....	26,932 22		
Second District.....	.....	25,136 34		
Third District.....	.....	83,765 19		
Fourth District.....	.....	28,272 25		
Fifth District.....	.....	32,520 99		
Sixth District.....	.....	29,869 69		
Seventh District.....	.....	26,283 29		
Totals.....	.....	$281,104 31	$11,895 69	

Detailed Expenditures of the Bureau—Continued.

General Appropriation.	Amount appropriated.	Amount expended.	Amount merging.	Amount not merging.
Item 6. For the wages of mechanics, helpers and other workmen at the City construction and repair shop, $20,000 00 Increased by additional appropriation, 13,000 00				
Net appropriation to item	$33,000 00			
Wages:	.....	$32,493 51	$506 49	
Item 7. For the purchase of iron water pipe, special pipe castings and pig lead	$40,000 00			
Brass suspension bearings	.....	21 00		
Expressage	.....	56 90		
Machine work	.....	271 83		
2,332 lbs. specials, at 3½c	.....	81 62		
2,198 lbs. specials, at 5½c	.....	120 90		
12 12-in. pipe, 23,414 lbs., @ 1¾c	.....	313 75		
13,460 lbs. breeches pipe, @ 5$\frac{9}{10}$c	.....	794 14		
17,665 lbs. specials, @ 2$\frac{9}{10}$c	.....	521 12		
66,622 lbs. specials, @ 2¾c	.....	1,832 14		
152,528 lbs. specials, @ 2$\frac{5}{10}$c	.....	3,965 79		
3,9986-in. pipe, 1,45[illegible],98[illegible] lbs., @ 1$\frac{38}{100}$c	.....	20,051 20		
138,249 lbs. pig lead, @ 4$\frac{34}{100}$c	.....	6,000 00		
Totals	.....	$34,030 39	$5,969 61	
Item 8. For wages of the Hydrographic Corps and expenses incident thereto	$1,600 00			
Wages	.....	$1,596 00	$4 00	
Item 9. For the purchase of hardware, bolts and nuts	6,000 00	5,999 28	72	
Item 10. For the purchase of iron, steel and malleable castings	15,000 00			
Machine work	.....	141 75		
Steel forgings	.....	201 75		
96,755 lbs. frames, covers, stop box, @ 1¾c	.....	1,693 23		
114,323 lbs. grate bar, @ 1$\frac{85}{100}$c	.....	2,229 30		
110,941 lbs. fire hydrant, @ 2$\frac{65}{100}$c	.....	2,939 93		
74,324 lbs. stop, @ 2$\frac{7}{10}$c	.....	2,006 81		
38,871 lbs. machine, @ 2$\frac{9}{100}$c	.....	1,127 25		
52,506 lbs. pumping machinery, @ 3¾c	.....	1,969 00		
56,579 lbs. pumping machinery (loam), @ 4¾c	.....	2,687 50		
Totals	.....	$14,996 52	$3 48	
Item 11. For the purchase of gum goods and packing	$10,000 00			
Increased by transfer	7,330 06			
Net appropriation to item	$17,330 06			

Detailed Expenditures of the Bureau—Continued.

General Appropriation.	Amount appropriated.	Amount expended.	Amount merging.	Amount not merging.
Item 11—Continued.				
Deficiencies of 1902:				
Gum valves..... $1,217 30				
Packing 6,112 76				
	.....	$7,330 06		
Gum Goods.....	.....	2,377 42		
Packing	.....	4,471 79		
Valves.....	.....	3,109 57		
Totals.....	.....	$17,288 84	$41 22	
Item 12. For repairs to boilers...	$15,000 00			
Roxborough H. Service Station..	.....	$15 00		
Belmont High Service Station..	.....	24 00		
East Park Reservoir.....	.....	37 25		
City Shop.....	.....	102 84		
Frankford Station.....	.....	610 18		
Spring Garden Station.....	.....	2,046 78		
Belmont Station.....	.....	3,399 43		
Roxborough Station.....	.....	4,200 55		
Queen Lane.....	.....	4,557 43		
Totals.....	.....	$14,993 46	$6 54	
Item 13. For the purchase of Chandlery.....	$4,000 00			
Chandlery.....	.....	$1,997 35		
Cotton waste.....	.....	1,969 74		
Totals.....	.....	$3,967 09	$32 91	
Item 14. For the purchase of wrought iron pipe and fittings.	$3,000 00	$2,944 80	$55 20	
Item 15. For the purchase of fire brick and fire clay.....	1,500 00	845 00	655 00	
Item 16. For the purchase of brass fittings, cocks and valves for steam and water.....	7,500 00			
Brass fittings.....	.....	3,918 84		
CORPORATION COCKS.				
100 ¾-inch @ 56 cents.....	.....	56 00		
125 1-inch @ 90 cents.....	.....	112 50		
212 2-inch @ $2.64.....	.....	559 68		
5,725 ½-inch @ 32 cents.....	.....	1,832 00		
1,760 ½-inch curb stops @ 35 cents.	.....	616 00		
Totals.....	.....	$7,095 02	$404 98	
Item 17. For covering steam pipes and boilers.....	$1,000 00	$1,000 00		

Detailed Expenditures of the Bureau—Continued.

General Appropriation.	Amount appropriated.	Amount expended.	Amount merging.	Amount not merging
Item 18. For the purchase of lumber	$5,000 00	$4,999 98	$0 02	
Item 19. For the purchase of forage	4,000 00	3,999 76	24	
Item 20. For hauling water pipe and machinery	4,000 00	3,996 98	3 02	
Item 21. For the purchase of cement	2,500 00	2,372 80	127 20	
Item 22. For the purchase of iron and steel	1,500 00	1,458 50	41 50	
Item 23. For the purchase of bricks, blocks, lime, sand and building stone	5,000 00	4,143 50	856 50	
Item 24. For the purchase of electric supplies	2,000 00	1,961 89	38 11	
Item 25. For repairs to roofs	2,500 00			
Chestnut Hill Station		9 75		
Second District		13 00		
Queen Lane Station		13 00		
Seventh District		16 25		
Frankford High Service Station		16 25		
Sixth District		35 75		
Frankford Station		45 50		
Belmont High Service Station		58 50		
Belmont Station		104 00		
Roxborough Station		133 25		
City Shop		214 50		
Spring Garden Station		1,820 00		
Totals		$2,479 75	$20 25	
Item 26. For the purchase of granite curb and coping stone $1,000 00				
Diminished by transfer 1,000 00				
Item 27. For the purchase of brass castings, expansion metal and lead coating	$5,000 00			
200 lbs. Babbitt metal, @ 7c		$14 00		
200 lbs. Babbitt metal, @ 9c		18 00		
658½ lbs. special metal, @ 8c		52 68		
3,646 lbs. lead coating, @ 4⅝c		168 63		
574 lbs. bronze rods, @ 55c		315 70		
1,542 lbs. expansion metal, @ 24½c.		377 79		
6,753 lbs. yellow brass, @ 11 $\frac{45}{100}$c		773 26		
12,034 lbs. red brass, @ 13¼c		1 579 43		
7,600 lbs. Ajax metal, @ 22⅜c		1,700 49		
Totals		$4,999 98	$0 02	

Detailed Expenditures of the Bureau—Continued.

General Appropriation.	Amount appropriated.	Amount expended.	Amount merging.	Amount not merging.
Item 28. For the purchase of stationery, engineers' supplies and printing..... $5,000 00 Increased by transfer.. 2,500 00				
Net appropriation to item.....	$7,500 00	$7,471 35	$28 65	
Item 29. For clerk hire in writing up duplicates... $2,500 00 Diminished by transfer 70 00				
Net appropriation to item.....	2,430 00	2,429 25	75	
Item 30. For the keep of horse for Chief of Bureau, General Superintendent and assistant.	1,200 00	1,200 00		
Item 31. For the purchase of horses and for horseshoeing...	1,000 00			
Three (3) horses, at $225.....	.....	675 00		
Horseshoeing.....	.....	325 00		
Totals.....	.....	$1,000 00		
Item 32. For the purchase of tapping machines and fittings	$1,500 00	$1,494 90	5 10	
Item 33. For the purchase of and repairs to wagons and carts...	2,000 00			
One (1) wagon, "B".....	.....	172 78		
One (1) wagon "A".....	.....	183 22		
Repairs.....	.....	1,248 70		
Totals.....	.....	$1,604 65	395 35	
Item 34. For the purchase of stable supplies and harness and repairs thereto.....	$1,000 00	$998 06	1 94	
Item 35. For the purchase of donkey pumps and machine tools.....	2,000 00			
Lever jacks.....	.....	60 00		
Portabl - drill.....	.....	340 00		
Boring, drilling and milling machine.....	.....	1,600 00		
Totals.....	.....	$2,000 00		
Item 36. For asphalt and granolithic paving, and repairs thereto.....	$1,000 00	$176 25	823 75	
Item 37. For advertising office supplies, text books and incidentals.....	$2,000 00			
Carriage hire.....	.....	$24 75		

Detailed Expenditures of the Bureau—Continued.

General Appropriation.	Amount appropriated.	Amount expended.	Amount merging.	Amount not merging.
Item 37—Continued.				
Clocks and repairs		$37 83		
Current (electrical)		255 58		
Disinfectors (rental)		108 00		
Fire extinguishers (rental)		22 50		
Freight		41 75		
Furnishing meals to workmen		158 50		
Ground rent (918 Cherry st.)		26 66		
Incidentals (hydrographic)		106 59		
Inspectors (badge)		3 25		
Maps		160 00		
Office supplies		170 04		
Plants		81 90		
Postage stamps		146 00		
Professional services (V. S.)		167 95		
Rent of office and shop, Fifth District		145 50		
Rent of stable, Fifth District		72 00		
Repairs to wagon		4 50		
Serving morning papers		7 80		
Subscriptions (periodicals)		44 00		
Text books		68 00		
Towel service		114 75		
Use of dump		5 00		
Washing towels		27 00		
Totals		$1,999 85	.15	
Item 38. For the purchase of special articles, small stores, the repairs to tools, pipes and pavements	$2,500 00			
Boiler compound		$371 04		
Brazing castings		60 00		
Current (electrical)		26 67		
Dynamite		220 15		
Fire extinguishers (rental		45 00		
Glass bearings		67 00		
Hire of boats		24 00		
Office supplies		99 45		
Plants		89 75		
Plumbing		72 43		
Postage stamps		20 00		
Purifier		75 00		
Repairs to condenser $39 96				
Repairs to gauge 6 20				
Repairs to meters 444 61				
Repairs to pumps 88 52				
Repairs to siding 55 73				
Repairs to torches 14 28				
		649 30		
Services of diver		55 00		
Special articles		600 00		
Valve		22 50		
Total		$2,499 29	.71	

Detailed Expenditures of the Bureau—Continued.

General Appropriation.	Amount appropriated.	Amount expended.	Amount merging.	Amount not merging.
Item 39. For the purchase of lead pipe, block tin and sheet lead.	$5,000 00			
Block tin, 1,403½ lbs. at 28½ c.	.....	$400 00		
Lead pipe, 87,619 lbs. at 5¼ c.	.....	4,600 00		
Total	.....	$5,000 00		
Item 40. For emergencies	$2,500 00			
Repairs to condenser	.....	$65 50		
Boring cylinder	.....	164 00		
Steel castings	.....	340 03		
Valves	.....	859 80		
Machine work	.....	1,070 60		
Total	.....	$2,499 93	07	
Item 41. For hauling ashes from Spring Garden, Queen Lane and Belmont stations $3,500 00				
Increased by transfer... 10,300 00				
Net appropriation to item	$13,800 00	$13,800 00		
Queen Lane	.....	$2,800 00		
Belmont	.....	3,500 00		
Spring Garden	.....	7,500 00		
Total	.....	$13,800 00		
Item 42. For direct water supply for fire purposes	38,000 00			
Incidentals	.....	7 10		
Gasket	.....	15 81		
Office supplies	.....	23 50		
Oil	.....	30 53		
Gas for fuel	.....	50 70		
Furnishing and laying mains	.....	36,933 62		
Wages	.....	938 25		
Total	.....	$37,999 51	49	
Item 43. For land for filtration purposes. Torresdale beds	500,000 00	.....	.....	500,000 00
Item 44. Improvement in West Philadelphia. Balance Jan. 1, 1903	845 70	.....	.....	845 70
Item 45. Improvement, extension and filtration of the water supply. Balance Jan. 1, 1903	1,261,246 20			
Advertising	.....	$351 45		
Affidavits	.....	138 50		
Altering pipe	.....	256 08		
Awnings	.....	17 75		
Blue prints	.....	403 23		

Detailed Expenditures of the Bureau—Continued.

General Appropriation.	Amount appropriated.	Amount expended.	Amount merging.	Amount not merging.
Item 45—Continued.				
Boiler saddles		556 72		
Brass fittings		45 87		
Bricks		66 00		
Bronze work		289 50		
Calipers		50 25		
Casing head of stairs		43 86		
Chandlery		34 63		
Changing copper floats		189 75		
Chemicals		260 02		
Cleaning sand		1,659 75		
Coal		194 26		
Concrete moulds		47 50		
Dampers		265 00		
Drilling core-wells		1,296 00		
Electrical current		64 14		
Electrical supplies		282 81		
Engine foundations		360 00		
Engineer supplies		1,263 46		
Filter		3 00		
Filter sand		76 95		
Filtering material, Belmont Filters		84,677 26		
Fire hose		241 00		
Fire insurance		102 00		
Gas for fuel		161 30		
Gauges		88 30		
Gum goods		718 23		
Hauling		154 00		
Hardware		139 00		
Ice		358 04		
Incidentals		1,571 26		
Iron fittings		351 90		
Laboratory supplies		206 99		
Land damages		336,282 82		
Lower Roxborough Filters		1,049 50		
Lumber		329 73		
Luncheon		125 00		
Machine work		55 00		
Office supplies		195 40		
Oil		896 54		
Oil tank		8 63		
Plastering		30 00		
Photo supplies		182 55		
Pipe lines for sand ejector		3,075 00		
Preliminary filters, lower Roxborough		39,714 96		
Pumps and engines, upper Roxborough		8,916 50		
Pumping station, etc., Belmont Filters		24,150 74		
Refrigerators		10 00		
Rent of office		80 00		
Repairs to condenser,		20 12		
Repairs to still		4 50		
Sand washers		6,595 00		
Screens		79 50		
Services of diver		36 50		
Services of experts		25 00		
Services of inspectors		1,282 27		
Services of jurors		552 00		
Services of stenographer		132 00		
Signs		25 00		
Stationery and printing		201 26		
Steel Figures		5 00		

Detailed Expenditures of the Bureau—Continued.

General Appropriation.	Amount appropriated.	Amount expended.	Amount merging.	Amount not merging.
Item 45—Continued.				
Steam pipe		206 00		
Subscriptions, periodicals		16 00		
Strainers		6 00		
Text books		45 35		
Testing asphalt		62 50		
Towel service		253 57		
Transportation		606 39		
Traveling expenses (inspectors)		531 18		
Upper Roxborough filters		39,539 44		
Valves		214 25		
Water meters		640 00		
Water rent		10 25		
Salaries		120,184 22		
Wages:				
Fourth District		652 00		
Bureau of Filtration		12,152 80		
Total		$696,194 23		$565,051 97
Item 46. Filtration Balance Jan. 1, 1903	$7,413,269 98			
Advertising		$255 45		
Belmont filters		661,522 77		
Blue prints		360 72		
Brass fittings		5 75		
Bolts, nuts and washers		1,583 11		
Bronze tablets		250 00		
Canvas		4 40		
Cnandlery		71 83		
Chemicals		133 53		
Cleaning sand		682 09		
Coal		49 17		
Electric current		24 22		
Electric plant. Lower Roxborough		8,356 99		
Electric supplies		296 22		
Engineer supplies		548 85		
Filters		15 00		
Filtering material, etc., Roxborough filters		167,882 78		
Fire hose		512 70		
Fire insurance		90 00		
Furnishing and laying mains		74,715 68		
Gas for fuel		49 50		
Gum goods		301 65		
Hardware		304 37		
Heating apparatus		280 00		
Ice		222 66		
Incidentals		518 95		
Iron pipe and fittings		1,217 49		
Iron safe		52 50		
Laboratory supplies		80 00		
Lumber		185 47		
Moving tool house		83 39		
Oak Lane reservoir		170,682 02		
Office supplies		1,449 10		
Oil		626 28		
Packing		10 10		
Photo supplies		153 26		
Photographs		24 30		
Pumping machinery, Upper Roxborough		20,982 09		

Detailed Expenditures of the Bureau—Continued.

General Appropriation.	Amount appropriated.	Amount expended.	Amount merging.	Amount not merging.
Item 46—Continued.				
Pumping machinery, Frankford		$61 280 41		
Pumping station, Frankford		300,602 03		
Pumping station, Upper Roxborough		20,497 36		
Rent of 'phones		60 14		
Repairs to floor		89 01		
Sand ejectors		440 00		
Sand washers		3,549 00		
Screens		5,095 80		
Services of experts		400 00		
Services of inspectors		1,300 68		
Services of referee		793 00		
Services of stenographers		1,279 40		
Sponge clippings		12 61		
Stoves, etc		25 30		
Subscription, periodical		3 00		
Stationery and printing		2,584 11		
Testing cement		30 00		
Textbooks		30 55		
Torresdale conduit		795,471 52		
Torresdale filters		2,345,076 34		
Towel service		77 40		
Transportation		338 05		
Traveling expenses (inspectors)		161 40		
Typewriter		108 00		
Valves		478 92		
Water attachment		3 50		
Salaries		54,468 36		
Wages;				
Fourth District		1,064 63		
Bureau of Filtration		7,776 23		
Total		$4,717,881 14		$2,695,388 84
Item 47. High Pressure Fire Service, balance January 1, 1903	$261 96			
Incidentals		$26 71		
Wages		234 37		
Total		$261 08	88	
Item 48. High Pressure Fire Service, balance January 1, 1903	$244,559 00			
Bronze tablet		$98 00		
Electrical connection		60 00		
Furnishing and laying mains		2,500 00		
Gasket		14 55		
Gas for fuel		152 90		
Incidentals		2 50		
Pumps and engines		76,123 03		
Pumping station		61,700 00		
Total		$140,650 98		$103,908 02
Item 49. For furnishing and laying mains for filtered water, balance January 1, 1903	$1,300,000 00	$452,373 36		$847,626 64

Detailed Expenditures of the Bureau—Continued.

General Appropriation.	Amount appropriated.	Amount expended.	Amount merging.	Amount not merging.
Item 50. Refund for laying water pipe, Ordinance May 21, 1903....	$100 00	$100 00		
Item 51. For the completion of the Fire Pipe Line Service, Ordinance May 21, 1903... $30,000 00				
Diminished by transfer, 2,729 00				
$27,271 00				
Increased by transfer.. 3,000 00				
Net appropriation to item.....	$30.271 00			
Electric current.....	.....	156 72		
Electric supplies.....	.....	479 90		
Fitting up heating boilers.....	.....	360 00		
Iron castings.....	.....	337 32		
Iron pipe and fittings.....	.....	599 60		
Oil.....	.....	219 85		
Pavement.....	.....	423 09		
Pumping station.....	.....	20,025 11		
Radiators.....	.....	950 40		
Wages.....	.....	5,257 19		
Totals.....	.....	$28,869 18		$1,461 82

RECAPITULATION.

General Appropriation.			
Balances from books of 1902.....	$10,220,182 84		
Additional appropriation.....	363,837 68		
Annual appropriation.....	1,712,713 00		
		.....	$12,296,733 52
Expended for refunds.....	$100 00		
Expended for deficiencies.....	135,916 60		
Expended for high pressure fire service.....	207,720 75		
Expended for filtration.....	5,866,448 73		
Expended for maintenance.....	1,327,148 54		
		$7,537,334 62	
Amount merging.....	$32,011 91		
Amount not merging.....	4,714,282 99		
Amount transferred.....	13,104 00		
		4,759,398 90	12,296,733 52

List of Miscellaneous Receipts for the Year 1903.

Jan.	3	Burnham, Williams & Co..	Moving 6-inch pipe.....	$36 55
	8	Snellenburg & Co.....	Renewing stop.....	6 00
	8	Snellenburg & Co.....	Removing 6-inch main....	146 08
	8	U. G. I. Co.....	Remov'g service conn'tion.	8 64
	21	Phila. Rapid Transit Co....	Resetting fire hydrant.....	12 59
	21	Phila. Rapid Transit Co....	Drawing ferrule.....	3 15
	27	Geo. A. Fuller Co.....	Moving fire hydrant.....	50 66
	30	Boone and Sampel.....	Repairing fire hydrant....	1 49
Feb.	16	Phila. Rapid Transit Co....	Moving 6-inch stop.....	31 30
	16	Phila. Rapid Transit Co....	Moving 6-inch stop.....	31 44
	16	Phila. Rapid Transit Co....	Moving 6-inch stop.....	30 57
	16	Phila. Rapid Transit Co....	Placing No. 1 fire hydrant.	26 36
Mar.	2	Warrant No. 5252, 1902.....	Overdrawn.....	15 75
	2	Warrant No. 5255, 1902.....	Overdrawn.....	3 50
	2	.....	Sale of horse.....	22 50
	26	Powers & Weightman.....	Removing 4-inch stop.....	28 89
	30	Oscar A. Kahler.....	Shutting off ferrule.....	5 37
April	3	Spreckels' Sugar Refi'g Co.	Removing fire hydrant....	27 45
	3	James T. McMahon.....	Making shut off.....	2 50
	3	James T. McMahon.....	Repairing 6-inch main.....	13 11
	3	James T. McMahon.....	Repairing 6-inch main	9 32
	18	Burnham, Williams & Co..	Renewing fire hydrant.....	31 07
	18	Phila. Rapid Transit Co....	Repairing 30-inch main....	101 69
	20	U. G. I. Co	Low'g fire hydrant con'tns.	52 22
	25	J. R. Nelson.....	7,600 lbs. brass turnings.....	684 76
	25	Warrant No. 1307.....	Overdrawn	2 50
May	1	U. G. I. Co.....	Lowering 6-in. fire hyd. con	27 97
	1	U. G. I. Co.....	Lowering 6-inch pipe.....	17 86
	4	John Morrison.....	Repairing 6-inch pipe.....	60 21
	4	John Morrison.....	Renewing 6-inch stop.....	25 22
	4	John Morrison.....	Repairing 6-inch main.....	13 89
	13	U. G. I. Co.....	Repairing 4-inch main.....	10 55
	18	P. W. & B. R. R. Co.....	Renewing 6-inch stop.....	39 61
	19	Phila. Rapid Transit Co....	Renewing 6-inch stops.....	12 80
	19	Phila. Rapid Transit Co....	Renewi'g No. 1 fire hydrant	9 77
June	2	Girard Iron and Metal Co.	49,668 lbs. scrap iron	2,787 21

List of Miscellaneous Receipts for the Year 1903.

June 3	B. & O. R. R. Co.....	Repairing private stop....	$10 68
5	Robert P. Ryan.....	Repairing service main....	11 71
8	Pennsylvania R. R. Co.....	Relaying 6-inch pipe.....	132 60
10	U. G. I. Co.....	Lowering 6-in. fire hydrant	28 50
10	U. G. I. Co.....	Lower'g 6-in. fire hyd. con.	26 65
10	U. G. I. Co.....	Raising 6-inch pipe.....	28 39
19	Blum Bros.....	Digging for leaks.....	4 50
23	Phila. Rapid Transit Co....	Chan'g location of 6-in stop	30 50
27	U. G. I. Co.....	Lowering 6-inch pipe.....	18 35
27	U. G. I. Co.....	Lowering 6-inch pipe.....	38 57
27	U. G. I. Co.....	Lowering 6-in. fire hydrant	21 11
27	U. G. I. Co.....	Lowering 6-inch pipe.....	40 15
July 1	Wetherhill & Bro.....	Removing stop box.....	6 08
7	Warrant No. 2591.....	Wages, overdrawn.....	5 25
9	U. G. I. Co.....	Cutting out 6-inch pipe	21 08
9	U. G. I. Co.....	Cutting out 6-inch pipe....	22 60
9	U. G. I. Co.....	Cutting out 6-inch pipe	33 15
9	U. G. I. Co.....	Cutting out 6-inch pipe....	20 95
9	U. G. I. Co.....	Cutting out 6-inch pipe....	22 66
July 20	Phila. Rapid Transit Co....	Moving 6-inch stop.....	22 41
20	Phi'a. Rapid Transit Co....	Shifting 10-inch stop.....	46 46
20	Phila. Rapid Transit Co....	Moving 6-inch stop.....	28 60
20	Phila. Rapid Transit Co....	Moving 12-inch stop.....	65 18
20	Phila. Rapid Transit Co....	Moving stop box.....	15 80
29	J. H. Loucheim & Co.....	Driving 6-inch joint.....	10 50
Aug. 1	.....	Proceeds from sale of horse	81 90
6	Geo. Tummey.....	Repairing 6-inch main.....	6 35
10	David McMahon.....	Renewing No. 1 fire hydrant	5 45
13	J. H. Loucheim.....	Straightening 6-inch main.	9 50
13	J. H. Loucheim.....	Repairing 6-inch main.....	8 45
13	George A. Vare.....	Shifting 6-inch pipe.....	31 30
13	George A. Vare.....	Laying 2-inch pipe.....	258 92
20	Phila. Rapid Transit Co....	Lowering 12-inch pipe.....	60 58
20	J. H. Loucheim & Co.....	Drawing ferrule.....	90 40
20	Penna. R. R. Co.....	Removing No. 1 fire hyd'nt.	32 60
Sept. 9	Phila. & Reading R. R. Co..	Laying 6-inch stop.....	5 28

List of Miscellaneous Receipts for the Year 1903.

Sept. 8	J. H. Loucheim	Laying pipe	$72 32
15	Edwin F. Merritt	Oil barrels, 1903	362 05
22	Phila. Rapid Transit Co.	Moving fire hydrant con.	14 70
22	Phila. Rapid Transit Co.	Moving 6-inch stop	35 06
Oct. 6	U. G. I. Co	Repairing break in main	367 55
12	Thomas Parker	Lowering 6-inch pipe	40 77
22	Phila. Rapid Transit Co.	Cutting out fire hydrant	6 35
22	Phila. Rapid Transit Co.	Repairing 6-inch main	43 19
22	Phila. Rapid Transit Co.	Renewing stop boxes	30 00
Nov. 6	James Duhan	Repairing 12-inch main	99 66
6	George Woodward	Changing meter	8 50
10	George W. Blabon Co.	Putting in 6-inch fire con.	65 00
13	Phila. & Reading R. R. Co.	Recaulking joint	6 25
16	Phila. Democrat Pub. Co.	Placing meter	6 88
17	Burnham, Williams & Co.	Recaulking 6-inch pipe	5 81
20	Phila. Rapid Transit Co.	Renewing stop boxes	27 93
20	Phila. Rapid Transit Co.	Shifting 6-inch pipe	50 49
20	Phila. Rapid Transit Co.	Renewing and shifting pipe	68 75
20	Phila. Rapid Transit Co.	Removing 6-inch pipe	113 18
20	Phila. Rapid Transit Co.	Changing 6-inch stops	84 79
20	Phila. Rapid Transit Co.	Removing 6-inch stops	72 09
20	Phila. Rapid Transit Co.	Removing 6-inch stops	67 08
24	Hoben and Doyle	Turning off ferrule	24 03
27	Bell Telephone Co.	Removing 6-inch stops	82 47
Dec. 3	Maignen Filtration Co.	Labor on preliminary plant	19 81
7	H. D. Stratton	Testing meter	2 00
10	Powers & Weightman	Repacking 4-inch stop	2 17
11	J. M. Schwehm	Testing meter	2 00
11	B. & O. R. R.	Removing 6-inch stop	55 09
11	George A. Vare	Repairing 6-inch main	14 52
11	George A. Vare	Renewing No. 1 fire hydrant	37 54
11	George A. Vare	Repairing 6-inch main	12 54
18	B. & O. R. R.	Putting in 4-inch screw	2 83
23	Phila. Rapid Transit Co.	Repairing 12-inch main	46 54
23	Phila. Rapid Transit Co.	Putting in fire hydrant	34 25
23	Phila. Rapid Transit Co.	Renewing 6-inch stop	31 64
		Total	$7,709 19

Receipts from Operations of the Bureau of Water as Reported by the Receiver of Taxes.

1903.	Schedule Rates.	Penalties.	Delinquent.	Penalties.	New Connections.	Meters Current and Delinquent.	Ferrules on New Connections.	Searches.	Pipe Frontage.	Specials.	Collected by City Solicitor.	Totals.
January	.....	.....	$4,005 50	$552 02	$2,490 00	$12,248 57	$364 00	$203 75	$3,458 66	$265 16	$2,543 51	$26,131 17
February	$212,805 38	.....	1,526 00	249 81	3,453 95	37,309 88	590 00	185 25	8,881 20	119 67	2,756 84	267,877 48
March	259,974 25	.....	3,120 50	474 67	5,083 45	11,864 90	705 00	264 75	13,092 01	76 01	3,814 72	298,470 26
April	331,680 99	.....	6,442 50	984 57	7,834 65	5,450 09	1,584 00	299 50	14,956 39	924 62	3,665 11	373,822 42
May	1,862,09› 41	.....	8,632 07	1,295 08	8,475 73	41,711 83	793 00	284 75	6,825 33	218 03	6,070 70	1,936,401 98
June	58,165 55	$2,544 66	1,559 00	236 12	7,009 74	18,963 13	608 00	309 25	13,054 29	3,178 92	6,018 81	111,647 47
July	80,708 04	1,567 29	1,423 50	182 60	5,670 68	23,078 94	1,380 00	266 25	16,000 53	320 72	3,146 06	133,744 61
August	87,363 00	4,430 36	753 00	126 45	3,169 38	45,753 11	642 00	191 75	11,508 16	585 40	2,212 65	156,735 26
September	42,705 29	6,137 89	758 00	116 65	3,614 72	9,287 26	1,687 00	239 75	9,276 99	489 41	2,404 70	76,717 66
October	65,879 50	9,816 97	999 00	153 50	4,987 73	9,673 40	1,444 00	275 50	16,954 29	487 86	4,440 93	115,112 68
November	19,635 10	2,948 48	925 00	138 75	2,965 68	52,269 33	1,528 00	252 75	9,827 35	782 91	3,260 72	94,534 07
December	28,409 55	4,066 95	897 25	147 50	2,442 50	8,965 53	469 00	248 50	4,430 62	260 43	3,221 08	53,558 91
Total, 1903	$2,999,422 06	$31,512 60	$31,041 32	$4,657 72	$57,198 21	$276,575 47	$11,794 00	$3,021 75	$128,265 82	$7,709 19	$43,555 83	$3,594,753 97
Total, 1902	2,919,655 15	32,127 18	30,304 20	5,824 46	73,452 22	226,634 10	11,246 00	2,914 00	100,710 50	10,479 99	36,692 92	3,459,090 72
Increase	$79,766 91	.....	.....	.....	.....	$49,891 37	$548 00	$107 75	$27,555 32	.....	$6,862 91	$134,732 26
Decrease	.....	$614 58	$8,262 88	$1,166 74	$16,254 01	.....	.....	.....	.....	$2,770 80	.....	29,069 08
Net increase	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	$135,663 25

APPENDIX B

REPORT

OF THE

GENERAL SUPERINTENDENT

SUBMITTING

TABLES OF EXPENSES, PUMPAGE AND CONSUMPTION OF WATER DURING 1903

Philadelphia, January , 1904.

F. L. HAND, ESQ.,
Chief of Bureau.

DEAR SIR:—I have the honor to submit the following report of operations and expenses in connection with the work performed at the several pumping stations during 1903:

The tables herewith submitted show the average daily maximum and minimum, as well as the monthly and total pumpage and consumption for the year.

There has been an increase in the pumpage, averaging 19,774,001 gallons per day, and a corresponding increase in the quantity of coal consumed, which, at 13 cents more per ton, increased the amount of this item for the year's supply $133,043.97.

There was also additional expenses for oils, small stores,

repairs to machinery, etc., which, with the amount for coal, makes a total increase of $140,227.84 for pumping water during 1903.

The following tables, showing the pumpage, expenses and other data are respectfully submitted.

Very respectfully yours,

ALLEN J. FULLER,
General Superintendent.

Classifications and Prices of Coal Consumed during 1903.

Pumping Stations.	Classifications.	Tons.	Price per ton.	Cost.	Total cost.
Spring Garden	Buckwheat	25,175	$2 83	$71,245 25	
	Pea	39,742	3 56	141,481 52	$212,726 77
Belmont	Buckwheat	11,370	2 81	31,949 70	
	Pea	21,807	3 55	77,414 85	109,364 55
Queen Lane	Buckwheat	27	3 08	83 16	
	Pea	49,639	3 81	189,124 59	189,207 75
Roxborough	Pea	39,191	3 56	139,519 96	139,519 96
Frankford	Buckwheat	8,270	3 11	25,719 70	
	Pea	11,805	4 24	47,933 20	73,652 90
Totals and averages		206,526	$3 50½		$724,471 93
HIGH SERVICE STATIONS.					
Belmont	Buckwheat	542	$3 47	$1,880 74	
	Pea	1,053	4 21	4,433 13	$6,313 87
Roxborough	Pea	1,767	3 96	6,997 32	6,997 32
Roxborough Annex	Pea	994	3 96	3,936 24	3,936 24
Mt. Airy	Buckwheat	323	4 00	1,292 00	1,292 00
Chestnut Hill	Pea	106	3 85	408 10	408 10
Frankford	Pea	279	4 10	1,143 90	1,143 90
Totals and averages		5,064	$3 96¾		$20,091 43
Grand totals		211,590	$3 51½		$744,563 36
Increase for 1903		31,122	13		$133,043 97

CURRENT EXPENSES AND WORK OF THE PUMPING STATIONS FOR THE YEAR 1903.

Pumping Stations.	Pay of Employees at the Station.	Coal Consumed.			Lubricants.			Lighting.		Repairs to Boilers and Machinery.	Miscellaneous Supplies and Small Stores.	Total Expenses.	Total Gallons Pumped.	Lift in Feet, including Suction and Friction.	Gallons Pumped One Hundred Feet High, Suction and Friction included.	Cost of Raising One Million Gallons One Hundred Feet.	Percentage of Work done at each Station.
		Tons.	Average price per ton.	Total Cost.	Oils. Gallons.	Grease. Pounds.	Cost.	Oil.	Electricity.								
Fairmount	$18,210 34	.....	.....	.....	612	462	$298 32	$26 68	.....	$4,995 16	$606 08	$24,136 58	7,736,381,403	125.	9,720,476,753	$2 48	3.907
Spring Garden	115,855 26	64,917	$3 27/10	$212,726 77	8,567	5,503	4,059 90	59 22	$1,896 50	20,460 20	7,135 37	371,193 22	50,880,364,940	141.5	71,995,716,390	5 16	28 941
Belmont	56,917 30	33,177	3 29⅔	109,364 55	4,853	228	2,022 24	67 32	1,725 00	18,113 31	2,980 77	191,190 49	14,253,406,226	248.6	35,433,967,877	5 40	14.244
Queen Lane	59,153 29	49,666	3 81	189,207 75	5,917	8,261	3,263 90	73 68	1,765 00	25,028 42	7,482 99	285,975 03	27,141,857,200	274.9	74,612,965,442	3 83	29.993
Roxborough	58,412 57	39,191	3 56	139,519 96	3,873	2,256	1,821 28	49 71	1,675 00	17,004 05	2,603 81	221,086 38	8,515,486,050	387.7	33,014,539,415	6 70	13.271
Frankford	37,405 03	19,575	3 76¼	73,652 90	6,494	1,581	2,883 63	18 44	1,604 75	21,493 17	3,159 15	140,167 07	11,073,123,381	182.6	20,219,523,293	6 93	8.128
Totals and Averages	$345,953 79	206,526	$3 50½	$724,471 93	30,316	18,091	$14,299 27	$295 05	$8,666 25	$116,094 31	$23,968 17	$1,233,748 77	119,600,619,200	204.8	244,997,189,170	$5 04	98.484
High Service Stations.																	
Belmont	$8,773 82	1,595	$3 95½	$6,313 87	554	380	$266 25	$6 25	.....	$189 15	$213 43	$15,762 77	867,121,005	142.9	1,289,115,916	$12 72	.498
Roxborough	8,451 04	*1,767	3 96	6,997 32	524	372	253 09	12 69	.....	207 57	560 67	16,482 38	1,545,930,145	116.3	1,797,916,758	9 17	.723
Roxborough Annex	1,466 48	*994	3 96	3,936 24	357	50	152 08	2 11	.....	.....	77 11	5,634 02	1,930,680,000	33.8	652,569,840	8 63	.262
Mt. Airy	5,859 90	323	4 00	1,292 00	25	18	12 10	2 35	.....	72 61	79 02	7,317 98	36,713,146	89.8	32,968,647	221 76	.013
Chestnut Hill	2,444 63	106	3 85	408 10	1	.....	41	12 33	.....	.....	27 95	2,893 42	189,420	112.9	213,855	†13,520 65	.001
Frankford	8,765 19	279	4 10	1,143 90	94	.....	38 73	18 44	$296 25	198 17	156 42	10,617 10	34,681,753	140.8	48,831,908	216 67	.019
Totals and Averages	$35,761 06	5,064	$3 96¾	$20,091 43	1,555	820	$722 66	$54 17	$296 25	$667 50	$1,114 60	$58,707 67	4,415,315,469	85.4	3,771,616,924	$15 56	1.516
Grand Totals and Averages 1903	$381,714 85	211,590	$3 51½	$744,563 36	31,871	18,911	$15,021 93	$349 22	$8,962 50	$116,761 81	$25,082 77	$1,292,456 44	124,015,934,669	200.6	248,768,806,094	$5 20	100.000
Increase during 1903	.....	31,122	13	$133,043 97	3,187	1,895	$1,559 89	$57 55	$717 27	$13,326 15	$508 43	$140,227 84	7,217,510,169	.....	9,070,261,081	40	
Decrease during 1903	$8,985 42																

*Coal consumed from May to December approximated for both Stations.

†This Station is practically out of service.

Jonval Turbine No. 1—Capacity, 2,000,000 gallons per day.
Jonval Turbine No. 3—Capacity, 5,330,000 gallons per day.
Jonval Turbine No. 4—Capacity, 5,336,000 gallons per day.
Jonval Turbine No. 5—Capacity, 5,330,000 gallons per day.

FAIRMOUNT PUMPING STATION, 1903.

Total Capacity, 33,290,000 Gallons per Day.

Jonval Turbine No. 7—Capacity, 5,100,000 gallons per day.
Jonval Turbine No. 8—Capacity, 5,100,000 gallons per day.
Jonval Turbine No. 9—Capacity, 5,100,000 gallons per day.

1903.	Running Time of each Turbine in Hours.							Gallons Pumped by each Turbine.							Total Pumpage of each Month.	Average Pumpage per Day.	Oils.	
																	Cylinder.	Engine.
Months.	No. 1.	No. 3.	No. 4.	No. 5.	No. 7.	No. 8.	No. 9.	No. 1.	No. 3.	No. 4.	No. 5.	No. 7.	No. 8.	No. 9.	Gallons.	Gallons	Quarts	Quarts.
January	702	713	715	711	711	72	192	59,637,434	160,589,795	160,752,782	162,650,666	156,219,956	12,311,975	39,871,645	752,034,203	24,259,168	45	155
February	640	658	658	153	662	662	662	53,227,412	146,363,079	148,203,560	32,809,000	144,546,685	148,878,857	147,665,875	821,694,468	29,346,231	63	157
March	709	721	721	.....	734	706	731	59,095,868	154,955,152	157,514,944	.....	153,315,775	77,132,870	156,582,470	758,597,079	24,470,874	80	179
April	701	698	619	.....	706	216	706	62,133,302	153,848,575	123,095,267	.....	148,129,025	46,336,225	154,250,634	687,793,028	22,926,434	75	182
May	450	508	635	.....	642	595	699	37,661,056	110,763,270	138,289,012	.....	131,879,285	124,531,950	149,244,355	692,368,928	22,334,482	74	189
June	448	484	667	.....	600	665	587	39,387,854	97,762,749	141,872,896	.....	120,465,673	134,743,153	117,531,650	651,763,975	21,725,466	62	159
July	254	367	626	.....	566	583	562	22,094,266	80,796,362	130,329,957	.....	118,931,900	123,062,825	118,429,748	593,645,058	19,149,841	68	172
August	352	353	615	108	437	556	500	33,354,040	80,391,385	138,234,447	24,648,848	95,310,450	126,212,872	110,683,530	608,835,572	19,639,857	67	145
September	195	207	431	186	450	431	333	17,676,032	45,928,508	94,384,795	37,993,385	94,088,928	94,543,800	72,310,935	456,866,383	15,228,879	40	110
October	300	348	347	441	478	496	496	27,255,480	65,950,374	73,531,002	94,616,350	98,728,450	107,393,975	105,115,948	572,591,579	18,470,696	28	80
November	71	140	164	475	437	572	602	6,394,368	28,442,317	35,742,835	105,831,770	90,067,137	119,340,130	123,913,199	509,731,756	16,991,059	38	118
December	291	47	542	505	342	638	611	25,744,620	9,669,894	118,094,417	113,451,398	84,237,384	142,647,415	136,614,246	630,459,374	20,337,399	30	130
Totals and averages	5,113	5,244	6,740	2,579	6,765	6,192	6,681	443,661,732	1,135,461,460	1,460,045,864	571,941,417	1,435,920,648	1,257,136,047	1,432,214,235	7,736,381,403	21,195,565	670	1,776

No. 5.—Southwark Vertical Compound, Capacity, 20,000,000 gallons per day.
No. 6.—Simpson Rotary Compound, Capacity, 10,000,000 gallons per day.
No. 7.—Cramp Marine Rotary Compound, Capacity, 20,000,000 gallons per day.
No. 8.—Worthington Duplex, Capacity, 10,000,000 gallons per day.
No. 11—Gaskill Compound, Capacity, 20,000,000 gallons per day.

SPRING GARDEN PUMPING STATION, 1903.

Total Capacity, 170,000,000 gallons per day.

No. 2.—Holly Vertical Triple Expansion, Capacity, 30,000,000 gallons per day.
No. 3.—Holly Vertical Triple Expansion, Capacity, 30,000,000 gallons per day.
No. 9.—Worthington Duplex, Capacity, 15,000,000 gallons per day.
No. 10.—Worthington Duplex, Capacity, 15,000,000 gallons per day.

1903.	Running Time of each Engine.									Gallons Pumped by each Engine.									Total Pumpage of each Month.	Average Pumpage per Day.	Coal.		Percentage of Ashes.	Oils.		Mean Water Pressure and Mean Suction Lift in Pounds per Square Inch.									Gallons Raised 100 Feet per Pound of Coal.
	Old House.					New House.				Old House.					New House.									Cylinder.	Engine.	Old House.					New House.				
Months.	No. 5.	No. 6.	No. 7.	No. 8.	No. 11.	No. 2.	No. 3.	No. 9	No. 10.	No. 5.	No. 6.	No. 7.	No. 8.	No. 11.	No. 2.	No. 3.	No. 9.	No. 10.	Gallons.	Gallons.	Tons.	Lbs.		Qts.	Qts.	No. 5.	No. 6.	No. 7.	No. 8.	No. 11.	No. 2.	No. 3.	No. 9.	No. 10.	
January	789	589	780	721	332	625	680	715	736	642,295,500	226,590,000	545,683 500	363,933,470	298,076,000	717,255,000	595,621,250	485,389,880	494,760,000	4,389,605,200	139,987,295	5,482	1,335	.25	1,745	1,387	54	45	45	73	54	52	52	56	56	509.52
February	629	672	672	374	.....	652	626	667	633	548,613,400	282,240,000	501 984,000	189,252,000	.....	753,145,000	476,525,000	455,710,920	422,152,000	3,629,621,920	129,629,354	4,961	200	.25	1,418	1,090	54	45	45	70	.....	52	52	56	56	461.61
March	519	740	744	240	138	712	713	738	689	451,876,900	311,220,000	558,527,000	120,960,000	112,608,000	822,150,000	499,520,000	511,389,150	463,306,900	3,846,557,950	124,082,515	5,238	302	.25	1,492	1,128	54	45	45	54	54	52	52	56	56	457.37
April	514	696	688	323	706	527	541	714	706	452,092,700	292,380,000	476,586,000	102,911,500	575,688,000	607,635,000	378,875,000	495,937,700	474,660,403	3,916,916,300	130,563,877	5,302	1,378	.25	1,555	1,238	45	45	45	64	52	54	52	57	57	462.44
May	719	269	466	736	725	727	733	704	666	627,044,250	112,980,000	347,728,500	370,944,000	591,600,000	839,527,000	513,695,000	473,434,360	445,141,300	4,322,094,410	139,422,400	5,705	608	.25	1,605	1,299	54	45	54	70	46	60	52	61	61	450.42
June	661	694	720	708	172	613	708	718	699	576,061,500	261,240,000	537,840,000	356,832,000	140,352,000	707,647,500	495,980,000	495,317,410	469,950,800	4,041,221,210	134,707,374	5,279	593	.25	1,606	1,258	54	45	45	61	54	53	52	56	56	484.63
July	702	652	741	524	600	702	378	700	727	612,2 0,750	273,840,000	555,788,000	260,402.400	563,040,000	709,680,000	355,040,100	479,099,300	490,125,600	4,389,246,150	141,588,585	5,343	199	.25	1,664	1,336	54	45	45	54	54	52	52	56	56	515.24
August	510	38	744	555	677	628	727	740	643	448,157,750	15,960,000	555,394,500	279,720,000	572,024,000	720,405,000	837,742,500	506,105,390	431,770,400	4,342,279,540	140,073,534	5,168	1,846	.25	1,597	1,229	54	45	45	54	50	52	52	56	56	526.80
September	579	275	716	720	419	684	685	677	697	504,508,500	115,500,000	534,852,000	362,880,000	342,408,000	788,970,000	789,405,000	473,050,280	468,941,600	4,380,690,380	146,023,013	5,327	344	.25	1,583	1,229	54	45	45	77	45	53	52	56	56	529.25
October	715	330	739	477	667	726	720	734	724	623,122,900	138,810,000	552,033,000	238,896,000	514,272,000	887,600,000	831,442,500	504,557,950	487,107,200	4,757,930,650	153,481,634	5,695	1,634	.25	1,660	1,290	54	45	45	68	54	55	52	56	56	537.79
November	714	292	714	673	453	635	700	695	686	622,251,000	122,640,000	533,731,000	339,192,000	330,072,000	782,900,000	807,922,500	481,724,800	460,626,100	4,461,050,400	147,701,980	5,583	96	.25	1,602	1,254	54	45	45	77	54	51	52	55	58	513.42
December	733	605	494	744	250	719	730	734	616	638,809,500	299,300,000	360,01 ,000	374,976,000	211,344,000	881,000,000	841,805,000	504,667,280	412,132,050	4,483,141,830	144,617,478	5,830	674	.25	1,650	1,294	54	45	49	70	45	52	52	54	57	492.45
Totals and averages	7,734	5,862	8,118	6,795	5,238	7,945	7,941	8,536	8,222	6,742,153,750	2,452,860,000	6,064,165,500	3,420,899,370	4,231,479,000	9,158,004,500	7,423,758,850	5,866,384,920	5,520,674,950	50,880,964,940	139,398,260	64,917	249	.25	19,237	15,032	53	45	46	66	51	53	52	56	57	495.08

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.
No. 4—Worthington Duplex, Capacity 20,000,000 gallons per day.

BELMONT PUMPING STATION, 1903.

Total Capacity, 68,000,000 gallons per day.

No. 5.—Holly Rotary Duplex, Horizontal Compound, Capacity 10,000,000 gallons per day.
No. 6.—Holly Rotary Duplex, Horizontal Compound, Capacity 10,000,000 gallons per day.
No. 7.—Holly Rotary Duplex, Horizontal Compound, Capacity 10,000,000 gallons per day.

1903.	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.	Oils.		Mean Water Pressure and Mean Suction Lift in Pounds per Square Inch.							Gallons raised 100 Feet per Pound of Coal.
																				Cylinder.	Engine.							
Months.	No. 1.	No. 2.	No. 3.	No. 4.	No. 5.	No. 6.	No. 7.	No. 1.	No. 2.	No. 3.	No. 4.	No. 5.	No. 6.	No. 7.	Gallons.	Gallons.	Tons	Lbs.		Qts.	Qts.	No. 1.	No. 2.	No. 3.	No. 4.	No. 5.	No. 6.	No. 7.	
January	46	.....	45	695	579	514	399	10,584,000	.....	15,102,900	580,678,100	212,059,585	200,034,524	148,123,544	1,166,582,603	37,631,697	2,870	2,103	25	1,484	252	90	.....	91	95	100	100	100	449.22
February	278	179	282	208	350	584	473	69,552,000	46,912,320	97,597,400	250,767,000	131,301,916	228,257,828	179,805,716	1,004,194,180	35,864,078	2,782	860	25	1,248	156	90	90	91	95	100	100	100	396.31
March	655	651	19	.....	706	680	712	164,808,000	170,665,120	3,595,455	.....	284,776,490	276,806,784	284,739,088	1,185,390,937	38,238,417	2,899	1,138	25	1,496	200	95	95	95	.....	100	100	100	457.05
April	627	174	714	.....	692	616	689	159,260,000	47,025,440	246,808,800	.....	276,961,960	242,750,604	285,096,328	1,257,903,132	41,930,104	2,987	1,709	25	1,332	294	91	95	95	.....	100	100	100	466.48
May	520	466	330	98	712	647	718	130,914,000	123,973,920	116,459,300	82,467,000	291,707,232	261,496,212	292,473,680	1,299,491,344	41,919,076	3,095	495	25	2,048	90	90	91	95	95	100	100	100	464.02
June	61	.....	311	347	640	673	703	16,380,000	.....	110,562,695	287,351,540	256,388,492	272,517,004	284,908,648	1,228,108,379	40,936,946	2,683	548	25	1,392	76	95	.....	95	95	100	100	100	511.47
July	153	8	374	201	705	723	738	40,194,000	1,946,880	136,175,875	169,722,750	286,136,408	271,214,026	301,199,050	1,206,588,989	38,922,225	2,560	551	25	1,880	104	91	91	91	95	100	100	100	525.11
August	406	24	626	232	722	722	631	100,914,880	7,925,760	195,955,005	99,045,800	293,995,620	281,778,440	253,173,344	1,232,788,849	39,767,382	2,676	2,198	25	1,602	120	90	92	91	95	100	100	100	509.35
September	29	29	343	355	558	644	605	7,308,000	7,800,000	123,585,235	286,877,680	215,302,408	254,399,252	224,446,736	1,119,719,311	37,323,977	2,430	1,785	25	1,068	64	91	90	92	95	100	100	100	511.54
October	.....	35	564	162	690	724	715	.....	9,174,400	206,068,630	131,161,752	269,599,208	282,406,400	273,571,492	1,172,181,882	37,812,319	2,532	116	25	1,480	52	.....	90	92	95	100	100	100	515.43
November	8	55	436	229	667	671	571	2,016,000	12,204,440	165,218,050	177,891,120	265,492,918	266,030,720	222,715,852	1,111,569,100	37,052,303	2,608	2,105	25	1,484	.....	90	91	91	95	100	100	100	473.47
December	.....	.....	207	527	679	694	553	.....	.....	80,388,650	434,555,700	262,431,086	276,536,072	214,976,012	1,268,887,520	40,961,855	3,049	151	25	1,360	128	.....	.....	92	95	100	100	100	462.57
Totals and averages.	2,783	1,621	4,251	3,144	7,690	7,892	7,507	701,930,880	427,628,280	1,497,517,995	2,500,518,442	3,046,153,273	3,114,227,866	2,965,429,490	14,253,406,226	39,050,428	33,177	319	25	17,874	1,536	91	92	93	95	100	100	100	478.50

No. 1—Southwark Vertical Triple Expansion. Capacity 20,000,000 gallons per day.
No. 2—Southwark Vertical Triple Expansion. Capacity 20,000,000 gallons per day.

QUEEN LANE PUMPING STATION, 1903.

Total Capacity 80,000,000 gallons per day.

No. 3—Southwark Vertical Triple Expansion. Capacity 20,000,000 gallons per day.
No. 4—Southwark Vertical Triple Expansion. Capacity 20,000,000 gallons per day.

1903.	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.	Oils.		Mean Water Pressure and Mean Suction Lift in Pounds per Square Inch.				Gallons raised 100 feet per Pound of Coal.
														Cylinder.	Engine.					
Months	No. 1.	No. 2.	No. 3.	No. 4.	No. 1.	No. 2.	No. 3.	No. 4.	Gallons.	Gallons.	Tons.	Pounds		Quarts.	Quarts.	No. 1.	No. 2.	No. 3.	No. 4.	
January	677	695	717	711	565,198,100	575,106,330	597,996,510	595,641,750	2,333,942,690	75,288,474	4,365	1,680	.25	944	1,128	105	105	105	105	655.63
February	557	643	660	647	469,291,250	540,019,800	552,230,500	542,818,150	2,104,359,700	75,155,704	3,769	640	.25	833	999	105	105	105	105	685.20
March	676	709	720	678	560,776,050	592,463,100	602,228,800	563,431,900	2,318,899,850	74,803,221	4,048	1,480	.25	921	1,002	105	105	105	105	702.90
April	616	698	621	644	514,470,400	581,904,100	520,096,450	539,838,950	2,156,309,900	71,876,997	4,018	780	.25	868	1,038	105	105	105	105	658.55
May	633	686	694	687	507,006,750	562,408,910	577,396,530	566,534,930	2,213,347,120	71,398,294	5,261	1,260	.25	889	1,067	105	105	105	105	516.25
June	700	696	709	698	570,701,500	567,250,550	585,383,500	583,336,450	2,306,672,000	76,889,067	4,204	740	.25	926	1,106	105	105	105	105	673.35
July	725	704	718	713	597,274,850	585,291,280	600,766,000	598,178,750	2,381,510,880	76,822,932	3,782	1,520	.25	949	1,133	105	105	105	105	772.64
August	569	708	719	694	463,556,700	587,232,850	601,198,750	587,891,400	2,239,979,700	72,257,410	3,758	680	.25	903	1,086	105	105	105	105	731.44
September	696	685	698	687	576,682,550	570,260,500	584,383,000	574,348,810	2,305,674,950	76,855,832	3,803	1,480	.25	910	1,089	105	105	105	105	743.91
October	725	685	720	717	600,812,850	565,954,300	602,613,550	601,728,850	2,371,109,550	76,487,405	4,161	1,960	.25	943	1,129	105	105	105	105	699.18
November	599	687	668	685	504,255,500	571,050,250	560,265,150	571,677,450	2,207,248,350	73,574,945	4,075	720	.25	927	1,065	105	105	105	105	664.73
December	575	697	710	691	465,280,900	573,114,080	593,188,850	571,217,780	2,202,802,510	71,058,145	4,416	160	.25	830	986	105	105	105	105	613.17
Totals and averages	7,748	8,293	8,354	8,252	6,395,307,400	6,872,157,040	6,977,747,590	6,896,645,170	27,141,857,200	74,361,253	49,665	1,900	.25	10,843	12,828	105	105	105	105	676.41

No. 1—Worthington Duplex, Capacity, 4,000,000 gallons per day.
No. 2—Worthington Duplex. Capacity, 5,000,000 gallons per day.
No. 3—Worthington Duplex. Capacity, 6,500,000 gallons per day.

ROXBOROUGH PUMPING STATION, 1903.

Total Capacity, 35,500,000 gallons per day.

No. 4—Worthington High Duty Duplex. Capacity, 5,000,000 gallons per day.
No. 5—Worthington High Duty Duplex. Capacity, 5,000,000 gallons per day.
No. 6—Worthington High Duty Duplex. Capacity, 5,000,000 gallons per day.
No. 7—Worthington High Duty Duplex. Capacity, 5,000,000 gallons per day.

1903.	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.	Oils.		Mean Water Pressure and Mean Suction Lift in Pounds per Square Inch.							Gallons Raised 100 feet per pound of coal.
	Old House.			New House.				Old House.			New House.									Cylinder.	Engine.	Old House.			New House.				
Months	No. 1.	No. 2.	No. 3.	No. 4.	No. 5.	No. 6	No. 7.	No. 1.	No. 2.	No. 3.	No. 4.	No. 5.	No. 6.	No. 7.	Gallons.	Gallons.	Tons.	Lbs.		Qts.	Qts.	No. 1.	No. 2.	No. 3.	No. 4.	No. 5.	No. 6.	No. 7.	
January	200	704	733	727	698	696	724	28,704,000	152,064,000	192,612,800	129,798,030	123,646,365	116,042,205	125,004,065	867,871,465	27,995,854	3,743	1,880	.25	915	451	160	153	153	156	159	154	158	394.03
February	352	655	671	495	483	399	477	50,578,320	141,318,000	174,528,000	81,800,790	77,494,080	60,694,440	77,767,750	664,181,380	23,720,764	3,111	1,840	.25	807	422	160	160	160	162	160	160	160	373.33
March		535	497	621	591	567	604		116,096,000	129,610,800	111,933,075	112,912,910	96,248,745	100,775,140	667,576,670	21,534,731	2,963	1,560	.25	731	386		160	160	164	160	160	160	395.88
April		670	5	610	623	489	664		144,828,000	1,296,000	107,773,215	110,480,720	85,368,715	118,378,455	568,125,105	18,937,503	2,573	1,100	.25	606	358		160	160	166	160	165	160	330.42
May		108	689	692	704	603	709		24,192,000	179,200,000	120,518,460	118,517,295	107,609,700	122,163,130	672,200,585	21,683,890	2,886	1,880	.25	713	414		160	160	165	160	165	160	411.94
June		548	619	610	427	652	671		118,468,000	159,897,600	105,304,430	75,056,370	111,746,430	122,384,790	692,857,620	23,095,254	2,919	200	.25	759	451		160	160	165	160	160	160	417.21
July	37	654	720	714	189	710	731	5,310,240	141,156,000	187,264,800	120,721,470	30,380,595	117,301,105	125,865,940	728,000,150	23,483,876	3,171	1,800	.25	820	477	160	160	160	165	160	160	160	403.32
August	368	691	743	674	654	623	661	52,662,480	149,364,000	192,996,000	109,682,805	106,191,740	97,945,150	109,762,430	818,604,605	26,406,600	3,455	1,960	.25	910	563	165	160	160	165	160	160	160	416.45
September	696	604	531	693	470	564	521	99,889,920	128,528,'00	136,210,800	116,599,890	76,982,210	93,869,325	89,363,785	741,444,030	24,714,801	3,349	2,200	.25	881	543	165	160	160	165	160	160	160	389.99
October	109	678	685	345	667	401	652	28,112,240	145,649,700	178,892,400	59,674,500	118,814,500	71,809,970	114,058,000	717,011,310	23,129 397	3,438	1,880	.25	862	518	164	160	160	160	160	160	160	364.80
November	665	435	693	188	543	666	588	91,057,360	91,719,530	176,984,480	31,861,210	92,097,0 5	110,778,020	101,408,210	695,906,745	23,196,892	3,856	2,120	.25	898	558	165	165	162	165	162	162	162	320.52
December	548	374	677	2	713	675	643	74,215,280	79,301,450	174,869,400	359,115	122,670,600	115,802,305	114,488,235	681,706,385	21,990,529	3,718	800	.25	904	547	161	157	155	165	162	162	162	319.47
Totals and averages.	2,975	6,656	7,263	6,371	6,762	7,045	7,645	430,529,840	1,432,684,780	1,884,363,080	1,096,026,990	1,165,245,320	1,185,216,110	1,321,419,930	8,515,486,050	23,330,099	39,190	1,300	.25	9,806	5,688	162	160	159	164	160	161	160	378.11

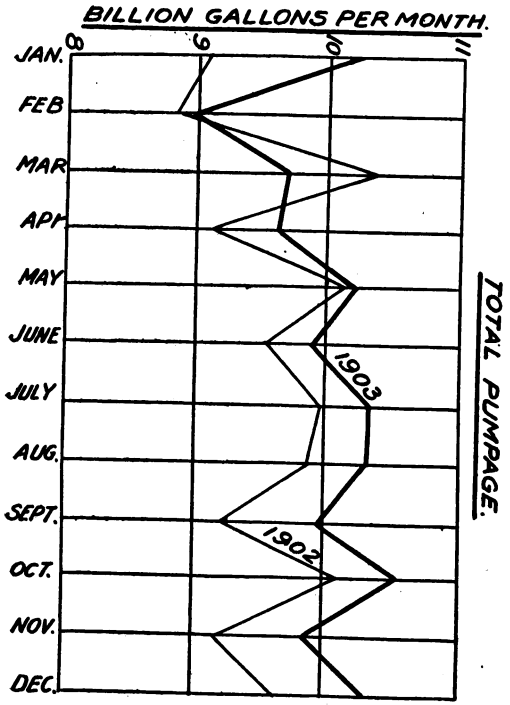
No. 1—Cramp Marine Compound Rotary. Capacity, 10,000,000 gallons per day.
No. 2—Corliss Compound Rotary. Capacity, 10,000,000 gallons per day.

FRANKFORD PUMPING STATION, 1903.

Total capacity, 57,000,000 gallons per day.

No. 3—Southwark Vertical Compound Rotary. Capacity, 22,000,000 gallons per day.
No. 4—Southwark Vertical Compound Rotary. Capacity, 15,000,000 gallons per day.

1903.	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.	Oils.		Mean Water Pressure and Mean Suction Lift in Pounds per Square Inch.				Gallons raised 100 feet per pound of coal.
														Cylinder.	Engine.					
Months.	No. 1.	No. 2.	No. 3.	No. 4.	No. 1.	No. 2.	No. 3.	No. 4.	Gallons.	Gallons	Tons.	Lbs.		Quarts.	Quarts.	No. 1.	No. 2.	No. 3.	No. 4.	
January	718	541	.....	713	247,570,670	207,750,750	.....	339,328,005	794,649,425	25,633,852	1,459	880	.25	680	915	70	70	.....	70	437.85
February	623	421	.....	611	211,655,620	159,004,110	.....	357,318,050	727,977,780	25,999,206	1,350	400	.25	768	1,000	70	70	.....	70	434.74
March	665	553	4	681	282,888,850	161,130,570	2,726,629	439,820,940	886,566,989	26,986,032	1,571	1,870	.25	869	1,180	70	70	70	70	429.85
April	113	542	564	631	39,468,900	204,301,200	300,271,570	414,473,680	958,515,330	31,950,511	1,812	1,278	.25	775	1,406	70	70	71	70	433.80
May	.....	554	672	669	.....	212,894,880	356,307,350	407,973,970	977,176,200	31,521,813	1,773	1,308	.25	955	1,464	.....	70	70	70	448.17
June	376	580	630	653	133,082,460	221,871,880	336,061,160	250,006,250	941 021,750	31,367,392	1,603	1,440	.25	1,100	1,520	70	70	70	70	477.67
July	673	598	407	613	243,049,670	229,021,755	213,996,090	299,076,805	985,144,320	31,778,849	1,547	610	.25	1,220	1,500	70	70	70	70	544.03
August	694	640	493	504	246,571,310	244,271,420	264,110,130	297,412,625	1,052,365,485	33,947,274	1,608	690	.25	955	1,260	70	70	70	70	530.12
September	572	234	488	670	197,021,040	90,289,600	275,867,080	413,772,080	976,949,800	32,564,993	1,653	640	.25	984	1,300	70	70	70	70	473.20
October	583	.....	600	707	201,720,522	.....	330,512,140	420,695,890	952,928,552	30,739,631	1,797	330	.25	1,050	1,240	70	.....	70	70	434.63
November	300	301	552	611	102,491,330	110,200,150	301,440,340	357,355,550	871,487,370	29,049,579	1,606	200	.25	955	990	70	70	70	70	443.91
December	.....	646	649	663	.....	247,045,800	359,805,170	391,489,410	998,340,380	32,204,528	1,791	1,708	.25	960	930	.....	70	70	70	455.55
Totals and averages	5,317	5,610	5,059	7,726	1,855,520,372	2,087,782,115	2,741,097,659	4,388,723,235	11,073,123,381	30,337,324	19,575	154	.25	11,271	14,705	70	70	70	70	461.96



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

BELMONT HIGH SERVICE STATION, 1903.

No. 2—Worthington High Service. Capacity, 5,000,000 gallons per day.

Total Capacity, 7,000,000 gallons per day.

1903.	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.	Oils.		Mean Water Pressure per Square Inch, less Mean Pressure on Suction Pipe.		Gallons Raised 100 Feet per Pound of Coal.
										Cylinder.	Engine.			
Months.	No. 1.	No. 2.	No. 1.	No. 2.	Gallons.	Gallons.	Tons.	Lbs.		Qts.	Qts.	No. 1.	No. 2.	
January	.....	744	.....	75,609,000	75,609,000	2,439,000	148	785	.25	186	8	.....	73	336.47
February	.....	672	.....	68,292,000	68,292,000	2,439,000	138	1,975	.25	168	7	.....	73	313.69
March	.....	744	.....	75,609,000	75,609,000	2,439,000	143	495	.25	186	8	.....	73	336.78
April	.....	720	.....	73,170,000	73,170,000	2,439,000	126	985	.25	180	7	.....	73	369.17
May	.....	744	.....	75,609,000	75,609,000	2,439,000	135	1,325	.25	186	8	.....	73	355.73
June	.....	720	.....	68,555,385	68,555,385	2,285,179	131	80	.25	180	7	.....	73	333.76
July	.....	744	.....	70,499,100	70,499,100	2,274,165	135	2,050	.25	186	8	.....	73	330.79
August	.....	744	.....	74,674,640	74,674,640	2,408,859	133	1,195	.25	186	7	.....	73	356.75
September	.....	720	.....	70,243,200	70,243,200	2,341,440	129	660	.25	150	7	.....	73	346.58
October	.....	744	.....	72,081,840	72,081,840	2,323,608	120	70	.25	154	8	.....	73	382.83
November	.....	720	.....	70,243,200	70,243,200	2,341,440	126	120	.25	180	7	.....	73	355.49
December	.....	744	.....	72,584,640	72,584,640	2,341,440	132	260	.25	186	8	.....	73	350.48
Totals and averages.	.....	8,760	.....	867,121,005	867,121,005	2,375,674	1,595	1,040	.25	2,128	90	.....	73	347.38

No. 1—Worthington Duplex. Capacity 5,000,000 Gallons per day.

ROXBOROUGH HIGH SERVICE STATION, 1903.

Total Capacity 10,000,000 Gallons per day.

No. 2—Worthington High Duty Duplex. Capacity 5,000,000 Gallons per day.

1903.	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.	Oils.		Mean Water Pressure per Square inch less Mean Pressure on Suction Pipe,		Gallons raised 100 feet per pound of coal.
										Cylinder.	Engine.			
Months.	No. 1.	No. 2.	No. 1.	No. 2.	Gallons.	Gallons.	Tons.	Lbs.		Qts.	Qts.	No. 1.	No. 2.	
January	7	737	1,547,370	122,037,425	123,584,795	3,986,606	131	1,310	.25	155	23	56	56	492.66
February	5	667	1,170,180	111,224,240	112,394 420	4,014,080	133	1,820	.25	140	21	56	56	440.59
March	6	738	1,363,230	125,060,470	126,423,700	4,078,184	144	420	.25	155	23	56	56	459.92
April	4	715	899,910	122,332,505	123,232,415	4,107,747	144	240	.25	150	22	56	56	448.56
May	99	643	20,947,430	118,245,315	139,192,745	4,490,089	159	744	.25	155	23	56	56	458.25
June	42	678	8,966,430	124,522,115	133,483,545	4,449,618	152	1,798	.25	150	23	56	56	458.25
July	2	742	445,500	140,486,820	140,932,320	4,546,204	161	725	.25	155	24	56	56	458.25
August	.....	744	.....	132,361,340	132,361,340	4,269,721	151	1,148	.25	155	23	.....	56	458.25
September	36	684	7,605,080	121,073,820	128,678,900	4,289,297	147	665	.25	150	22	56	56	458.25
October	4	739	849,420	130,963,395	131,812,815	4,252,026	150	1,981	.25	155	23	54	54	439.92
November	14	705	3,121,470	122,206,595	125,328,065	4,177,602	143	1,034	.25	150	22	54	54	439.92
December	9	734	2,168,100	126,331,985	123,500,08›	4,145,164	147	207	.25	155	23	54	54	439.92
Totals and averages	228	8,524	49,084,120	1,496,846,023	1,545,930,145	4,235,425	1,767	892	.25	1,825	272	55	55	454 39

*Steam for Roxborough High Service and Roxborough Annex Stations, was generated from the same boilers, and the coal consumed from May to December, is approximated for both stations.

No. 1—Davidson Rotary, Capacity 1,000,000 Gallons per Day.

No. 2—Davidson Rotary, Capacity 1,000,000 Gallons per Day.

MOUNT AIRY PUMPING STATION.

1903.

Total Capacity 3,000,000 Gallons per Day.

No. 3—Knowles Rotary, Capacity 1,000,000 Gallons per Day.

1903.	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	Oils.		Mean Water Pressure per Square Inch, less Mean Pressure on Suction Pipe.			Gallons Raised 100 Feet per Pound of Coal.
												Cylinder.	Engine.				
Months.	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	.....	.....	.....	.....	.....	.....	.....	.....	20	1,700	.25	.....	.....	.....	.....	.....	.....
February	.....	.....	.....	.....	.....	.....	.....	.....	18	1,680	.25	.....	.....	.....	.....	.....	.....
March	.....	.....	.....	.....	.....	.....	.....	.....	20	1,700	.25	.....	.....	.....	.....	.....	.....
April	5	4	.....	243,750	195,000	.....	438,750	14,625	20	1,200	.25	½	½	50	50	.....	8.56
May	196	38	.....	9,385,396	1,948,000	.....	11,283,396	363,981	42	920	.25	14	4	50	50	.....	106.65
June	89	61	.....	4,337,750	2,973,750	.....	7,311,500	243,717	33	1,880	.25	9	4	50	50	.....	86 61
July	33	40	.....	1,608,750	1,965,000	.....	3,573,750	115,282	27	1,720	.25	5	3	50	50	.....	51.59
August	50	20	.....	2,515,000	975,000	.....	3,490,000	112,581	28	280	.25	5	3	50	50	.....	49.74
September	95	18	.....	4,638,750	88 ,000	.....	5,523,750	184,125	32	1,820	.25	6	3	50	50	.....	67.48
October	12	32	.....	611,250	1,642,000	.....	2,253,250	72,685	24	1,740	.25	4	1	50	50	.....	36.45
November	12	23	.....	607,500	1,203.750	.....	1,811,250	60,375	25	1,000	.25	6	2	50	50	.....	28.53
December	6	14	.....	292,500	735,000	.....	1,027,500	33,145	26	1,760	.25	6	2	50	50	.....	15.37
Totals and Averages..	498	250	.....	24,190,646	12,522,500	.....	36,713,146	100,584	322	1,720	.25	57½	22½	50	50	.....	50.11

No. 1—Knowles, Capacity 250, 000 gallons per day.

CHESTNUT HILL PUMPING STATION, 1903.

Total Capacity 750,000 gallons per day.

No. 2—Worthington Duplex, Capacity 500,000 gallons per day.

1903.	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.	Oils.		Mean Water Pressure per Square Inch less Mean Pressure on Suction Pipe.		Gallons raised 100 Feet per Pound of Coal.
										Cylinder.	Engine.			
Months.	No. 1.	No. 2.	No. 1.	No. 2.	Gallons.	Gallons.	Tons.	Lbs.		Qts.	Qts.	No. 1.	No. 2.	
January							11	40	.25					
February							9	1,800	.25					
March							8	1,120	.25					
April							8	590	.25					
May							8	1,006	.25					
June		1		36,900	36,900	1,230	8	425	.25		1		50	2.25
July							8	1,227	.25					
August							8	1,341	.25					
September							8	870	.25					
October		2		73,800	73,800	2,381	9	145	.25		1		50	4.10
November							8	880	.25					
December		2		78,720	78,720	2,539	9	550	.25		2		50	4.29
Totals and averages		5		189,420	189,420	519	106	1,034	.25		4		50	3.54

No. 1—Holly Rotary Duplex.
Capacity, 3,000,000 gallons per day.

FRANKFORD HIGH SERVICE STATION, 1903.

Total Capacity, 7,000,000 Gallons per day.

No. 2—D'Auria Horizontal Compound.
Capacity, 4,000,000 gallons per day.

1903.	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.	Oils.		Mean Water Pressure per Square Inch less Mean Pressure on Suction Pipe.		Gallons Raised 100 Feet per Pound of Coal.
										Cylinder.	Engine.			
Months.	No. 1.	No. 2.	No. 1.	No. 2.	Gallons.	Gallons.	Tons.	Lbs.		Qts.	Qts.	No. 1.	No. 2.	
January	23	23	1,336,680	1,304,928	2,641,608	85,213	29	605	.25	21	13	71	71	56.72
February	22	22	1,222,920	1,258,192	2,481,112	88,611	24	505	.25	20	11	71	71	64.37
March	30	17	1,724,175	982,741	2,706,916	87,320	20	1,155	.25	21	12	71	71	81.86
April	15	30	871,720	1,683,633	2,555,353	85,178	19	185	.25	13	11	71	71	84.17
May	23	37	1,320,688	2,109,870	3,430,558	110,663	20	580	.25	15	16	71	71	106.43
June	27	27	1,548,202	1,550,602	3,098,804	103,293	21	295	.25	19	13	71	71	92.17
July	32	32	1,794,928	1,797,720	3,592,648	115,892	23	480	.25	25	15	71	71	97.27
August	27	27	1,535,760	1,531,872	3,067,632	98,956	23	260	.25	21	13	71	71	83.41
September	27	26	1,517,320	1,507,050	3,024,370	100,812	23	315	.25	16	14	71	71	82.15
October	24	24	1,463,120	1,401,664	2,864,784	92,412	22	1,310	.25	17	13	71	71	79.73
November	22	23	1,279,800	1,276,560	2,556,360	85,212	23	330	.25	17	12	71	71	69.41
December	23	23	1,336,680	1,324,928	2,661,608	85,858	29	1,771	.25	15	12	71	71	56.16
Totals and Averages.	295	311	16,951,993	17,729,760	34,681,753	95,018	279	1,071	.25	220	155	71	71	79.49

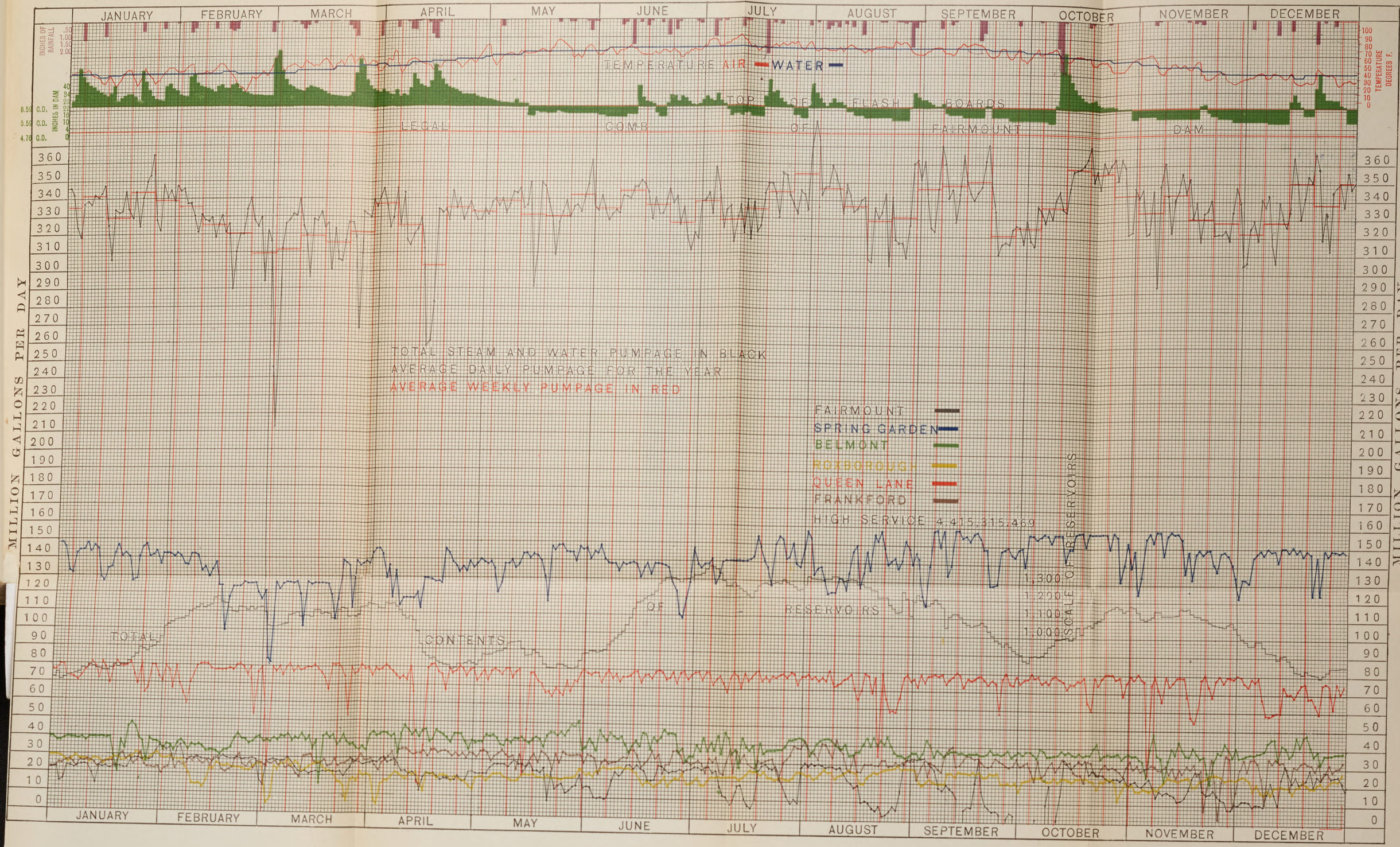
NG STATION TYPE

arden ..... | Marine,

TOTAL GALLONS PUMPED AND CONSUMED DURING 1903.

Months.	Pumpage.								Consumption.			Supplementary Pumpage.								Total Pumpage and Supplementary Pumpage.	Average Total Pumpage per Day.	Percentage of Pumpage.	Total Steam Pumpage.	Total Water Pumpage.
	Fairmount.	Spring Garden.	Belmont.	Queen Lane.	Roxborough.	Frankford.	Total.	Average per day.	Stored in Reservoirs at the End of Each Month.	Total.	Average per day.	Belmont.	Roxborough.	Roxborough Annex.	Mt. Airy.	Chestnut Hill.	Frankford.	Total.	Average daily.					
December, 1902									711,433,194															
January, 1903	752,034,203	4,339,605,200	1,166,582,603	2,533,942,690	867,871,465	794,649,425	10,254,685,586	330,796,309	950,717,175	10,015,401,605	323,077,471	75,609,000	123,584,795				2,641,608	201,835,403	6,510,819	10,456,520,989	337,307,128	8.43	9,704,486,786	752,034,203
February	821,694,408	3,629,621,920	1,004,194,180	2,104,359,700	664,181,380	727,977,780	8,952,029,428	319,715,336	1,128,406,441	8,774,340,162	313,369,291	68,292,000	112,394,420				2,481,112	183,167,532	6,541,697	9,135,196,960	326,257,034	7.37	8,313,502,492	821,694,408
March	758,597,079	3,846,557,950	1,185,330,937	2,318,899,850	667,576,670	836,566,989	9,613,589,475	310,115,789	1,147,795,925	9,594,200,291	309,490,332	75,609,000	126,423,700				2,706,916	204,739,616	6,604,503	9,818,329,991	316,720,293	7.92	9,059,782,012	758,597,079
April	687,793,028	3,916,916,300	1,257,903,182	2,156,309,900	568,125,105	958,515,330	9,545,562,795	318,185,426	826,844,221	9,866,514,199	328,883,807	73,170,000	123,232,415		438,750		2,555,353	199,396,518	6,646,550	9,744,950,313	324,831,977	7.86	9,057,166,285	687,793,028
May	692,368,928	4,322,094,410	1,290,491,344	2,213,347,120	672,200,585	977,176,200	10,176,678,587	328,279,954	885,441,684	10,118,081,124	326,389,714	75,609,000	139,192,745		11,283,306		3,430,558	229,515,699	7,403,782	10,406,194,286	335,683,686	8.39	9,713,825,358	692,368,928
June	651,763,975	4,041,221,210	1,228,108,379	2,306,672,000	692,857,620	941,021,750	9,861,644,934	328,721,497	1,312,253,897	9,434,832,721	314,494,424	68,555,385	133,488,545		7,311,500	36,000	3,098,804	212,401,134	7,083,037	10,074,136,068	335,804,535	8.12	9,422,972,093	651,763,975
July	503,645,058	4,389,246,150	1,206,588,989	2,381,510,880	728,000,150	985,144,320	10,284,135,547	331,746,307	1,258,177,824	10,343,211,620	333,651,987	70,499,100	140,932,320	297,000,000	3,573,750		3,502,648	515,687,818	16,635,090	10,799,823,365	348,381,398	8.71	10,206,178,307	593,645,058
August	608,835,572	4,342,279,540	1,232,788,849	2,239,979,700	818,904,605	1,052,365,485	10,294,853,751	332,092,056	1,111,014,410	10,437,017,165	336,677,973	74,674,040	132,361,340	328,780,000	3,490,000		3,067,632	542,379,612	17,495,922	10,837,227,963	349,587,979	8.74	10,228,391,791	608,835,572
September	456,866,383	4,380,690,380	1,119,719,511	2,305,674,950	741,444,030	976,940,800	9,981,344,854	332,711,495	916,883,760	10,175,475,495	339,182,516	70,243,200	128,678,900	306,450,000	5,523,750		3,024,370	513,920,220	17,130,674	10,495,265,074	349,842,169	8.46	10,038,398,691	456,866,383
October	572,591,579	4,757,930,650	1,172,181,882	2,371,109,550	717,011,310	952,928,552	10,543,753,523	340,121,081	1,160,380,498	10,300,256,794	332,266,348	72,031,840	131,812,815	327,750,000	2,253,250	73,800	2,864,784	536,786,489	17,315,693	11,080,540,012	357,436,774	8.93	10,507,948,433	572,591,579
November	509,731,756	4,431,059,400	1,111,569,100	2,207,248,350	695,906,745	871,487,370	9,827,002,721	327,566,757	1,066,666,989	9,920,716,850	330,690,569	70,243,200	125,328,065	340,850,000	1,811,250		2,556,360	540,788,875	18,026,295	10,367,791,596	345,593,053	8.36	9,858,059,840	509,731,756
December	630,459,374	4,483,141,890	1,203,887,520	2,202,802,510	681,706,385	908,340,380	10,265,337,999	331,139,935	855,526,415	10,476,477,953	337,950,902	72,584,640	12 ,500,085	329,760,000	1,027,500	78,720	2,661,608	534,612,553	17,245,566	10,799,950,552	348,385,501	8.71	10,169,491,178	630,459,374
Totals	7,736,381,403	50,880,364,940	14,253,406,226	27,141,857,200	8,515,486,050	11,073,123,381	119,600,619,200	327,672,929		119,456,525,979	327,278,153	867,121,005	1,545,960,145	1,930,680,000	36,713,146	189,420	34,681,753	4,415,315,469	12,096,755	124,015,934,669	339,769,684	100.00	116,270,553,266	7,736,381,403
Increase during 1903	113,899,184		2,783,659,886	1,171,314,040	1,362,965,525	64,678,808	5,140,454,821	14,083,438		4,849,211,617	13,285,511	228,044,985		1,930,680,000				2,077,055,348	5,690,563	7,217,510,169	19,774,001		7,103,610,985	113,899,184
Decrease during 1903		356,056,022											41,105,865		33,646,304	6,794,382	173,086							

PUMPAGE DIAGRAM FOR THE YEAR 1903



APPENDIX C

REPORT

OF THE

Assistant in Charge of Distribution

Philadelphia, January 25, 1904.

F. L. HAND, ESQ.,
Chief, Bureau of Water.

DEAR SIR:—I have the honor to submit the following report on the distribution system for the year 1903:

Mains.

The following is a statement of the mains laid, re-laid, taken up, etc.:

New Work.

By Bureau of Water:

Service mains laid	125,219 feet
Supply mains laid	1,877 feet
Connections, etc.	7,795 feet
Total	134,891 feet

High Pressure Fire Service:

Mains	1,500 feet

Comparison of conditions relative to the Distribution, 1902-1903.

	1902.	1903.	Increase.	Decrease.
Service mains, 4-in. to 12-in.	87,943	125,219	37,276	
Supply mains, 10-in. to 48-in.	1,034	1,877	843	
Fire main, 20-in.	.....	1,500	1,500	
Connections & miscellaneous work.	7,762	7,795	33	
Totals in feet	96,739	136,391	39,652	
Re-laid, 6-in. to 36-in.	16,042	12,205	.....	3,837
Miscellaneous repairs 3-in. to 48-in.	3,754	3,049	.....	705
Taken up, 3-in. to 48-in.	13,335	7,980	.....	5,355
Lowered, raised and shifted, 6-in. to 48-in	7,256	5,606	.....	1,650
Totals in feet	40,387	28,840	.....	11,547
Pipe cut off and abandoned, 3-in. to 20-in.	4,884	5,892	1,008	

Meters.

	1902.	1903.	Increase.	Decrease.
Meters in use	1,502	1,775	273	

Number of Dwellings and Principal Appliances for the use of City Water.

	1902.	1903.	Increase.	Decrease.
Dwellings with water	244,506	249,980	5,474	
Dwellings without water	11,738	11,750	12	
Water closets	277,960	293,497	15,537	
Baths	284,478	290,759	6,281	
Wash paves	95,685	96,092	407	
Basins and sinks	108,338	114,271	5,933	
Urinals	5,813	6,001	188	

Repairs.

Mains relaid	12,205	
Repairs and connections	3,049	
		15,254
Old pipe taken up	7,980	
Pipe lowered, raised and shifted	5,606	
		13,586
Total		28,840

Abandoned.

Three-inch	1,670	
Four-inch	1,951	
Six-inch	2,108	
Ten-inch	30	
Twelve-inch	133	
Total		5,892

The total quantity of pipe handled, for all purposes, throughout the year, was 165.231 feet, weighing 8,011,122 pounds.

The total quantity of new pipe laid was 136,391 feet, or 25.83 miles, making, in addition to that previously laid, 1,445.59 miles now in use.

Fire Hydrants.

New style fire hydrants in new locations	348
New style fire hydrants in place of old style	190
Total	538
New style fire hydrants taken out	31
Old style fire hydrants taken out	5
Total	36

The total number of new style fire hydrants added to the distribution system was 312, and the total number in use December 31, 1903, was 13,647, of which 528 are of the old style and 13,119, or 96.13 per cent. are of the new pattern.

Drills for Attachments.

One-half inch	4,990	area of openings	980	square inches
Five-eighth inch	230	area of openings	71	square inches
Three-quarter inch ...	120	area of openings	53	square inches
One inch	101	area of openings	79	square inches
One and one-quarter inches	28	area of openings	34	square inches
One and one-half in...	38	area of openings	67	square inches
Two inches	93	area of openings	292	square inches
Three inches	14	area of openings	99	square inches
Four inches	17	area of openings	214	square inches
Six inches	6	area of openings	170	square inches
Total	5,637	area of openings	2,059	square inches

For attachments, including ferrules, service pipes and curb stops, which were put in from the street mains to the curb, by employees of this Bureau, in order to provide for possible future service, without breaking of street pavements, see Table "A."

Tabulations of work performed and of expenditures made are also submitted herewith, together with various other tables, compiled as in previous years.

The report of the Pipe Inspector, relative to the inspection of pipes and other castings during the year, in tabulated form, also accompanies this report.

Respectfully submitted,

W. WHITBY,

Assistant in Charge of Distribution.

SERVICE AND SUPPLY MAINS LAID DURING 1903.

First District.

Comprising the 1st, 2d, 3d, 4th, 26th, 30th, 36th and 39th Wards.

	Purposes for which used.	Size in Inches. 3	4	6	8	10	12	20	Total Feet and Pounds.
New pipe or feet added.	Service mains	.....	.....	4,638	4,390	2,606	625	.....	12,259
	Supply mains	.....	.....	.....	.....	.....	.....	1,512	1,512
	Supply main connections	.....	.....	.....	.....	33	63	.....	96
	Fire hydrant connections	.....	.....	445	.....	.....	.....	.....	445
	Fire connections (private)	.....	.....	44	.....	.....	.....	.....	44
	Supply connections (private)	.....	20	.....	.....	.....	.....	.....	20
	Motor connections (private)	17	.....	.....	.....	.....	.....	.....	17
	Total — Feet	17	20	5,127	4,390	2,639	688	1,512	14,393
	Total — Pounds	255	400	169,191	184,380	145,145	51,600	234,360	785,331
Pipe used, but adding nothing to feet in gr'd.	Pipe relaid	.....	.....	107	100	70	1,357	.....	1,634
	Repairs, general	.....	3	223	.....	18	16	.....	260
	Pipe taken up	5	131	160	.....	.....	.....	.....	296
	Total — Feet	5	134	490	100	88	1,373	.....	2,190
	Total — Pounds	75	2,680	16,170	4,200	4,840	102,975	.....	130,940
Total handled		Feet 22	154	5,617	4,490	2,727	2,061	1,512	16,583
		Pounds 330	3,080	185,361	188,580	149,985	154,575	234,360	916,271
Pipe cut off and abandoned		9	1,289	26	.....	.....	.....	.....	1,324

Second District.

Comprising the 5th, 6th, 7th, 8th, 9th, 10th, 11th, 12th, 13th, 14th, 16th and 17th Wards.

Purposes for which used.		Size in Inches. 3	4	6	8	10	12	30	20	Total in Feet and Pounds.
New pipe or feet added.										
Service mains		.....	.....	953	.....	.....	.....	.....	.....	953
Fire mains		.....	.....	.....	.....	.....	.....	.....	1,500	1,500
Fire hydrant connections		.....	.....	120	.....	.....	.....	.....	.....	120
Fire connections (private)		.....	14	68	.....	.....	.....	.....	.....	82
Supply connections (private)		119	73	331	.....	.....	.....	.....	.....	523
Total	Feet	119	87	1,472	.....	.....	.....	.....	1,500	3,178
	Pounds	1,785	1,740	48,576	.....	.....	.....	.....	600,000	652,101
Pipe used but adding nothing to feet in ground.										
Pipe relaid		.....	.....	1,378	66	.....	.....	.....	.....	1,444
Repairs, general		3	.....	366	.....	17	13	3	.....	402
Pipe taken up		267	75	432	.....	.....	.....	.....	.....	774
Pipe raised		.....	.....	.....	.....	15	.....	.....	.....	15
Pipe shifted		.....	.....	689	.....	.....	.....	.....	.....	689
Total	Feet	270	75	2,865	66	32	13	3	.....	3,324
	Pounds	4,050	1,500	94,545	2,772	1,760	975	990	.....	105,548
Total handled	Feet	389	162	4,337	66	32	13	3	1,500	6,502
	Pounds	5,835	3,240	143,121	2,772	1,760	975	990	600,000	758,693
Pipe cut off and abandoned		665	363	584	.....	.....	133	.....	.....	1,745

Third District.

Comprising the 18th, 19th, 23d, 25th, 35th, 41st, and part of 33d and 42d Wards.

	Purposes for which used.	Size In Inches. 3	4	6	8	10	12	16	30	36	Total in Feet and Pounds.
New pipe or feet added.	Service mains	.....	.....	20,456	16,602	1,710	2,707	.....	.....	.....	41,475
	Supply mains	.....	.....	.....	.....	.....	365	.....	.....	.....	365
	Supply main connections	.....	.....	.....	.....	7	13	.....	.....	.....	20
	Fire hydrant connections	.....	.....	1,181	.....	.....	.....	.....	.....	.....	1,181
	Fire connections (private)	50	57	50	.....	.....	.....	.....	.....	.....	157
	Supply connections (private)	14	61	.....	.....	.....	.....	.....	.....	.....	75
	Motor connections (private)	15	.....	.....	.....	.....	.....	.....	.....	.....	15
	Total — Feet	79	118	21,687	16,602	1,717	3,085	.....	.....	.....	43,288
	Total — Pounds	1,185	2,360	715,671	697,284	94,435	231,375	.....	.....	.....	1,742,310
Pipe used, but adding nothing to feet in ground.	Pipe relaid	.....	.....	2,166	2,342	176	589	.....	.....	.....	5,273
	Repairs, general	.....	.....	611	8	18	49	.....	8	11	705
	Pipe taken up	.....	3,045	812	.....	131	10	24	.....	.....	4,022
	Pipe lowered	.....	.....	230	.....	.....	50	.....	.....	.....	280
	Pipe raised	.....	.....	850	.....	.....	.....	.....	.....	200	1,050
	Pipe shifted	.....	.....	50	.....	.....	24	.....	.....	.....	74
	Total — Feet	.....	3,045	4,719	2,350	325	722	24	8	211	11,404
	Total — Pounds	.....	60,900	155,727	98,700	17,875	54,150	2,760	2,640	88,620	481,372
	Total handled — Feet	79	3,163	26,406	18,952	2,042	3,807	24	8	211	54,692
	Total handled — Pounds	1,185	63,260	871,398	795,984	112,310	285,525	2,760	2,640	88,620	2,223,682
Pipe cut off and abandoned		.....	.....	743	.....	30	.....	.....	.....	.....	773

Fourth District.

Comprising the 15th, 20th, 28th, 29th, 32d and part of 37th and 38th Wards.

Purposes for which used.		Size in Inches. 3	4	6		10	12	16	20	30	Total in Feet and Pounds.
New pipe or feet added.	Service mains	.....	.....	511	8,201	311	408	.....	.....	.....	9,431
	Fire hydrant connections	.....	.....	254	.....	.....	.....	.....	.....	.....	254
	Fire connections (private)	.....	.....	25	.....	.....	.....	.....	.....	.....	25
	Supply connections (private)	86	74	17	.....	.....	.....	.....	.....	.....	177
	Total Feet	86	74	807	8,201	311	408	.....	.....	.....	9,887
	Total Pounds	1,290	1,480	26,631	344,442	17,105	30,600	.....	.....	.....	421,548
Pipe used, but adding nothing to feet in ground.	Pipe relaid	.....	.....	38	350	55	114	.....	.....	.....	557
	Repairs, general	.....	19	169	3	24	24	5	17	.....	261
	Pipe taken up	.....	15	250	.....	54	103	.....	.....	.....	422
	Pipe lowered	.....	.....	.....	.....	.....	216	.....	.....	.....	216
	Pipe raised	.....	.....	474	.....	.....	.....	.....	.....	.....	474
	Pipe shifted	.....	.....	.....	.....	.....	.....	.....	.....	82	82
	Total Feet	.....	34	931	353	133	457	5	17	82	2,012
	Total Pounds	.....	680	30,723	14,826	7,315	34,275	575	2,635	27,060	118,089
Total handled	Feet	86	108	1,738	8,554	444	865	5	17	82	11,899
	Pounds	1,290	2,160	57,354	359,268	24,420	64,875	575	2,635	27,060	539,637
Pipe cut off and abandoned		.....	9	184	.....	.....	.....	.....	.....	.....	193

Fifth District.

Comprising the 21st and part of the 38th Wards.

	Purposes for which used.	Size in Inches. 3	4	6	8	10	12	16	20	30	36	48	Total in Feet and Pounds.
New pipe or feet added.	Service mains	.....	.....	1,320	1,418	2,853	410	.....	.....	.....	.....	.....	6,001
	Pumping main connections	.....	.....	98	.....	.....	.....	.....	.....	.....	.....	.....	98
	Bye-pass connections	.....	.....	32	.....	.....	.....	.....	.....	.....	.....	.....	32
	Fire hydrant connections	.....	.....	32	.....	.....	.....	.....	.....	.....	.....	.....	32
	Fire connections (private)	.....	.....	40	.....	.....	.....	.....	.....	.....	.....	.....	40
	Supply connections (private)	2	13	.....	.....	.....	.....	.....	.....	.....	.....	.....	15
	Drains	.....	.....	15	592	.....	404	.....	.....	14	.....	.....	1,025
	Total — Feet	2	13	1,587	2,010	2,853	814	.....	.....	14	.....	.....	7,243
	Total — Pounds	30	260	50,721	84,420	156,915	61,050	.....	.....	4,620	.....	.....	358,016
Pipe used, but adding nothing to feet in ground.	Pipe relaid	.....	.....	23	.....	.....	.....	.....	.....	.....	.....	.....	23
	Repairs, general	.....	8	59	.....	26	39	8	8	63	14	18	243
	Pipe taken up	.....	20	.....	.....	.....	.....	.....	364	.....	.....	115	499
	Pipe lowered												
	Total — Feet	.....	28	82	.....	26	39	8	372	63	14	133	765
	Total — Pounds	.....	560	2,706	.....	1,430	2,925	920	57,660	20,790	5,880	86,450	179,321
	Total handled — Feet	2	41	1,619	2,010	2,879	853	8	372	77	14	133	8,008
	Total handled — Pounds	30	820	53,427	84,420	158,345	63,975	920	57,660	25,410	5,880	86,450	537,337
	Pipe cut off and abandoned	.....	11	.....	.....	.....	.....	.....	.....	.....	.....	.....	11

Sixth District.

Comprising the 22d and part of 33d, 37th, 38th and 42d Wards.

	Purposes for which used.		Size in Inches. 3	4	6	8	10	12	20	30	Total in Feet and Pounds.
New pipe or feet added.	Service mains		.....	.....	8,850	7,754	1,581	2,624	.....	.....	20,809
	Supply main connections		.....	.....	.....	.....	.....	7	.....	.....	7
	Bye pass connections		.....	.....	27	.....	.....	34	.....	.....	61
	Fire hydrant connections		.....	.....	1,026	.....	.....	.....	.....	.....	1,026
	Fire connections (private)		.....	.....	72	.....	.....	.....	.....	.....	72
	Supply connections (private)		82	.....	17	.....	.....	.....	.....	.....	99
	Drains		.....	.....	33	.....	.....	.....	.....	.....	33
	Total	Feet	82	.....	10,025	7,754	1,581	2,665	.....	.....	22,107
		Pounds	1,230	.....	330,825	325,668	86,955	199,875	.....	.....	944,553
Pipe used but adding nothing to feet in ground.	Pipe relaid		.....	.....	1,202	13	677	22	.....	.....	1,914
	Repairs, general		.....	.....	144	20	276	79	13	38	570
	Pipe taken up		.....	.....	166	.....	604	.....	.....	.....	770
	Pipe lowered		.....	.....	564	.....	7	94	.....	706	1,371
	Pipe raised		.....	.....	.....	.....	.....	75	.....	.....	75
	Pipe shifted		.....	.....	848	145	.....	33	.....	.....	1,026
	Total	Feet	.....	.....	2,924	178	1,564	303	13	744	5,726
		Pounds	.....	.....	96,492	7,476	86,020	22,725	2,015	245,520	460,248
Tota handled		Feet	82	.....	12,949	7,932	3,145	2,968	13	744	27,833
		Pounds	1,230	.....	427,317	333,144	172,975	222,600	2,015	245,520	1,404,801
Pipe cut off and abandoned			996	178	365	.....	.....	.....	.....	.....	1,589

Pipe cut off and abandoned	996	178	365						1,589

SEVENTH DISTRICT.

Comprising the 24th, 27th, 34th and 40th Wards.

Purposes for which used.		SIZE IN INCHES.								Total in Feet and Pounds.
		3	4	6	8	10	12	20	36	
New pipe or feet added.	Service mains			19,705	5,408	8,143	1,035			34,291
	Supply main connections							28		28
	Bye-pass connections			18						18
	Fire hydrant connections			1,417						1,417
	Fire connections (private)		41							41
	Supply connections (private)	22	62	25						109
	Drains		12	284				95		391
	Total.....Feet	22	115	21,449	5,408	8,143	1,035	123		36,295
	Total.....Pounds	330	2,300	707,817	227,136	447,865	77,625	19,065		1,482,138
Pipe used, but adding nothing to feet in ground.	Pipe relaid			318	196	846				1,360
	Repairs, general		4	400	27	111	32	15	19	608
	Pipe taken up			1,197						1,197
	Pipe lowered			18		100				118
	Pipe raised			136						136
	Total.....Feet		4	2,069	223	1,057	32	15	19	3,419
	Total.....Pounds		80	68,277	9,366	58,135	2,400	2,325	7,980	148,563
Total handled.	Feet	32	119	23,518	5,631	9,200	1,067	138	19	39,714
	Pounds	330	2,380	776,094	236,502	506,000	80,025	21,390	7,980	1,630,701
Pipe cut off and abandoned			101	206						307

Total Feet of Pipe in Use December 31, 1903.

Size in Inches.	Total in Use Dec. 31, 1902.	Extensions and Relays during 1903.			Deductions during 1902.			Total in Use Dec. 31, 1903.
		Laid.	Relaid.	Total.	Taken up.	Abandoned.	Total.	
1	175	.....	.....	.....	.....	.....	.....	175
1½	3,566	.....	.....	.....	.....	.....	.....	3,566
2	3,655	.....	.....	.....	.....	.....	.....	3,655
3	81,633	407	3	410	272	1,670	1,942	80,101
4	189,810	427	34	461	3,286	1,951	5,237	185,034
6	5,050,178	62,104	7,204	69,308	3,017	2,108	5,125	5,114,361
8	261,596	44,365	3,125	47,490	.....	.....	.....	309,086
10	424,764	17,244	2,314	19,558	789	30	819	443,103
12	459,836	8,695	2,334	11,029	118	138	246	470,619
16	144,744	.....	18	18	24	.....	24	144,738
18	16,085	.....	.....	.....	.....	.....	.....	16,085
20	265,957	3,135	53	3,188	364	.....	364	268,781
22	606	.....	.....	.....	.....	.....	.....	606
23	27	.....	.....	.....	.....	.....	.....	27
24	5,058	.....	.....	.....	.....	.....	.....	5,058
30	293,058	14	112	126	.....	.....	.....	294,484
36	101,348	.....	44	44	.....	.....	.....	101,392
48	192,488	.....	18	18	115	.....	115	192,391
Total.	7,495,484	136,391	15,254	151,645	7,980	5,892	13,872	7,633,257

Recapitulation of Fire Hydrants Set, Renewed and Removed.

	Districts.	Style.				Total.
		O. S.	No. 1.	No. 2.	No. 3	
Set.	First	.....	32	3	.....	35
	Second	.....	11	5	.....	16
	Third	.....	73	10	20	103
	Fourth	.....	15	3	3	21
	Fifth	.....	17	.....	6	23
	Sixth	.....	62	3	7	72
	Seventh	.....	39	39	.....	78
	Total	.....	249	63	36	248
Renewed.	First	.....	.....	.....	.....	.....
	Second	.....	26	18	.....	44
	Third	.....	12	8	18	38
	Fourth	.....	.....	.....	.....	.....
	Fifth	.....	22	.....	.....	22
	Sixth	.....	30	2	2	34
	Seventh	.....	35	17	.....	52
	Total	.....	125	45	20	190
	Total new fire hydrants	.....	374	108	56	538
Removed.	First	.....	2	.....	.....	2
	Second	1	5	5	.....	11
	Third	2	2	3	1	8
	Fourth	1	1	1	.....	3
	Fifth	1	.....	.....	.....	1
	Sixth	.....	6	1	.....	7
	Seventh	.....	4	.....	.....	4
	Total	5	20	10	1	36
	Total added during 1903	.....	.....	.....	.....	312

Fire Hydrants by Wards.

Wards.	Style.						Total.
	O. S.	No. 1.	No. 2.	No. 3.	No. 4.	No. 5.	
First	3	200	67	8	.....	.....	278
Second	3	121	91	15	.....	.....	230
Third	3	76	42	6	.....	.....	127
Fourth	1	64	33	14	.....	.....	112
Fifth	18	100	60	7	.....	.....	185
Sixth	8	76	49	8	.....	.....	141
Seventh	6	142	85	7	.....	1	241
Eighth	10	119	99	5	.....	1	234
Ninth	.....	117	81	3	.....	1	202
Tenth	.....	108	70	.....	.....	4	182
Eleventh	4	75	26	1	.....	.....	106
Twelfth	7	60	29	5	.....	.....	101
Thirteenth	23	62	70	9	.....	.....	164
Fourteenth	.....	88	90	.....	.....	.....	178
Fifteenth	.....	235	210	6	1	2	454
Sixteenth	2	83	40	2	1	.....	128
Seventeenth	11	80	34	.....	.....	.....	125
Eighteenth	12	202	60	9	.....	.....	283
Nineteenth	31	330	124	2	.....	.....	487
Twentieth	19	132	139	.....	.....	.....	290
Twenty-first	66	323	52	6	.....	.....	452
Twenty-second	70	1,097	150	22	.....	.....	1,339
Twenty-third	38	313	78	3	.....	.....	432
Twenty-fourth	49	295	152	13	.....	.....	509
Twenty-fifth	1	535	135	4	.....	.....	675
Twenty-sixth	1	229	123	14	.....	.....	367
Twenty-seventh	26	319	113	4	.....	1	463
Twenty-eighth	1	156	136	23	.....	.....	316
Twenty-ninth	19	197	199	11	.....	1	427
Thirtieth	5	119	110	6	.....	.....	240
Thirty-first	.....	236	70	6	.....	.....	312
Thirty-second	9	126	94	10	.....	1	240
Thirty-third	23	676	175	19	1	.....	894

Fire Hydrants by Wards—Continued.

Wards.	Style.						Total.
	O. S.	No. 1.	No. 2.	No. 3.	No. 4.	No. 5.	
Thirty-fourth	25	507	116	10	.....	1	659
Thirty-fifth	.....	94	12	3	.....	.....	109
Thirty-sixth	7	315	102	29	.....	.....	453
Thirty-seventh	5	96	80	6	.....	.....	187
Thirty-eighth	16	390	97	7	.....	.....	510
Thirty-ninth	.....	214	90	7	.....	.....	311
Fortieth	7	203	53	2	.....	.....	265
Forty-first	.....	51	8	6	.....	.....	65
Forty-second	.....	156	8	10	.....	.....	174
Totals	529	9,122	3,652	328	3	13	13,647

Fire Hydrants by Purveyors' Districts.

Districts.	Style.						Totals
	O. S.	No. 1.	No. 2.	No. 3.	No. 4.	No. 5.	
First	20	1,348	689	102	.....	.....	2,159
Second	82	1,118	732	50	1	7	1,990
Third	108	2,317	635	52	1	.....	3,113
Fourth	59	1,009	889	47	1	4	2,009
Fifth	68	420	53	7	.....	.....	548
Sixth	84	1,586	221	41	.....	.....	1,932
Seventh	107	1,824	434	29	.....	2	1,896
Totals	528	9,122	3,653	328	3	13	13,647

STATEMENT OF THE NUMBER OF FIRE HYDRANTS BY DISTRICTS AND WARDS DURING 1903 AND TOTAL PREVIOUS THERETO.

	FIRST DISTRICT.									SECOND DISTRICT.														THIRD DISTRICT.										FOURTH DISTRICT.									FIFTH DISTRICT.			SIXTH DISTRICT.						SEVENTH DISTRICT.						Totals.
	Wards.								Total.	Wards.													Total.	Wards.									Total.	Wards.							Total.	Wards.		Total.	Wards.				Total.	Wards.				Total.	
	1	2	3	4	26	30	36	39		5	6	7	8	9	10	11	12	13	14	16	17		18	19	23	25	31	33	35	41	42		15	20	28	29	32	37	38		21	38		22	33	37	38	42		24	27	34	40		
Prior to 1903									2,126													1,985									3,018							1,991			526					1,867				1,822	13,335
During 1903	1		1	1	4		21	7	35			1	5	3	3				3	1		16	12	2	6	36	5	19	3	3	17	103	1		13	1			6	21	21	2	23	26	18	4	8	16	72	4	20	46	8	78	348
Total									2,161													2,001									3,121							2,012			549					1,939				1,900	13,683
Taken out, 1903	1		1						2				1	6	3				1			11	2	1		2	2	1			8			1	1			1	3	1		1	5	1			1	7	1	2		1	4	36
Total in city									2,159													1,990									3,113							2,009			548					1,932				1,896	13,647

Number of attachments for fire purposes previously reported..... 779

Made during 1903....

First District	3
Second District	9
Third District	9
Fourth District	1
Fifth District	3
Sixth District	3
Seventh District	2

Total..... 809

Attachments., etc., made by the Purveyors in Accordance with Permits Issued by the Bureau of Water, Arranged by Districts.

Attachments., etc., made by the Purveyors in Accordance with Permits Issued by the Bureau of Water, Arranged by Districts.

Districts.	NEW ATTACHMENTS.											SHUT OFF BY PERMITS.							WORK DONE WITHOUT PERMIT.				
	Size.															Repairs			Drawn.				
	½-inch.	⅝-inch.	¾-inch.	1-inch.	1¼-inch.	1½-inch.	2-inch.	3-inch.	4-inch.	6-inch.	Total.	Reamed for Larger Attachment.	Re-driven.	Discontinued.	Transfer.	Not Drawn.	Drawn and Re-driven.	Total.	Discontinued and Abandoned.	Delinquent.	Leak.	Total.	Drawn and Re-driven.
First.....	451	27	27	14	....	8	10	....	1	2	540	.....	59	51	.....	....	76	186	31	.....	104	135	.....
Second.....	153	40	43	34	13	10	16	....	....	....	309	91	37	232	1	....	128	489	26	1	69	96	104
Third.....	1,032	23	18	27	3	11	34	5	7	3	1,163	.....	.....	25	3	....	57	85	114	1	138	253	224
Fourth.....	246	35	4	6	3	3	11	6	5	1	320	22	91	30	.....	45	26	214	.....	.....	115	115	.....
Fifth.....	119	2	2	2	1	1	1	....	....	....	128	7	.....	8	2	17	26	60	.....	.....	.....	.....	1
Sixth.....	948	43	5	8	5	2	8	4	4	....	1,026	30	22	49	4	21	45	171	.....	.....	25	25	1
Seventh,....	2,041	60	21	10	3	3	13	....	....	....	2,151	18	6	19	3	....	46	92	3	1	43	47	18
Total.....	4,990	230	120	101	28	38	93	14	17	6	5,837	168	215	414	13	83	404	1,297	174	3	494	671	348

Permits issued during the year 1903.

Aquaria	5	Lawn sprinklers	6
Bakeries	19	Laundries	13
Barber shops	91	Laboratories	1
Bars	60	Machines for scouring, rinsing, etc	51
Basins and sinks in dwellings	5,008	Milk houses	87
Basins and sinks in offices, stores, etc	1,120	Motors, beer	70
Baths in Dwellings	6,299	Motors, organ	22
Baths in hotels, etc	87	Photograph galleries	6
Baths, shower	34	Pantry sinks	525
Bidets	2	Pools, swimming	2
Boats, etc. (supply of)	100	Pools in churches	3
Bottling establishments	19	Restaurants and eating saloons	37
Building purposes	265	Slaughter houses	1
Carriages and wagons	77	Stables	20
Cellar drainers	14	Stalls in stables	905
Dwellings	5,484	Stalls cow)	5
Dwellings (half)	11	Steam boilers (number)	127
Drug stores	21	Steam boilers, horse power.	6,611
Dye houses	2	Steam engines (number)	27
Factories	17	Steam engines, horse power.	285
Ferrules (number)	5,790	Street sprinklers	90
Filters	4	Tubs, vats and tanks	57
Fire hydrants (use of)	250	Urinals in dwellings	15
Fish trough and stands	8	Urinals in stores, offices etc	235
Forges	59	Urinal troughs	70
Fountains, counter	25	Wash paves and screw nozzles	2,119
Fountains, garden	11	Wash paves, for watering horses	40
Green houses	19	Wash tubs (stationary)	4,419
Heating boilers	25	Water closets in dwellings.	14,975
Hydrants in new dwellings.	4,684	Water closets in stores, etc	769
Hydraulic elevators	12		
Ice cream saloons	11		

Premises supplied and Appliances in use January 1, 1904.

Aquaria	23	Filters	25
Arsenals	2	Fire stations	55
Asylums	7	Fountains, garden	50
Bakeries	1,317	Fountains, counter	541
Barber shops	1,817	Forges	1,202
Bars	1,810	Furnaces	26
Basins and sinks in dwellings	83,517	Gas works holders	8
		Glass works	16
Basins and sinks in offices and stores	30,754	Green houses	1,090
Baths in dwellings	268,978	Grindstones	127
Baths, public	1,384	Halls and club houses	230
Baths, shower	299	Hatters' planks, per set	18
Baths, foot	98	Hydrants	260,415
Beam houses and tanneries	24	Hospitals	55
Bidets	439	Hotels	60
Bottling establishments	676	Hydraulic elevators	263
Brickyards	13	Ice cream saloons	323
Brickyards, gangs of men	70	Institutions, charitable	95
Breweries	90	Ice machines	150
Barrels brewed	2,450,320	Laundries	799
Cars, steam and electric	1,600	Lawn sprinklers	280
Carriages and wagons	9,241	Laboratories	36
Cellar drainers	60	Machines for washing, scouring, etc	133
Cemeteries	23	Marble yards	80
Churches	690	Malt houses	17
Coal yards	245	Market houses	39
Coloring rooms	120	Milk houses	419
Condensers	25	Mints	1
Depot and railway stations	100	Motors, beer	1,892
Dwellings with water	249,980	Motors, organ	186
Dwellings without water	2,010	Photograph galleries	140
Dwellings half without water	9,740	Photograph galleries, operators	175
Dyers	740	Polishing wheels	20
Drug stores	404	Police stations and patrols	50
Dye houses	670	Pools, swimming	30
Engines on railroads	350	Pools in churches	88
Factories, foundries, mills	2,010		

Premises Supplied and Appliances in use—Continued.

Printing establishments....	170	Steam saws.....	60
Prisons.....	4	Steam presses and hammers.....	65
Rectifying establishments..	7	Shops and stores with water	5,906
Restaurants and oyster saloons.....	1,160	Shops without water.....	900
Shot towers.....	1	Schoolhouses.....	330
Slaughter houses.....	455	Theatres.....	23
Soap boiling establishments	18	Tubs, vats and tanks.....	2,280
Stand pipes for watering engines.....	38	Turbine wheels.....	36
Stalls.....	8,340	Urinals in dwellings.....	270
Stalls in stables.....	53,027	Urinals in stores, offices, etc.	5,031
Stalls, cow	179	Urinals, troughs.....	700
Stalls, fish and trough.....	96	Vinegar establishments....	10
Steam boilers, number.....	3,762	Wash paves and screw nozzles	95,404
Steam boilers, horse power..	130,312	Wash paves for watering horses.....	688
Steam boilers, heating.....	945	Wash tubs, stationary.....	40,579
Steam boilers, heating, horse power.....	5,725	Water closets in dwellings.	265,497
Steam engines, number.....	2,152	Water closets in stores, etc.	28,000
Steam engines, horse power	24,700	Wool washers.....	100

TABLE "A."

Service Attachments laid to the Curb (on streets to be paved or repaved) by the Bureau of Water.

Districts.	Number of Connections.			Total.	Length in Feet.			Total in feet.
	½-inch.	¾-inch.	1½-inch.		⅝-inch.	¾-inch.	1½-inch.	
First	702	.....	.....	702	10,479	.....	.....	10,479
Second								
Third	1,825	.....	1	1,826	25,830	.....	15	25,845
Fourth	36	.....	.....	36	672	.....	.....	672
Fifth	68	.....	.....	68	945	.....	.....	945
Sixth	487	.....	.....	487	6,949	.....	.....	6,949
Seventh	685	1	.....	686	12,749	22	.....	12,771
Totals	3,748	1	1	3,750	57,624	22	15	57,661

Account of Iron Stop Boxes, New Stops and Check Valves for 1903.

Districts.	Iron Stop Boxes.	Stops.					Check Valves.	Totals
		Bureau of Water.		Eddy.	Smith's	Ludlow.		
		2-way.	Butterfly.					
First	2	82	.....	.....	.....	.....	.....	82
Second	.....	23	.....	.....	26	.....	.....	49
Third	29	169	2	.....	3	4	.....	178
Fourth	32	51	.....	.....	4	.....	.....	55
Fifth	.....	30	1	4	2	5	.....	42
Sixth	6	91	1	.....	.....	1	.....	93
Seventh	14	125	.....	1	6	3	1	136
Totals	93	571	4	5	41	13	1	635

Repairs to Mains, Stops and Fire Hydrants, also Stops and Fire Hydrants removed during 1903.

Districts.	Repairs to Mains.	Stops.			Fire Hydrants.		
		Repaired.	Renewed	Removed.	Repaired.	Renewed.	Removed.
First	41	96	2	2	217	.....	2
Second	156	1,821	6	14	1,345	44	11
Third	140	107	29	10	166	38	8
Fourth	259	474	2	11	527	.....	3
Fifth	166	29	7	2	24	22	1
Sixth	72	6	13	10	8	34	7
Seventh	118	278	14	9	147	52	4
Totals	952	2,811	73	58	2,434	190	36

Check Valves Put In.

Street.	Location.	Ward.	Size.
Belmont Pumping Station	114 feet W. of E. building line of Engine Room, and 133 feet N. of Boiler House, on 36-inch Pumping Main Leading to Filter Plant	24	36

Total number of Stop Valves in the City arranged by Districts.

Pattern.	Size.	Outlets.	Districts.							Totals.
			1st.	2d.	3d.	4th.	5th.	6th.	7th.	
Single Gate Bureau of Water.	3	2-way.	1	185	5	21	2	15	12	241
	4	2-way.	99	251	46	158	46	95	75	770
	6	2-way.	3,740	2,575	4,266	3,114	692	2,457	3,021	19,865
	8	2-way.	160	118	154	116	10	76	291	925
	10	2-way.	227	343	228	227	33	171	196	1,425
	12	2-way.	124	185	313	146	52	214	208	1,242
	16	2-way.	38	43	45	20	5	39	19	209
	18	2-way.	.....	.....	5	.....	.....	1	.....	6
	20	2-way.	24	35	19	37	14	16	26	171
	30	2-way.	8	9	29	37	15	3	4	105
	36	2-way.	3	1	8	12	11	.....	7	42
	48	2-way.	.....	.....	3	9	.....	.....	.....	12
	Totals....		4,424	3,745	5,121	3,897	880	3,087	3,859	25,013
Butterfly. Bureau of Water.	20	2-way.	.....	1	5	8	3	3	5	25
	30	2-way.	2	2	7	7	9	2	5	34
	36	2-way.	.....	.....	5	17	2	.....	.....	24
	48	2-way.	.....	1	7	27	22	.....	.....	57
	Totals....		2	4	24	59	36	5	10	140
Butterfly Eddy.	30	2-way.	.....	.....	.....	.....	.....	1	.....	1
	Total.....		.....	.....	.....	.....	.....	1	.....	1
Barton.	6	4-way.	3	3	.....	12	.....	.....	13	31
	8	4-way.	.....	.....	.....	5	.....	.....	.....	5
	6	5-way.	12	24	.....	.....	.....	.....	.....	36
	6	6-way.	.....	6	.....	.....	.....	.....	.....	6
	Totals....		15	33	.....	17	.....	.....	13	78

Total number of Stops, Valves, etc.—Continued.

Pattern.	Size.	Outlets.	Districts.							Totals.
			1st.	2d.	3d.	4th.	5th.	6th.	7th.	
Viney.	6	2-way.	5	.....	4	3	.....	.....	.....	12
	6	3-way.	49	55	30	232	5	9	19	399
	8	3-way.	.....	.....	.....	.....	.....	.....	5	5
	10	3-way.	.....	.....	.....	3	.....	.....	.....	3
	12	3-way.	.....	1	.....	3	.....	.....	1	5
	6	4-way.	24	28	22	100	4	10	22	210
	8	4-way.	1	.....	2	.....	.....	.....	5	8
	10	4-way.	.....	.....	.....	14	.....	.....	4	18
	12	4-way.	.....	.....	.....	.....	.....	2	.....	2
	6	5-way.	24	5	1	26	.....	.....	3	59
	Totals....		103	89	59	381	9	21	59	721
Smith's Patent.	8	2-way.	1	37	.....	1	.....	.....	6	45
	4	2-way.	4	30	2	4	.....	.....	5	45
	6	2-way.	1	51	23	17	9	6	19	126
	8	2-way.	1	.....	9	.....	.....	.....	.....	10
	10	2-way.	.....	4	8	.....	2	1	4	19
	12	2-way.	1	4	8	.....	.....	.....	.....	13
	16	2-way.	4	.....	2	.....	.....	.....	.....	6
	20	2-way.	.....	1	1	.....	.....	.....	2	4
	Totals....		12	127	53	22	11	7	36	268
Ludlow.	3	2-way.	.....	.....	6	.....	.....	1	7	14
	4	2-way.	.....	.....	.....	1	.....	.....	.....	1
	6	2-way.	.....	.....	.....	.....	5	.....	3	8
	Totals ...		.....	.....	6	1	5	1	10	23

Total number of Stops, Valves, etc.—Continued.

Pattern.	Size.	Outlets.	Districts. 1st.	2d.	3d.	4th.	5th.	6th.	7th.	Totals.
Eddy.	6	2-way.	.....	.....	.....	.....	4	.....	.....	4
	10	2-way.	.....	.....	.....	.....	2	.....	.....	2
	24	2-way.	.....	.....	.....	.....	3	.....	.....	3
	30	2-way.	.....	.....	.....	.....	1	.....	.....	1
	36	2-way.	.....	.....	.....	.....	.....	1	.....	1
	Totals ...		.....	.....	.....	.....	10	1	.....	11
Total number of stops.....			4,556	3,998	5,268	4,877	951	3,122	3,988	26,255
Check Valves. Bureau of Water.	12	.....	.....	1	.....	.....	.....	.....	.....	1
	20	.....	.....	.....	.....	.....	.....	.....	1	1
	30	.....	.....	.....	1	.....	4	.....	3	8
	36	.....	.....	.....	1	.....	4	.....	2	7
	48	.....	.....	.....	4	4	6	.....	.....	14
	Totals ...		.....	1	6	4	14	.....	6	31

Number of Valves raised in the several Districts during the year 1903.

Districts.	Barton.		Viney.			Single Gate.						Old Style.	Totals.
	4-way.	5-way.	3-way.	4-way.	5-way.	6-inch.	8-inch.	10-inch.	12-inch.	16-inch.	36-inch.		
First.....	.....	.....	1	4	1	9	1	....	....	....	....	....	16
Second.....	4	1	3	7	1	10	....	5	1	1	1	1	35
Total.....	4	1	4	11	2	19	1	5	1	1	1	1	51

Number of Complaints and Examinations during 1902 and 1903.

Months.	Hydrants.		Service Pipes.		Wash Paves.		Spigots.		Water Closets.		Horse Troughs.		No Leaks.		Total.	
	1902.	1903.	1902.	1903.	1902.	1903.	1902.	1903.	1902.	1903.	1902.	1903.	1902.	1903	1902.	1903.
January	156	201	173	206	16	10	8	13	49	38	1	2	22	9	425	479
February	188	112	167	117	7	4	13	12	40	44	.....	.....	27	11	442	300
March	153	128	181	110	7	4	9	13	69	71	.....	.....	6	7	425	333
April	162	130	154	118	4	4	14	6	60	43	1	.....	4	8	399	309
May	122	159	148	120	9	1	3	21	68	52	.....	.....	9	11	359	364
June	148	132	133	89	1	5	6	12	37	46	.....	.....	6	6	331	290
July	117	173	132	124	3	8	12	24	22	37	3	.....	11	13	300	379
August	141	226	110	128	4	5	14	26	34	65	.....	.....	8	18	311	468
September	122	193	121	132	5	7	10	22	32	34	.....	.....	7	11	300	399
October	166	162	157	117	4	10	23	40	54	50	.....	.....	18	3	422	382
November	122	200	115	102	4	3	7	29	24	50	1	.....	2	6	275	390
December	134	220	106	132	1	7	23	27	39	58	3	1	8	11	314	456
Total	1,731	2,036	1,700	1,495	65	68	142	245	528	588	9	3	128	114	4,303	4,549

NEW METERS SET.

Ward.	Occupant.	Location.	Business.	Date when Set.	Name of Meter.	Size. ½-inch.	⅝-inch.	¾-inch.	1-inch.	1½-inch.	2-inch.	3-inch.	4-inch.	6-inch.	Total.	Cubic Feet Consumed.	Remarks.
1	Henry Goldner.....	1402 East Montgomery avenue..	Dwelling	June 6.	Trident	....	1	....	....	....	....	....	....	....	1	3,000	
1	Spreckels Sugar Refining Co.....	N. W. cor. Reed and Meadow streets...	Office and stable....	July 23.	Wort'n.	....	....	....	....	1	....	....	....	....	1	28,900	
1	Morris Brownstein..	1633 South Orkney street.....	Dwelling.....	July 24.	Trident	....	1	....	....	....	....	....	....	....	1	5,500	
3	William McColigan.	407 Christian street.....	Dwelling	June16.	Trident	....	1	....	....	....	....	....	....	....	1	2,200	
5	American Building Co.....	410 Sansom street.....	Office building.....	Mar. 2.	Gem ...	....	....	....	....	....	....	1	....	....	1	12,900	
5	Philadelphia Demokrat Pub. Co.....	612-14 Chestnut street.....	Printing office.....	Oct. 25.	Keyst'e	....	....	....	....	....	1	....	....	....	1	63,000	
6	Trust Co. of North America	220 N. Second street and rear.....	Machine shop, etc..	Feb. 3.	Union	....	....	....	1	....	....	....	....	....	1	179,900	
6	Henry C. Lea.....	19-23 S. Second street.....	Warehouse (vacant)	Mar. 9.	Union..	....	....	....	1	....	....	....	....	....	1	.....	No water used.
6	D. E. Dallam, trustee	12-14 S. Orianna street.....	Printing office.....	Apr. 10.	Hersey.	....	....	....	1	....	....	....	....	....	1	128,800	
6	John G. Schmidt....	325 Arch street.....	Dwelling.....	Apr. 30.	Colu'a..	....	1	....	....	....	....	....	....	....	1	4,800	
6	Verga Suit Case and Bag Co.....	103 Arch street.....	Leather goods.....	May 26.	Wort'n.	....	....	....	....	....	1	....	....	....	1	35,600	
7	George H. Edmonds.	1724 Spruce street.....	Dwelling.....	May 12.	Crown .	....	....	....	1	....	....	....	....	....	1	.....	No water used.
7	E. H. Cloud.....	2230 Spruce street.....	Dwelling.....	June 8.	Colu'a..	....	1	....	....	....	....	....	....	....	1	11,300	

New Meters Set—Continued.

Ward.	Occupant.	Location.	Business.	Date when Set.	Name of Meter.	Size. ½-inch.	⅝-inch.	¾-inch.	1-inch.	1½-inch.	2-inch.	3-inch.	4-inch.	6-inch.	Total.	Cubic Feet Consumed.	Remarks.
8	Land Title and Trust Co.	N. W. cor. Broad and Sansom streets	Office building	May 19.	Gem	....	....	....	....	....	....	....	1	....	1	905,100	
8	Land Title and Trust Co.	N. W. cor. Broad and Sansom streets	Dwelling	May 21.	Gem	....	....	....	....	....	....	....	1	....	1	162,700	
8	Mary H. Jones	2051 Walnut street	Dwelling	June 2.	Colu'a	....	1	....	....	....	....	....	....	....	1	6,100	
8	John W. Hallahan	1632-34-36 Chestnut street	Dwelling	June 3.	Hersey	....	....	....	....	....	....	1	....	....	1	7,400	
8	Mary C. Seidel	254 South Sixteenth street	Apartment house	July 24.	Union	....	....	....	....	1	....	....	....	....	1	59,000	
9	Ernest Abhau	44 North Ninth street	Dwelling	Jan, 24.	Union	....	1	....	....	....	....	....	....	....	1	7,000	
9	D. E. Dallam, agent	N. W. cor. Fifteenth and Chestnut sts.	Office building	Apr. 25.	Hersey	....	....	....	....	....	....	....	1	....	1	864,400	
9	Morris Liveright	S. W. cor. Thirteenth and Arch streets	Clothing mfrs., etc.	July 2.	Crown	....	....	....	....	....	1	....	....	....	1	368,900	
9	J. R. Jones	1217 Market street	Miscellaneous	July 6.	Gem	....	....	....	....	....	....	1	....	....	1	88,000	
10	Pittsb'rg Plate Glass Co.	N. E. cor. Eleventh and Arch streets	Office and wareh'se.	Feb. 15.	Stand'd	....	....	....	....	....	....	....	1	....	1	2,363,600	
10	A. H. Stewart	252 N. Twelfth street	Dwelling	Apr. 14.	Colmb.	....	1	....	....	....	....	....	....	....	1	8,200	
11	R. T. Randall	331 N. Second street	Dairy supplies	Jun. 27.	Trident	....	1	....	....	....	....	....	....	....	1	8,400	
12	Catherine Wilson	327 N. Fifth street	Lodging house	Mar. 14.	Colmb.	....	1	....	....	....	....	....	....	....	1	45,200	
12	Catherine Wilson	328 N. Lawrence street	Dwelling	Mar. 19.	Colmb.	....	1	....	....	....	....	....	....	....	1	4,100	

New Meters Set—Continued.

Ward.	Occupant.	Location.	Business.	Date when Set.	Name of Meter.	Size.								Total.	Cubic Feet Consumed.	Remarks.
						½-Inch.	⅝-Inch.	¾-Inch.	1-Inch.	1½-Inch.	2-Inch.	3-Inch.	4-Inch.	6-Inch.			
13	Harry Streitfeldt	714 Parrish street	Dwelling	July 15.	Trident.		1								1	6,600	
15	H. F. Bornot	S. E. cor. Seventeenth and Fairmo'nt av.	Dyers and scourers.	Apr. 3.	Crown				1						1	2,400	
15	W. H. McMillan	1815 Wallace street	Dwelling	Apr. 14.	Colmb.		1								1	1,100	
15	Freda B. Green	2326 Poplar street	Dwelling	Apr. 28.	Trident.		1								1	7,400	
15	Chas. E. Schmidt	854 N. Twenty-second street	Dwelling	Apr. 28.	Colmb.		1								1	2,000	
15	S. L. Schumo	880 N. Twenty-second street	Dwelling	May 5.	Trident.		1								1	6,100	
15	S. L. Schumo	2520 Poplar street	Dwelling	May 5.	Trident.		1								1	4,900	
15	John G. Powell	864 N. Twenty-second street	Dwelling	May 28.	Trident.		1								1	7,900	
15	Frank C. Scherer	825 N. Twenty-seventh street	Dwelling	Jun. 30.	Colmb.		1								1	5,400	
15	George Abbott	S. E. cor. Twentieth and Green streets.	Experimental	Oct. 29.	Hersey			1							1	5,300	
17	Samuel Nittinger	1202-04 N. Fifth street	Piano warehouse	Jun. 23.	Colmb.		1								1	7,300	
18	Estate Geo. W. Middleton	701 E. Girard avenue	Box factory	Apr. 16.	Crown.				1						1	114,200	
18	David S. Crewson	1125 Shackamaxon street	Dwelling	June 1.	Trident.		1								1	3,200	
19	Chas. W. Groeling	525 York street	Dwelling	Mar. 30.	Colu'ia		1								1	1,000	
19	John Moore	2316 Howard street	Dwelling	Apr. 24.	Trident.		1								1	17,700	

New Meters Set—Continued.

Ward.	Occupant.	Location.	Business.	Date when Set.	Name of Meter.	Size.								Total.	Cubic Feet Consumed.	Remarks.
						½-inch.	⅝-inch.	¾-inch.	1-inch.	1½-inch.	2-inch,	3-inch.	4-inch.	6-inch.			
19	John Moore	2318 Howard street	Dwelling	Apr. 24.	Trident	....	1	....	....	....	....	....	....	....	1	5,400	
19	John Moore	2210 Bodine street	Dwelling	Apr. 28.	Trident	....	1	....	....	....	....	....	....	....	1	49,900	
19	S. L. Schumo	S. W. cor. Third and Dauphin streets	Rectory	June 1.	Trident	....	1	....	....	....	....	....	....	....	1	63	
19	A. H. Raven	727 Cumberland street	Dwelling	June 5.	Nash	....	....	1	....	....	....	....	....	....	1	4,100	
19	S. L. Schumo, warden	N. W. cor. Third and Dauphin streets	Church	July 15.	Trident	....	1	....	....	....	....	....	....	....	1	5,900	
19	S. L. Schumo	169 W. Susquehanna avenue	Dwelling (vacant)	July 18.	Trident	....	1	....	....	....	....	....	....	....	1	.....	No water used.
20	Louis H. Heffe	2142 N. Eighth street	Dwelling	Mar. 26.	Colu'ia	....	1	....	....	....	....	....	....	....	1	8,300	
20	Harry W. Riday	732 Norris street	Dwelling	Apr. 1.	Colu'ia	....	1	....	....	....	....	....	....	....	1	1,700	
20	Thomas J. Holton	1717 N. Seventh street	Dwelling	June 10.	Trident	....	1	....	....	....	....	....	....	....	1	9,400	
20	W. H. Bilyea	1740 N. Seventh street	Dwelling	June 19.	Colu'ia	....	1	....	....	....	....	....	....	....	1	4,700	
20	W. H. Bilyea	723 Berks street	Dwelling	June 19.	Colu'ia	....	1	....	....	....	....	....	....	....	1	3,300	
20	W. H. Bilyea	1738 N. Seventh street	Dwelling	June 19.	Colu'ia	....	1	....	....	....	....	....	....	....	1	16,000	
20	W. H. Bilyea	1807 Franklin street	Dwelling	June 19.	Colu'ia	....	1	....	....	....	....	....	....	....	1	7,100	
20	W. H. Bilyea	1809 Franklin street	Dwelling	June 22.	Colu'ia	....	1	....	....	....	....	....	....	....	1	.....	No water used.
20	W. H. Bilyea	1813 Franklin street	Dwelling	June 22.	Colu'ia	....	1	....	....	....	....	....	....	....	1	.....	No water used.

New Meters Set—Continued.

Ward.	Occupant.	Location.	Business.	Date when Set.	Name of Meter.	Size. ½-inch.	⅝-inch.	¾-inch.	1-inch.	1½-inch.	2-inch.	3-inch.	4-inch.	6-inch.	Total.	Cubic Feet Consumed.	Remarks.
20	W. H. Bilyea	1827 Franklin street	Dwelling	June 23.	Colu'ia.	....	1	....	....	....	....	....	....	....	1	6,200	
20	W. H. Bilyea	1829 Franklin street	Dwelling	June 23.	Colu'ia.	....	1	....	....	....	....	....	....	....	1	6,100	
20	L. Schutte & Co	1251-57 N. Twelfth street	Dwelling	June 23.	Union.	....	....	....	....	....	1	....	....	....	1	237,800	
20	W. H. Bilyea	1839 Franklin street	Dwelling	June 24.	Colu'a.	....	1	....	....	....	....	....	....	....	1	3,900	
20	W. H. Bilyea	1841 Franklin street	Dwelling	June 24.	Colu'a.	....	1	....	....	....	....	....	....	....	1	1,100	
20	W. H. Bilyea	1821 Franklin street	Dwelling	June 26.	Colu'a.	....	1	....	....	....	....	....	....	....	1	.....	Closed.
20	R. H. Farley	1630 N. Eighth street	Dwelling,	June 26.	Trident	....	1	....	....	....	....	....	....	....	1	32,000	
20	W. H. Bilyea	1909 Franklin street	Dwelling	July 2.	Colu'a.	....	1	....	....	....	....	....	....	....	1	.....	Closed.
21	O. K. Chemical Co	4212 Cresson street	Chemicals	Jan. 6.	Keyst'e	....	1	....	....	....	....	....	....	....	1	23,700	
21	Joseph H. Maurer	4345 Main street	Hardware, etc	Feb. 3.	Colu'a.	....	1	....	....	....	....	....	....	....	1	10,900	
21	Joseph Reiley	4402 Main street	Dwelling	Mar. 5.	Union.	....	1	....	....	....	....	....	....	....	1	6,800	
21	Wm. C. Todd, M. D.	421 Lyceum avenue	Dwelling	Apr. 4.	Union.	....	....	1	....	....	....	....	....	....	1	4,000	
21	Hull & Co	S. E. side Hermitage ave., 160 feet E. of Fleming street	Dwelling	Apr. 3.	Crown.	1	....	....	....	....	....	....	....	....	1	4,368	
21	William J. Hurst	4417 Main street	Dwelling	Apr. 8.	Union.	....	1	....	....	....	....	....	....	....	1	16,800	
21	Manayunk Nat'l Bk.	4375-77 Main street	Bank	Apr. 15.	Colu'a.	....	1	....	....	....	....	....	....	....	1	5,500	

New Meters Set—Continued.

Ward.	Occupant.	Location.	Business.	Date when Set.	Name of Meter.	Size.									Total.	Cubic Feet Consumed.	Remarks.
						⅝-inch.	¾-inch.	1-inch.	1½-inch.	2-inch.	3-inch.	4-inch.	6-inch.				
21	Samuel Long	4412 Dexter street	Dwelling	Apr. 15.	Colu'a		1								1	900	
21	Frank R. Smith	Lyceum ave., N. of Manayunk ave	Dwelling	May 13.	Crown			1							1	10,500	
21	James Stafford	Krams ave., E. of Wilde street	Woolen mill	June 1.	Union					1					1	57,700	
21	Frank Hund	106 Cotton street	Club house	June 4.	Colu'a		1								1	3,100	
21	Richard Eckersley	73 Rochelle avenue	Dwelling	June 19.	Trident		1								1	4,000	
21	William Johnson	Sumac street, 2d house E. of Retta st	Dwelling	June 19.	Nash			1							1	10,100	
21	H. C. Ball & Co	E. S. of Main st., 4th property N. of Ridge ave	Woolen mill	July 22.	Union				1						1	213,400	
21	Edmond H. Kase	7309 Boyer street	Dwelling	Mar. 6.	Union		1								1	8,800	
22	Germantown Dispensary Hospital	N. E. side E. Penn street / S. W. side Chew street	Hospital	April 6.	Gem						1				1	64,800	
22	Germantown Dispensary Hospital	N. E. side E. Penn street / S. W. side Chew street	Hospital	April 7.	Crown					1					1	414,900	
22	Germantown Dispensary Hospital	N. E. side E. Penn street / S. W. side Chew street	Hospital	April 9.	Gem						1				1	236,000	
22	George W. Cliffe	40 E. Walnut lane	Dwelling	April 17	Colu'a		1								1	6,700	
22	Germantown Cricket Club	N. W. S. Manheim street / S. W. c. Morris street	Club house	May 4.	Crown									1	1	62,200	

New Meters Set—Continued.

Ward.	Occupant.	Location.	Business.	Date when Set.	Name of Meter.	Size. ½ inch.	⅝ inch.	¾ inch.	1 inch.	1½ inch.	2 inch.	3 inch.	4 inch.	6 inch.	Total.	Cubic Feet Consumed.	Remarks.
22	H. E. Currier.....	26 Meehan street.....	Dwelling.....	May 11.	Nash...	....	1	....	....	....	....	....	....	....	1	600	
22	H. E. Currier.....	28 Meehan street.....	Dwelling.....	May 11.	Nash...	....	1	....	....	....	....	....	....	....	1	12,000	
22	Robert Killough.....	6334 Green street.....	Dwelling.....	May 18.	Colu'a..	....	1	....	....	....	....	....	....	....	1	10,300	
22	Arthur M. Greene...	5816 Morris street.....	Dwelling.....	June 9..	Colu'a..	....	1	....	....	....	....	....	....	....	1	3,900	
22	Arthur M. Greene ..	5818 Morris street.....	Dwelling.....	June 9...	Colu'a..	....	1	....	....	....	....	....	....	....	1	2,900	
22	Arthur M. Greene...	5820 Morris street.....	Dwelling.....	June 9..	Colu'a..	....	1	....	....	....	....	....	....	....	1	10,700	
22	Arthur M. Greene...	612 Rittenhouse street.....	Dwelling.....	June 9..	Colu'a..	....	1	....	....	....	....	....	....	....	1	3,600	
22	R. Alexander	614 Rittenhouse street.....	Dwelling.....	June 10.	Colu'a..	....	1	....	....	....	....	....	....	....	1	1,800	
22	Arthur M. Greene...	408 W. Chelten avenue.....	Dwelling.....	June 10.	Colu'a..	....	1	....	....	....	....	....	....	....	1	3,000	
22	Est. Annie Gardoin.	155 W. Washington lane.....	Dwelling.....	June 10.	Colu'a..	....	1	....	....	....	....	....	....	....	1	2,800	
22	Arthur M. Greene...	620 W. Rittenhouse street.....	Dwelling.....	June 10.	Colu'a..	....	1	....	....	....	....	....	....	....	1	3,100	
22	Arthur M. Greene...	618 W. Rittenhouse street.....	Dwelling.....	June 11.	Colu'a..	....	1	....	....	....	....	....	....	....	1	1,400	
22	rthur M. Greene...	622 W. Rittenhouse street.....	Dwelling.....	June 11.	Colu'a..	....	1	....	....	....	....	....	....	....	1	2,600	
22	Arthur M Greene...	624 W. Rittenhouse street.....	Dwelling.....	June 11.	Colu'a..	....	1	....	....	....	....	....	....	....	1	3,300	
22	Arthur M. Greene...	626 W. Rittenhouse street.....	Dwelling.....	June11.	Colu'a..	....	1	....	....	....	....	....	....	....	1	3,100	

New Meters Set—Continued.

Ward.	Occupant.	Location.	Business.	Date when Set.	Name of Meter.	Size.								Total.	Cubic Feet Consumed.	Remarks.
						½-inch.	⅝-inch.	¾-inch.	1-inch.	1¼-inch.	2-inch.	3-inch.	4-inch.	6-inch.		
22	C. W. Cathers	6035 Magnolia street	Dwelling	June 17.	Colu'a	....	1	....	....	....	....	....	....	....	1	1,500	
22	C. W. Cathers	6031 Magnolia street	Dwelling	June 17.	Colu'a	....	1	....	....	....	....	....	....	....	1	2,800	
22	C. W. Cathers	6029 Magnolia street	Dwelling	June 17.	Colu'a	....	1	....	....	....	....	....	....	....	1	2,700	
22	C. W. Cathers	6027 Magnolia street	Dwelling	June 17.	Colu'a	....	1	....	....	....	....	....	....	....	1	5,600	
22	F. C. Goodwin	153 Harvey street	Dwelling	July 7.	Colu'a	....	1	....	....	....	....	....	....	....	1	8,900	
22	James H. Walter	142 Herman street	Dwelling	July 7.	Colu'a	....	1	....	....	....	....	....	....	....	1	1,100	
22	I. Newton Fretz	40 Pastorius street	Dwelling	July 7.	Colu'a	....	1	....	....	....	....	....	....	....	1	1,700	
22	William L. Jones	46 Pastorius street	Dwelling	July 7.	Colu'a	....	1	....	....	....	....	....	....	....	1	4,600	
23	Robt. H. Foerderer	W. S. Paul, S. of Vandyke street	Leather manufact'r	April 4.	Gem	....	....	....	....	....	....	....	1	....	1	182,700	
23	George H. Boyson	4312 Frankford avenue	Paper hanging	June 10.	Col'bia	....	1	....	....	....	....	....	....	....	1	3,900	
24	F. H. Kornbau	736 Union street	Dwelling	April 2.	Col'bia	....	1	....	....	....	....	....	....	....	1	2,400	
24	Phila. Country Club	N. S. Conshohocken ave., 300 feet E. of Windemere avenue	Golf links	April 9.	AA Gem	....	....	....	....	....	1	....	....	....	1	36,700	
24	John McGill, Jr.	S. W. S. Conshohocken av., E. of 40th st.	Residence	June 25.	Empire	....	....	....	....	1	....	....	....	....	1	32,500	
24	R. H. Farley	430 North Thirty-second street	Dwelling	July 20.	Trident	....	1	....	....	....	....	....	....	....	1	2,800	
24	J. B. Walter	3935 Folsom street	Dwelling	July 20.	Co 'bia	....	1	....	....	....	....	....	....	....	1	1,100	

New Meters Set—Continued.

Ward.	Occupant.	Location.	Business.	Date when Set.	Name of Meter.	Size. ½-inch.	⅝-inch.	¾-inch.	1-inch.	1½-inch.	2-inch.	3-inch.	4-inch.	6-inch.	Total.	Cubic Feet Consumed.	Remarks.
25	Thos. Henry & Sons.	S. W. cor. Trenton avenue and Tioga st.	Worsted manuf'rs.	Jan. 24.	Gem	....	....	....	....	....	1	....	....	....	1	350,500	
25	George E. Drum	2047 E. Cambria street	Residence	June 25.	Trident	....	1	....	....	....	....	....	....	....	1	.....	No water used.
25	George B. McCarty.	3507-13 Mercer street	Ice cream manuf'r.	June 25.	Trident	1	....	....	....	....	....	....	....	....	1	2,500	
25	James McCutcheon Mfg. Co	N. E. S. Schiller st., from Allen to Melvale streets	Leather Goods	July 24.	Gem	....	....	....	....	....	....	....	1	....	1	162,200	
25	A. J. Cameron Co	N. W. cor. Glenwood and Pacific aves.	Textile manuf'rs	Aug. 5.	Gem	....	....	....	....	....	....	1	....	....	1	22,900	
26	Charles Rutherford.	1338 S. Tenth street	Dwelling	Feb. 3.	Col'bia.	....	1	....	....	....	....	....	....	....	1	5,900	
26	Charles Rutherford,	1340 S. Tenth street	Dwelling	Feb. 4.	Col'bia.	....	1	....	....	....	....	....	....	....	1	12,400	
27	Allison Mfg. Co	S. E. cor. Thirty-second and Walnut sts.	Car works	Jan. 16.	AA Gem	....	....	....	....	....	1	....	....	....	1	214,800	
27	Allison Mfg. Co	S. E. cor. Thirty-second and Walnut sts.	Car works	Jan. 16.	AA Gem	....	....	....	....	....	1	....	....	....	1	129,900	
27	Allison Mfg. Co	S. E. cor. Thirty-second and Walnut sts.	Car works	Jan. 17.	AA Gem	....	....	....	....	....	1	....	....	....	1	34,000	
27	Mary A. Lord	4650 Market street	Leather goods	Apr. 15.	Union	....	....	....	....	1	....	....	....	....	1	80,270	
27	W. A. Kirk	4715 Hazel avenue	Residence	June 9.	Trident	....	1	....	....	....	....	....	....	....	1	7,700	
27	R. T. Randall	3461 Chestnut street	Dwelling	June 16.	Trident	....	1	....	....	....	....	....	....	....	1	17,200	
28	George P. Eckert	2522 N. Sixteenth street	Dwelling	Mar. 20.	Col'bia.	....	1	....	....	....	....	....	....	....	1	4,200	

New Meters Set—Continued.

Ward.	Occupant.	Location.	Business.	Date when Set.	Name of Meter.	Size. ½-inch.	⅝-inch.	¾-inch.	1-inch.	1½-inch.	2-inch.	3-inch.	4-inch.	6-inch.	Total.	Cubic Feet Consumed.	Remarks.
28	F. L. Hand	2606 North Thirty-third street	Dwelling	Mch. 26.	Nash	....	1	....	....	....	....	....	....	....	1	1,700	
28	F. L. Hand	2413 North Thirty-third street	Dwelling	Apr. 29.	Nash	....	1	....	....	....	....	....	....	....	1	3,200	
28	Michael Freney	2608 North Thirty-third street	Dwelling	June 4.	Trident	....	1	....	....	....	....	....	....	....	1	5,900	
28	P. E. Apgor	2411 North Thirty-third street	Dwelling	June 4.	Trident	....	1	....	....	....	....	....	....	....	1	1,900	
28	P. E. Apgor	2415 North Thirty-third street	Dwelling	June 4.	Trident	....	1	....	....	....	....	....	....	....	1	2,300	
28	John M. Smith	2441 North Thirtieth street	Dwelling	June 5.	Trident	....	1	....	....	....	....	....	....	....	1	5,900	
28	John A. O'Brien	2255 North Chadwick street	Dwelling	June 5.	Nash	....	....	1	....	....	....	....	....	....	1	6,900	
28	American Product Company	S. W. cor. Twenty-fifth & Dauphin sts.	Incinerating Plant.	June 8.	Union	....	....	....	....	1	....	....	....	....	1	.....	Not in use.
28	Harry Sabins	2600 North Thirty-third street	Dwelling	June 12.	Trident	....	1	....	....	....	....	....	....	....	1	4,300	
28	James C. Kirk	2616 North Thirty-third street	Dwelling	June 12.	Trident	....	1	....	....	....	....	....	....	....	1	8,700	
28	Clifford Hewitt	2436 North Nineteenth street	Dwelling	June 17.	Trident	....	1	....	....	....	....	....	....	....	1	3,200	
28	Horace B. Stevenson	3208 Susquehanna avenue	Dwelling	June 18	Trident	....	1	....	....	....	....	....	....	....	1	10,500	
28	Commonwealth T., I. and T. Co.	N. S. Glenwood ave., bet. 20th and 21st sts	Planing Mill	June 26.	Crown	....	....	1	....	....	....	....	....	....	1	5,800	
28	W. F. Schaefer	2654 North Thirty-third street	Dwelling	June 26.	Trident	....	1	....	....	....	....	....	....	....	1	4,600	

New Meters Set.—Continued.

Ward.	Occupant.	Location.	Business.	Date when Set.	Name of Meter.	Size. ½-inch.	⅝-inch.	¾-inch.	1-inch.	1½-inch.	2-inch.	3-inch.	4-inch.	6-inch.	Total.	Cubic feet consumed.	Remarks.
28	Mary C. Taylor.....	2508 North Thirty-third street.....	Dwelling.....	Aug. 3.	Trident	....	1	....	....	....	....	....	....	....	1	.....	No water used.
28	Frederick Hermon..	2453 North Thirty-third street.....	Dwelling.....	Aug 3..	Colu'a..	....	1	....	....	....	....	....	....	....	1	3,700	
29	Willis E. Warner....	2830 Oxford street.....	Dwelling.....	Mch. 23.	Colu'a..	....	1	....	....	....	....	....	....	....	1	4,100	
29	Charles W. Goger...	1617 North Twenty-seventh street.....	Dwelling.....	Mch. 26.	Colu'a..	....	1	....	....	....	....	....	....	....	1	1,400	
29	John H. Interman..	1627 North Twenty-seventh street.....	Dwelling.....	Apr. 1.	Colu'a..	....	1	....	....	....	....	....	....	....	1	5,000	
29	John S. Coulter.....	1625 North Twenty-seventh street.....	Dwelling.....	Apr. 14.	Colu'a..	....	1	....	....	....	....	....	....	....	1	1,400	
29	Clara Thompson.....	2817 Oxford strret.....	Dwelling.....	Apr. 23.	Colu'a..	....	1	....	....	....	....	....	....	....	1	2,800	
29	David P. Mellor.....	1612 N. Twenty-seventh street.....	Dwelling.....	April 23	Colu'a..	....	1	....	....	....	....	....	....	....	1	11,800	
29	Samuel Denny.....	2418 Columbia avenue.....	Dwelling	April 23	Colu'a..	....	1	....	....	....	....	....	....	....	1	3,700	
29	Walter K. Sexton...	1704 Jefferson street.....	Dwelling	May 6..	Trident.	....	1	....	....	....	....	....	....	....	1	4,100	
29	S. L. Schumo.....	1721 N. Twenty-fifth street.....	Dwelling	May 28.	Trident.	....	1	....	....	....	....	....	....	....	1	20,100	
29	J. S. Thorn.....	2314 Columbia avenue.....	Jewelry.....	June 24.	Trident.	....	1	....	....	....	....	....	....	....	1	4,500	
29	W. H. Bilyeu.....	3022 Girard avenue.....	Dwelling.....	June 26.	Colu'a..	....	1	....	....	....	....	....	....	....	1	10,000	
29	W. H. Bilyeu.....	3024 Girard avenue.....	Dwelling.....	June 26.	Colu'a..	....	1	....	....	....	....	....	....	....	1	5,700	
29	W. H. Bilyeu.....	3012 Girard avenue.....	Dwelling.....	June 29.	Colu'a..	....	1	....	....	....	....	....	....	....	1	2,400	

New Meters Set—Continued.

Ward.	Occupant.	Location.	Business.	Date when set.	Name of Meter.	Size. ½ inch.	⅝ inch.	¾ inch.	1 inch.	1½ inch.	2 inch.	3 inch.	4 inch	6 inch.	Total.	Cubic feet consumed.	Remarks.
29	A. C. Cressman	N. side Columbia ave., W. of Broad.....	Livery stable.....	July 17.	Union..	....	....	....	....	1	....	....	....	....	1	74,200	
30	Sou'rn Elec. Li'gt Co.	S. side Carpenter, opp. Twenty-sixth st.	Electric light works	Mar. 25.	AA Gem	....	....	....	....	....	....	1	....	....	1	1,335,500	
30	H. J. Allen.....	1908 Bainbridge street.....	Dwelling.....	April 30	Colu'a..	....	1	....	....	....	....	....	....	....	1	12,700	
30	Elizabeth J. Kemp..	630 S. Nineteenth street.....	Dwelling.....	July 31.	Colu'a..	....	1	....	....	....	....	....	....	....	1	1,600	
31	James Pollock & Son	2221 Fletcher street.....	Carpet, yarn, etc....	Mar. 28.	Crown..	....	....	....	....	1	....	....	....	....	1	69,000	
31	Smith & Drum.....	2503-09 Coral street.....	Dwelling.....	May 25.	Trident.	....	....	....	....	1	....	....	....	....	1	88,400	
32	F. L. Hand.....	1948 N. Eighteenth street.....	Dwelling.....	Feb. 20..	Trident.	....	1	....	....	....	....	....	....	....	1	14,100	
32	Mrs. M. Edsall.....	3010 Fontaine street.....	Dwelling.....	Mar. 23.	Colu'a..	....	1	....	....	....	....	....	....	....	1	6,200	
32	F. B. Worley.....	2116 Natrona street.....	Dwelling.....	April 16	Colu'a..	....	1	....	....	....	....	....	....	....	1	3,400	
32	John Moore	21 2 W. Susquehanna avenue.....	Dwelling.....	April 29	Trident.	....	1	....	....	....	....	....	....	....	1	8,200	
32	Mrs. Adolph Woll...	N. E. cor. Thirty-third and Diamond sts	Dwelling.....	June 4..	Trident.	....	....	1	....	....	....	....	....	....	1	27,000	
32	F. L. Hand	3035 Fontaine street.....	Dwelling	June 5..	Nash...	....	....	1	....	....	....	....	....	....	1	800	
32	Eliza Mullen	2037 North Thirty-first street.....	Dwelling	June10.	Trident	....	1	....	....	....	....	....	....	....	1	.....	Closed.
33	Joseph T. Riday.....	1318 Jerome street	Dwelling	Jan. 12.	Union .	....	1	....	....	....	....	....	....	....	1	4,800	
33	Jessie T. Froelich ...	1320 Jerome street	Dwelling.....	Jan. 12.	Union..	....	1	....	....	....	....	....	....	....	1	14,200	

New Meters Set—Continued.

Ward.	Occupant.	Location.	Business.	Date when Set.	Name of Meter.	Size.									Total.	Cubic Feet Consumed	Remarks.
						⅜-inch	⅝-inch.	¾-inch.	1-inch.	1½-inch.	2-inch.	3-inch.	4-inch.	6-inch.			
33	K. W. Robinson.....	1321 Jerome street.....	Dwelling	Jan. 12.	Union..	....	1	....	....	....	....	....	....	....	1	2,400	
33	Geo W. Greenman..	1323 Jerome street.....	Dwelling.....	Jan. 13.	Union..	....	1	....	....	....	....	....	....	....	1	2,900	
33	Jacob Hartman.....	1326 Jerome street.....	Dwelling.....	Jan. 13.	Union..	....	1	....	....	....	....	....	....	....	1	3,500	
33	William J. Ramsay.	1328 Jerome street.....	Dwelling.....	Jan. 13.	Union..	....	1	....	....	....	....	....	....	....	1	3,500	
33	Louis B. Hoffer.....	1332 Jerome street.....	Dwelling.....	Jan. 13.	Union..	....	1	....	....	....	....	....	....	....	1	7,300	
33	John H. Menke.....	1356 Jerome street.....	Dwelling.....	Jan. 14.	Union..	....	1	....	....	....	....	....	....	....	1	5,200	
33	Kate Kaechline.....	4146 North Broad street.....	Dwelling.....	Jan. 21.	Empire	....	1	....	....	....	....	....	....	....	1	16,900	
33	Sophia H. Fulton...	4144 North Broad str et.....	Dwelling.....	Jan. 21.	Empire	....	1	....	....	....	....	....	....	....	1	9,100	
33	John MacInnes.....	4142 North Broad street.....	Dwelling.....	Jan. 21.	Empire	....	1	...	....	....	....	....	....	....	1	5,900	
33	J. Milton Titlow.....	1319 Jerome street.....	Dwelling.....	Jan. 27.	Union..	....	1	....	....	....	....	....	....	....	1	1,800	
33	Armure Tapestry Mill Co.....	2739 Fairhill street.....	Tapestry mfrs.....	Feb. 5.	Union	....	....	1	....	....	....	....	....	....	1	65,600	
33	Mary P. Leer.....	1331 Jerome street.....	Dwelling.....	Feb. 6.	Colu'a..	....	1	....	....	....	....	....	....	....	1	3,600	
33	Louis J. O'Neill.....	1329 Jerome street.....	Dwelling.....	Feb. 6.	Colu'a..	....	1	....	....	....	....	....	....	....	1	3,700	
33	Robert Glass	1327 Jerome street.....	Dwelling.....	Feb. 25.	Colu'a..	...	1	....	....	....	....	....	....	....	1	1,900	
33	H. J. Llewellyn.....	1325 Jerome street.....	Dwelling.....	Feb. 25.	Colu'a,.	....	1	....	....	....	....	....	....	....	1	7,100	

New Meters Set—Continued.

Ward.	Occupant.	Location.	Business.	Date when Set.	Name of Meter.	Size.									Total.	Cubic Feet Consumed.	Remarks.
						⅜-inch.	⅝-inch.	¾-inch.	1-inch.	1½-inch.	2-inch.	3-inch.	4-inch.	6-inch.			
33	George P. Eckert....	1352 Jerome street.....	Dwelling.....	Mar. 8.	Colu'a	....	1	....	....	....	....	....	....	....	1	10,800	
33	John S. Bowker.....	1354 Jerome street.....	Dwelling.....	Mar. 8.	Colu'a	....	1	....	....	....	....	....	....	....	1	4,600	
33	Thomas B O'Neill..	1340 Jerome street.....	Dwelling.....	Mar. 8.	Colu'a....	....	1	....	....	....	....	....	....	....	1	5,300	
33	S. F. Randolph.....	1344 Jerome street.....	Dwelling.....	Mar. 8.	Colu'a....	....	1	....	....	....	....	....	....	....	1	4,800	
33	C. H. Meeker.....	1336 Jerome street.....	Dwelling.....	Mar. 5.	Colu'a....	....	1	....	....	....	....	....	....	....	1	4,300	
33	H. J. Keeler.....	1338 Jerome street.....	Dwelling.....	Mar. 5.	Colu'a....	....	1	....	....	....	....	....	....	....	1	5,700	
33	James R. Gibb.....	1334 Jerome street.....	Dwelling,.....	Mar. 5.	Colu'a....	....	1	....	....	....	....	....	....	....	1	16,700	
33	B. D. Segni.....	1357 Jerome street.....	Dwelling.....	Mar. 5.	Colu'a....	....	1	....	....	....	....	....	....	....	1	4,700	
33	Selig. S. Wolfson....	1315 Jerome street.....	Dwelling.....	Mar. 10.	Colu'a....	....	1	....	....	....	....	....	....	....	1	8,700	
33	Kate B. Edams.....	1316 Jerome street.....	Dwelling.....	Mar. 10.	Colu'a....	....	1	....	....	....	....	....	....	....	1	4,500	
33	John H. Welp.....	1355 Je.ome street.....	Dwelling.....	Mar. 10.	Colu'a....	....	1	....	....	....	....	....	....	....	1	4,300	
33	Mrs. C. M. Thompson	1342 Jerome street.....	Dwelling.....	Mar. 10.	Colu'a....	....	1	....	....	....	....	....		....	1	16,000	
33	Percival A. Wilson..	1358 Jerome street.....	Dwelling.....	Mar. 12.	Colu'a....	....	1	....	....	....	....	....	....	....	1	3,800	
33	Wm. W. Mick.....	1346 Jerome street.....	Dwelling.....	Mar. 12.	Colu'a....	....	1	....	....	....	....	....	....	....	1	4,200	
33	Harry Kulp.....	3627 N. Sixteenth street.....	Dwelling.....	Mar. 13.	Colu'a....	....	1	....	....	....	....	....	....	....	1	3,600	

New Meters Set—Continued.

Ward.	Occupant.	Location.	Business.	Date when Set.	Name of Meter.	Size. ⅜-inch.	⅝-inch.	¾-inch.	1-inch.	1½-inch.	2-inch.	3-inch.	4-inch.		Total.	Cubic Feet Consumed.	Remarks.
33	Elizabeth Kulp	3629 N. Sixteenth street	Dwelling	Mar. 13.	Colu'a.	....	1	....	....	....	....	....	....	....	1	4,000	
33	Phil. Hildenbraud	N. W. cor. Sixth and Erie avenue	Brewery	Mar. 17.	AA Gem	....	....	....	....	....	....	1	....	....	1	710,000	
33	John H. Flood	3519 Mervine street	Dwelling	Mar. 31.	Colu'a.	....	1	....	....	....	....	....	....	....	1	1,200	
33	John Mitcheson	3602 York Road	Dwelling	Apr. 21.	Colu'a.	....	1	....	....	....	....	....	....	....	1	2,800	
33	John Garber	3610 York Road	Dwelling	Apr. 21.	Colu'a	....	1	....	....	....	....	....	....	....	1	8,200	
33	John Moore	3416 Philip street	Dwelling	Apr. 27.	Trident	....	1	....	....	....	....	....	....	....	1	1,900	
33	Chas. Meinel	3035 Fairhill street	Dwelling	Apr. 28.	Trident	....	1	....	....	....	....	....	....	....	1	2,500	
33	S. L. Schumo, trust'e	3302 N. Fifth street	Dwelling	Apr. 30.	Trident	....	1	....	....	....	....	....	....	....	1	3,400	
33	S. L. Schumo, trust'e	3304 N. Fifth street	Dwelling	Apr. 30.	Trident	....	1	....	....	....	....	....	....	....	1	4,400	
33	John Moore	3414 Philip street	Dwelling	May 5.	Trident.	....	1	....	....	....	....	....	....	....	1	700	
33	S. L. Schumo	553 Indiana avenue	Dwelling	May 5.	Trident.	....	1	....	....	....	....	....	....	....	1	1,700	
33	B. Frank Atkins	1236 Butler street	Dwelling	May 8.	Colu'a.	....	1	....	....	....	....	....	....	....	1	4.500	
33	Samuel Wallace	2952 N. Second street	Dwelling	May 11.	Trident.	....	1	....	....	....	....	....	....	....	1	8,600	
33	mith Bros	S. E. cor. Tenth and Westmoreland av.	Planing mill	May 20.	Colu'a.	....	....	....	1	....	....	....	....	....	1	18,500	
33	E. J. McAleer	1233 Erie avenue	Dwelling	June 5.	Colu'a.	....	1	....	....	....	....	....	....	....	1	4,900	

New Meters Set—Continued.

Ward.	Occupant.	Location.	Business.	Date when Set.	Name of Meter.	Size. ½-inch.	⅝-inch.	¾-inch.	1-inch.	1½-inch.	2-inch.	3-inch.	4-inch.	6-inch.	Total.	Cubic Feet Consumed.	Remarks.
33	H. H. Jago	4152 N. Broad street	Dwelling	June 8.	Colu'a	....	1	....	....	....	....	....	....	....	1	6,400	
33	Chas. W. Zimmerman	1322 Jerome street	Dwelling	June 12.	Colu'a	....	1	....	....	....	....	....	....	....	1	.....	Closed.
33	Grace I. Henderson	1348 Jerome street	Dwelling	June 12.	Colu'a	....	1	....	....	....	....	....	....	....	1	3,700	
33	E. H. Thomas	3639 York street	Dwelling	June 15.	Trident	....	1	....	....	....	....	....	....	....	1	2,400	
33	J. P. Otterstetter	4421 Germantown avenue	Real estate office	June 18.	Colu'a	....	1	....	....	....	....	....	....	....	1	4,500	
33	Eliza Kelly	3631 Germantown avenue	Dwelling	Aug. 3.	Colu'a	....	1	....	....	....	....	....	....	....	1	3,100	
33	Jacob Boyer	3635 Old York road	Dwelling	Aug. 3.	Colu'a	....	1	....	....	....	....	....	....	....	1	1,600	
33	James Hawkins	3631 Old York road	Dwelling	Aug. 3.	Colu'a	....	1	....	....	....	....	....	....	....	1	2,700	
33	Wm. A. Ball	3631 Camac street	Dwelling	Aug. 3.	Colu'a	....	1	....	....	....	....	....	....	....	1	1,200	
33	Elisabeth Campbell	3413 N. Twelfth street	Dwelling	Aug. 3.	Colu'a	....	1	....	....	....	....	....	....	....	1	3,400	
34	W. E. Speckman	1328 N. Fifty-fourth street	Dwelling	May 29.	Col'b'a	....	1	....	....	....	....	....	....	....	1	2,200	
34	Emil J. Wengel	6019 Kershaw avenue	Dwelling	June 22.	Col'bia	....	1	....	....	....	....	....	....	....	1	4,300	
34	Frank McNutt	410 N. Fifty-second street	Dwelling	June 22.	Col'bia	....	1	....	....	....	....	....	....	....	1	3,400	
34	Louisa R. Ferguson	1336 N. Fifty-second street	Dwelling	June 27.	Trident	....	1	....	....	....	....	....	....	....	1	900	
34	G. F. Haertrich	121 N. Fifty-second street	Dwelling	July 15.	Trident	....	1	....	....	....	....	....	....	....	1	700	

New Meters Set—Continued.

Ward.	Occupant.	Location.	Business.	Date when Set.	Name of Meter.	Size.									Total.	Cubic Feet Consumed.	Remarks.
						½-inch.	⅝-inch.	¾-inch.	1-inch.	1½-inch.	2-inch.	3-inch.	4-inch.	6-inch.			
34	Harry W. Rush	5153 Haverford avenue	Dwelling	July 15.	Trident	....	1	....	....	....	....	....	....	....	1	1,900	
36	Atlantic Refin'g Co.	S. S. Passyunk ave., 260 ft. W. of 30th st.	Oil works	July 28.	Crown	....	....	....	....	....	1	....	....	....	1	16,800	
37	Adam Wanner	2452 Germantown avenue	Dwelling	Mar. 26.	Col'bia	....	1	....	....	....	....	....	....	....	1	1,700	
37	M. C. Keeler	2816 N. Twelfth street	Dwelling	Mar. 27.	Col'bia	....	1	....	....	....	....	....	....	....	1	2,200	
37	F. H. Kornbau	2446 Germantown avenue	Dwelling	April 1.	Col'b'a	....	1	....	....	....	....	....	....	....	1	8,300	
37	F. H. Kornbau	2450 Germantown avenue	Dwelling	April 1.	Col'bia	....	1	....	....	....	....	....	....	....	1	11,100	
37	S. R. Slifer, M. D.	3500 Germantown avenue	Drug store	April 29	Co''bia	....	1	....	....	....	....	....	....	....	1	45,800	
37	Crumbie Bros.	3149 N. Broad street	Drug store	April 29	Col'bia	....	1	....	....	....	....	....	....	....	1	16,300	
37	H. Lewis Doll	2940 N. Twelfth street	Dwelling	May 6.	Trident	....	1	....	....	....	....	....	....	....	1	1,600	
37	Andrew E. Weiler	1213 Seltzer street	Dwelling	May 8.	Trident	....	1	....	....	....	....	....	....	....	1	1,400	
37	Thomas N. Heuson.	2934 N. Camac street	Dwel ing	May 11.	Trident	....	1	....	....	....	....	....	....	....	1	3,300	
37	Champion Candy Machine Co.	Rear 32-35-37 N. Twelfth street	Confect'rs supplies.	May 13.	Crown	....	....	....	1	....	....	....	....	....	1	2,300	
37	Charles Rambo	2243 N. Broad street	Dwelling	June 5.	Trident	....	1	....	....	....	....	....	....	....	1	1,300	
37	William H. Hagel	1335 Tioga street	Dwelling	June 12.	Col'bia	....	1	....	....	....	....	....	....	....	1	4,500	
37	George A. Bilyea	2919 Park avenue	Dwelling	June 29.	Col'bia	....	1	....	....	....	....	....	....	....	1	3,100	

New Meters Set—Continued.

Ward.	Occupant.	Location.	Business.	Date when Set.	Name of Meter.	Size.									Total.	Cubic Feet Consumed.	Remarks.
						½-inch.	⅝-inch.	¾-inch.	1 inch.	1½-inch.	2-inch.	3-inch.	4-inch.	6-inch.			
37	George A. Bilyea	2921 Park avenue	Dwelling	June 29.	Colu'a.	....	1	....	....	....	....	....	....	....	1	.....	Closed.
37	George A. Bilyea	2913 Park avenue	Dwelling	June 29.	Colu'a.	....	1	....	....	....	....	....	....	....	1	2,300	
37	George A. Bilyea	2915 Park avenue	Dwelling	June 29.	Colu'a.	....	1	....	....	....	....	....	....	....	1	2,600	
37	George A. Bilyea	2903 Park avenue	Dwelling	June 29.	Colu'a.	....	1	....	....	....	....	....	....	....	1	.....	Closed.
37	George A. Bilyea	2911 Park avenue	Dwelling	June 29.	Colu'a.	....	1	....	....	....	....	....	....	....	1	.....	Closed.
37	C. W. Hallowell	3144 North Twelfth street	Dwelling	June 29.	Colu'a.	....	1	....	....	....	....	....	....	....	1	1,900	
37	George A. Bilyea	2917 Park avenue	Dwelling	June 30.	Colu'a.	....	1	....	....	....	....	....	....	....	1	.....	Closed.
37	William F. Schaefer	2213 Camac street	Dwelling	June 30.	Trident	....	1	....	....	....	....	....	....	....	1	4,400	
37	George A. Bilyea	2923 Park avenue	Dwelling	June 30.	Colu'a.	....	1	....	....	....	....	....	....	....	1	1,500	
37	George A. Bilyea	2925 Park avenue	Dwelling	July 2.	Colu'a.	....	1	....	....	....	....	....	....	....	1	.....	Closed.
37	George A. Bilyea	2901 Park avenue	Dwelling	July 7.	Colu'a.	....	1	....	....	....	....	....	....	....	1	.....	Closed.
37	Charles H. Carman	1201 Allegheny avenue	Dwelling	July 10.	Keyst'n	....	1	....	....	....	....	....	....	....	1	2,500	
37	Hugh Caskey	1231 Allegheny avenue	Dwelling	July 10.	Trident	....	1	....	....	....	....	....	....	....	1	13,100	
37	N. J. Hayes	E. S. Broad st., 204 feet S. of Erie avenue	Apartment House	July 16.	Colu'a.	....	....	....	1	....	....	....	....	....	1	83,600	
37	L. K. Slifer	3506 Germantown road	Grocery Store	July 16.	Col'ua.	....	1	....	....	....	....	....	....	....	1	18,000	

New Meters Set—Continued.

Ward.	Occupant.	Location.	Business.	Date when Set.	Name of Meter.	Size.								Total.	Cubic Feet Consumed.	Remarks.
						½-Inch.	⅝-Inch.	¾-Inch.	1-Inch.	1½-Inch.	2-Inch.	3-Inch.	4-Inch.	6-Inch.			
37	L. K. Slifer	3508 Germantown road	Confectionery	July 16.	Colu'a	....	1	....	....	....	....	....	....	....	1	4,200	
37	L. K. Slifer	3510 Germantown road	Grocery Store	July 16.	Colu'a	....	1	....	....	....	....	....	....	....	1	7,300	
37	Titlow Bros	3427-29 North Broad street	Livery Stable	July 17.	Colu'a	....	....	....	1	....	....	....	....	....	1	48,900	
37	Titlow Bros	3427-29 North Broad street	Livery Stable	July 17.	Colu'a	....	1	....	....	....	....	....	....	....	1	1,900	
37	L. K. Slifer	3504 Germantown road	Meat Store	July 17.	Colu'a	....	1	....	....	....	....	....	....	....	1	6,700	
38	Annie E. Young	3835 North Sydenham street	Dwelling	Mar. 16.	Colu'a	....	1	....	....	....	....	....	....	....	1	2,000	
38	E. P. Balderson	1622 Westmoreland street	Dwelling	Mar. 16.	Colu'a	....	1	....	....	....	....	....	....	....	1	5,100	
38	John S. Atkins	3836 N. Fifteenth street	Dwelling	Mar. 27.	Colu'a	....	1	....	....	....	....	....	....	....	1	4,600	
38	Chas. E. Geckler	3625 N. Sixteenth street	Dwelling	Mar. 31.	Colu'a	....	1	....	....	....	....	....	....	....	1	3,200	
38	D. Geckler	3623 N. Sixteenth street	Dwelling	Mar. 31.	Colu'a	....	1	....	....	....	....	....	....	....	1	5,200	
38	William C. Bird	2114 Tioga street	Dwelling	Apr. 23.	Colu'a	....	1	....	....	....	....	....	....	....	1	10,300	
38	F. M. Vanderherchen	3447 N. Sydenham street	Dwelling	Apr. 27.	Trident	....	1	....	....	....	....	....	....	....	1	2,300	
38	F. T. Jennings	3532 N. Eighteenth street	Dwelling	May 6.	Trident	....	1	....	....	....	....	....	....	....	1	2,700	
38	George W. Moss	3529 Germantown avenue	Dwelling	May 15.	Colu'a	....	1	....	....	....	....	....	....	....	1	6,700	
38	W. Robinson	4180 Germantown avenue	Dwelling	May 15.	Colu'a	....	1	....	....	....	....	....	....	....	1	6,100	

New Meters Set—Continued.

Ward.	Occupant.	Location.	Business.	Date when Set.	Name of Meter.	Size. ½-inch.	⅝-inch.	¾-inch.	1-inch.	1½-inch.	2-inch.	3-inch.	4-inch.	6-inch.	Total.	Cubic Feet Consumed.	Remarks.
38	Sauquoit Silk Manufacturing Co	4015 Clarissa street	Silk Goods Mfrs.	May 21.	Trident	....	....	....	....	....	1	....	....	....	1	154,000	
38	Barbara A. Young	2740 N. Fifteenth street	Dwelling	May 22.	Colu'a	....	1	....	....	....	....	....	....	....	1	.....	No water used.
38	Sauquoit Silk Manufacturing Co	4015 Clarissa street	Silk Goods Mfrs.	May 25.	Trident	....	....	....	....	....	....	1	....	....	1	703,000	
38	Thomas S. Shibe	3237 N. Fifteenth street	Dwelling	June 1.	Trident	....	1	....	....	....	....	....	....	....	1	4,400	
38	Jennie B. Risley	1805 W. Venango street	Dwelling	June 1.	Trident	....	1	....	....	....	....	....	....	....	1	2,500	
38	George R. Ulrich	1419 Venango street	Dwelling	June 3.	Trident	....	1	....	....	....	....	....	....	....	1	5,200	
38	A. S. Golden	1449 Venango street	Dwelling	June 3.	Trident	....	1	....	....	....	....	....	....	....	1	6,700	
38	E. E. Wilson	1500 Tioga street	Drug Store	June 8	Trident	....	1	....	....	....	....	....	....	....	1	11,500	
38	Josephine Lewis (S. H. Lewis, trustee)	1423 Venango street	Dwelling	June 8.	Trident	....	1	....	....	....	....	....	....	....	1	4,700	
38	A. C. Bonner	3710 N. Carlisle	Dwelling	June 8.	Colu'a	....	1	....	....	....	....	....	....	....	1	1,800	
38	Edward W. Schmidt	1413 Ontario street	Dwelling	June 9.	Colu'a	....	1	....	....	....	....	....	....	....	1	.....	Closed.
38	Anna S. Ashmead	1539 Venango street	Dwelling	June 9.	Colu'a	....	1	....	....	....	....	....	....	....	1	3,100	
38	C. B. Fenstermacher	3024 N. Fifteenth street	Dwelling	June 11.	Colu'a	....	1	....	....	....	....	....	....	....	1	.....	Closed.
38	Anna S. Ashmead	1541 Venango street	Drug Store	June 11.	Colu'a	....	1	....	....	....	....	....	....	....	1	5,300	

New Meters Set—Continued.

Ward.	Occupant.	Location.	Business.	Date when Set.	Name of Meter.	Size. ½-inch.	⅝-inch.	¾-inch.	1-inch.	1½-inch.	2-inch.	3-inch.	4-inch.	6-inch.	Total.	Cubic Feet Consumed.	Remarks.
38	Geo. W. Mills.....	1417 W. Ontario street.....	Dwelling.....	June12.	Colu'a..	....	1	....	....	....	....	....	....	....	1	3,400	
38	Frank C. Buckley...	3538 N. Eighteenth street.....	Dwelling.....	June15.	Trident.	....	1	....	....	....	....	....	....	....	1	11,000	
38	John M. Harkness..	3480 N. Sydenham street.....	Dwelling.....	June17.	Trident.	....	1	....	....	....	....	....	....	....	1	6,100	
38	Geo. A. Bilyea.....	3025 N. Sixteenth street.....	Dwelling.....	July 8.	Colu'a..	....	1	....	....	....	....	....	....	....	1	4,600	
38	Geo. A. Bilyea.....	3027 N. Sixteenth treet.....	Dwelling.....	July 8.	Colu'a..	....	1	....	....	....	....	....	....	....	1	2,200	
38	Geo. A. Bilyea.....	3029 N. Sixteenth street.....	Dwelling.....	July 8.	Colu'a..	....	1	....	....	....	....	....	....	....	1	3,840	
38	Geo. A. Bilyea.....	3031 N. Sixteenth street.....	Dwelling.....	July 8.	Colu'a..	....	1	....	....	....	....	....	....	....	1	.....	Closed.
38	Geo. A. Bilyea.....	3033 N. Sixteenth street.....	Dwelling.....	July 8.	Colu'a..	....	1	....	....	....	....	....	....	....	1	2,100	
38	Geo. A. Bilyea.....	3035 N. Sixteenth street.....	Dwelling.....	July 8.	Colu'a..	....	1	....	....	....	....	....	....	....	1	.....	Closed.
38	Geo. A. Bilyea.....	3037 N. Sixteenth street.....	Dwelling.....	July 8.	Colu'a..	....	1	....	....	....	....	....	....	....	1	8,500	
38	Geo. A. Bilyea.....	3039 N. Sixteenth street.....	Dwelling.....	July 8.	Colu'a..	....	1	....	....	....	....	....	....	....	1	3,700	
38	Geo. A. Bilyea.....	3041 N. Sixteenth street.....	Dwelling.....	July 8.	Colu'a..	....	1	....	....	....	....	....	....	....	1	1,700	
38	Geo. A. Bilyea.....	3045 N. Sixteenth street.....	Dwelling.....	July 8.	Colu'a..	....	1	....	....	....	....	....	....	....	1	3,100	
38	Geo. A. Bilyea.....	3047 N. Sixteenth street.....	Dwelling.....	July 8.	Colu'a..	....	1	....	....	....	....	....	....	....	1	.....	Closed.
38	Geo. A. Bilyea.....	3049 N. Sixteenth street.....	Dwelling.....	July 8.	Colu'a..	....	1	....	....	....	....	....	....	....	1	.....	Closed.

GENERAL SUMMARY OF METER OPERATIONS FOR THE YEAR 1903.

In Use January 1, 1903.

Size of Meters	Crown.	Gem.	Nash.	Union.	Venturi.	Thomson.	Hersey.	Trident.	Empire.	Deacon.	Standard.	Pittsburg.	Worthington.	Total.
½-inch	21	....	4	4	....	....	....	....	....	....	....	....	....	29
⅝-inch	....	....	....	3	....	....	....	8	1	....	....	1	....	13
¾-inch	216	....	4	13	....	....	....	19	2	....	1	5	....	260
1-inch	222	....	1	2	....	....	....	6	6	....	....	....	....	237
1½-inch	132	....	3	34	....	....	2	12	3	....	....	4	5	195
2-inch	168	96	....	12	....	....	1	6	2	....	....	1	4	290
3-inch	69	101	....	3	....	3	2	11	1	....	1	....	....	191
4-inch	51	183	....	1	....	....	....	....	....	1	2	....	....	238
6-inch	6	30	....	....	....	....	3	....	....	6	5	....	....	50
12-inch	....	....	....	....	1	....	....	....	....	....	....	....	....	1
20-inch	....	....	....	....	2	....	....	....	....	....	....	....	....	2
30-inch	....	....	....	....	1	....	....	....	....	....	....	....	....	1
36-inch	....	....	....	....	1	....	....	....	....	....	....	....	....	1
48-inch	....	....	....	....	2	....	....	....	....	....	....	....	....	2
Totals	885	410	12	72	7	3	8	62	15	7	9	11	9	1,510

Set During 1903.

Size of Meters	Crown.	Gem.	Nash.	Union.	Hersey.	Trident.	Empire.	Columbia.	Standard.	Worthington.	Keystone.	Total.
½-inch	2	....	....	....	....	....	....	....	....	....	....	2
⅝-inch	....	....	4	12	....	67	3	161	....	....	3	250
¾-inch	1	....	3	2	1	2	....	1	....	....	....	10
1-inch	5	....	1	3	1	1	....	3	....	1	....	15
1½-inch	1	....	....	6	....	1	1	....	....	....	....	9
2-inch	3	5	....	2	....	1	....	.	....	1	1	13
3-inch	....	6	....	....	1	1	....	....	....	....	....	8
4-inch	1	3	....	....	1	....	....	....	1	....	....	6
6-inch	1	1	....	....	....	....	....	....	....	....	....	2
12-inch	....	....	....	....	....	....	....	....	....	....	....	....
20-inch	....	....	....	....	....	....	....	....	....	....	....	....
30-inch	....	....	....	....	....	....	....	....	....	....	....	....
36-inch	....	....	....	....	....	....	....	....	....	....	....	....
48-inch	....	....	....	....	....	....	....	....	....	....	....	....
Totals	14	15	8	25	4	73	4	165	1	2	4	315

Renewed—Taken Out.

Size of Meters	Crown.	Gem.	Nash.	Trident.	Union.	Standard.	Pittsburg.	Worthington.	Total.
½-inch	1	....	1	....	....	....	....	....	2
⅝-inch	....	....	1	2	....	....	....	....	3
¾-inch	12	....	1	7	....	1	1	....	22
1-inch	11	....	....	1	....	....	....	....	12
1½-inch	13	....	....	....	7	....	....	2	22
2-inch	9	9	....	2	4	....	1	....	25
3-inch	....	6	....	....	....	....	....	....	6
4-inch	1	10	....	....	....	....	....	....	11
6-inch	....	1	....	....	....	....	....	....	1
12-inch	....	....	....	....	....	....	....	....	....
20-inch	....	....	....	....	....	....	....	....	....
30-inch	....	....	....	....	....	....	....	....	....
36-inch	....	....	....	....	....	....	....	....	....
48-inch	....	....	....	....	....	....	....	....	....
Totals	47	26	3	12	11	1	2	2	104

Renewed—Put In.

Size of Meters	Crown.	Gem.	Trident.	Pittsburg.	Worthington.	Nash.	Union.	Columbia.	Total.
½-inch	....	....	....	....	....	....	....	....	....
⅝-inch	....	....	1	....	....	....	....	....	1
¾-inch	10	....	6	1	....	3	1	....	21
1-inch	7	....	1	....	....	....	....	1	9
1½-inch	12	....	....	....	....	....	4	....	16
2-inch	13	12	....	....	....	....	3	....	28
3-inch	....	5	....	....	1	....	....	....	6
4-inch	....	11	....	....	....	....	....	....	11
6-inch	....	1	....	....	....	....	....	....	1
12-inch	....	....	....	....	....	....	....	....	....
20-inch	....	....	....	....	....	....	....	....	....
30-inch	....	....	....	....	....	....	....	....	....
36-inch	....	....	....	....	....	....	....	....	....
48-inch	....	....	....	....	....	....	....	....	....
Totals	42	29	8	1	1	3	8	1	93

Discontinued.

Size of Meters	Crown.	Gem.	Trident.	Union.	Hersey.	Standard.	Total.
½-inch	2	....	....	....	....	....	2
⅝-inch	....	....	....	....	....	....	....
¾-inch	5	....	2	....	....	....	7
1-inch	5	....	1	....	....	....	6
1½-inch	5	....	....	1	....	....	6
2-inch	7	1	....	....	....	....	8
3-inch	....	1	1	....	....	....	2
4-inch	1	4	....	....	....	....	5
6-inch	....	1	....	....	1	1	3
12-inch	....	....	....	....	....	....	....
20-inch	....	....	....	....	....	....	....
30-inch	....	....	....	....	....	....	....
36-inch	....	....	....	....	....	....	....
48-inch	....	....	....	....	....	....	....
Totals	25	7	4	1	1	1	39

In Use December 31, 1903.

Size of Meters	Crown.	Gem.	Nash.	Deacon.	Trident.	Union.	Empire.	Hersey.	Venturi.	Standard.	Thomson.	Keystone.	Columbia.	Worthington.	Total.
½-inch	20	....	3	....	....	4	....	....	....	....	....	....	....	....	27
⅝-inch	....	....	3	....	74	15	4	....	....	....	....	4	161	....	261
¾-inch	210	....	9	....	18	16	2	1	....	....	....	5	1	....	262
1-inch	218	....	2	....	6	5	6	1	....	....	....	....	4	1	243
1½-inch	127	....	3	....	13	36	4	2	....	....	....	4	....	3	192
2-inch	168	103	....	....	5	13	2	1	....	....	....	1	....	5	298
3-inch	69	105	....	....	11	3	1	4	....	1	3	....	....	1	198
4-inch	50	183	....	1	....	1	....	....	....	3	....	....	....	....	238
6-inch	7	30	....	6	....	....	....	2	....	4	....	....	....	....	49
12-inch	....	....	....	....	....	....	....	....	1	....	....	....	....	....	1
20-inch	....	....	....	....	....	....	....	....	2	....	....	....	....	....	2
30-inch	....	....	....	....	....	....	....	....	1	....	....	....	....	....	1
36-inch	....	....	....	....	....	....	....	....	1	....	....	....	....	....	1
48-inch	....	....	....	....	....	....	....	....	2	....	....	....	....	....	2
Totals	869	421	20	7	127	93	19	11	7	8	3	14	166	10	1,775

Stock on Hand.

Size of Meters	Crown.	Gem.	Nash.	Trident.	Union.	Hersey.	Pittsburg.	Total.
½-inch	....	....	....	....	....	....	....	....
⅝-inch	....	....	....	2	....	....	....	2
¾-inch	4	....	1	9	....	....	....	14
1-inch	6	....	....	3	....	....	....	9
1½-inch	8	....	....	1	1	....	....	10
2-inch	7	6	....	2	6	....	1	22
3-inch	....	7	....	1	1	....	1	10
4-inch	3	4	....	....	....	....	....	7
6-inch	....	....	....	....	....	1	....	1
12-inch								
20-inch								
30-inch								
36-inch								
48-inch								
Totals	28	17	1	18	8	1	2	75

Miscellaneous Work.

METERS.

Sizes.	Repaired.													Used in Service.					Meters Purchased.	Meters Packed.									Meters Tested.											
	Crown.	Gem.	Trident.	Union.	Worthington.	Standard.	Columbia.	Hersey.	Pittsburg.	Empire.	Nash.	Thomson.	Total.	Crown.	Gem.	Trident.	Nash.	Total.		Crown.	Gem.	Trident.	Union.	Columbia.	Worthington.	Empire.	Standard.	Pittsburg.	Total.	Crown.	Gem.	Trident.	Union.	Columbia.	Empire.	Nash.	Worthington.	Hersey.	Pittsburg.	Keystone.	Total.
½-inch	3	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	3	4	.....	.....	.....	4		5	.....	.....	.....	.....	.....	.....	.....	.....	5	2	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	2
⅝-inch	.....	.....	12	7	.....	.....	21	.....	.....	2	3	.....	45	.....	.....	.....	.....	.....		.....	.....	12	2	9	.....	.....	.....	.....	23	2	.....	95	11	209	3	8	.....	.....	.....	2	330
¾-inch	69	.....	11	6	.....	1	3	.....	3	1	6	.....	100	.....	1	1	.....	2		56	.....	3	5	.....	.....	1	.....	.....	65	12	.....	12	.....	4	.....	10	.....	1	1	.....	40
1-inch	80	.....	3	4	.....	.....	.....	1	.....	1	.....	.....	89	2	1	.....	.....	3		57	.....	2	2	.....	.....	1	.....	.....	62	10	.....	2	3	5	.....	2	1	1	.....	.....	24
1½-inch	75	.....	4	24	3	3	.....	.....	1	1	.....	.....	111	.....	.....	.....	.....	.....		33	.....	.....	3	.....	.....	1	.....	.....	37	18	.....	.....	14	.....	2	.....	.....	.....	.....	1	35
2-inch	73	58	9	10	6	1	.....	3	.....	.....	1	.....	161	.....	.....	.....	2	2		21	10	.....	4	.....	2	1	2	1	41	25	11	2	5	.....	.....	1	2	1	.....	1	48
3-inch	34	85	9	1	2	7	.....	5	.....	.....	.....	1	144	.....	.....	.....	.....	.....		5	4	3	.....	.....	1	.....	.....	.....	13	1	19	4	.....	.....	.....	.....	1	1	.....	.....	26
4-inch	18	76	.....	.....	1	6	.....	3	.....	.....	.....	.....	104	.....	.....	.....	.....	.....		1	3	.....	.....	.....	.....	1	.....	.....	5	3	20	.....	.....	.....	.....	.....	.....	1	.....	.....	24
6-inch	6	14	.....	.....	.....	3	.....	.....	.....	.....	.....	.....	23	.....	.....	.....	.....	.....		.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	2	.....	.....	.....	.....	.....	.....	.....	.....	2
Total	358	233	48	52	12	21	24	12	4	5	10	1	780	6	2	1	2	11	No meters purchased year 1903.	178	17	20	16	9	3	4	3	1	251	73	52	115	33	218	5	21	4	5	1	4	531

Examinations.				Miscellaneous.						
Meters.	Leaks.	Short Supply.	Total.	New Boxes.	Boxes Repaired.	Iron Covers.	Fish Traps.	Service Pipes Repaired.	Total.	Statements.
1432	80	5	1517	56	56	3	9	445	569	24,460

New Meters Set—Continued.

Ward.	Occupant.	Location.	Business.	Date when Set.	Name of Meter.	Size. ½ inch.	⅝ inch.	¾ inch.	1 inch.	1½ inch.	2 inch.	3 inch.	4 inch.	6 inch.	Total.	Cubic Feet Consumed	Remarks.
38	Geo. A. Bilyea.....	3057 N. Sixteenth street.....	Dwelling.....	July 8.	Colu'a..	....	1	....	....	....	....	....	....	....	1	4,700	
38	George A. Bilyea....	3059 N. Sixteenth street.....	Dwelling.....	July 8..	Col'bia.	....	1	....	....	....	....	....	....	....	1	6,100	
38	S. A. Bachman.....	3650 N. Broad street.....	Dwelling.....	July 13.	Keyst'e.	....	1	....	....	....	....	....	....	....	1	9,300	
38	John H. Laws.....	3425 N. Eighteenth street.....	Dwelling.....	July 13.	Trident.	....	1	....	....	....	....	....	....	....	1	3,100	
38	Jacob A. Spitzer.....	3546 N. Broad street.....	Dwelling.....	July 17.	Col'bia.	....	1	....	....	....	....	....	....	....	1	5,500	
39	Zophar Howell, est.	2100 S. Eighth street.....	Wall paper mf'g....	Mar. 28.	Trident.	....	....	....	1	....	....	....	....	....	1	500	Vacant.
39	Chas. G. Blatchley...	Swanson and McKean streets.....	Pump maker.....	July 24.	Crown..	1	....	....	....	....	....	....	....	....	1	3,900	
42	Jno. Kuhn.....	N. side Tabor road W. of Fourth street.	Hot houses.....	April 17.	Union..	....	....	....	....	1	....	....	....	....	1	35,400	
	Total.....	.....	.....	.....	.....	2	250	10	15	9	13	8	6	2	315		

DISTRIBUTION EXPENSES DURING THE YEAR 1903.

Including Expenses of Main Office, Purveyors' Districts and Meter Shops.

Materal and Labor.	First District.	Second District.	Third District	Fourth District.	Fifth District.	Sixth District.	Seventh District.	Distribution.	Meter Stop.	Main office.	Totals.
Lead	$1,519 00	$217 00	$1,660 00			$651 60	$1,302 00				$5,349 00
Gasket	43 74		115 62		$23 65	69 28					252 29
Coke	50 00	42 00	163 35	$299 25	48 00	112 20	78 75				793 55
Wood						56 00					56 00
Straight Pipes								$20,051 20			20,051 20
Small specials								5,261 50			5,261 50
Large specials, 20 inch								859 37			859 37
Large specials								1,779 51			1,779 51
Frames and covers	74 86	34 56	189 84	218 34	68 71	152 45	266 98				1,005 74
Cast iron stop boxes	137 61	68 83	177 82	138 81		27 86	136 57				687 50
Hauling, transportation & hotel								3,968 98			3,968 98
Supplies, tools, small stores, etc	1,097 41	838 29	635 31	1,989 56	1,188 54	1,610 33	930 42	1,770 87	$395 41	$47 10	10,403 24
Plumb'g & plumb'g supplies					1 50	76 43		11,616 39			11,694 32
Meters, etc									569 06		569 06
Brick, stone, lime & cement	55 90	213 05	183 10	503 70	218 80	261 80	141 70				1,578 05
Lumber	6,504 81	82 32	546 98	717 85	695 43	807 30	447 24		496 60		10,298 53
Hay, feed, etc	1,059 36	771 60	1,358 98	1,000 53	196 59	158 26	784 37				5,329 69

Distribution Expenses—Continued.

Material and Labor.	First District.	Second District.	Third District.	Fourth District.	Fifth District.	Sixth District.	Seventh District.	Distribution.	Meter Shop.	Main Office.	Totals.
Stable supplies	$301 60	$226 98	$40 41	$711 25	$131 50	$99 13	$121 98	.....	.....	.....	$1,632 85
Stable repairs	255 41	111 10	479 25	119 75	80 50	67 25	125 61	.....	.....	.....	1,238 87
Stable medicines	16 00	40 45	77 00	21 90	.....	2 00	94 30	.....	.....	.....	251 65
Stable shoeing	279 50	131 00	193 40	193 65	71 63	14 00	129 00	.....	.....	.....	1,112 18
Supplies, stationery	295 64	330 41	272 90	212 85	116 51	223 72	299 20	531 46	238 10	81 62	2,602 41
Wages.... Per diem	26,892 28	18,793 91	71,780 35	27,492 82	16,255 53	28,766 02	21,159 41	.....	.....	.....	211,140 32
Wages.... Salary	4,651 44	4,631 80	7,303 00	6,699 53	3,019 75	3,944 62	3,821 30	.....	.....	.....	34,071 44
Total cost of labor and material on account of distribution	$43,234 56	$26,533 30	$85,177 31	$40,319 79	$22,116 64	$37,099 65	$29,858 83	$45,839 28	$1,699 17	$128 72	$331,987 25
Buildings, grounds and reservoirs	.....	$1,789 14	$13,250 72	$2,886 37	$15,564 11	$1,103 67	$4,985 78	.....	.....	.....	$39,579 79
Filtration	.....	.....	464 64	1,716 63	1,741 54	.....	.....	.....	.....	.....	3,922 81
High pressure fire service	....	298 59	.....	.....	.....	.....	958 72	.....	.....	.....	1,257 31
Total labor and material	$43,234 56	$28,621 03	$98,892 67	$44,922 79	$39,422 29	$38,203 32	$35,783 33	$45,839 28	$1,699 17	$128 72	$376,747 16

Schedule of Pipe and Special Castings Rejected and Accepted During the Year 1903.

	Manufacturer.	Size in Inches.		Ordered.	Inspected.	Rejected.	Cancelled.	Accepted.	
		Pipe.	Special Castings.					Quantity.	Cost.
Bureau of Water.	R. D. Wood & Co.	6 in.	.....	4,000	6,322	2,324	2	3,998	$20,081 20
		.....	breeches pipe.....	2	2	1	1	1	859 37
		.....	20 in. to 48 in.....	7	7	.....	.....	7	574 22
	Donaldson Iron Co.	.....	3 in. to 20 in.....	884	1,001	117	.....	884	4,285 22
		.....	20 in. to 48 in.....	31	33	2	.....	31	897 23
	J. A. Clark	.....	meter fr'mes & cov's	25	21	.....	4	21	191 50
		.....	meter fr'mes & cov's	200	106	5	9	191	660 96
		.....	extra covers.....	100	93	.....	7	93	153 28
		.....	stop boxes.....	100	100	.....	.....	100	687 50
	Total	.....	.....	5,349	7,775	2,449	23	5,326	$28,390 48
High Pressure Fire Service.	R. D. Wood & Co.	20 in.	.....	38	40	2	.....	38	472 84
		.....	3 in. to 20 in.....	12	12	.....	.....	12	
		.....	20 in. to 48 in.....	32	45	13	.....	32	
		.....	3 in. to 20 in.....	10	12	2	.....	10	
	Donaldson Iron Co.	.....	3 in. to 20 in.....	58	62	4	.....	58	503 44
		.....	20 in. to 48 in.....	8	8	.....	.....	8	308 06
	Total	.....	.....	158	179	21	.....	158	$1,284 34

Schedule of Pipe and Special Castings, etc.—Continued.

	Manufacturer.	Size in Inches.		Ordered.	Inspected.	Rejected.	Cancelled.	Accepted.	
		Pipe.	Special Castings.					Quantity.	Cost.
Bureau of Correction.	Donaldson Iron Co.	.....	3 in. to 20 in.	12	13	1	.....	12	
		12 in.	.....	5	5	.....	.....	5	
	U. S. C. I. Pipe and Foundry Co.	.....	3 in. to 20 in.	5	7	2	.....	5	
	R. D. Wood & Co.	.....	3 in. to 20 in.	18	27	9	.....	18	
		3 in.	.....	167	313	146	.....	167	
		6 in.	.....	84	174	90	.....	84	
	Total	.....	.....	291	539	248	.....	291	
Holmesburg Water Co.	U. S. C. I. Pipe and Foundry Co.	12 in.	.....	275	308	33	.....	275	
	Total	.....	.....	275	308	33	.....	275	
	Grand Total	.....	.....	6,073	8,801	2,751	23	6,050	

New Attachments Made and Delivered to Districts during the Year 1903.

Districts.	Number of Attachments made and delivered.	Feet of Lead Pipe.		Total.
		⅝-inch.	1-inch.	
First	806	12,892	18	12,910
Second	.....	.....	.....	.....
Third	1,848	28,702	.....	28,702
Fourth	.....	.....	.....	.....
Fifth	150	2,400	.....	2,400
Sixth	460	7,705	.....	7,705
Seventh	729	9,777	23	9,800
Total	3,993	61,476	41	61,517

APPENDIX D

REPORT

OF THE

Operations at the Construction and Repair Shop, Bureau of Water. Twelfth and Reed Streets

Philadelphia, January 1, 1904.

MR. F. L. HAND,
Chief, Bureau of Water.

SIR:—I herewith submit the annual report of operations at the Construction and Repair Shop, Twelfth and Reed streets, for the year ending December 31, 1903.

Respectfully,

JAS. H. DEAN,
Superintendent of Shop.

MERCHANDISE.		DR.
Inventory January 1, 1903		$24,553 38
Bolts and nuts	615 35	
Hardware	439 26	
Steel	1,243 84	
Wrought iron	1,097 73	
Iron castings	10,874 30	
Brass castings	4,368 88	
Lead coating	168 63	
Expansion metal	377 79	
Babbit metal	18 00	
Special metal	79 04	
Chandlery	155 84	
Gum goods	248 24	
Coal	1,987 52	
Coke	20 00	
Lumber	816 15	
Paints, brushes, oils, etc.	95 91	
Brass fittings	125 19	
Oils and tallows	224 05	
Wrought iron pipe and fittings	3 10	
Refined lead	651 00	
Plug valves	266 74	
Forage, stable supplies, etc.	164 85	
Miscellaneous	1,935 12	
Wages	32,493 51	
		58,470 04
Total Dr.		$83,023 42

MERCHANDISE.		CR.
First District	$4,046 63	
Second District	1,417 63	
Third District	6,137,66	
Fourth District	2,389 16	
Fifth District	1,607 88	
Sixth District	2,699 92	
Seventh District	5,491 47	
		$23,790 35
Spring Garden machinery	3,846 21	
Spring Garden boilers	4,420 97	
		8,267 18
Fairmount machinery	752 84	
		752 84

Belmont machinery	3,464 43	
Belmont boilers	968 30	
Belmont buildings and grounds	47 54	
		4,480 27
Queen Lane machinery	3,080 22	
Queen Lane boilers	1,789 21	
		4,869 43
Roxborough machinery	2,965 69	
Roxborough boilers	1,076 69	
Roxborough buildings and grounds,	261 48	
		4,303 86
Mount Airy machinery	72 61	
		72 61
Frankford machinery	7,973 05	
Frankford boilers	980 76	
Frankford building and grounds	65 18	
		9,018 99
East Park Reservoir	88 12	
		88 12
General buildings and grounds	1,251 88	
		1,251 88
Distribution	280 01	
Main office	149 77	
Meter department	616 50	
Fixed patterns	803 50	
Shop machinery	1,793 21	
Hydrographic work	74 36	
High pressure fire service	2,091 00	
Extension, improvement and filtration	134 37	
Hoffman Engineering Co.	5 75	
Old metals, etc.	462 48	
Construction and repair shop	1,636 27	
		8,047 22
		$64,942 75

Credit	$64,942 75
Inventory, January 1, 1904	21,537 36
Total Cr.	86,480 11
Total Dr.	83,023 42
Balance	$3,456 69

INVENTORY, JANUARY 1, 1904.

16 4-inch stop valves, at $13.....	$208 00	
2 16-inch stop valves, at $65.....	130 00	
2 30-inch stop valves, at $192.....	384 00	
1 36-inch stop valve, at $300.....	300 00	
2 6-inch stop valves, at $18.....	36 00	
Hat Flanged.		
1 10-inch stop valve, at $33.....	33 00	
2 6-inch globe valves, $30.....	60 00	
4 8-inch globe valves, $40.....	160 00	
1 10-inch globe valve, $55.....	55 00	
2 4-inch Ludlow blow-off valves, $30	60 00	
2 20-inch check valves, at $170.....	340 00	
1 30-inch check valve, at $325.....	325 00	
4 large drill machines, at $60.....	240 00	
3 small drill machines, at $45.....	135 00	
1 air pump barrel	15 00	
4 bell cranks, at $15.....	60 00	
		$2,541 00
1 48-inch rotary valve (unfinished)	536 00	
5 20-inch rotary quadrants, at $10.	50 00	
10 30-inch rotary quadrants, at $10.	100 00	
11 48-inch rotary quadrants, at $16.	176 00	
		862 00
Finished parts of fire hydrants..	1,609 06	
Fnished parts of stop valves.....	1,547 01	
Finished parts of rotary valves..	183 50	
		3,339 57
48 old style stop screws.....	324 25	
36 Viney stop screws, $1.75.....	63 00	
18 Viney stop screws, $2.....	36 00	
33 Viney stop screws, $4,50.....	148 00	
27 Barton stop screws, $4.....	108 00	
12 Barton screws and bonnets, $8...	96 00	
		775 75
280 new style stop screws, 4 inches to 48 inches	1,029 00	
79 socket screws, $2.....	178 00	
45 spindles, $2.25	101 25	
		1,308 25
463 iron bands, from 44 inches to 48 inches	1,230 75	
		1,230 75

185	4-inch fire hydrant valves, 62c...	$114 70	
14	6-inch fire hydrant valves, $1.59..	22 26	
			$136 96
	Screws, nuts, etc., for high pressure fire service	309 75	
			309 75
29	air pump rod straps, $9.....	261 00	
61	air pump rod brasses, $2.50.....	152 50	
56	sets, gibs and keys, $4.50.....	252 00	
8	spindles for drill machine, $6.50	52 00	
218	fire hoe heads, $1.75.....	381 50	
			1,099 00
	Articles and tools carried in stock, issued to Districts....	2,263 65	
			2,363 65
21,680	lbs. wrought iron, 2¼ cts.....	487 80	
254	lbs. Norway iron, 3½ cts.....	12 39	
17,869	lbs. steel	1,090 81	
2,203	lbs. iron forgings, 9 cts.....	198 27	
1,497	lbs. expansion metal, 24½ cts...	366 77	
90	lbs. Babbit metal, 9 cts.....	8 10	
16	lbs. Bismuth, $1.95	31 20	
12,350	lbs. refined lead, 4.34 cts.....	586 63	
			$2,781 97
2,180	lbs. stop valve castings, 2 7-10 cts.	58 86	
2,682	lbs. fire hydrant castings, 2.65 cts.	71 07	
5,680	lbs. machinery castings, 3¾ cts..	213 00	
7,855	lbs. Ajax metal castings, 22⅜ cts.	1,757 56	
5,968	lbs. brass castings	743 57	
457	lbs. rolled brass, 19 cts.....	73 12	
282	lbs. brass tubing, 24 cts.....	67 68	
			2,984 91
	Hardware	129 70	
	Bolts and nuts	926 52	
	Oils and tallows	79 80	
	Chandlery	63 72	
	Paints, paint oils, brushes, etc.	56 61	
	Gum goods	113 43	
	Lumber	534 02	
			1,903 80
			$21,537 36

PRINCIPAL ARTICLES MANUFACTURED DURING 1903.

201	No. 1 fire hydrants, $28	$5,628 00	
26	4-inch stop valves, $13	278 00	
217	6-inch stop valves, $14.50	3,146 50	
65	8-inch stop valves, $22	1,430 00	
25	10-inch stop valves, $30	750 00	
25	12-inch stop valves, $37	925 00	
			$12,157 50
6	8-inch globe valves, $40	$240 00	
1,438	brass plugs	480 00	
670	wood plugs	335 00	
136	fish traps, 1¼ inches to 4 inches,	688 00	
2	set shear poles, $75	150 00	
2	crab winches, $150	300 00	
			$2,193 00
			$14,350 50

Principal Articles Delivered to Purveyors' Districts and Works.

Districts.	No. 1 Fire Hydrants.	Wedge Stop Valves.								Plugs.		Fish Traps.				Globe Valves.			Iron Bands.	Stop Screws.	Viney Screws.
		4-inch.	6-inch.	8-inch.	10-inch.	12-inch.	16-inch.	20-inch.	30-inch.	Wood.	Brass.	1¼-inch.	2-inch.	3-inch.	4-inch.	6-inch.	8-inch.	10-inch.			
First	32	4	18	15	5	13	....	1	....	30	306	....	....	....	....	....	....	....	2	13	9
Second	11	....	11	....	4	2	....	....	....	84	194	....	....	....	....	....	....	....	....	4	3
Third	56	3	87	19	9	9	....	....	....	196	323	....	....	....	....	....	....	....	16	2	1
Fourth	15	2	10	23	....	....	1	....	....	24	204	....	....	....	....	....	....	....	....	....	6
Fifth	25	....	....	....	2	....	....	....	....	....	24	....	....	....	....	....	....	....	3	19	....
Sixth	34	....	33	4	2	2	....	....	....	10	74	....	....	....	....	....	....	....	6	24	....
Seventh	31	2	70	8	9	2	....	2	1	114	134	....	....	....	....	....	....	....	8	22	....
Meter Department	....	....	....	....	....	....	....	....	....	....	....	76	37	11	12	....	....	....	....	....	....
Works	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	3	2	1	....	....	....
Totals	201	11	229	69	31	28	1	3	1	458	1 239	76	37	11	12	3	2	1	35	84	19

APPENDIX E

REPORT

OF THE

CHIEF DRAUGHTSMAN

FOR THE YEAR 1903

Philadelphia, January 1904.

F. L. HAND, ESQ.,
Chief, Bureau of Water.

DEAR SIR:—The following report of work under my charge in the draughting room for the year 1903 is respectfully submitted.

A large number of diagrams, tables of statistics, sketches, computations, etc., were made which were not recorded as drawings, but which were placed on file for future reference.

Drawings relating to the following-named subjects were made and recorded during the year: Engines, 22; boilers, 4; special castings 6; High Pressure Fire Service, 18; plans and profiles, 4; diagrams, 14.

The drawings made during the past year have been mostly for repairs to machinery and the replacing of old or broken pieces of machinery with new parts, making it

necessary, in most cases, for the draughtsmen to visit the works and make the proper measurements.

The drawings mentioned above represent a great amount of labor required to complete them.

The electric light printing frame was in use every day, and about two thousand two hundred (2,200) blue prints were made, a number which it would have been impossible to have made under the former method of depending upon days when there was bright sunlight.

The photographer formerly in the service of the Bureau was transferred to another Department and the blue prints needed have been made by the recording clerk.

From data prepared by the inspectors of the Bureau one hundred and ninety-four (194) calculations for boiler horse power were made. From these calculations are determined the water rents to be paid by owners of steam boilers using water from the City mains.

A large number of indicator cards were taken and worked out by two draughtsmen assigned to the work.

The daily pumpage and storage charts showing the height of the water in Fairmount pool; also the rainfall and the temperature of the air and water, together with the daily stream flow charts of the Perkiomen, Neshaminy, Tohickon and Wissahickon creeks for the year 1903, have been prepared as in previous years.

As required by the contractor, full size detail drawings of the terra cotta work, door frames, Window frames, etc.; also a new foundation plan, composed of concrete and iron rods, were made for the High Pressure Fire Service pumping station.

In August I inspected and approved, for the Bureau of Filtration, at the works of the Lukens Steel and Iron Company, sixteen (16) steel plates for the boilers for the Belmont Filtration Low Service pumping station.

These plates were of fire box steel, ultimate tensile

strength 52,000 to 62,000 pounds per square inch, elastic limit by observed drop of scale beam, not less than one-half the ultimate strength, elongation 26 per cent., cold bends 180 degrees flat on itself without fracture on outside of bent portion.

At various times during the year I inspected and approved, also for the Bureau of Filtration, at the works of Henry R. Worthington, Inc., Elizabethport, N. J., one (1) pump chamber and one (1) sub base casting; at the works of the George F. Blake Mfg. Co., East Cambridge, Mass., six (6) valve chambers: at the works of the Hunt-Spellier Co., South Boston, Mass., nine (9) pump plungers and three (3) second receiver shell castings, and at the Standard Steel Casting Co., Chester, Pa., two (2) cast steel valve decks.

I also accompanied the Chief of the Bureau of Water and Messrs. M. R. Muckle, Jr., and T. C. Smith, representing Messrs. M. R. Muckle, Jr., & Co., contractors for installing the pumping plant for the High Pressure Fire Service, to East Pittsburg, Pa., to witness the test of the gas engines for the station, which were built by the Westinghouse Co.

I also inspected three of the pumps to be driven by these engines at the works of the Deane Steam Pump Co., Holyoke, Mass.

I also inspected at the works of H. R. Worthington, Inc., Brooklyn, N. Y., two (2) pump chambers for the Roxborough pumping station.

REPORT

ON THE

HYDROGRAPHIC WORK

FOR THE YEAR 1903

The following report on hydrographic work in charge of the Chief Draughtsman, and on data collected during the year 1903, is respectfully submitted:

Rainfall observations at the twenty stations furnishing the Bureau with rainfall data have been continued, completing twenty-one years of continuous records.

Nine of these stations are maintained by the Bureau and furnished with instruments, stationery and postage, and the observers are paid a small monthly salary for the services rendered.

Three of the stations are furnished with self-registering rain gauges, also with automatic stream gauges for recording the daily height of water flowing in the streams in which they are placed.

Stream flow observations on the Perkiomen, Neshaminy and Tohickon Creeks, and on the Schuylkill river were continued, making twenty years of continuous records relative to stream flow on the three streams first named.

Work on the dam and bridge across the Wissahickon creek required that the water should be again drawn off the lower dam, which prevented stream flow observations on this creek from being taken after October 10.

Observations on the Schuylkill river, with the automatic stream gauge put in operation at Fairmount dam in 1897, were continued.

Daily computations of the amount of water flowing over the flash boards were made on the observations taken at Fairmount dam, together with the known pumpage from the river and the quantity used for power through the wheels, the leakage and lockage (both estimated), which gives an approximate estimate of the monthly flow of the river at Fairmount.

A comparison of the inches of rainfall flowing off in the Schuylkill river, with the run off on the Perkiomen and Neshaminy creeks, is shown in the following table:

Inches of rainfall flowing off January to December.	Perkiomen.	Neshaminy.	Schuylkill.
1898	21.50	22.22	24.39
1899	24.66	21.06	22.29
1900	15.21	17.27	18.23
1901	17.55	22.80	17.80
1902	29.01	30.74	29.02
1903	27.23	26.32	27.79

At present no method is available by which the low water flow for periods of less than one month can be determined.

The average daily flow of the Schuylkill river, as given in Table VIII, is computed from the total monthly flow, and is often, for several days at a time, much less than shown in the table.

The greatest monthly rainfall on the watershed of the Schuylkill during the year was 6.72, being the average for 18 stations for the month of June. There was a deficiency of rainfall on the same area during the months of May and September. That for May was remarkable, there being less than one inch of rainfall, for the month, over a very large area east of the Blue Ridge Mountains in Pennsylvania and extending into New York and New Jersey. This was over three inches below the normal rainfall for this section.

The rainfall for the entire year is about three inches above the normal, and the tables of computed flow of streams show a corresponding increase in the run off.

A very severe wind and rain storm occurred on October 8, 9, 10 and 11, the rainfall exceeding nine inches in many places, nearly all of which fell in thirty-three hours. All the rivers and creeks were filled to the extreme flow line. The Schuylkill was not as high as it has been known to be on the dam, but the Delaware river was higher than ever before known, and carried away all the bridges above Trenton, N. J.

The following named tables, compiled as in previous years, accompany this report:

I. Monthly precipitation on sundry water sheds.

II., III., IV. Rain storms exceeding ½ inch per hour ..... Philadelphia. Forks of Neshaminy. Spring Mount.

V. Inches of rainfall flowing in the..... Perkiomen. Neshaminy.

VI. Average annual yield of streams .... Tohickon. Wissahickon.

VII. Comparative stream flow..... Schuylkill.

VIII., IX. Monthly and daily yield of ..... Perkiomen. Neshaminy Tohickon. Wissahickon. Schuylkill.

The Bureau is indebted to the following-named persons who have kindly furnished rainfall records:

Mr. J. L. Heacock, Quakertown, Pa.

Mr. Thomas J. Bean, Moorestown, N. J.

During the years 1902 and 1903 all observations on rainfall were taken uniformly in accordance with instructions given at the beginning of the year.

Yours respectfully,

JOHN E. CODMAN,
Chief Draughtsman.

TABLE II.

Rain Storms Exceeding in Rate 0.25 Inches per Hour as Recorded by the Automatic Rain Gauge at Philadelphia, for the Year 1903.

Date of Observation.	Automatic Rain Gauge.					Remarks.
	Total Fall		Maximum Fall.			
	Amount in Inches.	Duration—Hours. Minutes.	Amount in Inches.	Duration in Minutes.	Rate per Hour during Maximum Fall.	
January 11th, rain storm	1.01	5—30	.15	20	0.45	
January 21st, rain storm	0.73	10—30	.15	25	0.36	
March 7th and 9th, rain storm	1.12	48—30	.15	25	0.36	
March 30th, rain storm	1.02	10—50	.20	40	0.36	
April 8th, rain storm	0.67	8—30	.10	20	0.30	
April 14th, rain storm	3.08	44—25	.10	15	0.40	
May 4th, shower	0.39	2—20	.20	40	0.30	
May 29th, shower	0.75	5—10	.42	25	1.01	
June 7th and 8th, rain storm	0.46	29—40	.10	20	0.30	
June 10th, shower	1.65	2—00	.80	40	1.20	
June 14th, rain storm	0.45	14—50	.10	10	0.60	
June 22d, rain storm	1.08	4—35	.60	15	2.40	
July 3d, shower	0.89	3—30	.69	35	1.17	
July 11th, shower	0.79	1—00	.46	30	0.92	
July 18th, shower	2.23	8—50	.64	30	1.28	
July 30th, shower	0.38	2—50	.20	15	0.80	
August 6th, shower	0.48	3—30	.30	20	0.90	
August 14th, rain storm	0.97	11—30	.10	10	0.60	
Aug. 27th and 28th, rain storm	2.50	35—15	.20	15	0.80	
Aug. 27th and 28th, rain storm	2.50	35—15	.30	20	0.90	
September 5th, shower	0.59	3—25	.40	25	0.96	
September 16th, rain storm	0.96	7—15	.30	20	0.60	
September 17th, rain storm	0.72	7—00	.35	20	1.05	
September 27th, shower	0.38	3—30	15	30	0.30	
Oct. 8th and 9th, rain storm	5.69	37—10	.40	10	1.20	
Oct. 8th and 9th, rain storm	5.69	37—10	.20	15	0.80	

TABLE III.

Rain Storms Exceeding in Rate 0.25 Inches per Hour, as Recorded by the Automatic Rain Gauge at Forks of the Neshaminy, for the Year 1903.

Date of Observation.	Automatic Rain Gauge.					Remarks.
	Total Fall.		Maximum Fall.			
	Amount in Inches.	Duration—Hours, Minutes.	Amount in Inches.	Duration in Minutes.	Rate per Hour during Maximum Fall.	
January 3d, rain storm	1.26	10—00	.25	20	.75	
January 21st, rain storm ...	.83	9—40	.15	30	.26	
February 4th, rain storm...	.95	7—40	.20	20	.60	
February 28th, rain storm..	1.11	21—55	.50	40	.76	
March 21st to 23d, rain storm	1.75	56—20	.15	20	.45	
March 30th, rain storm.....	.75	7—20	.10	20	.30	
June 7th and 8th, rain storm	1.15	28—25	.20	15	.80	
June 10th to 12th, rain storm	1.36	—20	.20	20	.60	
June 14th, rain storm	.47	8—15	.10	12	.50	
June 20th, rain storm.....	.89	13—40	.20	20	.60	
June 29th, shower.....	1.12	14—00	.70	35	1.20	
July 3d, shower.....	1.04	4—40	.90	30	1.80	
July 11th, shower.....	.20	1—20	.15	20	.45	
July 18th, rain storm.....	2.91	6—05	2.76	2—55	.76	
July 20th, shower.....	.19	1—20	.15	20	.90	
July 22d, shower.....	.18	—20	.19	20	.57	
July 30th, shower.....	.89	2—40	.50	20	1.50	
August 4th, rain storm.....	.74	9—25	.10	10	.60	
August 14th, rain storm	.86	9—30	.15	10	.90	
August 27th and 28th, rain storm.....	1.64	33—45	10	20	.30	
September 6th, shower.....	.50	3—30	.20	10	1.20	
September 16th and 17th, rain storm.....	1.52	7—30	.45	35	.77	
September 16th and 17th, rain storm	.68	7—10	.45	20	1.35	
September 27th, shower.....	.42	4—10	.35	20	1.05	
October 7th, shower.....	.12	—17	.10	15	.40	
October 8th and 9th, rain storm.....	6.43	33—00	.35	40	.52	
October 9th, rain storm	6.43	33—00	.15	15	1.00	

TABLE IV.

Rain Storms Exceeding in Rate 0.25 Inches per Hour as Recorded by the Automatic Rain Gauge at Spring Mount for the Year 1903.

Date of Observation.	Automatic Rain Gauge.					Remarks.
	Total Fall.		Maximum Fall.			
	Amount in Inches.	Duration—Hours. Minutes.	Amount in Inches.	Duration in Minutes.	Rate per Hour during Maximum Fall.	
January 3d, rain storm.....	1.56	11—10	.20	20	.60	
February 4th, rain storm...	1.11	13—35	.17	12	.85	
March 22d, rain storm.....	.71	17—35	.40	30	.80	
March 30th, rain storm.....	.61	13—30	.25	40	.38	
April 8th, rain storm.....	.75	8—20	.10	16	.38	
May 28th, shower.....	.96	—40	.96	40	1.44	
June 7th, rain storm.....	.56	6—25	.15	20	.45	
June 11th & 12th, rain storm	2.88	17—40	.57	30	1.14	
June 14th, rain storm.....	.50	8—30	.10	15	.40	
June 23d, rain storm.....	.90	19—20	.15	20	.45	
June 29th, rain storm.....	.45	12—35	.15	20	.45	
July 3d, shower.....	.48	3—30	.36	20	1.08	
July 18th, shower.....	2.88	7—05	1.00	25	2.40	
July 21st, shower.....	.35	—20	.35	20	1.05	
July 30th, shower.....	.54	1—45	.29	20	.87	
August 4th, shower.....	.85	7—45	.10	15	.40	
August 11th, shower.....	.18	—60	.15	20	.45	
Aug. 27th & 28th, rain storm	2.40	36—30	.10	15	.40	
Aug. 27th & 28th, rain storm	2.40	36—30	.40	20	1.20	
September 5th, shower.....	.20	3—0	.12	10	.72	
September 17th, rain storm	.56	3—30	.35	12	1.75	
September 27th, shower....	.39	1—30	.25	15	1.00	
October 7th, shower.....	.12	—16	.10	15	.60	
Oct. 8th & 9th, rain storm...	5.09	40—40	.75	30	1.50	
October 9th, rain storm.....	5.09	40—40	1.00	45	1.33	
November 17th, rain storm.	.70	16—50	.20	15	.80	

TABLE V.

Inches of Rainfall Flowing in the Perkiomen, Neshaminy and Tohickon Creeks.

WATERSHEDS.	Area in miles.	PERCENTAGE OF TOTAL AREA.				AVERAGE FOR 20 YEARS, 1883-1903.											
		Woodland.	Cultivated.	Flats.	Roads.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.
Perkiomen at Frederick, 20 years	152.	25	71	2	2	2.95	3.69	3.76	2.21	1.38	0.86	1.22	0.94	0.96	1.07	1.52	2.30
Neshaminy below Forks, 20 years	139.3	6	92	¼	1¾	3.21	4.13	3.65	2.16	1.63	0.76	1.03	0.96	0.83	0.97	1.36	2.47
Tohickon, 20 years	102.2	24	72	2	2	3.77	4.63	4.73	2.56	1.87	0.81	1.22	1.13	1.15	1.07	1.84	3.00
Perkiomen at Frederick — Maximum 20 years						5.40	9.73	5.58	3.48	6.66	2.65	4.89	2.48	3.68	2.82	6.67	6.45
Perkiomen at Frederick — Minimum 20 years						0.59	1.25	2.38	0.97	0.46	0.28	0.17	0.28	0.16	0.20	0.24	0.63
Neshaminy below Forks — Maximum 20 years						6.77	10.41	5.55	4.20	7.41	2.46	5.47	3.37	3.81	4.55	6.31	5.55
Neshaminy below Forks — Minimum 20 years						1.60	0.90	1.84	1.03	0.35	0.08	0.04	0.14	0.03	0.06	0.11	0.41
Tohickon — Maximum years						7.34	10.41	7.10	4.76	8.56	3.43	6.41	3.75	5.49	4.24	7.07	7.58
Tohickon — Minimum years						0.54	1.19	2.98	0.73	0.17	0.08	0.11	0.04	0.05	0.05	0.14	0.67

TABLE VI.

Average Annual Yield of Sundry Watersheds to October 1st, 1903.

Watersheds.	Period covered, years.	Area in miles.	Average rainfall in inches.	Average rainfall flowing off in inches.	Per cent. flowing off.	Average annual yield in gallons.	Average daily yield in gallons.	Average yield in cubic feet per second per sq. mile of drainage area.	Average yield in cubic feet per second per sq. mile of drainage area for each inch of rainfall.
Perkiomen at Frederick..	20	152.0	47.640	23.159	48.65	84,433,000,000	167,567,000	1.7060	0.0358
Neshaminy below Forks.	20	139.3	47.852	22.770	47.63	72,194,000,000	156,529,000	1.7380	0.0363
Tohickon.....	20	102.2	49.037	27.780	56.69	63,516,700,000	135.073,000	2.0450	0.0417
Wissahickon.....	11 mos.	64.6	41.906	27.123	64.90	.....	91,166,000	2.1835	0.0521
Schuylkill.....	5	19.15	48.433	23.153	47.80	.....	2,111,481,000	1.7061	0.0352
Sudbury, Mass.....	28	72.5	46.38	22.702	48.00	.....	81,440,000		
Croton, N. Y.....	19	338.0	45 97	22.760	49.50	135,400,000,000	371,600,000	1.680	0.0365

TABLE VII.

Comparative Daily Stream Flow, 1902 and 1903.

Watersheds.	Area of watershed	Maximum Gallons.		Date.	Minimum Gallons.		Date.
		Per day.	Per sq. mile.		Per day.	Per sq. mile.	
Perikomen.....	152.0	3,994,900,000	26,300,000	February 28..	18,450,000	122,000	September 28.
Neshaminy.....	139.3	3.221,200,000	22,980,000	February 28..	7,223,000	51,600	July 17.
Tohickon.....	102.2	2,260,800,000	22,600,000	February 28..	2,320,000	22,700	May 29.
Wissahickon.....	64.6	715,500,000	11,500,000	February 28..	6,440,000	99.800	August 1.
Schuylkill.....	19.15	19,400,000,000	.....	October 10 ...			

TABLE VIII—PRECIPITATION AND STREAM FLOW ON SCHUYLKILL AND WISSAHICKON WATERSHEDS.

DATE. 1902.	SCHUYLKILL. AREA OF WATERSHED 1,915 SQUARE MILES.							WISSAHICKON. AREA OF WATERSHED, 64.6 SQUARE MILES.						
	Rainfall in Inches.	Inches of Rainfall Flowing Off.	Percentage Flowing Off.	Monthly Yield of Stream.	Average Daily Yield of Stream.		Average Yield in Cubic Feet per Second per Square Mile.	Rainfall in Inches.	Inches of Rainfall Flowing Off.	Percentage Flowing Off.	Monthly Yield of Stream.	Average Daily Yield of Stream.		Average Yield in Cubic Feet per Second per Square Mile.
				Cubic Feet.	Cubic Feet.	Gallons.					Cubic Feet.	Cubic Feet.	Gallons.	
October	5.982	2.748	46	12,229,800,000	394,510,000	2,951,140,000	2.3844							
November	1.730	1.290	74	5,741,780,000	191,393,000	1,431,620,000	1.1567	1.690	1.146	70	171,910,000	5,731,330	42,866,000	1.0266
December	7.110	5.582	78	24,842,000,000	801,343,000	5,994,500,000	4.8432	6.420	5.021	77	753,520,000	24,306,100	181,829,000	4.3550
1903.														
January	4.130	3.754	90	16,706,000,000	538,900,000	4,031,300,000	3.2570	3.870	4.133	106	620,205,000	20,006,000	149,666,000	3.5845
February	5.300	3.934	74	17,507,200,000	625,255,000	4,677,130,000	3.7790	4.625	3.451	74	517,842,000	18,494,300	138,347,000	3.3135
March	4.180	5.111	122	22,730,000,000	733,200,000	5,487,100,000	4.4343	3.620	3.837	106	575,822,000	18,575,000	138,950,000	3.3280
April	4.210	4.057	96	18,052,300,000	601,741,000	4,501,330,000	3.6369	3.410	4.444	130	667,017,000	22,234,000	166,321,000	3.9835
May	0.987	1.059	107	4,712,980,000	152,032,000	1,137,280,000	0.9189	0.625	1.781	285	267,227,000	8,620,000	64,483,700	1.5444
June	6.720	1.286	19	5,720,620,000	186,347,000	1,393,970,000	1.1263	6.415	1.162	18	174,433,000	5,814,430	43,494,900	1.0417
July	5.730	1.606	28	7,145,500,000	230,500,000	1,724,260,000	1.3931	4.925	1.242	25	186,416,000	6,013,400	44,983,700	1.0773
August	5.200	1.198	23	5,330,020,000	175,941,000	1,316,130,000	1.0633	3.800	0.490	13	73,587,000	2,373,700	17,757,000	0.4253
September	2.550	0.770	30	3,424,030,000	110,454,000	826,250,000	0.6676	2.506	0.416	16	62,519,000	2,083,970	15,589,200	0.3734
Totals	53.622	32.415	60	144,142,230,000	394,920,000	2,954,200,000	2.3868	41.906	27.123	64	4,070,495,000	12,187,100	91,166,000	2.1835
October	6.500	2.671	41	11,886,400,000	383,432,000	2,868,210,000	2.3174							
November	1.360	0.753	55	3,349,220,000	111,641,000	835,130,000	0.6747							
December	3.830	1.588	42	7,065,920,000	227,933,000	1,705,060,000	1.3776							
Totals for	50.697	27.787	55	123,630,190,000	338,713,000	2,533,740,000	2.0471							

TABLE IX.—PRECIPITATION AND STREAM FLOW ON PERKIOMEN, NESHAMINY AND TOHICKON WATERSHEDS.

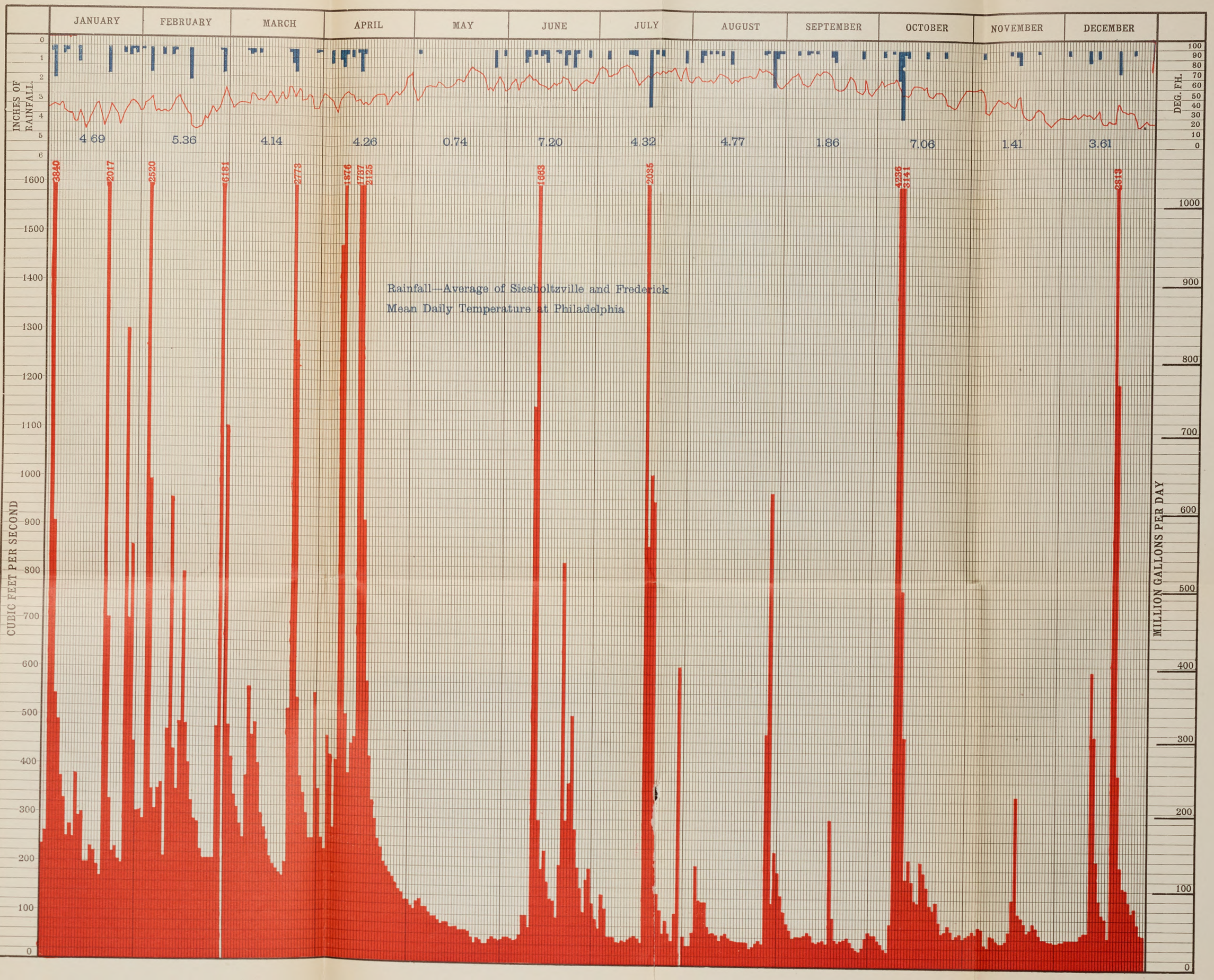
DATE. 1902.	PERKIOMEN AT FREDERICK. AREA OF WATERSHED 152 SQUARE MILES.							NESHAMINY BELOW FORKS. AREA OF WATERSHED 139.3 SQUARE MILES.							TOHICKON. AREA OF WATERSHED 102.2 SQUARE MILES.						
	Rainfall in Inches.	Inches of Rainfall Flowing Off.	Percentage Flowing Off.	Monthly Yield of Stream.	Average Daily Yield of Stream.		Average Yield in Cubic Feet per Second per Square Mile.	Rainfall in Inches.	Inches of Rainfall Flowing Off.	Percentage Flowing Off.	Monthly Yield of Stream.	Average Daily Yield of Stream.		Average Yield in Cubic Feet per Second per Square Mile.	Rainfall in Inches.	Inches of Rainfall Flowing Off.	Percentage Flowing Off.	Monthly Yield of Stream.	Avearge Daily Yield of Stream.		Average Yield in Cubic Feet per Second per Square Mile.
				Cubic Feet.	Cubic Feet.	Gallons.					Cubic Feet.	Cubic Feet	Gallons.					Cubic Feet.	Cubic Feet.	Gallons.	
October	6.155	2.777	45	980,476,000	31,628,300	236,596,000	2.4083	6.403	4.551	71	1,472,940,000	47,514,200	354,481,000	3.9478	5.837	4.247	73	1,010,140,000	32,585,300	243,755,000	3.690
November	1.935	0.902	46	318,643,000	10,621,400	79,454,000	0.8088	1.656	0.761	46	246,197,000	8,206,560	61,389,300	0.6819	1.672	0.818	49	194,141,000	6,486,280	48,520,700	0. 329
December	7.430	6.447	86	2,276,520,000	73,435,100	549,340,000	5.5920	6.993	5.552	80	1,796,630,000	57,955,700	433,540,000	4.8154	7.290	7.576	103	1,798,930,000	58,391,000	430,215,000	6.5718
1903.																					
January	4.690	4.179	89	1,475,610,000	47,598,000	356,050,000	11 3.6243	3.886	3.634	93	1,176,180,000	37,941,300	283,821,000	8 3.1524	3.932	4.343	110	1,031,090,000	33,261,000	248,811,000	9 3.7668
February	5.360	4.627	86	1,634,060,000	58,360,000	436,560,000	12 4.4438	5.190	4.424	85	1,431,720,000	51,133,000	382,501,000	12 4.2485	4.832	4.512	93	1,071,290,000	38,260,400	286,213,000	12 4.3330
March	4.135	3.596	87	1,268,730,000	40,959,200	306,391,000	9 3.1188	3.980	3.765	95	1,218,280,000	39,299,200	293,978,000	9 3.2653	4.787	4.444	92	1,055,150,000	34,037,100	254,615,000	11 3.8547
April	4.255	3.862	91	1,363,820,000	45,460,700	340,070,000	10 3.4626	3.920	4.206	107	1,361,250,000	45,375,000	339,428,000	11 3.7701	4.466	4.234	95	1,005,340,000	33,511,400	250,683,000	10 3.7951
May	0.740	0 582	80	205,658,000	6,634,120	49,626,000	2 0.5052	0.670	0.456	70	147,485,000	4,757,600	35,589,100	2 0.3953	0.615	0.174	28	41,211,800	1,329,440	9,944,940	1 0.1506
June	7.200	1.966	27	694,050,000	23,135,300	173,054,000	7 1.9223	5.640	0.463	8	149,830,000	4,997,660	37,385,100	3 0.4153	8.087	1.547	19	367,416,000	12,247,200	91,615,100	5 1.3870
July	4.320	1.582	36	558,732,000	18,023,600	134,800,000	5 1.4974	5.463	0.914	17	295,868,000	9,544,130	71,395,100	6 0.7930	6.890	2.333	34	553,960,000	17,869,400	133,675,000	6 2.0234
August	4.765	0.899	19	317,442,000	10,240,000	76,601,000	4 0.8508	4.430	0.533	12	172,748,000	5,572,500	41,685,300	4 0.4630	4.980	0.902	18	214,748,000	6,911,400	51,700,000	4 0.7827
September	1.855	0.547	30	193,320,000	6,444,000	48,204,000	1 0.4907	2.127	0.562	26	181,795,000	6,059,800	45,331,500	5 0.5034	2.355	0.621	26	147,536,000	4,917,900	36,780,000	3 0.5569
Totals	52.840	31.966	60	11,287,061,000	30,903,500	231,323,000	2.3547	50.358	29.822	59	9,650,923,000	26,441,000	197,792,000	2.1969	55.743	35.761	64	8,490,952,000	23,263,000	174,020,000	2.6345
October	7.060	2.822	40	996,426,000	32,143,000	242,111,000	8 2.4475	7.803	4.130	53	1,323,500,000	43,016,800	321,788,000	10 3.5742	8.375	3.567	42	846,860,000	27,318,000	204,353,000	8 3.0937
November	1.405	0.633	43	212,890,000	7,096,300	53,084,000	3 0.5404	1.280	0.415	33	134,369,000	4,478,980	33,505,000	1 0.3722	1.462	0.412	28	97,761,800	3,258,700	24,377,000	2 0.3691
December	3.610	1.969	54	695,400,000	22,432,200	167,805,000	6 1.7081	4.007	2.823	70	913,680,000	29,474,000	220,480,000	7 2.4488	4.180	2.666	63	632,960,000	20,418,000	152,737,000	7 2.3123
Totals	49.395	27.234	55	9,616,132,000	26,345,700	197,080,000	2.0061	48.396	26.325	54	8,516,705,000	23,334,400	174,580,000	1.9387	54.961	29.755	54	7,065,823,600	19,357,000	144,810,000	2.1921

TABLE OF COMPUTED DAILY FLOW OF THE SCHUYLKILL RIVER AT FAIRMOUNT DAM.

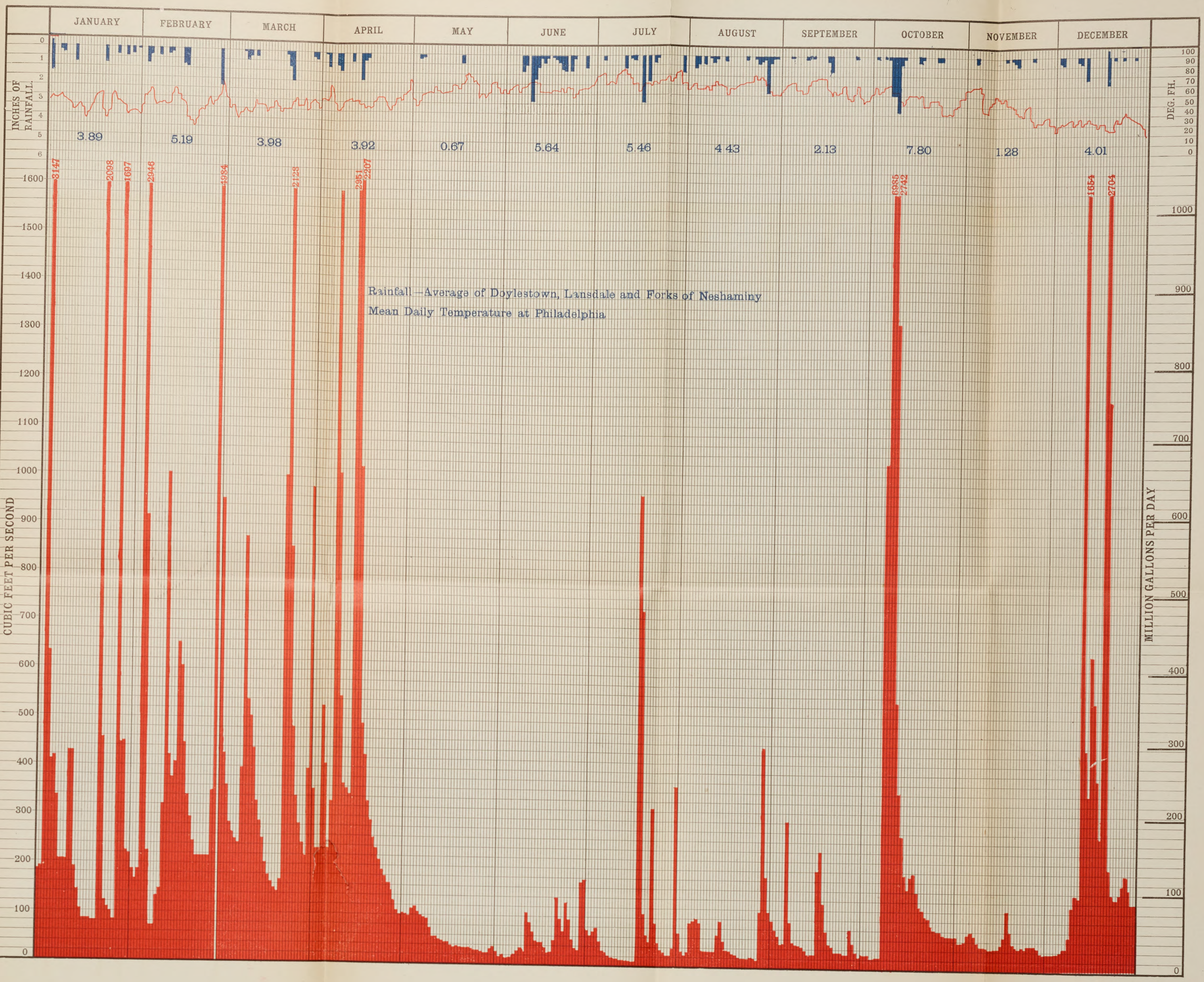
Showing Flow over Flashboards in Gallons per Day, Height of Water Above or Below Top of Flashboards in Inches, and Computed Pumpage, Leakage and Lockage from the Pool.

Date—1903.	January.	Inches.	February.	Inches.	March.	Inches.	April.	Inches.	May.	Inches.	June.	Inches.	July.	Inches.	August.	Inches.	September.	Inches.	October.	Inches.	November.	Inches.	December.	Inches.
1	444,400,000	3¾	1,813,050,000	9¾	18,271,890,000	45½	2,565,860,000	12¼	761,370,000	5½	.....	*7	1,440,950,000	8½	2,490,940,000	12	1,076,650,000	7	.....	*10	.....	*6	.....	*10
2	1,875,250,000	10	1,540,550,000	8¼	9,392,750,000	29¼	1,965,000,000	10¼	663,130,000	5	.....	*7	866,430,000	6	1,373,430,000	8	636,430,000	5	.....	*10	.....	*6	.....	*10
3	10,749,720,000	32	1,410,000,000	8¼	5,742,650,000	21	1,738,180,000	9½	615,940,000	4½	.....	*8	553,090,000	4½	519,090,000	4¼	279,530,000	2¾	.....	*10	.....	*6	.....	*10
4	7,078,100,000	24¼	7,083,000,000	24¼	4,340,800,000	17½	4,271,550,000	12¾	474,370,000	4	.....	*8	2,209,600,000	11½	86,400,000	1¼	62,900,000	1	.....	*10	.....	*6	.....	*10
5	5,324,200,000	20	8,051,750,000	26½	3,523,400,000	15¼	2,483,500,000	8¼	474,370,000	4	.....	*8	729,280,000	5¼	415,460,000	3¾	59,300,000	1	.....	*10	.....	*6	.....	*10
6	4,342,500,000	17½	4,867,250,000	18¾	3,024,000,000	13¾	1,813,050,000	9¾	474,370,000	4	.....	*8	237,180,000	2½	955,170,000	6½	266,850,000	2¾	.....	*12	.....	*8	.....	*10
7	3,631,300,000	15¼	3,885,480,000	16¼	2,603,000,000	12½	1,601,100,000	9	391,260,000	3½	.....	*8	.....	*3	668,160,000	5	.....	*4	.....	*12	.....	*8	.....	*12
8	2,786,000,000	13¾	3,530,000,000	15¼	2,465,270,000	12	3,248,380,000	14½	537,760,000	4¼	.....	*8	.....	*8	620,870,000	5	.....	*6	200,000,000	2¼	.....	*8	.....	*12
9	2,245,140,000	11¼	2,276,030,000	14½	3,370,050,000	14¾	8,112,400,000	26½	255,790,000	2½	.....	*6	.....	*6	237,180,000	2½	.....	*6	10,586,560,000	31¼	.....	*8	.....	*12
10	1,813,050,000	9¾	2,635,610,000	12½	3,698,000,000	15¾	5,941,820,000	21½	255,790,000	2½	.....	*6	.....	*6	.....	*8	.....	*6	18,565,000,000	46	.....	*8	.....	*12
11	1,348,160,000	8	2,164,500,000	11	3,445,320,000	15	4,262,900,000	17¼	167,790,000	2	.....	*6	.....	*6	.....	*8	.....	*6	9,552,900,000	20½	.....	*8	.....	*12
12	2,100,130,000	10¾	3,920,790,000	16¼	3,193,610,000	14¼	3,530,000,000	15¼	.....	*8	4,036,600,000	16¾	.....	*6	.....	*6	.....	*8	6,384,200,000	22½	.....	*8	.....	*12
13	4,048,230,000	16¾	4,374,950,000	17½	2,753,630,000	13	3,445,320,000	15	.....	*7	1,175,500,000	7¼	.....	*4	.....	*6	.....	*8	3,926,400,000	16½	.....	*8	861,330,000	6
14	686,450,000	5	3,276,000,000	14½	2,314,880,000	11½	5,654,010,000	20¾	.....	*6	426,900,000	3¾	.....	*8	.....	*6	.....	*8	2,483,500,000	12	.....	*8	2,304,160,000	11½
15	1,289,000,000	7	3,106,730,000	14	1,882,800,000	10	11,661,620,000	33¾	.....	*4	338,600,000	3½	.....	*8	.....	*8	.....	*8	1,787,500,000	10	.....	*8	753,358,000	5½
16	1,540,550,000	8¾	4,406,500,000	17½	1,601,100,000	9	8,924,200,000	28¼	.....	*4	167,800,000	2	.....	*8	.....	*8	.....	*8	1,329,000,000	8	.....	*8	59,270,000	1
17	1,738,180,000	9½	4,575,860,000	18	1,601,100,000	9	6,370,500,000	22½	.....	*5	.....	*4½	.....	*8	.....	*8	.....	*8	1,093,030,000	7	.....	*8	.....	*6
18	1,738,180,000	9½	3,198,660,000	14¼	1,540,550,000	8¾	4,534,500,000	18	.....	*5	.....	*8	1,162,140,000	9	.....	*8	154,080,000	2	1,349,600,000	8	284,380,000	2½	.....	*6
19	1,236,350,000	7½	2,257,410,000	11¼	1,410,000,000	8¼	3,619,000,000	15½	.....	*5	.....	*8	6,319,000,000	22½	.....	*8	154,080,000	2	1,583,900,000	8¾	309,010,000	3	.....	*6
20	672,960,000	5	2,028,000,000	10½	1,341,600,000	8	3,191,000,000	14¼	.....	*3	305,000,000	3	2,390,500,000	11¾	.....	*8	.....	*8	871,600,000	6	.....	*3	4,237,890,000	17¼
21	9,596,400,000	29¾	1,875,250,000	10	1,341,600,000	8	2,786,000,000	13	.....	*4	1,842,640,000	10	2,885,990,000	13¼	.....	*8	.....	*8	636,423,000	5	.....	*6	8,543,640,000	27½
22	5,590,540,000	20½	1,601,100,000	9	2,393,460,000	11¾	2,314,890,000	11½	.....	*5	1,616,220,000	9	1,071,560,000	6¼	.....	*8	.....	*8	391,260,000	3½	.....	*8	2,818,140,000	13
23	2,752,900,000	13	1,601,100,000	9	8,428,310,000	27¼	1,882,800,000	9¾	.....	*6	613,910,000	5	483,420,000	4	.....	*10	.....	*8	391,260,000	3½	.....	*8	1,327,440,000	8
24	1,349,500,000	8	1,601,100,000	9	14,752,000,000	39½	1,735,000,000	9½	.....	*6	1,609,340,000	9	130,670,000	1¾	.....	*10	.....	*8	391,260,000	3½	.....	*8	1,349,500,000	8
25	786,200,000	5½	1,601,100,000	9	11,750,500,000	34	1,735,000,000	9½	.....	*6	1,071,570,000	7	31,240,000	¾	.....	*10	.....	*10	237,970,000	2½	.....	*8	984,200,000	6½
26	610,940,000	4¾	1,601,100,000	9	6,469,290,000	22¾	1,650,000,000	9¼	.....	*6	450,550,000	4	.....	*6	.....	*10	.....	*10	59,270,000	1	.....	*8	1,007,300,000	6¾
27	568,750,000	4½	1,601,100,000	9	4,459,780,000	17½	1,550,000,000	8¾	.....	*6	148,630,000	1	.....	*6	.....	*10	.....	*10	55,900,000	1	.....	*10	140,800,000	1¾
28	3,942,330,000	16½	14,994,120,000	40	3,278,500,000	14½	1,232,100,000	7½	.....	*6	20,990,000	1½	.....	*8	.....	*0	.....	*10	59,270,000	1	.....	*10	65,210,000	1
29	4,707,240,000	18½	.....	.....	2,703,640,000	13	927,900,000	6¼	.....	*6	97,810,000	1½	.....	*8	2,312,500,000	11½	.....	*10	59,270,000	1	.....	*10	.....	*12
30	3,360 660,000	14¼	.....	.....	2,465,270,000	12	871,600,000	6	.....	*6	805,630,000	5¼	250,000,000	2½	1,422,300,000	8¼	.....	*10	.....	*8	.....	*10	.....	*12
31	2,820,000,000	13¼	.....	.....	2,786,000,000	13¼	.....	.....	.....	.....	.....	.....	5,271,230,000	20	1,050,600,000	6¾	.....	.....	.....	*8	.....	.....	.....	*12
Total over Flashboards	92,733,310,000	.....	97,875,150,000	.....	138,353,250,000	.....	105,609,180,000	.....	.....	.....	14,727,690,000	.....	26,131,290,000	.....	12,152,700,000	.....	2,689,820,000	.....	62,000,043,000	.....	593,390,000	.....	24,461,735,000	.....
Total Pumpage, Leakage and Lockage	32,234,857,000	.....	33,087,900,000	.....	31,747,933,000	.....	29,435,837,000	.....	.....	.....	28,066,542,000	.....	27,321,341,000	.....	27,718,570,000	.....	.....	.....	26,981,586,000	.....	24,460,475,000	.....	28,398,797,000	.....
Grand Total,	124,968,167,000	.....	130,963,050,000	.....	170,101,183,000	.....	135,043,017,000	.....	.....	.....	42,794,232,000	.....	53,452,631,000	.....	39,871,270,000	.....	.....	.....	88,981,629,000	.....	25,053,865,000	.....	52,855,532,000	.....

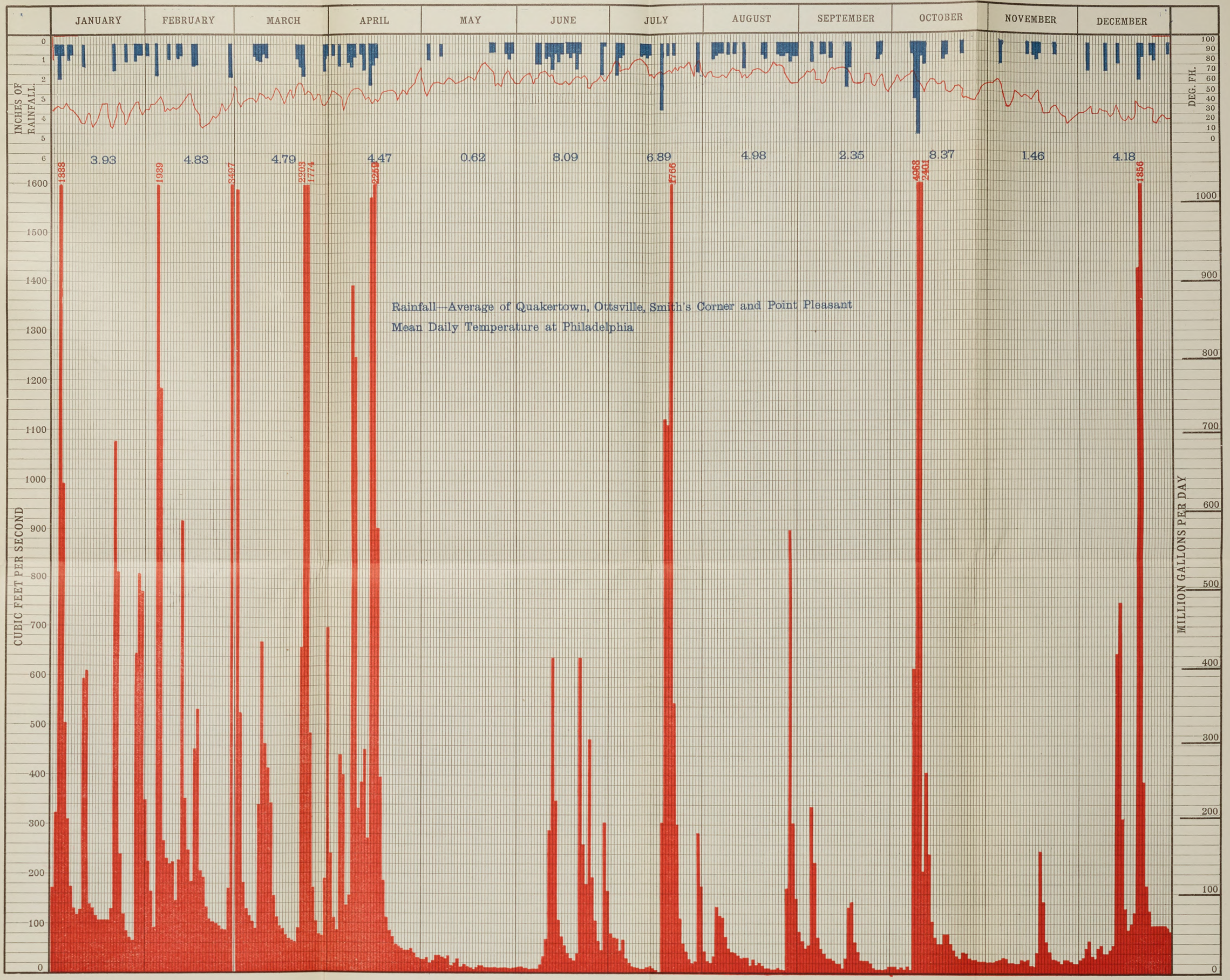
STREAM FLOW 1903—PERKIOMEN CREEK AT FREDERICK



STREAM FLOW 1903—NESHAMINY CREEK BELOW FORKS



STREAM FLOW 1903—TOHICKON CREEK



ANNUAL REPORT

OF THE

CHIEF ENGINEER

OF THE

BUREAU OF FILTRATION

For the Year 1903

DEPARTMENT OF PUBLIC WORKS

BUREAU OF FILTRATION

(Improvement, Extension and Filtration of the Water Supply)

OFFICERS, 1903

Chief Engineer,
JOHN W. HILL.

First Assistant Engineers.

HENRY C. HILL,
LA MONTE LLOYD.

Assistant Engineers in Charge of Construction.

T. NELSON SPENCER, Torresdale Conduit.

FRED. C. DUNLAP, Torresdale Filters.

D. JONES LUCAS, Oak Lane Reservoir.

CHARLES H. PAUL, Belmont Filters, Reservoirs and Auxiliaries.

SETH M. VAN LOAN, Lardner's Point Pipe Distribution System.

WILLIAM I. KLEIN, Upper and Lower Roxborough Filters and Auxiliaries.

S. M. SWAAB, Lardner's Point Pumping Station No. 2.

WILLIAM R. COPELAND, Bacteriologist in Charge of Testing Stations.

HOWARD W. UNDERWOOD, in Charge of Roxborough Filters.

Clerical.

J. WILLIAM LEE, Chief Clerk.
HOWARD L. KLOTZ, Stenographer.
AGNES K. LUCKENBILL, Stenographer.
ANDREW HAAG, JR., Messenger.

ANNUAL REPORT

OF THE

CHIEF ENGINEER

OF THE

BUREAU OF FILTRATION

FOR THE YEAR 1903

Philadelphia, December 31, 1903.

HON. PETER E. COSTELLO,
Director, Department of Public Works.

DEAR SIR:—I have the honor to submit herewith the annual report on the operations of the Bureau of Filtration for the year ending December 31, 1903.

For convenience in considering the matter relating to the Improvement, Extension and Filtration of the Water Supply, I have arranged the subjects as follows:

1. Financial Statement.
2. Land Appropriated.
3. Lower Roxborough Filters, including all contracts forming part of the works at this station.
4. Upper Roxborough Filters, including all contracts forming part of the works at this station.
5. Belmont Filters, including all contracts executed or to be offered which form a part of this station.
6. Extension of Pipe Distribution System, not including Contracts No. 28, 66 and 70.
7. Torresdale Filters, including all contracts executed or to be offered which form a part of this station.

8. Torresdale Conduit.

9. Lardner's Point Pumping Station, including all contracts to complete this station.

10. Lardner's Point Pumping Machinery, including all contracts to complete this work.

11. Lardner's Point Pipe Distribution System, including the completion of Contracts No. 28 and 70.

12. Oak Lane Reservoir.

13. Principal Items in the Contracts for the Improvement, Extension and Filtration of the Water Supply.

14. Recapitulation of Contracts Required to Complete the work.

15. Capacity of Works.

16. Principal Dimensions of Works.

17. Water-tightness of Structures.

18. Concrete Cubes.

19. Operation of Roxborough Filters.

20. Turbidity of Filter Effluents.

21. Sand Scrapings, Upper Roxborough Filters.

22. Description of Mode of Operating Filters at Roxborough.

23. Testing Stations.

24. Experiments with Floats in the Delaware river.

25. Changes in Staff.

26. Office and Field Force.

27. Typhoid Fever Epidemic in Ward 21.

28. Torresdale Laboratory.

Appendices.

Table showing contracts executed to date, including amounts paid thereon.

Tables showing unit prices paid on various contracts.

FINANCIAL STATEMENT.

The total fund provided by appropriations of Councils for the Improvement, Extension and Filtration of the Water Supply is as follows:

By ordinance, June 17, July 12, 1898.....	$500,000 00
By ordinance, January 12, 1900.....	3,200,000 00
By ordinance, March 23, 1900.....	12,000,000 00
By ordinance, June 30, 1902.....	1,300,000 00
By ordinance, Decemer 29, 1902.....	500,000 00
	$17,500,000 00

The appropriation of June 30, 1902 ($1,300,000), was limited to the Lardner's Point Pipe Distribution System, Contract No. 28, and the Ordinance of December 29, 1902 ($500,000), was limited to the Collectors and Filtering Materials for the Torresdale Filters, Contract No. 50.

Of the fund provided there has been paid out or charged off as limits of contracts the following amounts to January 1, 1904:

Paid on completed contracts.....	$2,433,177 47
Paid on uncompleted contracts.....	7,863,932 89
Limits of uncompleted contracts, less payments	4,402,764 11
Land damages	843,738 06
Expenses, supplies, advertising, etc.....	135,206 56
Inspections, by contract	10,635 01
Salaries and wages of Engineering Staff...	497,394 05
Expended by Bureau of Water	1,013,149 89
Damages to property on account of pipe laying	12,956 32
Repaving over pipe trenches	81,264 51
Available balance	205,781 13
	$17,500,000 00

LAND APPROPRIATED.

The total land appropriated for filters and other works comprises 465.302 acres, divided as shown below. Under

the caption "Land Damages" is included the jurors and experts' fees, and other legal expenses incident to the land takings.

Station.	Acres Appropriated.	Land Damages and Costs.
Upper Roxborough	34.518	$76,709 79
Shawmont Pumping Station (account Bureau of Water)	2.800	16,810 13
Belmont	60.572	351,305 96
Torresdale	343.500	323,737 18
Lardner's Point	3.089	9,970 02
Oak Lane	20.823	65,204 98
Total		$843,738 06

The above amounts will also be found charged under the respective stations.

LOWER ROXBOROUGH FILTERS.

CONTRACT NO. 10, FILTERS AND CLEAR WATER BASIN.

Daniel J. McNichol, Contractor.

This contract embraced five (5) plain sand filters of 0.53 acre net sand area, and a clear water basin of 3,000,000 gallons capacity at the normal flow line. The filters and clear water basin are covered with groined arches resting on square piers. Floors, piers, walls and vaulting are all of concrete. These filters were completed June 1, 1902, and started in service August 1, of that year, with applied water from the Upper Roxborough Reservoir. For a full description of the work embraced in this contract see the Report of the Bureau of Water, 1901, page 235.

Total expenditures on contract, $230,929.70.

CONTRACT No. 9—B, FLANGE STOP VALVES FOR THE LOWER ROXBOROUGH FILTERS.

Eddy Valve Company, Contractor.

This contract in part embraced the flange stop and check valves for the Lower Roxborough Filters. All valves were standard style and dimensions.

This contract was completed December 1, 1901.

Total expenditures on contract, $3,648.06.

CONTRACT No. 9—C, CAST IRON WATER PIPE AND SPECIAL CASTINGS FOR THE LOWER ROXBOROUGH FILTERS, ETC.

Daniel J. McNichol, Contractor.

This contract embraced the standard hub and spigot end water pipe and flange special castings for the Lower Roxborough Filters, and for the necessary lines of pipe and connections to the Lower Roxborough Reservoir to adapt this reservoir as a subsiding basin for these filters.

This contract was completed December 1, 1901.

Total expenditures on contract, $7,488.14.

CONTRACT No. 24, SAND WASHERS AND FILTERING MATERIALS.

Daniel J. McNichol, Contractor.

This contract embraced in part two five-hopper sand washers of the Hamburg type, and the lateral collectors, gravel underdrain materials and filtering sand for Lower Roxborough.

Each washer contains five hoppers, fitted with Korting ejectors, erected on a foundation in a court in front of the filters and covered with a neat frame house. Use of the washers indicate no special advantage in the houses either

as a shelter for the men or protection to the machines, and on subsequent contracts the washer houses were abandoned. If needed, however, the houses can be constructed as portable buildings and set in place over the washers. Experience at Upper Roxborough has not shown the necessity for these houses, although the present winter will furnish further information on this subject.

Water for the sand washers is taken from the refill pipe to the filters, under Roxborough stand pipe pressure, which is usually fifty-five pounds per square inch.

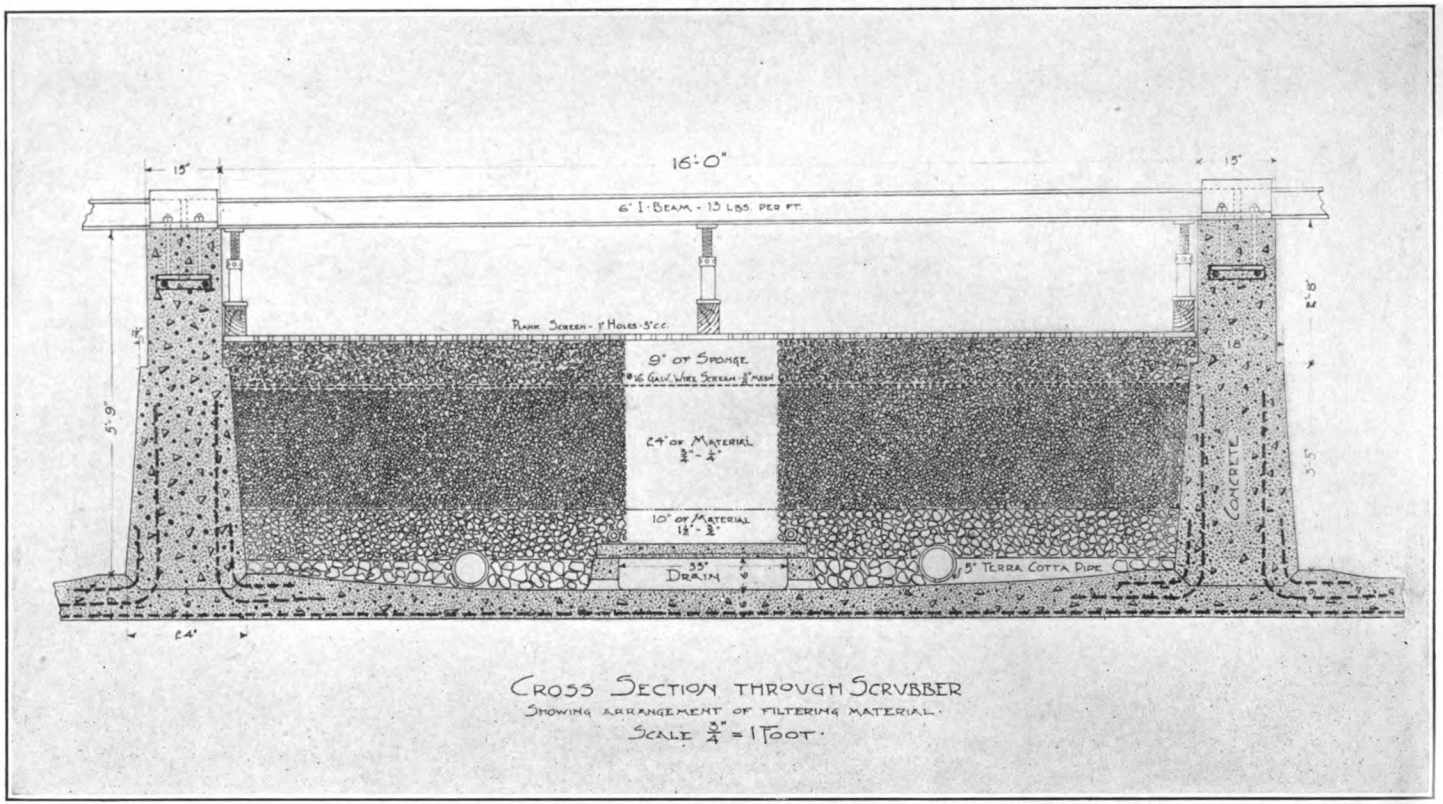
In washing sand at Lower and Upper Roxborough it has been found somewhat inconvenient to store large quantities in the court, and some thought has been given to devising a system for Belmont and Torresdale which will admit of taking the washed sand directly into a spare filter, and at one operation remove the scraped sand from one filter, wash it and place it in another filter which is ready for renewing the sand bed. In this manner considerable saving in the cost of restoring the sand will be effected, and the usual loss of sand from the dry piles in the court by the action of the wind will be avoided.

A system resembling in some respects this proposition is now in use at the works of the East London Water Company.

The underdrain and filtering materials put into the filters will be found fully described on page 269 of the Report of the Bureau of Water for 1901. This contract, as applied to Lower Roxborough, was completed November 7, 1902.

Total cost of contract (not including sand washers) as applied to Lower Roxborough, $89,148.36.

This contract also included two 5-hopper ejector sand washers and frame buildings placed in the court north of the filters. The supply of water for the sand washers is obtained from the refill pipe taking water from the Rox-



Section Through Preliminary Filters, Lower Roxborough.—Contract No. 37.

borough Auxiliary standpipe at the corner of Eva street and Shawmont avenue. The wash water from the hoppers is carried into the sewer built under Contract No. 10 and finally discharged into Shawmont avenue. In due time the waste water will be taken into the Shawmont avenue sewer connecting with the Manayunk intercepting sewer when the latter is extended as far north as Shawmont Station.

The cost of the two sand washers and houses was $10,000.

Contract No. 37, Lower Roxborough Preliminary Filters.

The Maignen Filtration Company, Contractors.

This contract embraced a system of preliminary or roughing filters for treatment of the subsided water taken from the Lower Roxborough reservoir. Each filter, of which there are eleven arranged as compartments of a unit tank of steel reinforced concrete, is 64 feet long, 16 feet wide and 5 feet 9 inches deep, in which is placed at the bottom five (5) inches of coarse gravel, ranging in size from 2½ to 1½ inches diameters; above this a layer of crushed furnace slag, 10 inches thick, ranging in dimensions from 1½ to ¾ inch; above this a layer of crushed furnace slag 24 inches thick, ranging in dimensions from ¾ to ¼ inch, and above this a layer of compressed sponge, 9 inches thick, weighing about five pounds per square foot of surface. The sponge is compressed on the layer of slag by a set of narrow planks spaced ½ inch apart by means of cleats nailed on the edges. The planks are pressed down on the sponge layer by timber beams running lengthwise of the filter tank and screw jacks, reacting upwards against 15-inch rolled I beams, weighing 42 pounds per foot run, held down by anchor bolts built into the concrete side walls

of the tanks. These beams are spaced on 8 feet centres, and span the filter tanks transversely.

The water is introduced into the bottom of the tanks through 5 inch diameter perforated tile pipes, and percolates upwards through the gravel, crushed slag and sponge, and is drawn off at the top of the filters through brass weir plates having rectangular notches 22.5 inches long and 9 inches deep.

The water enters the filters at the rear end and is drawn off at the front end into galvanized iron boxes, from which it flows into the collecting pipe and is thence conducted to the plain sand filters. The influent pipes are provided with butterfly regulating valves, actuated by galvanized iron floats in the filters, which maintain constantly the level of water to which the head on the weir may be adjusted.

The completed system at Lower Roxborough consists of the Lower Roxborough reservoir, formerly used as a storage basin, and now after some slight changes converted into a subsiding reservoir, having a capacity at a depth of 20 feet of 13,000,000 gallons, or about one day's supply for the filters.

The water is pumped into the reservoir at the bottom at the east end, and is drawn off near the surface through a screen chamber at the west end. The basin operates upon the continuous subsidence system, and will give a subsidence of the Schuylkill river water for 24 hours before it is passed to the preliminary filters. From the preliminary filters the water is passed to the plain sand filters, and thence to the clear water basin.

The preliminary filters each have a filtering area of 1,024 square feet, and when all are in service delivering 12,000,000 gallons per day, each will deliver 1,090,909 gallons, or at a rate of 46.4 million gallons per acre per day.

The preliminary filters are furnished with glass gauges showing the heads on the weirs and the losses of head in operating the filters.

In practice the slag layers in the filters are flushed daily, or as may be required, by stopping the flow and wasting through a large drain pipe at the bottom the contents of the tank. In due time when the sponge becomes clogged with mud it is removed from the tank by mechanical appliances and washed in laundry washers driven by an electric motor.

The contract is of an experimental character, and no payment will be made to the contractor until he has completed one year's operation and complied with the guarantees for removal of turbidity in the applied subsided water, and for cost per million gallons for operation. The price of the contract embraces the filters, sponge washers, electric motor, all piping, valves, regulators and other appurtenances.

The preliminary filters have not all been started, but it is expected that all will be in full service by December 31st of this year.

Limit of contract, $49,800.

CONTRACT NO. 37—A, FOUNDATION AND SUPERSTRUCTURE FOR THE LOWER ROXBOROUGH PRELIMINARY FILTERS.

Daniel J. McNichol, Contractor.

This contract embraced the foundation, puddle lining, granolithic floors and part of the concrete gullets in the filter house, the frame superstructure for an office and shelter house, the filter house and administration building.

The administration building contains an office and locker rooms for the Assistant Engineer in charge of the filters, and the filter attendants; a shelter lunch and locker room for the laborers employed about the filters; a storage

room for supplies, and a heater room, furnished with a J. L. Mott Iron Works heater, for warming the administration and filter buildings.

Sanitary conveniences with bowls and sinks are provided for the use of the employees.

This contract was completed December 31, 1903.

Total cost of contract, $47,010.48.

Total payments to date, $39,714.36.

SAND EJECTOR.

H. P. Morris, Contractor.

This apparatus consists of a light hopper of rolled steel plate, in the bottom of which is placed a Korting ejector, for the removal of scraped sand by means of a water jet from the filters to the sand washers in the court.

The hopper is fitted with handles and broad feet to render it portable, and provide for setting and connecting up with the water supply and discharge pipes at convenient places in the filters. The total weight of the ejector is 150 pounds.

The ejector is modeled after those in very successful use for several years at the works of the East London Water Company.

Total cost of the ejector, $114.

EJECTOR PIPES.

P. Gormley, Contractor.

In addition to the regular contracts, a special contract was made for the ejector pipes for the supply of water under pressure to the portable ejector, and for the conveyance of the mixed sand and water to the washers in the court. This consists of a line of 3-inch pipe for the water supply, and a line of 4-inch pipe for the mixed sand and water, hung from the roof of the filter. Each line of pipe is furnished with nozzles placed at convenient distances apart, from which lines of ordinary 2½ inch and 3 inch

fire hose are run to the supply and effluent connections of the ejector. The nozzles are of brass, closed when not in use, by caps. The supply of water for the ejector is obtained from the stand pipe of the Roxborough Auxiliary Pumping Station.

Total cost of ejector pipes, $899.

Contract No. 62. A System of Baffles for the Lower Roxborough Reservoir.

This contract contemplated the placing of baffle partitions in the Lower Roxborough reservoir in order to force a complete change from time to time of the contents of this basin, but by reason of the excessive cost of the work, and the probable limited advantage to be obtained, no contract was entered into for the construction of the work, and for the present at least the reservoir will be used as a simple settling basin without baffles.

Expense of preparing specification and advertising contract, $98.41.

Contract No. 7. Lower Roxborough Filters and Clear Water Basin.

The original contract for the Lower Roxborough filters and clear water basin was advertised as "Contract No. 7," taking unit prices on the different items entering into the constructing of the work. Subsequently this contract was abandoned and the work re-let under contract No. 10.

Cost of printing and advertising, $456.

Total expenditures on account of all contracts	$439,592 15
Salaries, inspections, supplies and expense of field corps	27,433.38
Total	$467,025 53

Percentage of cost of field corps, etc., 6.24.

The field work for above contracts was executed under the supervision of Assistant Engineers in Charge, Frank R. Fisher, Glenn D. Holmes and W. I. Klein.

UPPER ROXBOROUGH FILTERS.

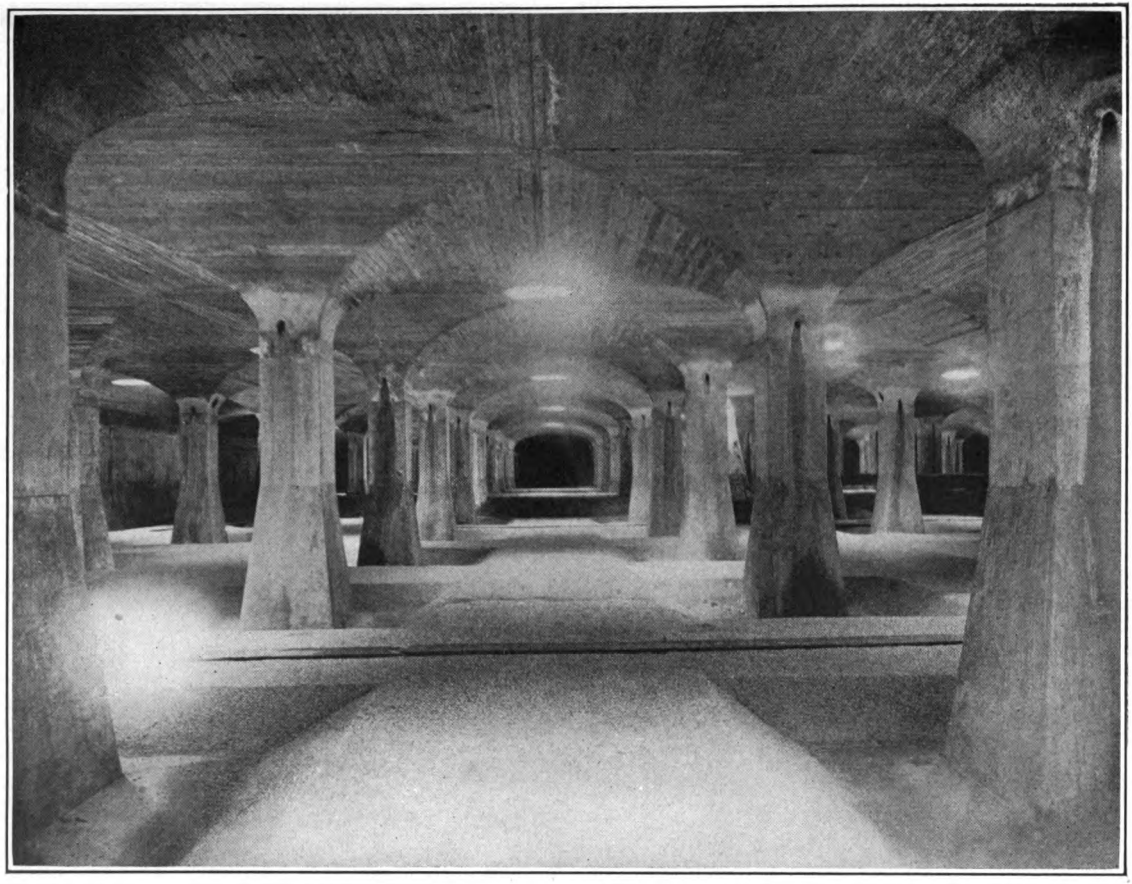
Contract No. 12, Filters and Clear Water Basin.

Daniel J. McNichol, Contractor.

This contract embraced eight filters, each of 0.709 acre net sand area, and a clear water basin of 8 million gallons capacity at normal high water line. A full description of the contract will be found on page 243 of the Report of the Bureau of Water for 1901.

The filters at Upper Roxborough will be supplied with subsided water from the Upper Roxborough reservoir, which contains at high water line 150,000,000 gallons. With these filters working at a daily rate of 15 million gallons, the water will usually have been subsided for ten days before going to the filters, provided there is a uniform circulation throughout the reservoir. The arrangement of influent and effluent pipes, together with lack of baffle partitions to force a complete and regular change of water in the two divisions of the reservoir during an interval of ten days more or less, will probably produce an actual subsidence of the raw water from the river, of seven or eight days before it goes to the filters. It is thought that the subsided water from this reservoir will permit the working of the filters up to 20 million gallons per day when the purveying district has been enlarged to take the water.

All the work on the original contract was practically



UNDERDRAIN MATERIALS AND FILTERING SAND, UPPER ROXBOROUGH FILTERS.

completed August 1, 1903, and the filters started in service July 3, 1903.

Total expenditures on contract, $550,911.59.

Contract No. 24, Filtering Materials and Underdrains for the Upper and Lower Roxborough Filters.

Daniel J. McNichol, Contractor.

This contract embraced the filtering materials and collectors for both the Upper and Lower Roxborough filters, and the sand washers and houses at Lower Roxborough, described under Lower Roxborough Filters.

The contract was completed during July, and all filters were operating by August 6, 1903.

Total expenditures on contract as applied to Upper Roxborough, $181,210.17.

Contract No. 18, Low Service Pumping Machinery for the Upper Roxborough Filters.

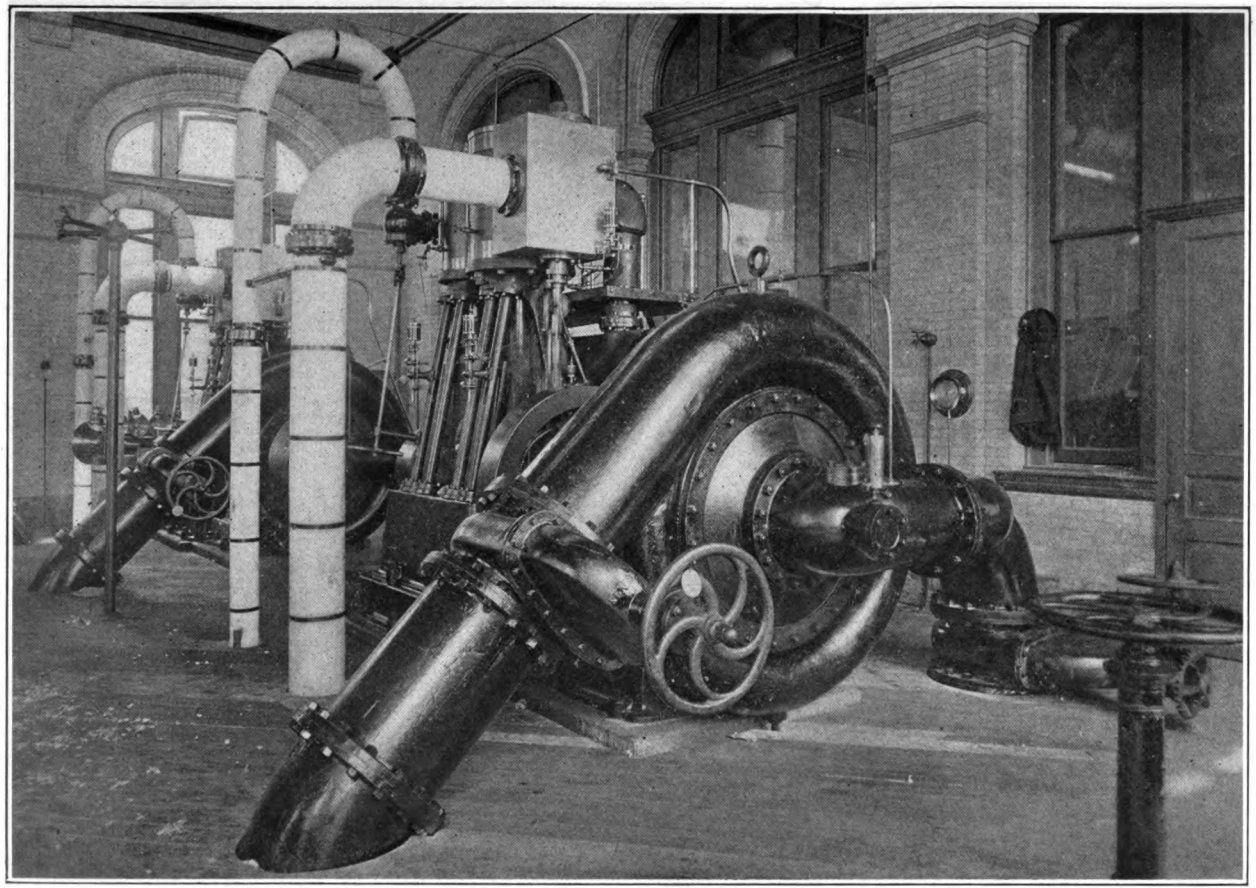
Henry R. Worthington, Ltd., Contractor.

This contract embraces three (3) centrifugal pumps and vertical driving engines to supply water from the Upper Roxborough reservoir to the Upper Roxborough filters. The water is supplied to the pumps by gravity, and the difference between the elevation of the water on the filters, approximately 419 C. D., and the elevation of the water in the reservoir, 414 C. D., or less, depending upon the stage of the water, is overcome by the action of the pumps.

This machinery was completed during the present year and subjected to the tests required by the contract.

The following table gives the principal dimensions of the engines and the results of the contract trials.

Data, 1903.	Quantities.	Engine No. 1. Nov. 2.	Engine No. 2. Oct. 31.	Engine No. 3 Nov. 1.
Diameter of H. P. cylinder	Inches	10.00	10.00	10.00
Diameter of L. P. cylinder	Inches	17.50	17.50	17.50
Stroke	Inches	12.00	12.00	12.00
Diameter of H. P. piston rod	Inches	1.75	1.75	1.75
Diameter of L. P. piston rod	Inches	2.25	2.25	2.25
Factor of H. P. = H. P. cylinder		1.104	1.123	1.105
Factor of H. P. = L. P. cylinder		3.402	3.461	3.405
Steam pressure at throttle	Pounds	102.99	103.65	103.00
Revolutions per minute		235.52	239.64	235.77
Moisture entrained in steam	Per cent.	0.85	0.95	0.65
Vacuum in condenser	Inches	27.40	28.44	27.29
Water pressure gauge on discharge pipe	Feet	71.88	69.90	72.30
Water pressure gauge on suction pipe	Feet	41.36	39.05	41.82
Difference, pumping head	Feet	30.52	30.85	30.48
Total water from surface condenser	Pounds	19,330.00	21,656.00	19,750.00
Average steam consum d per hour	Pounds	1,610.80	1,804.66	1,654.16
Apparent rate of discharge of pumps	M. G. D.	10.68	10.62	10.80
Loss of water level in filters	M. G. D.	0 9340	0.62348	0.8850
Difference, net rate of pumpage	M. G. D.	9.746	9.99652	9.915
Million foot pounds per hourly pound of steam consumed		1.5382	1.4234	1.5219
Average million foot pounds all engines and pumps			1.494	
Million foot pounds per hourly steam consumed by the terms of the contract			$\frac{10 \times 8.33 \times 31}{1800} = 1.434$	
Increased economy over contract requirements	Per cent.		4.22	
Mean effective pressure, H. P. cylinder	Pounds	37.256	42.425	37.536
Mean effective pressure. L. P. cylinder	Pounds	12.170	13.327	12.00
Indicated H. P		82.53	93.76	82.14
Steam per I. H. P. per hour	Pounds	19.518	19.248	20.138
Percentage of useful effect		63.176	57.66	64.50
Average mechanical efficiency			61.78	



LOW SERVICE PUMPING MACHINERY, UPPER ROXBOROUGH FILTERS.—CONTRACT NO. 18.

The performance of this machinery since it was started in service July 1, 1903, has been very satisfactory in all respects.

Total expenditure under contract	$21,700 00
In addition to the cost of the machinery the arrangement of the supply and discharge mains in Eva street to make proper connections with the pumps, which work was performed by the Bureau of Water and charged against the fund for the Improvement, Extension and Filtration of the Water Supply, amounted to.....	1,466 00
Total	$23,166 00
Total payments to date	20,982 09

CONTRACT No. 19, PIPE DISTRIBUTION SYSTEM.

Daniel J. McNichol, Contractor.

Pipe lines "M," "N" and "O," in Eva street, Port Royal avenue and Hagy street, for connection of the Upper Roxborough reservoir with the low service pumping machinery and of the low service pumping machinery to Upper Roxborough filters, described on page 266 of the Report of the Bureau of Water for 1901.

Pipe lines "P—1" and "P—2," and 20-inch connecting pipes at and near the standpipe at Roxborough Auxiliary Pumping Station were cancelled, as the connections had been placed by the Bureau of Water prior to commencing the work under this contract.

Total expenditure as applied to Upper Roxborough filters, $108,454.71.

Contract No. 20, Triplex Pumps and Gasoline Driving Engines.

Fairbanks, Morse & Company, Contractors.

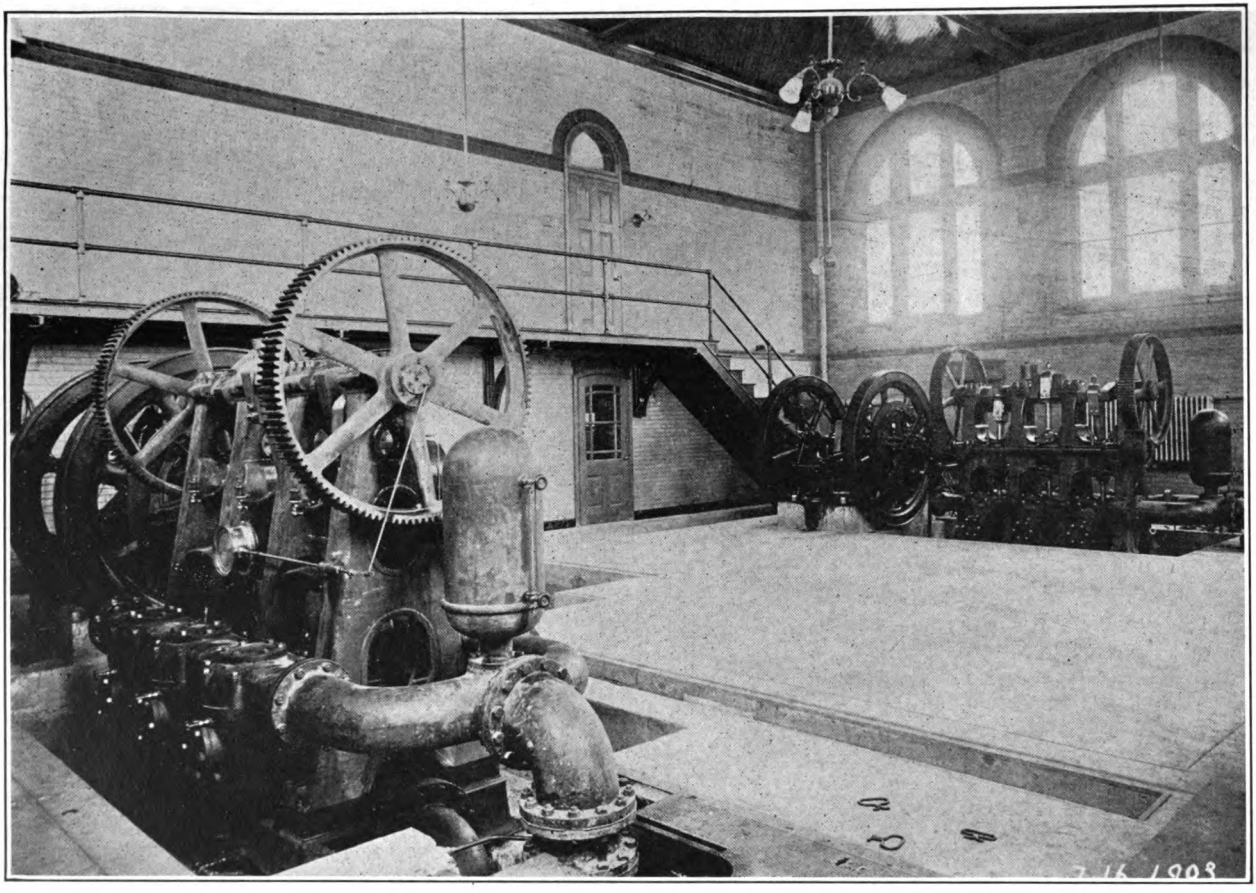
This contract embraces two sets of driving engines and pumps. Each set of this machinery consisted of a horizontal gasoline engine of 60 indicated horse power, and a vertical triplex double acting piston pump, each pump having a diameter of 10 inches, stroke of 12 inches and diameter of piston rod of 2.50 inches. The pumps are geared to the crank shaft of the driving engine through an intervening friction clutch, the engines running at a speed five times that of the pumps.

The supply for these pumps is taken through a line of 16-inch cast iron pipe from the clear water basin in the south court and is discharged through a line of 16-inch pipe to the sand washers and ejector pipes in the filters, and a line of 12-inch pipe in the north court to Filters No. 7 and 8, and to the north sand washers and ejector pipes.

The economy guaranteed for this machinery required the pumping of 6,000 gallons of water against a total delivery head and suction lift of 200 feet with a consumption of 1 gallon 74 degree Beaume gasoline.

Upon trial the engines and pumps performed an economy equal to 7,129.8 gallons of water pumped to the elevation specified with a consumption of one gallon of gasoline, showing an excess of economy guarantee of 1,129.8 gallons of water pumped per unit of fuel considered; an increase of 18.83 per cent. over the contract requirements.

The pumps were guaranteed to deliver each 1,200,000 gallons of water per day of 24 hours at a speed not to exceed 40 revolutions per minute. Upon capacity test, measuring the discharge of water by the rise of water level in Filter No. 4, the discharge after allowing eight gallons



SAND WASHER PUMPS, UPPER ROXBOROUGH FILTERS.—CONTRACT NO. 20.

per minute for cooling water to engine, at contract speed, was equal to 1,295,294 gallons per day at contract speed, showing an excess capacity of 7.94 per cent. above the contract requirements.

A comparison of the water delivered to the filter with the displacement of the pump pistons, showed a slip or loss of action and leakage of 4.34 per cent.

The actual water horse power developed by one pump, during the economy test, was 53.13, and assuming 90 per cent. of the power of the engine developed by the pumps, the indicated horse power of the engines was 59.3 while pumping under contract conditions.

The contract was completed and the machinery put in service about July 1, 1903, since which time it has given very satisfactory service.

Total cost of contract	$10,490 00
Total payments to date	8,916 50

Contract No. 21, Low Service Pumping Station for Upper Roxborough Filters.

Henderson & Company, Ltd., Contractors.

This contract embraced an addition to the Roxborough Auxiliary Pumping Station to accommodate the low service pumping machinery for the Upper Roxborough filters; the electric lighting machinery for supplying illumination for the Upper Roxborough Pumping Station; the Lower Roxborough plain sand filters; the Lower Roxborough preliminary filters and the upper Roxborough filters and administration building.

This contract is described on page 268 of the report of the Bureau of Water for the year 1901.

The entire work was completed during the year 1902.

Total expenditure under contract.....		$19,125 43
Heating apparatus		280 00
Sundries		181 49
		$19,586 92
Total payments to date		18,725 43

CONTRACT NO. 22, HAND TRAVELING CRANE FOR THE LOW SERVICE PUMPING STATION OF THE UPPER FILTERS.

Alfred Box & Company, Contractors.

This contract embraced a hand traveling crane erected in the Annex of the Roxborough Auxiliary Pumping Station for convenience in the repair and handling of the pumping engines and electrical machinery assembled in the room, and was completed August 9, 1902.

Total expenditures under contract.....		$2,800 00
Sundries		60 35
		$2,860 35
Total expenditures on account of all contracts		$942,782 21
Salaries, inspections, supplies and expenses of Field Corps		35,562 71
Percentage of cost of Field Corps..	3.772	
Land damages	$75,503 38	
Legal expenses	1,206.41	
		76,709 79
Total Upper Roxborough filters.....		$1,055,054 71

The field work for the above mentioned contracts was executed under the supervision of Assistant Engineers Stephen Harris, Frank R. Fisher, Frederick E. Field and William I. Klein.

ADMINISTRATION BUILDING AND PUMPING STATION AND SAND WASHER, UPPER ROXBOROUGH.

CONTRACT NO. 23—A. ADMINISTRATION BUILDING AND PUMPING STATION.

Daniel J. McNichol, Contractor.

The Administration Building contains an office for the Assistant Engineer and room for the filter attendants in charge of the filters; a shelter room for the laborers employed about the filters, locker room, store room, heater room and storage bin for coal, and a large, well lighted and equipped pump room for the gasoline engines and triplex pumps which furnish water under pressure for the sand ejectors and washers.

The building is neatly finished in yellow pine, natural wood, supplied with steam heat and electric lights, and modern toilet conveniences for the use of the employees.

This contract was awarded August 6, 1902, and completed ready for service July 1, 1903.

Total cost of contract	$38,440 60
Sundries	380 58
	$38,821 18

CONTRACT NO. 33, SAND WASHERS.

E. M. Nichols, Contractor.

This contract embraced four complete 5-hopper ejector sand washers, set in the courts, each washer to serve two filters. No houses are placed over the sand washers, and the upper edges of the cast iron hoppers are set at about the level of the court.

The contract was awarded March 27, 1903, and completed July 1, 1903.

Total cost of contract	$3,849 00
Sundries	41 29
	$3,890 29

SAND EJECTORS.

F. J. Stokes Machine Company, Contractors.

This contract embraced four portable sand ejectors of the same type, but of improved design to the single ejector used at Lower Roxborough.

Total cost of contract $316 00

SAND EJECTOR PIPES.

E. M. Nichols, Contractor.

This contract embraced a permanent system of water supply, and sand and water discharge pipes erected in each filter and permanently connected with the water pressure pipes.

In lieu of the brass nozzles and caps which were used at Lower Roxborough on the pressure lines supplying the ejectors, a set of eight removable hose valves were placed on the branches to admit of shifting the hose without shutting off the supply of water to the ejectors.

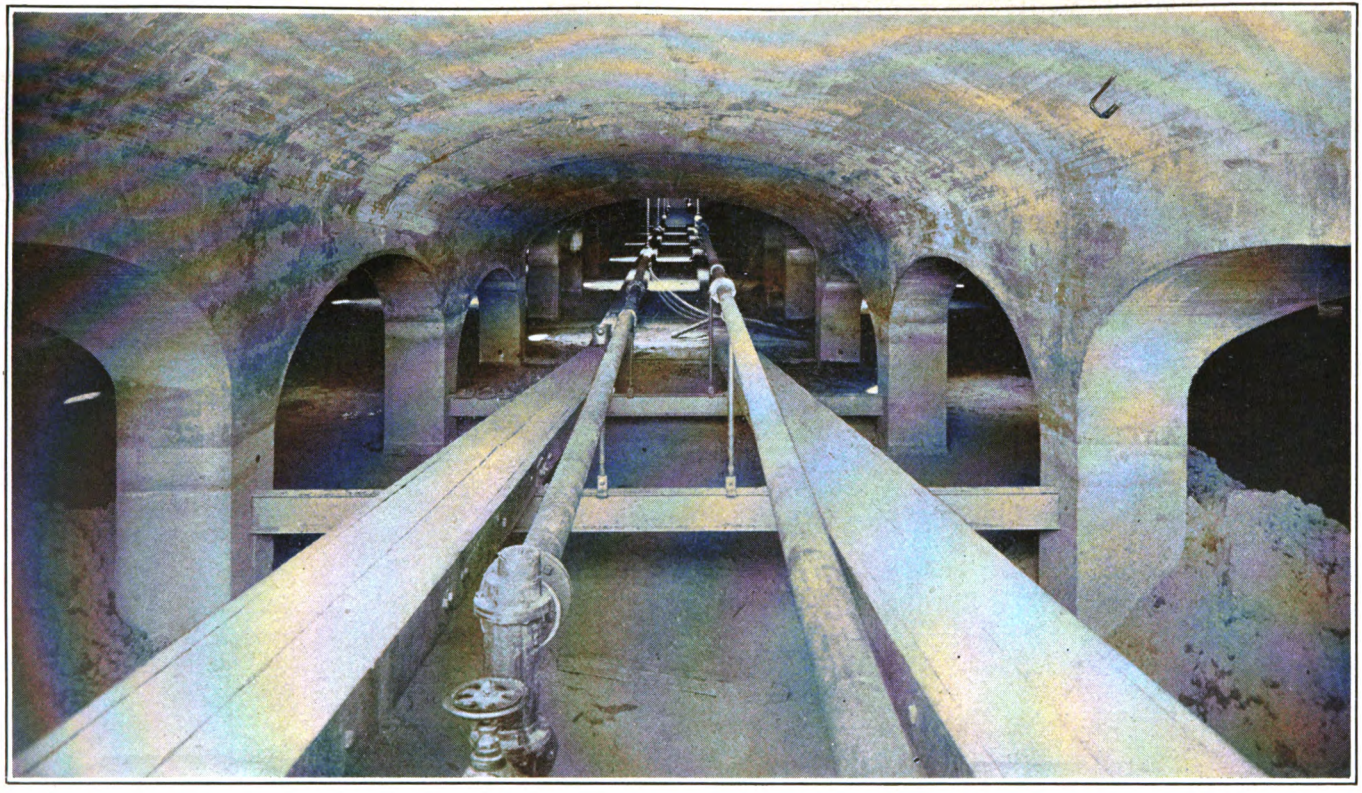
Total cost of contract $3,075 00

Electric Lighting Equipment—Roxborough.

CONTRACT NO. 44, AN ELECTRIC LIGHTING SYSTEM FOR THE UPPER AND LOWER ROXBOROUGH FILTERS.

The Pennsylvania Equipment Co., Contractors.

This contract embraced the two sets of driving engines and electrical generators, a main switchboard, all wiring, poles, cross arms and insulation for the Upper and Lower Roxborough filters, Lower Roxborough pre-filter house, Lower and Upper Roxborough Administration Buildings, regulator and gate houses, and the Roxborough Auxiliary Pumping Station, including all cut-outs, switches, meters, sockets and lamps.



Ejector Pipes for Transportation of Sand, Upper Roxborough.

The driving engines, generators and main switchboard are erected in the annex to the Roxborough Auxiliary Pumping Station, Contract No. 21, and the steam for power is taken from a branch of the main steam pipe from the Roxborough Auxiliary boilers, which has been run into the basement of the annex for the supply to the low service pumping machinery.

The two (2) driving engines were built by the Watertown (New York) Engine Company, and are of the horizontal centre crank self-oiling variety, direct connected to the electrical generators by plate couplings. Each engine is mounted on a cast iron base plate arranged to receive the generators. The steam cylinders are each 10 inches diameter by 12 inches stroke, and run at 275 revolutions per minute. Steam at 100 pounds gauge pressure at the throttle valves is supplied to the engines.

The electrical generators were supplied by the Fort Wayne Electric Company, and are each of the direct current, constant potential compound wound, six (6) pole variety. Each generator at a speed of 275 revolutions per minute has a capacity of 37½ to 40 kilowatts, with a potential of 250 volts on the voltmeter of the main switchboard. The generator frames are insulated from the sub-base, which also carries the engine bed plate, to withstand a 3,000 volt alternating current for ten seconds.

The generators are wound to work for ten hours at their full rated capacity, without raising the temperature in the windings more than 40 degrees Fahrenheit above the surrounding atmosphere. With an increased load of 25 per cent. and at 250 volts potential, the temperature increase in the windings will not exceed 55 degrees Fahrenheit above the surrounding air.

The main switchboard of blue Vermont marble is set near the north wall of the annex, and contains the usual instruments to measure the strength and amount of elec-

tric current furnished, and for the control of the electrical circuits.

Throughout, the engines, generators and switchboard represent the best class of materials and workmanship for the purpose.

The lighting system embraces three line circuits, as follows:

No. 1—Circuit to the Roxborough Auxiliary Pumping Station.

No. 2—Circuit to the Lower Roxborough Filters, and Preliminary Filter House.

No. 3—Circuit to the Upper Roxborough Filters.

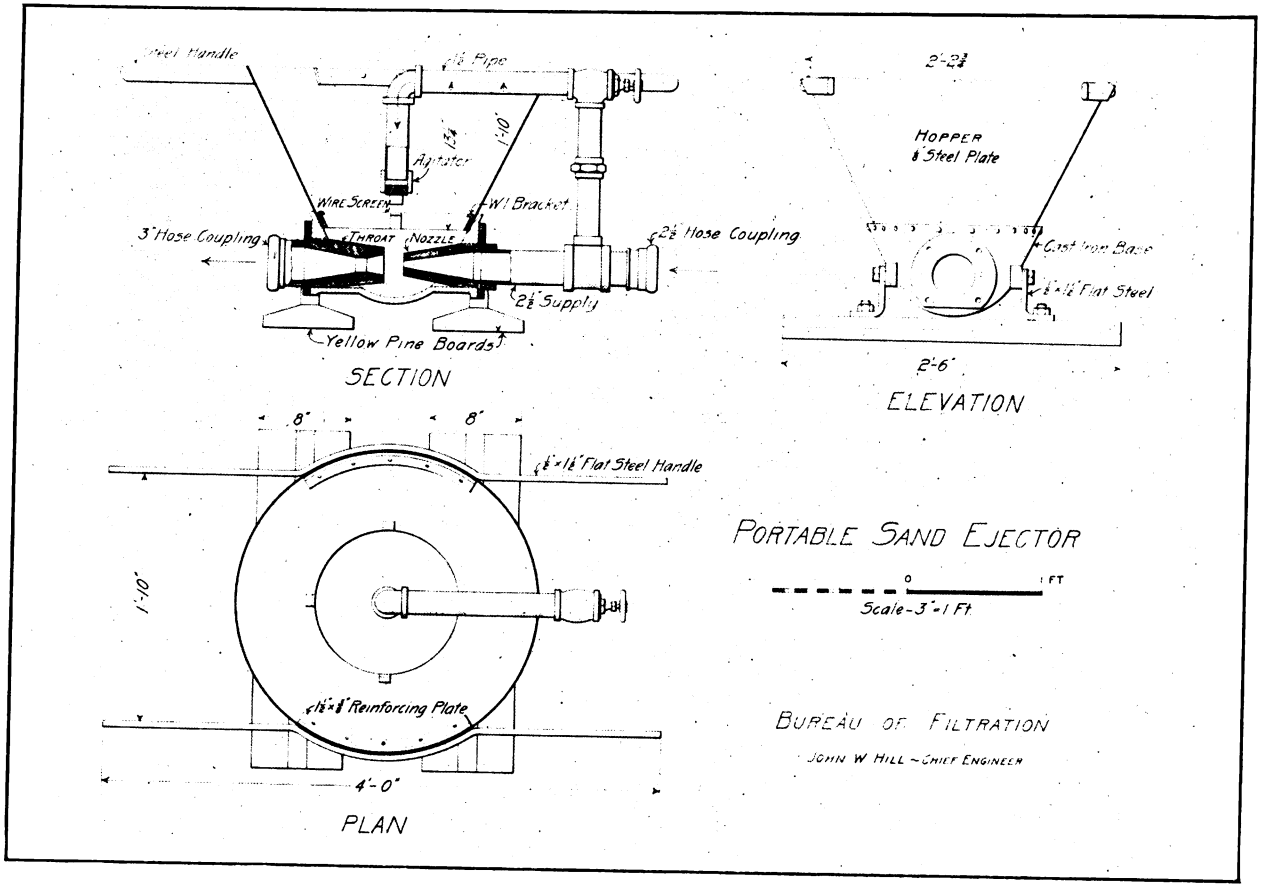
The incandescent lamps in the filters are each of 16 C. P., 3½ watts capacity, and in the regulator and gate houses, and administration and filter buildings, and the auxiliary pumping station, of 16 C. P., 4 watts, capacity.

Five inclosed arc lamps, each of 5-ampere capacity, at 220 volts potential are erected on iron poles at the Upper Roxborough filters, and three arc lamps of same kind on iron poles are erected at the Lower Roxborough filters.

At Lower Roxborough each filter is provided with 112 incandescent lamps, each regulator house with six lamps, each gate house of the clear water basin with five lamps, each sand washer house with six lamps, and the pre-filter house and administration building with 64 lamps.

At Upper Roxborough each filter is provided with 132 lamps, each double regulator house with eight lamps, the gate house of the clear water basin with five lamps, and the administration building with 40 lamps.

The contract is completed excepting the economy and efficiency tests of the driving engines and electrical generators, which will be made within a short time. The system has been in satisfactory operation since October 1, 1903, and it has been found very efficient in permitting the scraping and washing of sand to proceed after dark.



STANDARD SAND EJECTORS, AS USED AT UPPER AND LOWER ROXBOROUGH AND BELMONT.

Total cost of contract	$15,068 48
Foundations for engines	360 00
	$15,428 48
Salaries of Assistants, Inspection and other expenses	540 54
Total	$15,969 02
Percentage cost of inspection, etc.	3.50
Total payments to date	$8,356 99

The foregoing contracts complete the construction work for the Roxborough System of filters, and with the exception of distributing pipe lines "A," "B," "C" and "D," of Contract No. 17, represent all works required for the improvement of that part of the water supply known as the Roxborough Service. This service embraces at present Wards Twenty-one and Twenty-two, but by small expense for an additional distributing main in Wissahickon avenue, from Chelten avenue to Nicetown lane, in Nicetown lane to Venango street, in Venango street to Twenty-second street, and in Twenty-second street to Lehigh avenue, a large part of Ward No. 38, and about one-half of Ward No. 28 can be supplied from the Roxborough filters. This line of pipe is embraced in Contract No. 66.

BELMONT FILTERS.

The Belmont works for filtering the water supply of West Philadelphia, embracing the Twenty-fourth, Twenty-seventh, Thirty-fourth and Fortieth Wards, containing at the present time a population estimated at 170,000, are located on Belmont avenue, near the City line. The tract of land taken for these works contains 60.57 acres, lying

partly north and partly south of Ford road, between Belmont and Monument avenues. Upon the land located north of Ford road are placed the sedimentation and clear water basins, and on the land south of Ford road are placed the plain sand filters and preliminary filters. Enough land south of the plain sand filters is unoccupied and reserved for the construction in the future of eight more filters of the same effective sand area as those now built.

West Philadelphia, as shown by the census enumerations from 1860 to 1900, inclusive, has been growing at a greater rate than that portion of the City lying between the Delaware and Schuylkill rivers, and as a preliminary step in determining the capacity of the works of filtration required for the present and future supply of this section of the City, a careful study of the past and prospective growth of population was made.

By inspection of the diagram it will be seen that from a population of 23,738 in 1860, it has grown to 148,371 in 1900, and by plotting the mean annual rate of growth for each census decade, and drawing a smooth curve through the diagram, the smoothed rates of growth from 1860 to 1950, stated as the mean annual increase, are as follows:

	Per cent.		Per cent.
1860	7.72	1910	3.22
1870	6.03	1920	2.88
1880	4.95	1930	2.63
1890	4.20	1940	2.39
1900	3.64	1950	2.20

Corresponding to the following future populations:

1910	203,699
1920	270,582
1930	350,106
1940	443,373
1950	551,162

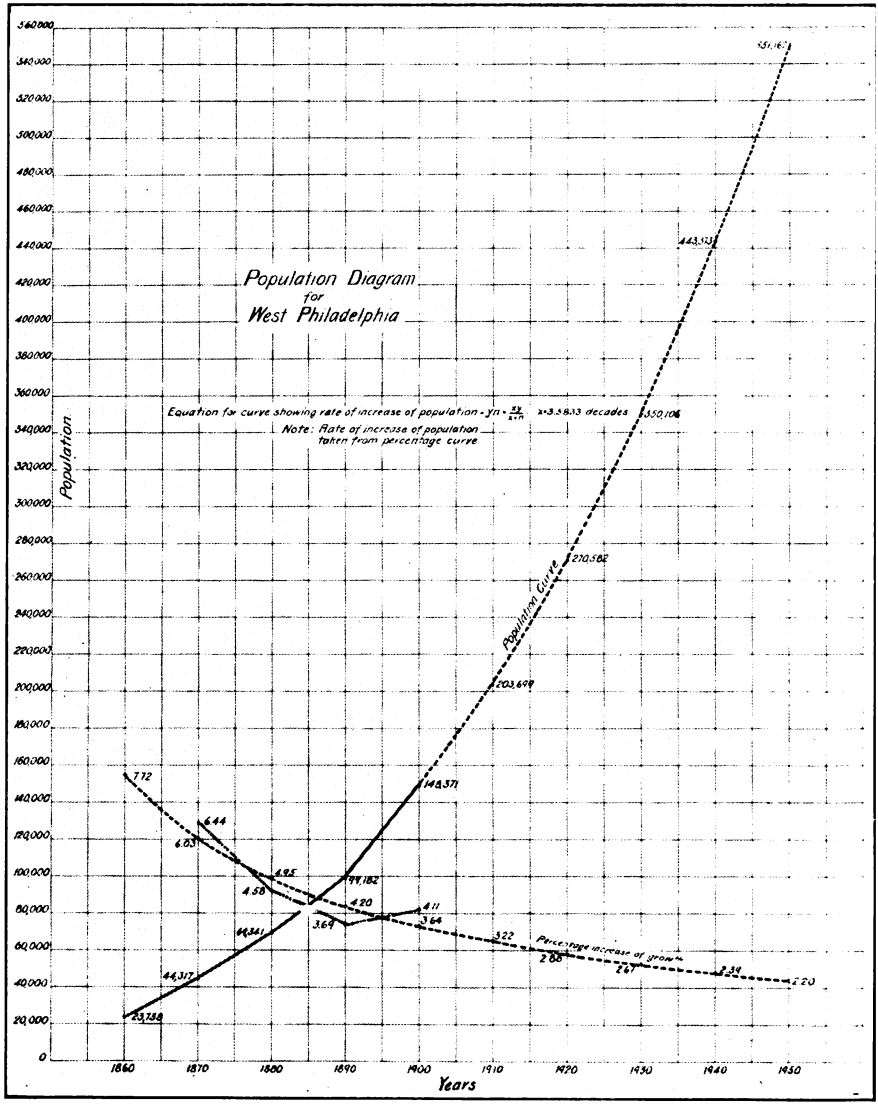


DIAGRAM OF GROWTH OF POPULATION, WEST PHILADELPHIA.

Upon a basis of 150 gallons of water per capita per day the consumption of water for each ten years of the next five decades should run about as follows:

	Gallons per day.
1910	30,554,800
1920	40,637,300
1930	52,515,900
1940	66,506,000
1950	82,674,300

The present consumption of West Philadelphia is, at an average, 185 gallons per capita per day, and if steps are not taken to reduce the unnecessary and avoidable waste of water, the consumption by 1950 will reach over 100,000,000 gallons per day, or about the ultimate capacity of the Belmont works.

In the report of the Expert Commission appointed by Mayor Samuel H. Ashbridge, May, 1899, it is stated that the least flow of the Schuylkill river has been shown to be about 150,000,000 gallons in twenty-four hours, and that it was thought prudent to not exceed this quantity as the maximum daily consumption of water from this source.

Apportioning this consumption of Schuylkill river water between West Philadelphia and Roxborough, it has been assumed that if the present rate of consumption is maintained, these two districts will require respectively 100,000,000 gallons and 50,000,000 gallons per day within the next fifty years—the entire allowable quantity which, according to the experts' report, should be drawn daily from the Schuylkill river.

The Belmont Works consists of two subsiding basins, each containing at flow line, about 36,000,000 gallons of water, which, at the present rate of consumption, represents 2.40 days' sedimentation of the water before it is drawn from the basins; eighteen plain sand filters, in part modeled after the filters at Berlin, Warsaw and St. Peters-

burg, and in part after the newer filters at Hamburg; a system of preliminary filters adapted at a rate of 80,000,000 gallons per acre per day, to deal with 40,000,000 gallons of water daily, and a clear water basin, 15 feet in depth, with a capacity of 16,500,000 gallons; eight hopper sand washers, patterned after the washers in use at the Hamburg filters; an administration building and pumping station; centrifugal pumping machinery to supply wash water to the preliminary filters; direct acting plunger pumps to supply water under pressure to the sand washers; steam boilers for power and heating the buildings, and an electric lighting equipment.

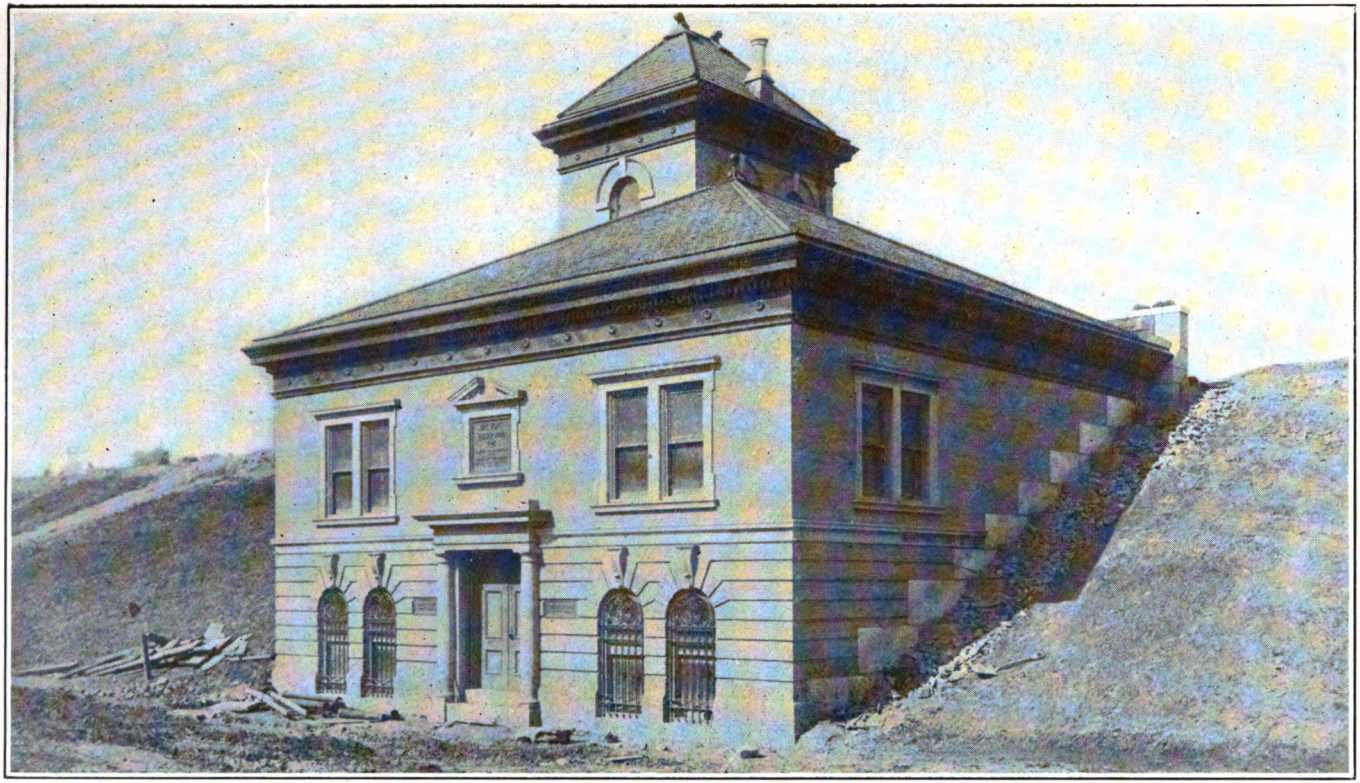
Contract No. 16, Filters and Sedimentation Reservoir.

Ryan & Kelley, Contractors.

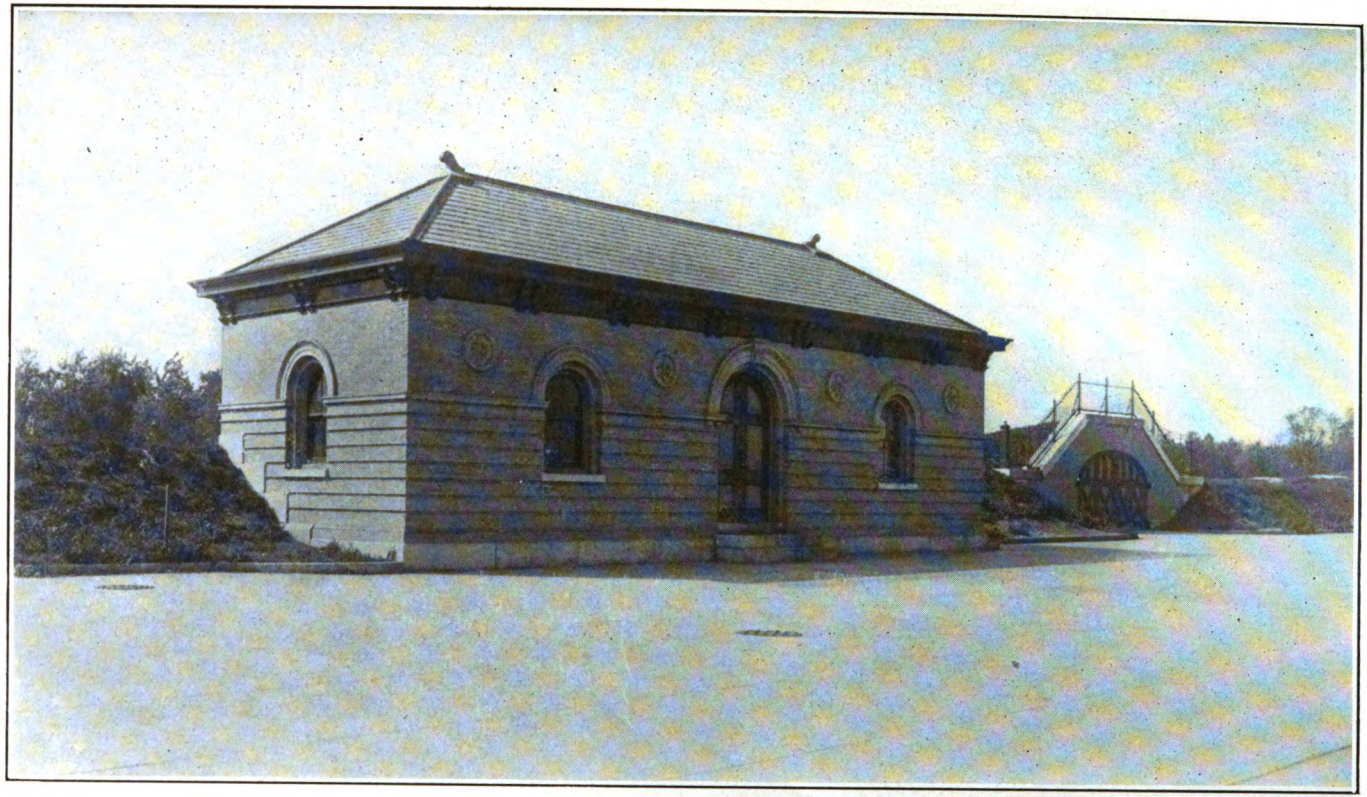
Sedimentation Reservoir.

The sedimentation reservoir consists of two divisions, or basins, each 25 feet deep, measured at the flow line, elevation 279.00 C. D., and 29 feet deep from the top of the embankment, elevation 283.00 C. D. The area of the east division at the flow line is 5.40 acres, and at the floor line 3.47 acres. The area of the west division at the flow line is 5.33 acres, and at the floor line 3.337 acres. The inside and outside slopes are at all points around the basins, two horizontal to one vertical.

Top width of embankment, 18 feet; width of toe at inner slope, 134 feet. The east division was constructed about equally of cut and embankment, while the west division, excepting the embankment along Ford road, was nearly all in excavation, some of which was quartzlike trap rock. The materials of excavation consisted of clay, micaceous rock, sand, gravel and hard rock, the latter requiring drilling and blasting for its removal.



GATE HOUSE TO SEDIMENTATION RESERVOIRS, BELMONT.—CONTRACT NO. 16.



Double Gate House and Entrance to Filters, Belmont.—Contract No. 16.

In making embankments, the best materials of excavation were placed next the inner slope, and all materials were rolled in thin layers. When the excavation in rock revealed fissures, these were filled with grout, and the irregular surfaces of the rock in the floors and slopes leveled up to sub-grade partly with concrete and partly with clay puddle.

In preparing the ground for rolled embankment for the sedimentation reservoir the top soil was first thoroughly stripped off and the inclined ground stepped in horizontal terraces.

The reservoir embankments and the fill under the filters on Monument avenue were rolled with four 25 horse-power traction engines weighing 10 tons each, or 3,300 pounds per foot width of roller wheels, two 18 horse-power traction engines weighing approximately 8 tons each, or 3,000 pounds per foot width of roller wheels, and one 10-ton traction roller, manufactured by the Julius Scholl Company of New York. All rollers were grooved.

In the original plan of the reservoir, the inner slopes were constructed with a berm at an elevation of 12.7 feet above the finished floors of the basins, and the upper slopes set back a distance of five feet to receive a granite block paving to be set dry, and backed with broken stone. This was intended as a protection to the puddle lining from frost, but further consideration of this feature of the construction raised doubt of its utility, and it was omitted in finishing the basins. Each division of the reservoir is lined on the floor and slope with 18 inches of clay puddle, on which is placed a 6-inch course of concrete. On the concrete to within a vertical depth of 10 feet from the water line is placed a $\frac{3}{4}$-inch mixture of asphalt, asphaltic mastic and grit.

Further description of these works will be found on page 254 of the Report of the Bureau of Water, 1901.

This contract is now completed, lacking only the tests for water tightness of the sedimentation reservoir, clear water basin, and four of the eighteen filters, which work is now in progress, and is expected will be completed during the next sixty days.

Total cost of contract.....	$1,960,560 37
Total payments to date	1,758,007 44

CONTRACT No. 19, DOUBLE LINE OF 36-INCH RISING MAIN.

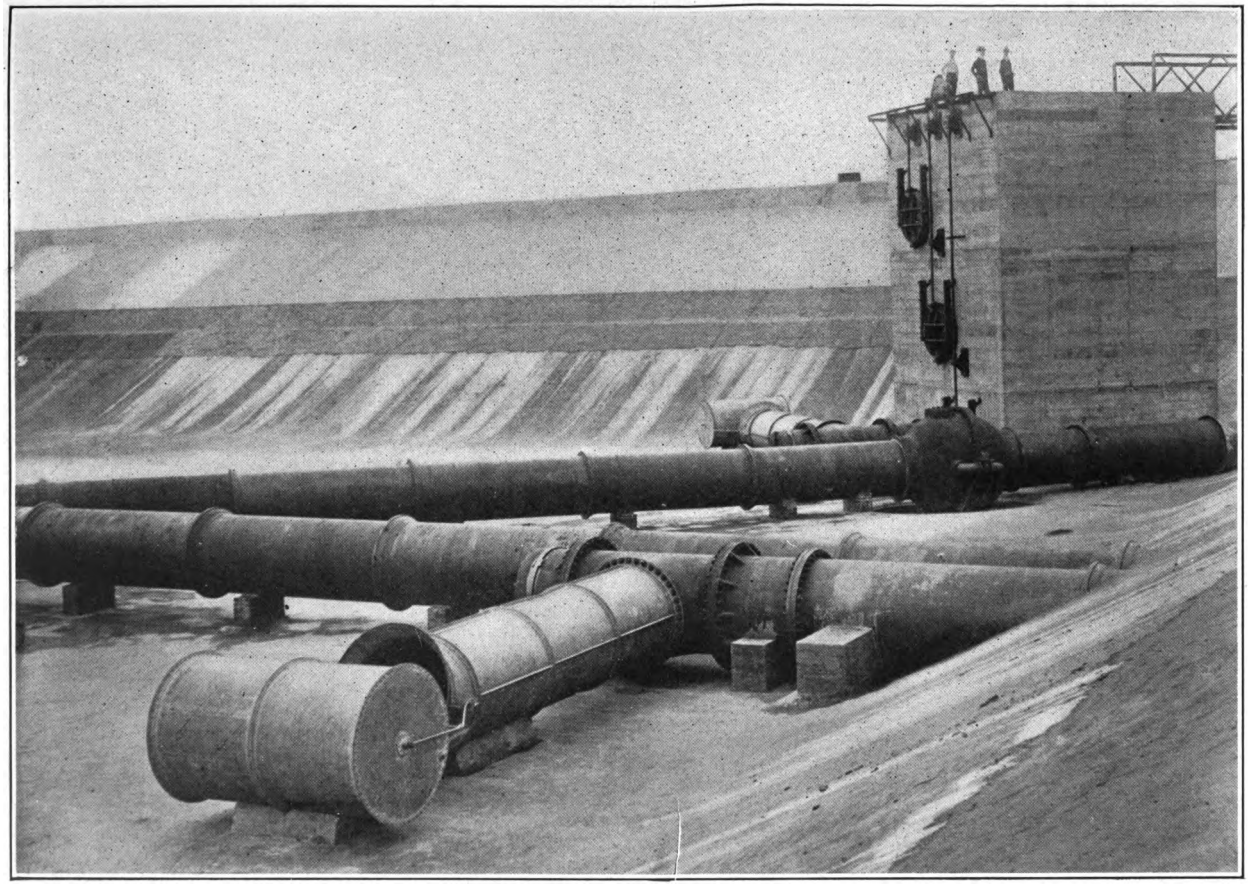
Daniel J. McNichol, Contractor.

This contract embraced the placing of a double line of 36-inch rising main (Pipe Line "L") from the Belmont Pumping Station to the new sedimentation reservoir north of the intersection of Belmont avenue and Ford road, laid in the West Park to the intersection of Belmont avenue and Crestline avenue, thence northwardly in Belmont avenue to Ford road, and thence eastwardly in Ford road to the gate house of the reservoir.

Connections have been made in the rising pipes in Belmont avenue, near Ford road, to take the supply of water direct to the preliminary filters, should occasion ever arise to take the sedimentation reservoir temporarily out of service; and at the same point a cross over connection has been provided to permit of using one line of pipe during an interval of time for repairs should the other at any time be injured in service.

This contract with reference to Pipe Line "L" was completed 1902.

Total expenditures on contract, $167,025.94.



SUPPLY AND DISCHARGE PIPES, SEDIMENTATION RESERVOIRS, BELMONT.—CONTRACT NO. 16.

Contract No. 40—A, Centrifugal Pumping Machinery.

Camden Iron Works, Contractor.

This contract embraces two sets of centrifugal pumps and driving engines to pump wash water to the preliminary filters, and if required to pump pre-filtered water from above the sand bed of low level filters to filters at higher level. In operation this latter service may not be required, as it has been the custom at Lower Roxborough not to drain from high to low level filters, but to allow each filter to continue at work after the supply has been shut off until the level of water is several inches below the sand line, and then to take it out of service for scraping the sand bed.

The suction and discharge connections of the centrifugal pumps have been so arranged that if at any time to avoid losing pre-filtered water it becomes desirable to quickly empty a filter, the water above the sand bed, and to any desired depth below, can be pumped into the supply of the other filters in service.

Each pump has a capacity of 5,000,000 gallons per day, 24 hours, against a head of 45 feet. While operating to pump wash water to the pre-filters, the pump will be under pressure from the subsiding basins. The suction and discharge openings are each 18 inches diameter. Each pump is provided with a double suction to avoid end thrust on the impeller shaft. The power is obtained from vertical single cylinder non-condensing engines, direct connected to the impeller shafts of the pumps through plate couplings. Steam at 130 pounds pressure will be supplied to the driving engines. Space has been provided in the engine room for a third pump and power, when the service of the station requires an increase of pumping capacity.

The pumps are mounted over a pump well under the floor of the engine room, and all suction and discharge connections are made up below the floor level in the well. This machinery is completed in the contractor's shops and ready for erection.

Total cost of contract, $7,300.

No payment has been made on this contract.

CONTRACT No. 40—B, DUPLEX DIRECT ACTING PUMPS.

The I. P. Morris Company, Contractor.

This contract embraces three (3) duplex direct acting pumps to supply filtered water under a pressure of 90 pounds per square inch to the sand washers and sand ejectors. Each pump contains steam cylinders 14 inches diameter, water plungers 12 inches diameter, and 12 inches stroke, and has a capacity of 1,250,000 gallons per day of twenty-four hours. The pumps have inside adjustable packed plungers.

The suction lift of the pumps will be approximately 16 feet, and the discharge will be against a pressure of 90 pounds per square inch.

The contract also embraces four internally fired return tubular marine type boilers, each of 200 commercial horsepower capacity at 130 pounds steam pressure per square inch, together with feed pumps, feed water heaters, main steam and exhaust pipes, and all appurtenances about the boiler room.

This machinery is completed in the contractor's shops, and will be erected as soon as the engine and pump room has progressed to a point when the work can proceed without interruption by other contractors.

Total cost of contract, $28,080.

No payments have been made on this contract.

CONCRETE PAVING IN SLOPES OF RESERVOIR, BELMONT.—CONTRACT NO. 16.

Contract No. 42, Administration Building and Pumping Station.

Harry B. Shoemaker & Company, Contractors.

This contract embraces the Administration Building and Pumping Station for the Belmont Works, and contains on the ground floor an office and shelter room for the employees about the filters, an engine pump room, boiler room and coal storage room. Over the office and shelter room at the administration end of the building, a laboratory for chemical and bacteriological examination of water samples has been provided.

In the basement under the office and shelter room, rooms have been arranged for the storage of tools and supplies.

The boiler house is furnished with a brick chimney of the Custodis pattern, 5 feet 6 inches internal diameter at the top and 125 feet high. Elevation base of chimney, 258.00 C. D.

The brick and face stonework and general treatment of the chimney and buildings have been made to match the other houses constructed under Contract No. 16. Outside face work light Roman brick, with Indiana limestone and terra cotta trimmings.

The administration end of the buildings is provided with locker rooms and modern toilet conveniences for the use of the men. Steam heat and electrical lighting will be supplied to the building.

The roof trusses and purlins over the engine and boiler rooms are of steel, and over the administration end of the building of timber. The roof is of Pennsylvania, Chapman slate, with yellow pine sheathing. Space is provided in the engine room for the electric lighting machinery and switchboard, Contract No. 46. This contract is rapidly approaching completion, and excepting the unfavorable

weather conditions the engine and boiler rooms would be in condition to receive the machinery.

Total cost of contract	$50,370 21
Sundries	242 87
Total payments to date	24,150 74

CONTRACT No. 46, ELECTRIC LIGHTING SYSTEM.

The Pennsylvania Equipment Co., Contractors.

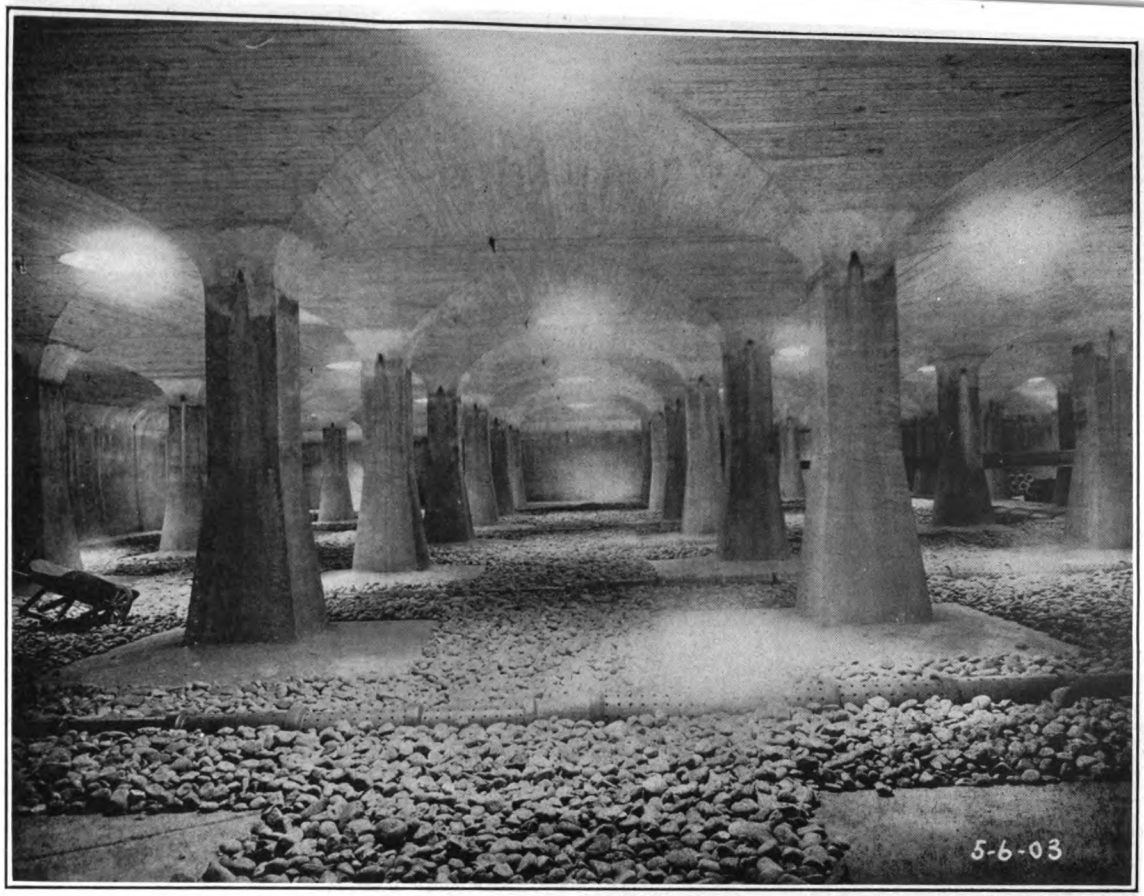
This contract embraces two sets of electrical generators and driving engines, and the main switchboard, poles, cross arms, cables, wiring, insulation, sockets, lamps and cut-outs for the electric lighting of the administration building, filters, regulator and gate houses, preliminary filter building and courts.

The driving engines are horizontal, center crank, self-oiling, connected to the armatures of the generators by plate couplings. Steam pressure at engines 125 pounds per square inch. Engine and generator speed 275 revolutions per minute. Each engine and generator is mounted on a continuous cast iron sub-base secured to the masonry foundation.

Engines furnished by the Watertown Engine Company.

The electrical generators are of the direct current, constant potential, compound wound, six pole type, each with a capacity of 275 revolutions per minute, and constant voltage of 250, of 37½ to 40 kilowatts. The generator frames are insulated from the sub-base to withstand for ten seconds an alternating current of 3,000 volts.

The generators are required to operate at full rated capacity for 10 hours without increasing the temperature in the windings more than 40 degrees Fahrenheit above the temperature of the surrounding air, and to take an overload of 25 per cent. without raising the temperature in



LATERAL COLLECTORS AND NO. 1 GRAVEL, BELMONT.—CONTRACT NO. 49.

the windings more than 55 degrees Fahrenheit above the atmosphere.

The main switchboard in the engine or dynamo room is of Vermont marble, furnished with the usual complement of instruments to measure and control the current, and the several circuits leading from the room.

Ten enclosed arc lamps mounted on iron poles are placed in the courts for general illumination of the works, and each filter and regulator and gate house is equipped with incandescent lamps. The lamps in the filters are of 55 volts, 3½ watts, and the houses and buildings 220 volts, 4 watts, capacity.

Four line circuits proceed from the main switchboard:

No. 1—To the Administration Building and Preliminary Filter House.

No. 2—To Gate House, Sedimentation Reservoir.

No. 3—To Filters Nos. 1, 2, 3, 4, 5, 6, 14, 15, 16, 17 and 18.

No. 4—To Filters Nos. 7, 8, 9, 10, 11, 12, 13 and all regulator houses, and the gate house of the clear water basin.

Total number of incandescent lamps in the system, 2,894.

Total cost of contract	$18,813 34
Sundries	146 60

No payments have been made on this contract.

Contract No. 49, Filtering Materials and Underdrains.

Daniel J. McNichol, Contractor.

This contract embraces the perforated terra cotta lateral collectors for the filters, and the gravel underdrains and filtering sand. The requirements for the collectors, sand,

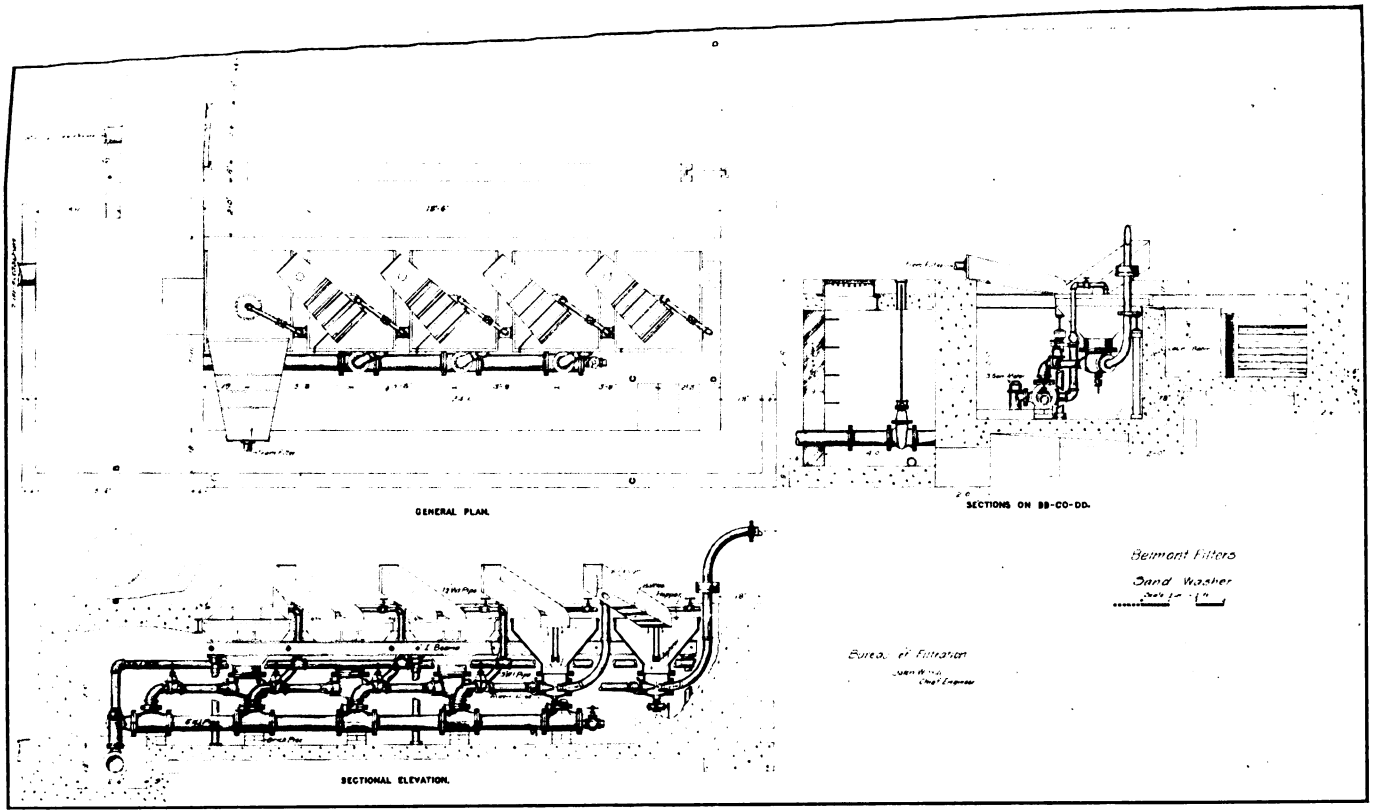
gravel and placing is the same as for the Roxborough filters, Contract No. 24, excepting some changes in the size of sand grains, and the placing of all underdrain materials after Plan "A," viz., with a clear space of 18 to 24 inches between the edges of the upper layer of underdrain gravel and the walls and piers of the filters.

The gravel upon this contract is being obtained partly from Oyster Bay, Long Island, and partly from the Delaware river, above Florence, New Jersey, and the sand is being obtained from banks near Pemberton, New Jersey; near Hainesport, New Jersey; on the banks of Rancocas creek, and from the Delaware river above Florence, New Jersey.

The perforated terra cotta collector pipes are obtained from Wheeling, West Virginia.

The furnishing of gravel and sand for the Belmont and Torresdale filters is the most stupendous proposition of its kind ever accepted by a single contractor in a short time. The total amount of sand and gravel required is about equal to one-half the quantity in all the filters of London, which has been prepared and placed progressively during a period of fifty years, while the attempt is being made with fair prospects of accomplishment to mine, wash, grade, transport and place within two years all the sand and gravel required for these two large works. Elaborate and in some respects novel machinery and appliances have been installed at the several places where the materials are being collected to rapidly prepare and grade the sand and gravel for use in the filters. The inspection of materials and placing are as rigid as our knowledge of the subject admits, because wholly upon the grading of the filtering materials and conscientious distribution in the filters, depends the quality of the filtered water to be furnished.

At the present time three filters have been supplied with the filtering materials, and are ready for service; two



SAND WASHERS, BELMONT.—CONTRACT NO. 63.

others are nearly completed, and as soon as six filters are finished, the filtration of water at this station will be commenced. It is expected, unless the weather conditions absolutely prohibit, that the first filtered water from Belmont will flow into the distribution system by February 1, 1904, and from time to time after this date as new filters are made ready for work, the service will be increased until by midsummer the whole supply for West Philadelphia will be filtered.

Total cost of contract	$352,695 00
Total payments to date	84,677 26

CONTRACT No. 63, SAND WASHERS.

P. Gormley, Contractor.

This contract embraces eight sets of 5-hopper sand washers of the same general design as those now in use at Upper Roxborough.

This contract was completed November 11, 1903, and the washers connected up ready for service.

Total expenditures for contract	$6,595 00
Sundries	115 70

CONTRACT No. 65, HAND TRAVELING CRANE FOR PUMP ROOM.

Alfred Box Company, Contractor.

This contract embraces a six ton hand traveling crane for the engines and pumps to facilitate the work of handling the heavier parts of the machinery when repairs or adjustments become necessary.

The crane is completed and ready for erection when the room is ready to receive it.

Total cost of contract	$2,700 00
Sundries	96 55

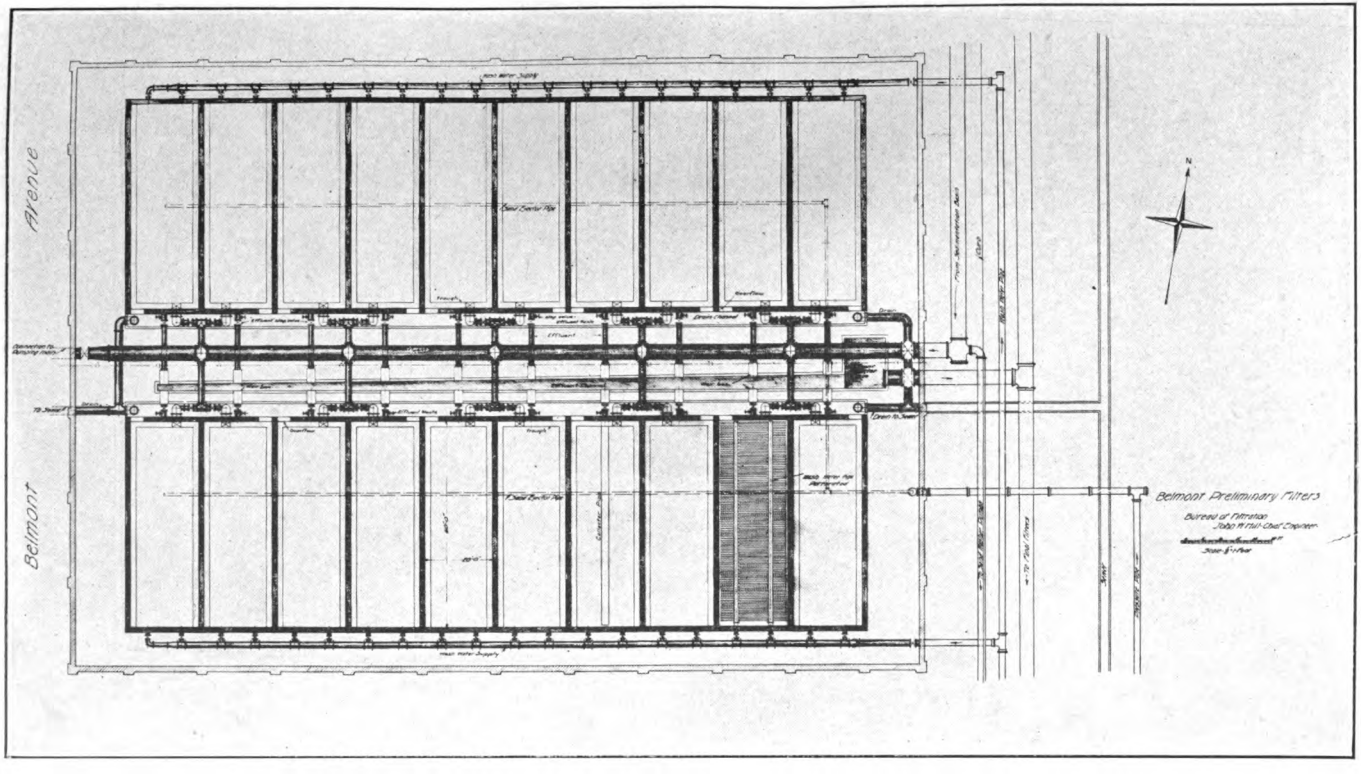
CONTRACT No. 38, BELMONT PRELIMINARY FILTERS.

This contract is now ready, and will be offered for letting at an early date next year.

The plans prepared by the Bureau consist of twenty (20) concrete steel reinforced tanks, each 20 feet wide by 60 feet long, 8 feet 6 inches deep, in which will be placed at the bottom twelve inches of coarse gravel, ranging in size from 2 inches to 1 inch diameter, above which will be placed a layer of sand 30 inches thick of 0.50 m. m., of effective size, and a uniformity co-efficient of 1.50 to 2.00. The sand is thus coarser and more uniform in grain size than that used in the plain sand filters. On the long axis of the filter at the bottom is placed a main collector, of same form and construction as the main collectors of the plain sand filters. The wash water pipes for applying a reverse current of water for washing the sand beds are placed at the surface of the gravel underdrains. The wash water will be carried out of the filter tank in galvanized iron troughs placed at an adjustable height above the surface of the sand. The effluent water will flow from the filters over a rectangular weir, proportioned for a discharge of about 2,100,000 gallons per day of 24 hours.

In operation, nineteen (19) of these filters will be capable of treating 40 million gallons of water per day, and one of the series will always be out of service. Each filter will work at a rate approximately 80 million gallons per acre per day.

The sand bed when clogged with mud and other matter in suspension in the water, will be washed daily or oftener by a reverse current of water applied under a head of 50 feet, and when the bed has become so clogged with mud balls and other suspended matter in the water as to render the washing by reverse current ineffective, the filter will be taken out of service, the sand removed by a water ejector



PLAN OF PRELIMINARY FILTERS, BELMONT.—CONTRACT NO. 38.

(such as are now in use for the transportation of sand at Lower and Upper Roxborough), washed in a 3-hopper washer, of the same type as those in use at the present filter stations, and discharged from the washer into the spare filter of the system.

The preliminary filters at Belmont, and elsewhere in the improvement of the water supply are intended to do in a short time what could be accomplished only in a very long time by plain subsiding reservoirs. Thus subsided Schuylkill water, as shown by experiments in Fairmount Basin No. 3, shows about the same average reduction of turbidity at the end of 21 days subsidence, as prefiltered water, and to show the relative time to prepare water for plain sand filters by the two methods the following illustration is offered:

The pre-filters at Belmont, operating at the rate of 40 million gallons per day will perform the same work in reducing the turbidity and amount of suspended matter in the water as would a sedimentation reservoir operating on the quiescent plan of 1,440 million gallons capacity, or on the continuous plan of 720 million gallons capacity, or from ten to twenty times the capacity of the present Belmont sedimentation reservoir.

There is a distinct limit to the advantage of carrying water in subsiding basins for great lengths of time by reason of the action of the wind and temperature on shallow bodies of water. Thus it was shown in the experiments at Fairmount, that the purification by quiescent subsidence was not improved by extending the time, and the maximum percentage reduction of turbidity was obtained during intervals of time ranging from eleven to twenty-four days. As a matter of interest the Fairmount basin tests are given:

Date of Test.	Original Turbidity.	Days of Subsidence.	Final Turbidity.	Percentage Reduction.	
				Short Term.	Long Term.
December 18, 1901, to January 9, 1902....	175	22	33	81	
1902.					
March 21—April 14.....	90	24	35	61	
April 21—May 5.....	12	14	9	25	
April 2—May 12.....	12	21	16	.....	33
May 19—May 30.....	11	11	4	64	
May 19—June 6.....	11	18	8	.....	27
June 16—July 2.....	12	16	6	50	
June 16—July 6.....	12	20	8	.....	33
July 18—August 5.....	11	18	3	73	
July 18—August 15.....	11	28	10	.....	9
Average.....	52	18	15	59	

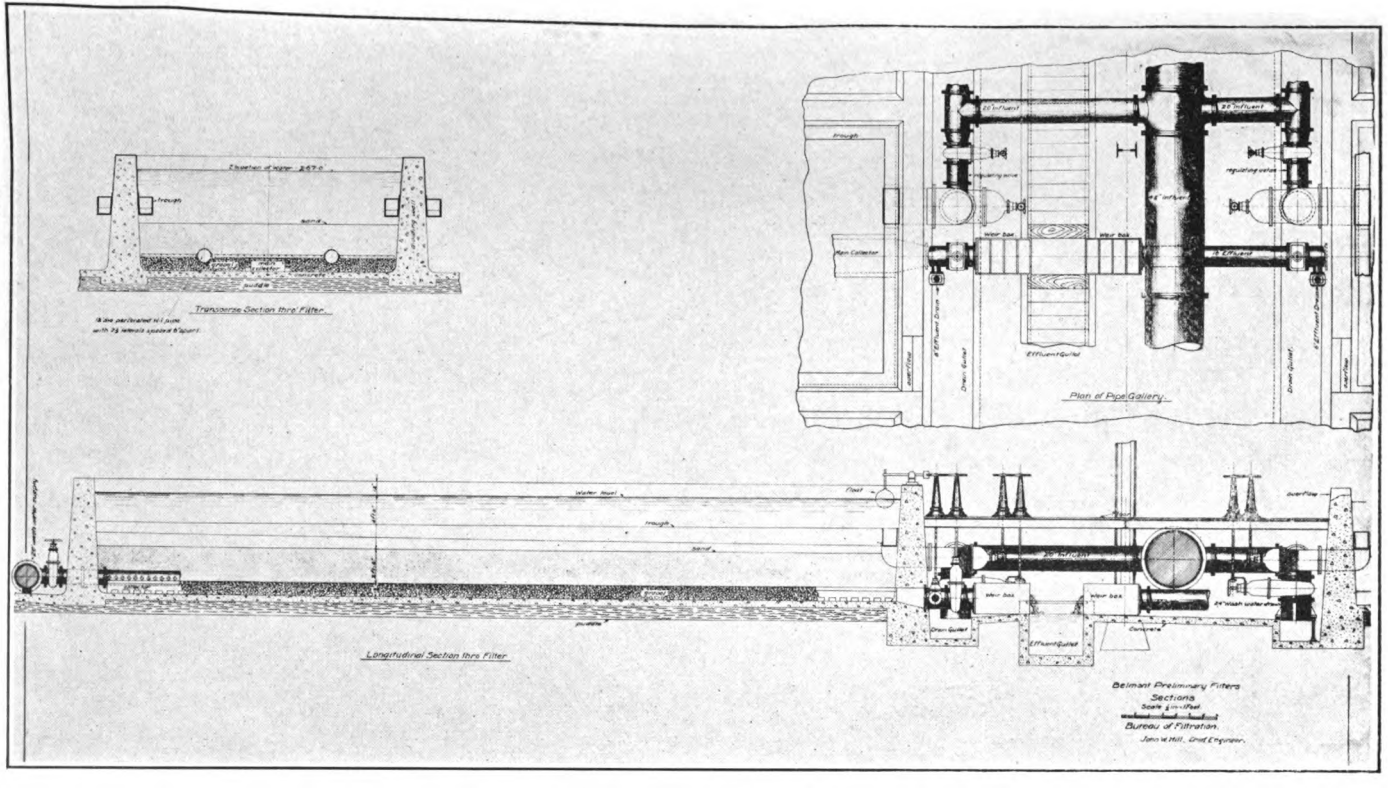
The figures show that by prolonging the time the reduction of turbidity is frequently diminished.

The average reduction of turbidity by quiescent subsidence for eighteen days in the Fairmount basin is shown to be 53 per cent., while the experiments with preliminary filters at the Spring Garden Testing Station on Schuylkill water, and Harrison Mansion Testing Station on Delaware water show reductions varying from 60 to 75 per cent., at rates of flow from ten to twenty times greater than would be possible with subsiding reservoirs.

Contract No. 64, Preliminary Filter House.

The plans and specifications for this contract are in progress, and the contract will be ready to offer at a letting at the same time as Contract No. 38.

The building is being carried out on lines which will allow the exterior to harmonize with the Administration



LONGITUDINAL SECTION THROUGH PRELIMINARY FILTERS, BELMONT.—CONTRACT NO. 38.

Building and other buildings at Belmont, but with no expense as to interior finish. The purpose of the building is to provide only a substantial weatherproof structure for the comfort and protection of the filter attendants.

Sand Ejectors.

Six sand ejectors upon the model adopted for Upper Roxborough will be required at Belmont and arrangements to procure these by inviting letter bids, as heretofore, will be made early next year.

Sand Ejector Pipes.

Each filter will be fitted with permanent water supply and sand and water discharge pipes, in the same manner as at Lower and Upper Roxborough.

The plans for this work are under way, and steps will be taken early in the year to install these pipes in anticipation of the earlier scraping of the first group of filters which will be started in service.

Fence Around Reservoir.

As a protection to life, a timber fence with cedar posts and yellow pine rails and pickets, has been provided around the City property north of Ford road. The material for the fence has been ordered, and the Water Bureau will furnish the carpenter work and labor for setting the fence as early as the weather will permit.

At the present time, with both divisions of the reservoir filled, much risk to trespassers is assumed, and it is the purpose to proceed with the construction of the fence as soon as possible.

Total actual expenditure on Belmont, not including Contract No. 38, Preliminary Filters; Contract No. 64, Pre-

liminary Filter House, Sand Ejectors, Sand Ejector Pipes, and fencing around reservoir		$2,594,139 86
Total to date for salaries, inspection, supplies and expense of field corps.....		64,608 90
Percentage cost of field corps (to date), 2.43.		
Land damages	$349,309 45	
Legal expenses	1,996 51	
		351,305 96
		$3,010,054 72
Estimated cost of all contracts required for the completion of the Belmont Works..		$239,828 75

The field work for these contracts was executed under the supervision of Assistant Engineers LaMonte Lloyd and Charles H. Paul.

EXTENSION OF PIPE DISTRIBUTION LINES IN THE ROXBOROUGH AND EAST PARK SERVICE.

CONTRACT No. 17.

Daniel J. McNichol, Contractor.

This contract embraced pipe lines "A" to "J," inclusive, as follows:

Pipe Line "A," for the supply of filtered water to Germantown, Ward 22, from the Lower Roxborough clear water basin, thirty (30) inch pipe, via Dearnley avenue, Fowler street, Domino lane, Silverwood street, Hermitage street, Pechin street, Walnut lane, Wissahickon avenue, Chelten avenue, Greene street and Coulter street to Germantown avenue.

Twenty (20) inch pipe, from Germantown avenue, on Coulter street, Boynton street, Penn street, Chew street,

Stenton avenue, Thorps lane to Twenty-first street, and on Greene street from Coulter street to Logan street (Germantown).

Sixteen (16) inch pipe on Greene street, from Logan to Berkley street, and from Greene street, on West Logan street, Germantown avenue and East Logan street to Fisher's Station.

Total length of line, 41,700 feet, or 7.90 miles.

Pipe Line "B," for the supply of filtered water to Manayunk, Ward 21, from the Lower Roxborough clear water basin, thirty (30) inch pipe on Dearnley avenue, Fowler street, Domino lane, Silverwood street, Leverington street, and Silverwood street to Greene street (Manayunk).

Twenty (20) inch pipe from Green lane, on Silverwood street, Cotton street, and Terrace street to Walnut lane (Manayunk).

Sixteen (16) inch pipe on Terrace street from Walnut lane to Ridge avenue.

Total length of line, 15,852 feet or 3.00 miles.

Pipe Line "C," for the supply of filtered water to Chestnut Hill, Ward 22, thirty (30) inch pipe from Shawmont avenue, on Ridge avenue, Rex avenue, Palairet property, Fairmount Park, Wissahickon drive, Rex avenue and Germantown avenue to Hartwell avenue.

Length of line, 14,964 feet, or 2.83 miles.

Pipe Line "D," for the supply of filtered water to Germantown, Ward 22, twenty (20) inch pipe from Wissahickon avenue, on Frank street, Greene street and Johnson street to Morton street (Germantown).

Sixteen (16) inch pipe from Johnson street, on Morton street, East Washington lane, and Chew street to Haines street (Germantown).

Length of line, 12,600 feet, or 2.39 miles.

Pipe Line "E," East Park System, thirty (30) inch pipe from York street, on Sixth street, and Susquehanna avenue to Fourth street.

Length of line, 2,280 feet, or 0.432 mile.

Pipe Line "F," East Park System, thirty (30) inch pipe on Girard avenue, from Front street to Eleventh street.

Length of line, 5,166 feet, or 0.977 mile.

Pipe Line "G," East Park System," thirty (30) inch pipe on Twelfth street, from Girard avenue to Poplar street.

Twenty (20) inch pipe on Twelfth street, from Poplar street to Spring Garden street.

Length of line, 3,420 feet, or 0.648 mile.

Pipe Line "H," East Park System, twenty (20) inch pipe on Broad street, from Callowhill street to Vine street.

Length of line, 600 feet, or 0.114 mile.

Pipe Line "J," East Park System, forty-eight (48) inch pipe from York street on Broad street, Buttonwood street, Thirteenth street, Wood street, and Broad street to Arch street.

Length of line, 14,052 feet, or 2.661 miles.

All of the work embraced in this contract was completed September 8, 1902, and has been in constant service since, excepting pipe lines "A" and "B," which were put in service upon starting the Lower Roxborough filters.

This contract also included the cast iron pipes required for the Lower Roxborough filters and about the Lower Roxborough reservoir to connect the latter as a settling basin with the filters, and four (4) lines of Class "A" 48-inch pipe crossing Frankford creek; three (3) lines on Frankford avenue, and one (1) on the line of Old Front

street, to eventually form a part of the Lardner's Point Pipe Distribution System.

The forty-eight (48) inch pipes at the Frankford creek crossings were placed under this contract in order to execute the work at the same time that other work was being performed by the Bureau of Surveys on the lines of the streets mentioned.

Total expenditure on contract, $749,455.01.

CONTRACT 9—A, CAST IRON STOP BOX FRAMES AND COVERS.

J. Alfred Clark, Contractor.

This contract embraced the iron stop box castings for use on the pipe lines described under Contract No. 17, and was completed December 1, 1901.

Total expenditures on contract, $1,563.80.

CONTRACT 9—B, HUB END STOP VALVES.

Eddy Valve Company, Contractor.

This contract embraced the standard hub-end stop valves for use on the lines of pipe described under Contract No. 17, and was completed December 1, 1901.

Total expenditures on contract, $10,755.00.

CONTRACT No. 13, ROTARY STOP VALVES.

Eddy Valve Company, Contractor.

This contract embraced a lot of 48-inch to 20-inch rotary stop valves, made after the designs of the Bureau of Water, for use on the lines of pipe mentioned under Contract No. 17, and was completed November 1, 1902.

Total expenditures on contract, $12,825.00.

Total expenditures on Contracts 9—A, 9—B, 13 and 17		$774,598 81
Salaries, Inspection, Supplies and Expense of field corps		22,821 73
Percentage cost of field corps, 2.95.		
Repaving on account of Contract No. 17	$81,264 51	
Property damages	11,671 70	
		92,936 21
Total		$890,356 75

Extension of Pipe System, West Philadelphia—Pipe Connections to Upper Roxborough Filters, and Rising Mains to Belmont Reservoir.

CONTRACT No. 19.

Daniel J. McNichol, Contractor.

Pipe Line "K," for the supply of filtered water to West Philadelphia, forty-eight (48) inch pipe from the Belmont clear water basin, on Monument and Belmont avenues to Montgomery avenue.

Length of line, 5,460 feet, or 1.034 mile.

Pipe Line "L," rising mains to Belmont sedimentation reservoir, two (2) lines of 36-inch pipe from the Belmont pumping station through the West Park to Belmont avenue, on Belmont avenue and Ford road to the gate house of sedimentation reservoir. (See Belmont Works.)

Total length of both lines, 15,456 feet, or 2.927 miles.

Pipe Line "M," supply and discharge pipes for the low service pumping machinery, supplying water to the Upper Roxborough filters.

Thirty-six (36) inch pipe from the Upper Roxborough reservoir on Eva street to the Roxborough Auxiliary Pump-

ing Station; also thirty-six (36) inch pipe connecting the northerly and southerly effluent pipes of the Upper Roxborough reservoirs.

Forty-eight (48) inch pipe on the discharge line to the filters in Eva street, Port Royal avenue and Hagy street.

Thirty (30) inch pipe on the discharge line in Eva street.

Total length of lines, 3,816 feet, or 0.723 mile.

Pipe Line "N," distribution pipe from the Upper Roxborough filters.

Forty-eight (48) inch pipe from the clear water basin, and main effluent of filters, Upper Roxborough, in Hagy street, Port Royal avenue and Eva street to Seffert street.

Thirty (30) inch pipe, connecting the forty-eight (48) inch distribution pipe with an old line of thirty (30) inch pipe in Eva street.

Total length of lines, 1,644 feet, or 0.311 mile.

Pipe Line "O," gravity draw-off pipe from Upper Roxborough filters, above the sand line, to the effluent pipes from Upper Roxborough sedimentation reservoir.

Twenty-four (24) inch pipe from the south court of filters on City property, Port Royal avenue and Eva street, to junction with Pipe Line "M."

Length of line, 1,500 feet, or 0.284 mile.

Pipe Line "P," connections at Roxborough stand pipe.

The materials and labor for this work was furnished by the Bureau of Water.

Pipe Line "Q," Belmont System. Sixteen (16) inch pipe on Locust street from Forty-fifth to Fifty-seventh street.

Ten (10) inch pipe for connections with intersecting lines of pipe.

Total length of lines, 4,212 feet, or 0.798 mile.

Pipe Line "R," Belmont System. Twenty (20) inch pipe, from the George's Hill stand pipe, via West Park, Wynnefield and Overbrook avenues, Upland Way, Woodbine avenue, and Sixty-third street to Lansdowne avenue.

Length of line, 14,712 feet, or 2.786 miles.

All of the work embraced in this contract was completed January 31, 1903, and excepting the lines "K" and "L," Belmont, and lines "M," "N" and "O," Roxborough, has been in service since that date. Lines "M," "N" and "O," Upper Roxborough filters, were put in service July 3, 1903, and line "L," Belmont filters, was put in service October 4, 1903.

Total expenditures on contract.....	$499,805 18
Salaries, inspection, supplies and expense of Field Corps	14,096 25
Total	$513,901 43

Percentage cost of Field Corps, 2.82.

CONTRACT No. 66. PIPE LINE "U"—EXTENSION OF PIPE LINE "A" (CONTRACT No. 17) ON WISSAHICKON AVENUE TO SUPPLY WATER FROM THE LOWER ROXBOROUGH FILTERS INTO WARDS 28 AND 38.

24-inch pipe (Pipe Line "U") on Wissahickon avenue from Chelten avenue to Nicetown lane.

20-inch pipe on Nicetown lane, Venango street and Twenty-second street to Allegheny avenue.

16-inch pipe on Twenty-second street to Lehigh avenue.

Total lengths of lines, 13,632 feet, 2.582 miles.

Estimated cost of Pipe Line "U," $65,000.00.

(The capacity of the Upper and Lower Roxborough filters when the pumpage of the Shawmont station reaches

FILTERS IN PROCESS OF CONSTRUCTION, TORRESDALE.—CONTRACT NO. 25.

25,000,000 gallons per day of 24 hours will exceed the requirements of the present Roxborough distribution district, and it was thought desirable to extend the filtered water at an early date into the nearest districts accessible from the main distributing line (Line "A"). Ward 38 lies next south of Ward 22, and at small comparative cost a line of pipe can be laid from Wissahickon and Chelten avenues into this ward, and by an extension on Twenty-second street to the northern boundary of Ward 28 it is anticipated that the line of pipe embraced in the contract (Contract No. 66) will supply filtered water to 33,104 people in Ward 38, and 25,938 people in Ward 28, representing an assumed consumption of about 10,000,000 gallons daily.)

This contract was advertised and bids received September 4, 1903, but no award was made, and the contract will be again offered at the next letting.

Estimated cost of Pipe Line "U," $65,000.00.

TORRESDALE FILTERS.

Contract No. 25, Filters and Clear Water Basin.

Daniel J. McNichol, Contractor.

This contract, which was well described in the report of the Bureau of Water for 1901, page 271, embraces fifty-five (55) plain sand filters arranged in five groups or batteries of eleven (11) filters each, and clear water basin of 50,000,000 gallons capacity at flow line, 207.00 T. D. Each filter has a net sand area of 0.75 acre, and with respect to the pipe and sewer systems, influent and effluent regulators, and other features of construction, is quite the same as the filters at Belmont and Upper Roxborough.

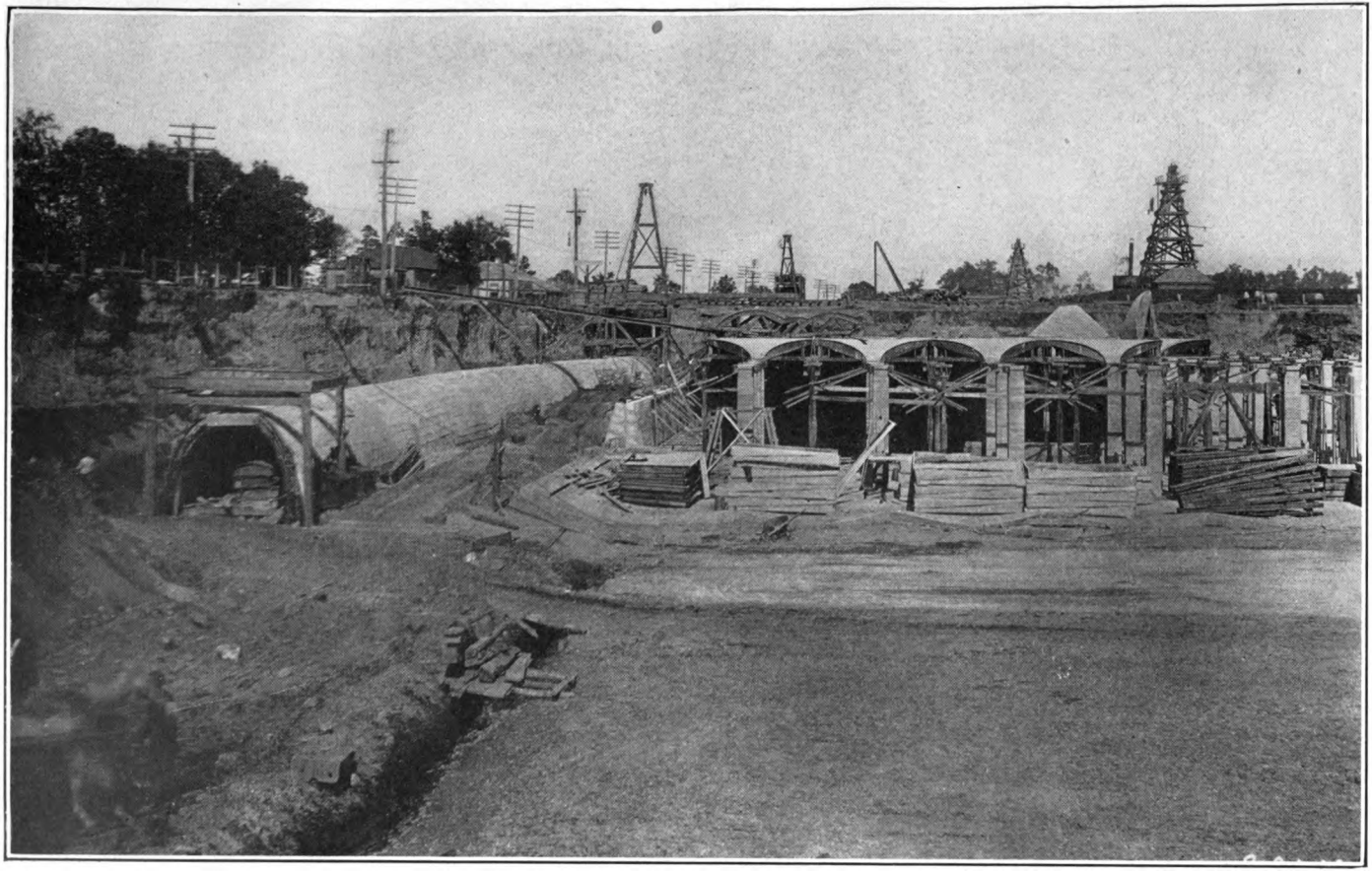
At the present time nearly 80 per cent. of the work has been performed, and it is thought no delay beyond the contract time will be experienced in the completion of the work.

Face of contract		$4,939,874 50
Limit of contract		5,000,000 00
Payment to date		3,555,346 42
Salaries, inspection, supplies and expense of field corps		63,460 68
Percentage cost of field corps to date, 1.79.		
Land damages	$311,463 13	
Jurors and legal fees	12,274 05	
		$323,737 18

While the contract in its construction is like that of all the other filter stations, the colossal character of the work taken as a whole gives it a unique position in water work structures. Like the great Staines reservoir on the river Thames, England, above Hampton Court, it is the largest project of this kind ever constructed. At this station within a space of two years, unless some unforeseen condition should arise, there will be supplied a volume of filtered water larger than the entire consumption by the city of London; a volume two and one-half ($2\frac{1}{2}$) times the combined capacity of the filtration work at Berlin and Hamburg.

From these works will come the water for nearly 1,100,000 present population. As projected they will represent nearly five-sixths the whole City water supply, and it is not unreasonable to expect that this, the largest filtration works in the world, when it is in successful operation, will be visited by people interested in the filtration of public water supplies from all parts of the world.

The filtered water from this station will flow by gravity to the pumping station at Lardner's Point, about three miles south of the Torresdale station.



CLEAR WATER CONDUIT AND BASIN, TORRESDALE FILTERS.—CONTRACT NO. 25.

Contract No. 50, Filtering Materials and Collectors.

Daniel J. McNichol, Contractor.

This contract embraces the furnishing and distribution of the perforated terra cotta lateral collectors and the filtering materials in the Torresdale filters, under the same specification and plans as are employed for the filtering materials for Belmont (Contract No. 49).

No part of the work has been performed to date.

Face of contract, $500,000.

Limit of contract, $500,000.

The total cost of the work for fifty-five (55) filters will amount to $1,028,079.13, but the appropriation by Councils December 29, 1902, of $500,000 for this purpose, limits the cost of the present work to that amount, which represents less than one-half the total cost for this work.

It may be well to remark that while the first cost of the filtering materials is very great they are practically indestructible, and excepting the small loss of sand in handling and washing, and by the action of the wind on the dry piles of washed sand in the courts, no losses occur, and the materials will endure to the end of time.

Required to complete contract, $527,878.50.

Total cost of contract when completed, $1,027,878.50.

Contract No. 34, Delaware River Intake.

This contract will embrace the necessary masonry works in the Delaware river opposite Pennypack street, and the conduit to conduct the raw river water to the pump well of the low service pumping station. It is desirable to place the intake pier as far off shore as the United States Government regulations will permit in order to avoid shore water at low tides.

The intake pier will be provided with removable screens to prevent large floating materials from entering the pier house and flowing with the water into the pump well and into the pumps. The screens will be raised and lowered, when required, by hand cranes supported on "I" beams.

CONTRACT No. 36, LOW SERVICE PUMPING STATION.

This contract will embrace the engine and pump room, boiler rooms, office and locker and toilet rooms for the engineers, firemen and coal wheelers.

The engine room will contain space for foundations for six (6) 50,000,000 gallons per day centrifugal pumps and driving engines; a pump well on the long axis of the room and space for the discharge pipes to the pre-filters.

This room will also accommodate the pumps which supply water under pressure to the sand washers and ejectors at the sand filters, and the pumps to supply wash water for the preliminary filters.

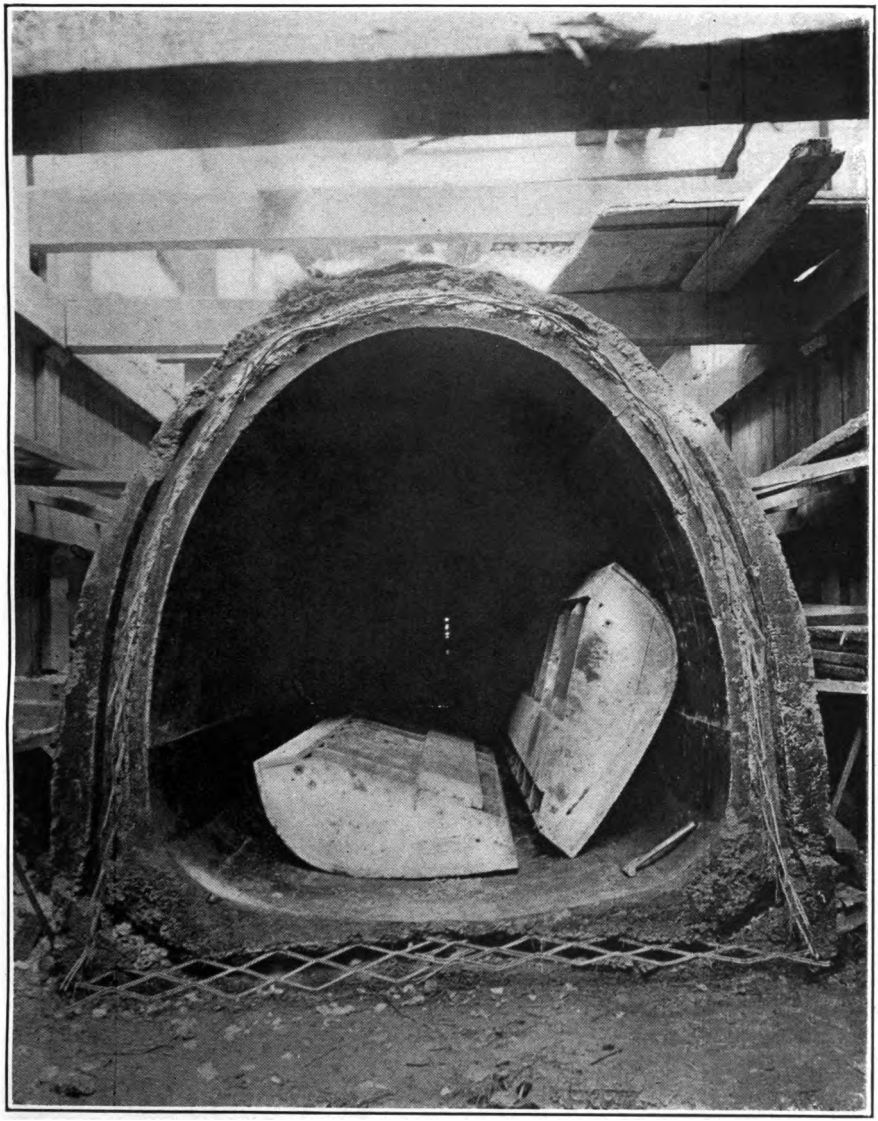
The boiler room will contain space for 2,800 commercial horse-power of internally fired marine boilers.

A single brick chimney 9 feet 6 inches diameter at top, one hundred and seventy-five (175) feet high, will form part of this contract.

CONTRACT No. 35, LOW SERVICE PUMPING MACHINERY.

This contract will embrace six (6) 50,000,000 gallon centrifugal pumps, with vertical compound or triple expansion driving engines direct connected to the impeller shafts of the pumps, to supply raw water from the Delaware river to the preliminary filters. In service five engines and pumps will be running, and one pump and engine always in reserve.

This contract will also embrace 2,800 commercial horse-power of internally fired marine boilers, boiler feed pumps,



9-FEET CLEAR WATER CONDUIT, TORRESDALE FILTERS.—
CONTRACT NO. 25.

steam and exhaust piping, and the necessary appurtenances for the engine and boiler rooms.

Contract No. 39, Preliminary Filters.

This contract will embrace preliminary or roughing filters of the same capacity as the plain sand filters, viz., 248,000,000 gallons per day of twenty-four hours. The Bureau plans of this contract follow the same principles of design as are described under Contract No. 38, Belmont preliminary filters.

Contract No. 69, Preliminary Filter House.

This contract will embrace the preliminary filter house, similar in design and finish to the building described under Contract No. 64, for the preliminary filters at Belmont. The exterior brickwork, trimmings and roof finish will match the regulator houses of the filters and the low service pumping station described under Contract No. 36.

The raw water will be pumped to the flow line of the preliminary filters, and the flow line of the gullet, which receives the prefiltered water, will be placed at an elevation to supply the plain sand filters by gravity.

Contract No. 41, Sand Washers and Preliminary Filter Pumps.

This contract will embrace the pumps to supply water under pressure to the sand washers and ejectors of the plain sand filters, and the pumps to furnish wash water to the preliminary filters.

The sand washer pumps will consist of three (3) 5,000,000 gallon plunger pumps to work against a pressure of 90 pounds per square inch, including friction of discharge mains. The capacity of the ejector and sand washer pumps is based upon the probable scraping, transportation and

washing of sand for seven filters at one time. Excepting in cases of emergency it is doubtful if more than one filter of each of the six batteries will be out of service at the same time. The water for the supply of the sand washer and ejector pumps will be taken from the clear water basin.

The pumps for the washing of the sand beds of the preliminary filters will be of the centrifugal type, and will consist of four (4) ten million (10,000,000) gallon machines, three (3) to operate and one (1) to be held in reserve. Under ordinary conditions two of the pumps will be capable of doing the work, but at times when the turbidity of the raw water is high, and the washings of the filters become more frequent, the third, and upon rare occasions the fourth pump will be required. Water for the supply of the preliminary filter wash pumps will be drawn from the discharge mains of the preliminary filters.

Contract No. 47, Electric Lighting System.

This contract will embrace the electric generators and driving engines, wiring, poles, arc and incandescent lamps, etc., to supply the illumination for the pumping station, preliminary filter house, plain sand filters, regulator and gate houses, and for the avenues, roads and courts around and through the filter grounds. The electrical machinery will consist of three generators and driving engines, each set of 60 kilowatts capacity at 220 volts.

Contract No. 52, Coal Handling Machinery and Pockets.

This contract will embrace the machinery for handling coal for steam use, from barges in the Delaware river, and from railway cars to the coal pockets.

Contract No. 54., Queen Lane Contingent of Filters.

This contract will embrace ten (10) additional filters of same size and capacity each as the filters now being constructed under Contract No. 25, with some slight modifications which are calculated to reduce the cost per filter, and overcome some working difficulties experienced with some of the operating devices at Lower and Upper Roxborough.

The plans and specifications for this contract are now ready to offer for letting, and will be included in the next letting of contracts.

Some explanation may be necessary for this contract, and Contracts Nos. 55, 56 and 59, which are contingent upon it. At the time the plans and contract for the Torresdale filters (Contract No. 25) were being prepared it was thought that the present Queen Lane basins of about 350,000,000 gallons capacity might be used as slow subsiding reservoirs, and that by ten days subsidence upon the continuous plan, the water would be as free from bacteria and turbidity as the filtered water from Torresdale, and that such water at the rate of 35,000,000 gallons per day could be supplied from this source. Experiments therefore were commenced on quiescent sedimentation on the Schuylkill water in basin No. 3, at the Fairmount Works, which was set aside for this purpose. Investigations running through a year indicated that no ordinary time of subsidence would render the water comparable in quality with filtered water, and the plan of drawing water from the Queen Lane basins, excepting in a case of emergency, was therefore abandoned, and plans made for an addition of filters at Torresdale sufficient to supply the volume of water which it was thought might be obtained from the Queen Lane basins by simple sedimentation.

The investigation with reference to the influence of

sedimentation for periods of time, ranging from one to four weeks, was not completed until March 13, 1902, or two months after the work of construction upon Contract No. 25 was started, and these filters could not have been fully anticipated at the time the Torresdale contract and plans were prepared.

Contract No. 55, Queen Lane Contingent of Preliminary Filters.

This contract will be merged in Contract No. 39, and will add to that contract a preliminary filtering capacity of 38,000,000 gallons per day, and increase the capacity provided for from 210,000,000 to 248,000,000 gallons per day of twenty-four hours.

Contract No. 56, Queen Lane Contingent of Sand, Gravel and Lateral Collectors.

This contract will be patterned after Contract No. 50, and will embrace the filtering sand, gravel, underdrains and perforated terra cotta lateral collectors for the ten additional filters provided for by Contract No. 54.

Contract No. 58, Spur from the Pennsylvania Railroad.

This contract will embrace a spur track from the main line, New York Division, of the Pennsylvania Railroad, to furnish fuel and other supplies to the station, together with sufficient sidings to temporarily hold cars while being unloaded.

Contract No. 59, Queen Lane Contingent of Sand Washers and Pumps, Torresdale.

This contract embraces the addition to the sand washers required on account of the Queen Lane contingent of filters at the Torresdale Station, and will be merged in Contract No. 41.

Contract No. 61, Shelter Houses.

This contract will embrace the frame shelter houses for the filter attendants and laborers employed about the filters, located centrally at the Delaware avenue end of each of the three courts between the batteries of filters. These houses will each be provided with an office for the filter attendant, lunch and locker rooms for the laborers, toilet conveniences, electric lighting equipment and steam heat.

The total cost of the contracts required to complete the Torresdale works is estimated at $3,590,000, not including the cost of completing Contract No. 50 (Sand, Gravel and Collectors), viz., $527,878.50, making a grand total of $4,117,878.50, or a total cost for the Torresdale Station of $10,470,029.99.

This station will have about 250,000,000 gallons daily filtering capacity, and the cost of construction per million gallons will be in round numbers $38,470.

Considering the estimated cost of works required to complete the Torresdale Station, it is fair to state that this estimate was made one year ago, at a time when the prices of some materials were greater than at present, and it is expected that when the contracts are made the cost of several will fall below the estimated cost.

TORRESDALE CONDUIT.

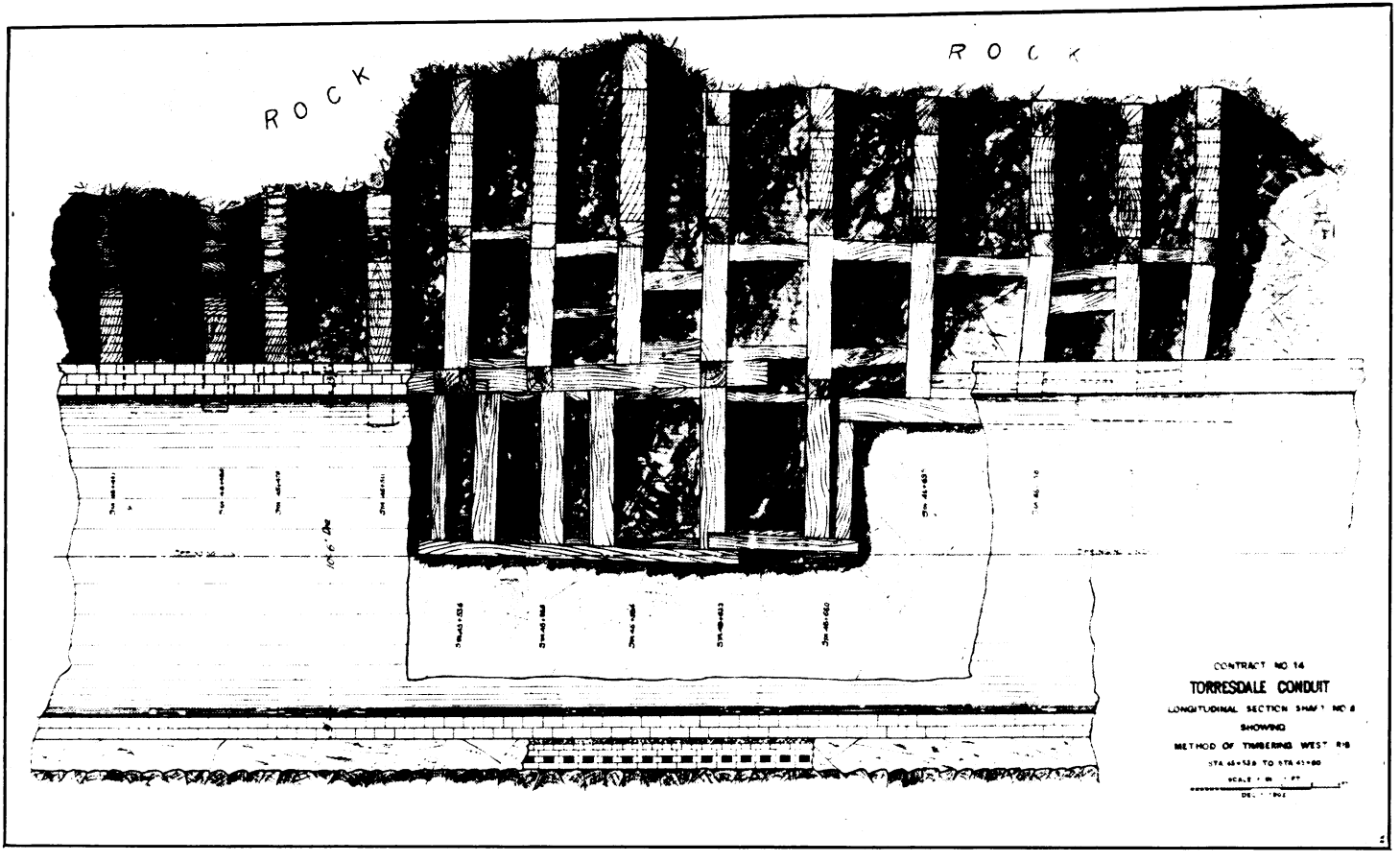
Contract No. 14, Torresdale Conduit.

Daniel J. McNichol, Contractor.

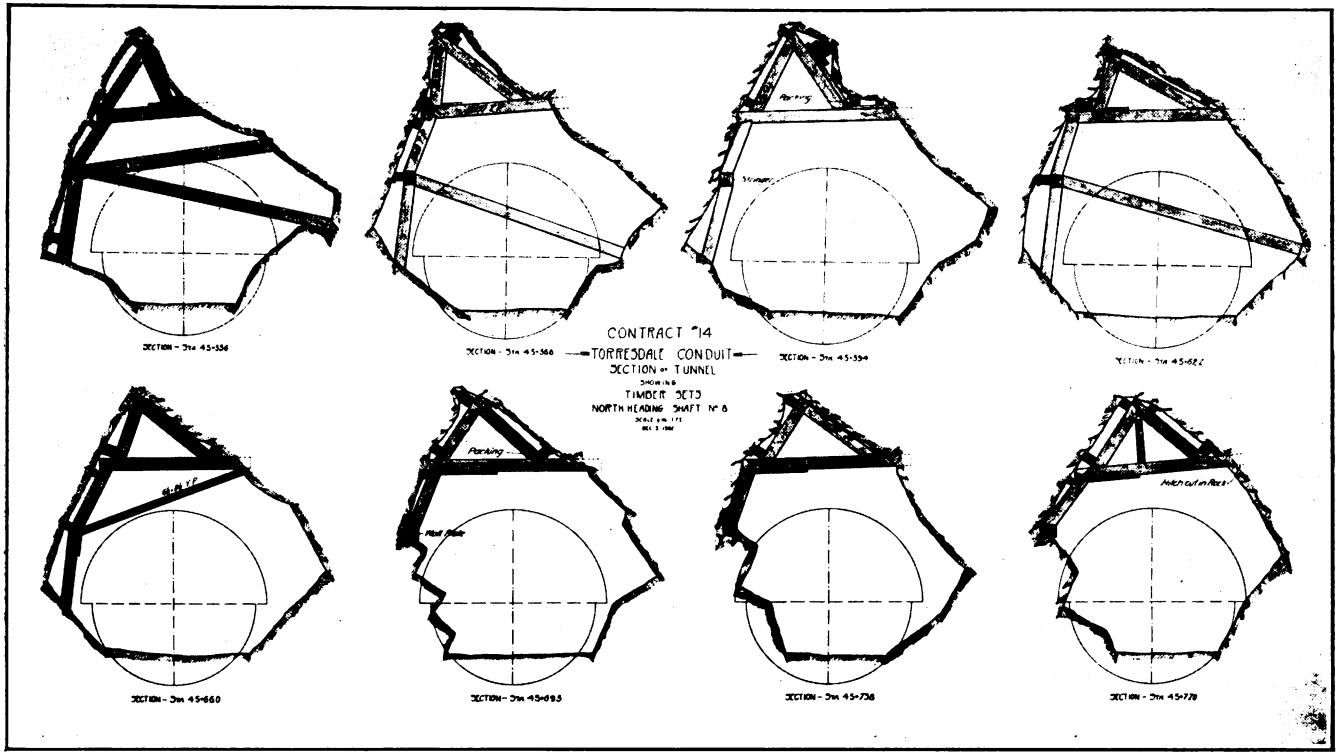
This contract is described in detail on page 247 of the Report of the Bureau of Water, 1901, and embraces a gravity conduit about 14,015 feet long, including end shafts, for the supply of filtered water from the Torresdale filters to the pumping machinery located at Lardner's Point. With the exception of the upper fifty feet of Shaft No. 11, Lardner's Point, the conduit is uniformly ten feet seven inches diameter inside the brick lining. At the time the plans were made it was thought advisable to plaster the inside of the brickwork with a coat of cement mortar (one of cement to one of sand), one-half inch thick, but the generally damp condition of the brick lining rendered this impracticable, and to compensate for the plastering the brickwork in both invert and arch was laid to neat lines and all excess mortar in the joints carefully scraped and cut away. It is believed that the excess diameter of one inch, and the care with which the lining was laid, will give the conduit as great a carrying capacity as a diameter of ten feet six inches would have done with a plastered surface.

In lining the tunnel where the ground was treacherous and liable to heavy falls, the standard arch of three rings was increased in thickness to four and in some locations to five rings of brick, to guard against injury to the conduit by subsequent motion of the material above the excavated section.

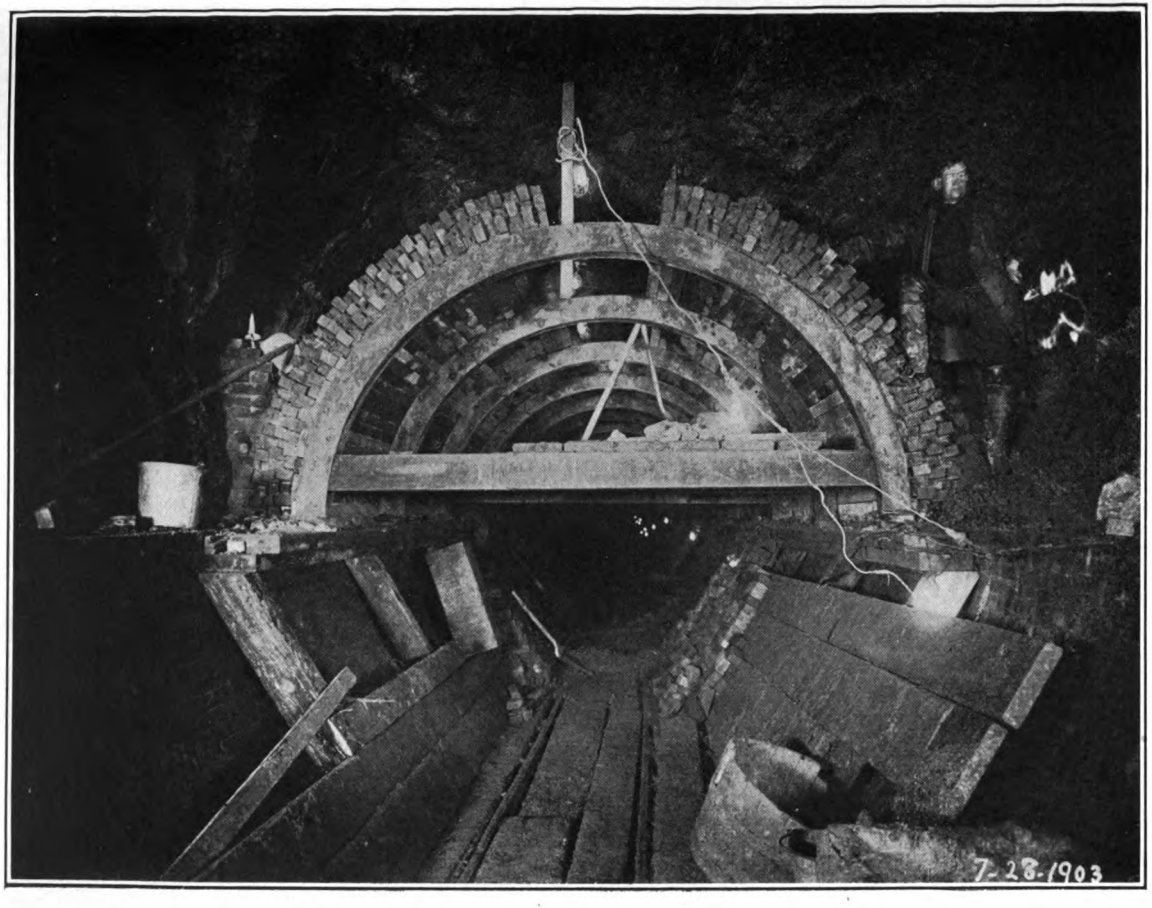
The concrete packing over the arch was conducted with the utmost care, no lining or packing was permitted excepting in the presence and under the supervision of experienced inspectors, and all voids which could not be



TIMBERING, TORRESDALE CONDUIT.—CONTRACT NO. 14.



TIMBERING, TORRESDALE CONDUIT.—CONTRACT NO. 14.



BRICK LINING, TORRESDALE CONDUIT.—CONTRACT NO. 14.

reached with concrete were filled with cement grout pumped under a pressure varying from fifty to one hundred pounds per square inch, through pipes built into the arch. After the packing in any section was completed, the weepers of wrought iron pipe were capped or plugged and finished flush with the interior of the brick lining.

The bends at the lower portion of the end shafts where these join the tunnel were planned of brickwork, but to secure better lines and avoid the possibility of doubtful work on the concave side of the bends, it was decided to substitute concrete for the brick, which was built to a centre, set in place at the bottom of each shaft. The inside surface of the bend is faced for one and one-half inch with granolithic finish.

The filtered water is drawn from the clear water basin through a concrete metal reinforced conduit, of horseshoe section, equivalent in area to a circular conduit 10 feet diameter, 855.00 feet long, from the outlet of the clear water basin to the shaft. This conduit is connected to the shaft at elevation 186.50 T. D., centre line, through a cast iron nozzle bolted to the steel shell of the shaft, 8 feet diameter, which is connected with the concrete conduit through a length of riveted steel pipe 8 feet diameter, 21 feet long.

In addition to the nozzle which connects with the conduit from the clear water basin, an additional nozzle 7 feet diameter is attached to the shell of Shaft No. 1, at right angles to the first mentioned nozzle, for a connection to an additional clear water basin, which in the future may be needed at Torresdale.

From Shaft No. 11 at Lardner's Point, the filtered water is conducted to the pump wells of Engine Houses No. 2 and No. 3, and to an additional pump well which will be required in Engine House No. 4, when built, through a cast iron nozzle tapering from 12 to 14 feet diameter, and con-

nected by a 14 feet diameter riveted steel pipe 28 feet long, to the 14 feet diameter concrete aqueduct forming part of Valve Chamber No. 3, Lardner's Point Pumping Station, and by a cylindrical cast iron nozzle, 7 feet diameter, with steel riveted pipe of same diameter, 28 feet long, to the reinforced concrete aqueduct leading to Valve Chamber No. 2, at Lardner's Point.

Considering the conduit as carrying 300,000,000 gallons of water per day, the velocities at different points will be as follows:

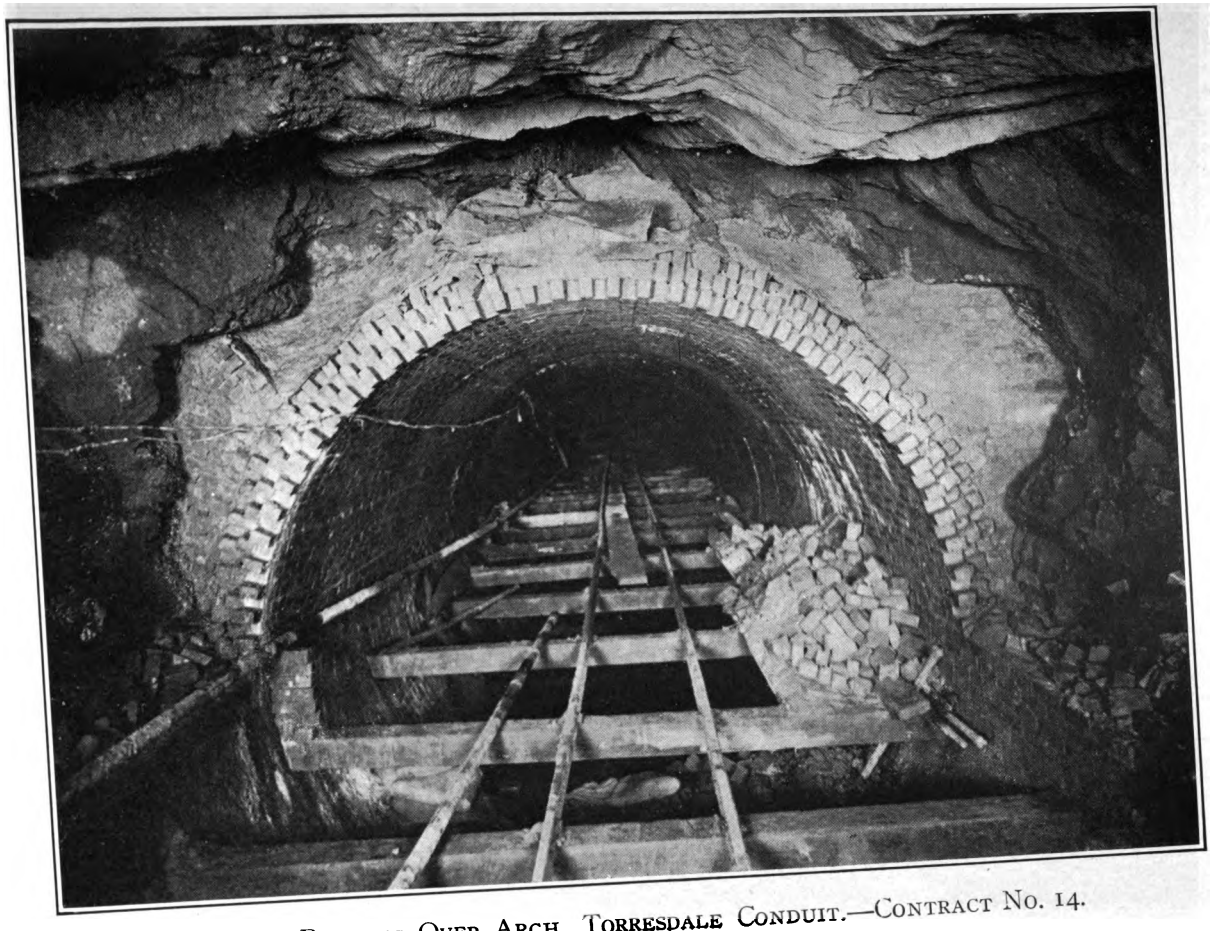
Ten (10) feet diameter conduit from clear water basin at Torresdale	5.920	feet	per	second.
Eight (8) feet diameter nozzle and steel pipe, Shaft No. 1...	9.240	"	"	"
Shaft No. 1 and tunnel.....	5.360	"	"	"
Shaft No. 11, at lower end.....	5.360	"	"	"
Shaft No. 11, at upper end.....	1.340	"	"	"
Aqueduct to pump wells Nos. 2, 3 and 4	3.015	"	"	"

The total loss of head between the clear water basin at Torresdale and the pump well at Lardner's Point for delivery of 300,000,000 gallons per day of twenty-four hours is estimated at 9.25 feet.

In order to arrive at the probable influence of gravel and rock water which may find its way in small quantity into the conduit between Shaft No. 8 (working shaft) and Shaft No. 11, chemical and bacteriological analyses are made from time to time of small streams which trickle through the brick joints in the lining. With the exception of the large quantity of iron in solution in the rock water, no other objectionable condition is found, and considering the small amount which may work into the conduit with a slightly lower head in the conduit than in the rock, it is

TIMBERING AND LINING, TORRESDALE CONDUIT.—CONTRACT NO. 14.

CENTERING FOR ELBOW, SHAFT NO. 11, TORRESDALE CONDUIT.—CONTRACT NO. 14.



CONCRETE PACKING OVER ARCH, TORRESDALE CONDUIT.—CONTRACT NO. 14.

possible that the influence of infiltration of water cannot be detected in the large volume of filtered water which will be flowing through the conduit to Lardner's Point.

Gaugings of the flow of rock water between Shafts No. 1 and No. 11, are going on and will be reported in due time.

To prevent the tunnel from becoming air bound it is graded at the rate of nine inches to 1,000 feet upwards from Shaft No. 1, Torresdale, to Shaft No. 11, Lardner's Point.

The north end of the work contained very hard rock, classified as Biotite Gneiss, with large well defined streams of water which entered the headings from time to time as the work of excavation progressed, while at the south end, between working shaft No. 7 and permanent shaft No. 11, the rock was much softer, with considerable pockets of black micaceous sand and clay, but with less water from the rock.

In the operation of the conduit at maximum estimated flow, the head in the tunnel will be greater than the head on the rock water, until working shaft No. 8 is reached, and no inflow of the rock water can take place.

The two cast iron nozzles and mouth pieces at Shaft No. 11 weigh nearly 60,000 pounds; the nozzle and mouth pieces at Shaft No. 1 weigh nearly 27,000 pounds.

Each end shaft is constructed of a steel shell down to the rock, the lower end of the shells being sealed with cement grout in the rock. Inside the steel shell is placed a brick lining 18 inches thick.

At the south end of the work much heavy timbering to prevent dangerous falls was required, and in some few instances the sets were not removed in lining the tunnel, but all loose timber, packing and poling boards were drawn as the packing over the arch progressed at such places.

This contract is now 95 per cent. completed.

Face of contract	$1,274,000 00
Additions to date	51,799 98
Total	$1,325,799 98
Limit of contract	1,350,000 00
Payments to date	1,194,304 08

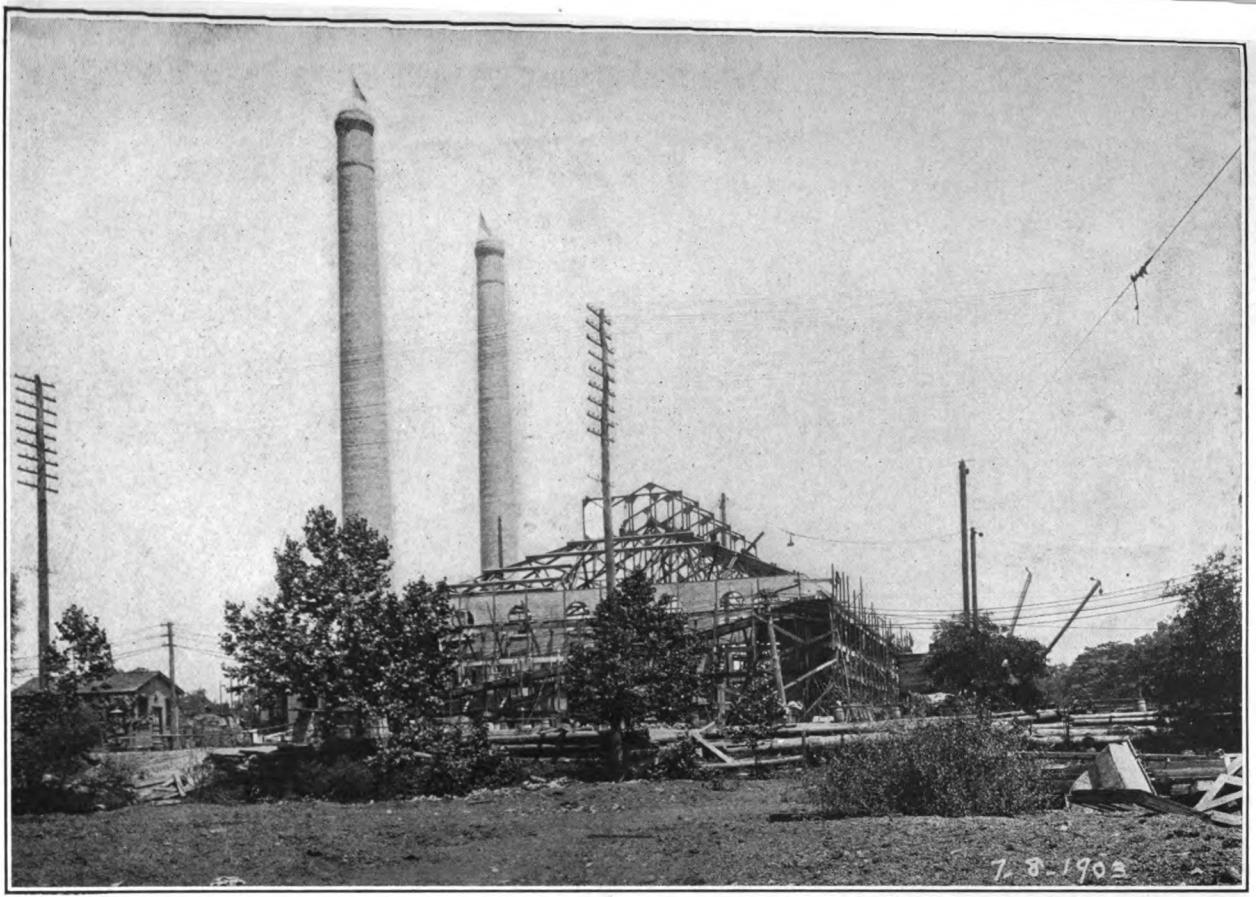
CONTRACT No. 5, TEST BORINGS (TORRESDALE CONDUIT).

Flaghouse & Beeson, Contractors.

This contract embraced the sinking of test holes in the drift and diamond drill borings in the rock on the projected line of the Torresdale conduit, in order to determine the quality of the materials through which the shafts and tunnel would have to be driven, and incidentally to arrive at the probable amount of water which would be encountered in the excavation of the work. Twenty of these holes were sunk along the line of the work, and the diamond drill borings carried into the rock to depths from 100 to 135 feet below the surface.

The cores and drillings from the diamond drill borings were carefully collected and placed in boxes, marked for the respective hole, and stored in Room 729, City Hall, for the use of the bidders at the time of taking bids upon the contract, and to govern the Bureau in determining the character of the work which would be required in the proper conduct of the work.

Total cost of contract	$8,833 30
Total cost of Contracts Nos. 14 and 5	1,334,633 28
Salaries, inspection, supplies and expense of field corps (Contracts Nos. 14 and 5) to date	47,153 05
Percentage cost of field corps, to date, 3.53.	
Damages to private property	1,100 62



General View of Lardner's Point Pumping Station.—Contract No. 29.

LARDNER'S POINT PUMPING STATION.

CONTRACT No. 29, LARDNER'S POINT PUMPING STATION No. 2.

George C. Dietrich, Contractor.

This contract embraces an engine house, boiler house, dynamo room, pump room for the boiler feeders, toilet rooms and two Custodis brick chimneys.

The engine house at the floor level of engine room has clear inside dimensions of 87 feet by 171 feet, and the boiler house at floor line clear inside dimensions of 82 feet 6 inches by 162 feet.

The engine and boiler houses are built on concrete foundations. The engine house is built as a skeleton steel structure with brick curtain walls. The face work is laid up with gray standard size pressed brick, and the lining of standard size light buff pressed brick; outside wall trimmings of pink granite and terra cotta; backing walls of stretcher brick.

The boiler house is built with solid brick walls faced with standard size gray brick the same as walls of engine house, and lined with selected stretcher brick. The inside surface of the walls of the boiler house is finished with asbestine.

The height of the basement of the engine house is such as to provide a clear space for the entire water ends of the pumps below the floor of engine room.

The engine and boiler house are each provided with a ventilator reaching the full length of roof between the hip trusses. Each ventilator is fitted with pivoted sash to be worked from the ground floor of the building.

All roof coverings over the matched sheathing are of Celadon red tile laid on Watson's roofing felt, with cold rolled copper flashings and trimmings.

All the steel structural work for the engine house has been placed in position and riveted up, the granite base course set, and the brick walls carried up to the top of the arches over the doors. The first course of yellow pine flooring, with slip tongues, has been placed, the roof sheathed, and the building far enough advanced to admit of setting up the pumping engines, which work will begin within a few weeks.

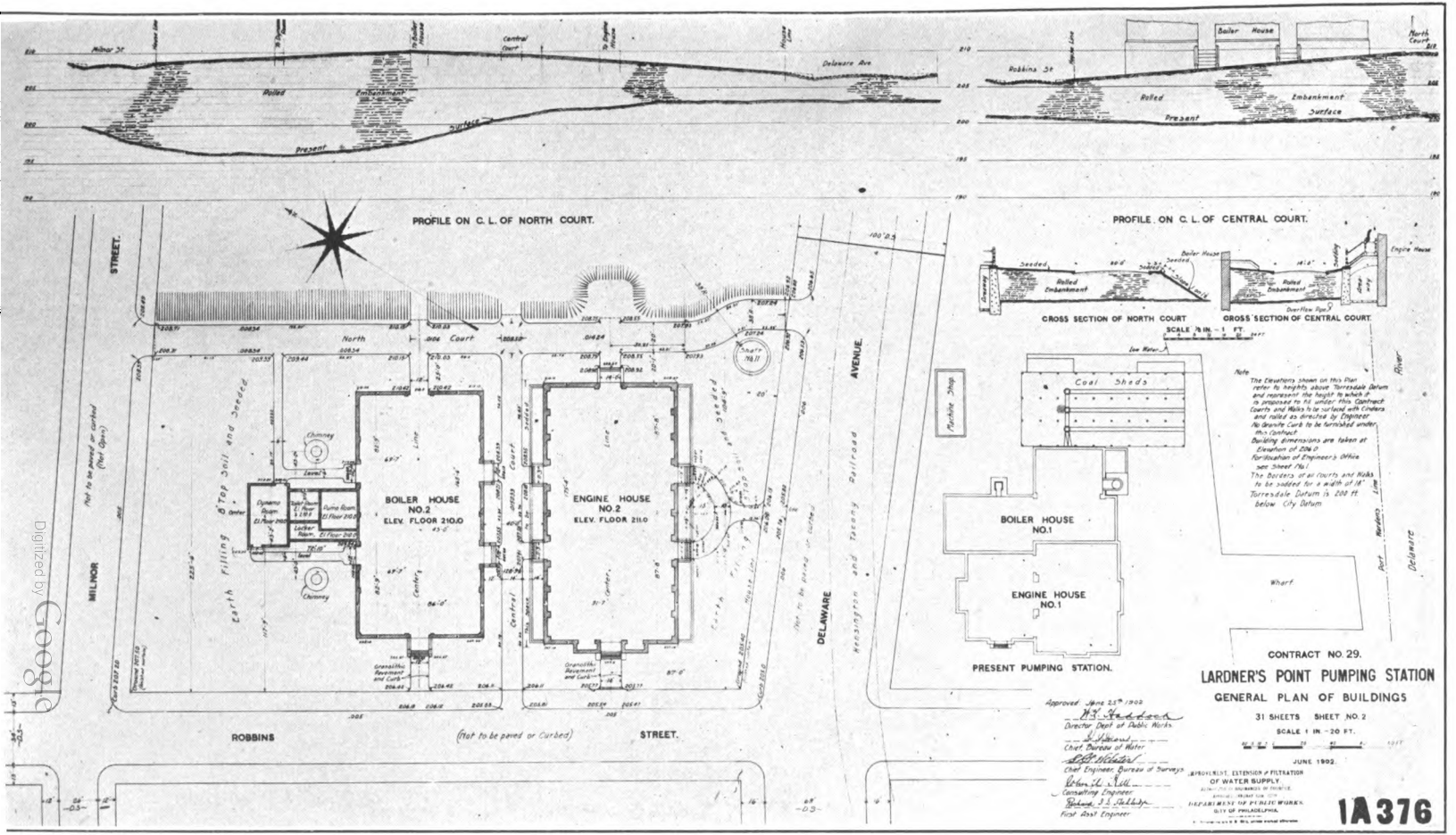
The stone entrances at the south end and east side of the building have been set.

The sub-structures for this contract have been the most difficult features of the work. All of the waterways, valve chambers, and the pump well are placed sufficiently below ground level to admit of an easy supply of water from the Torresdale filters of 300,000,000 gallons per day without risk of impairment of the work of the station, and in the case of the Delaware river connection lying alongside and near the present pump house, excavated partly in filled ground, of limited stability, across Delaware avenue and in front of the new pumping house, and with considerable quicksand in the bottom of the trench, the work has been very tedious and the rate of progress much less than was anticipated.

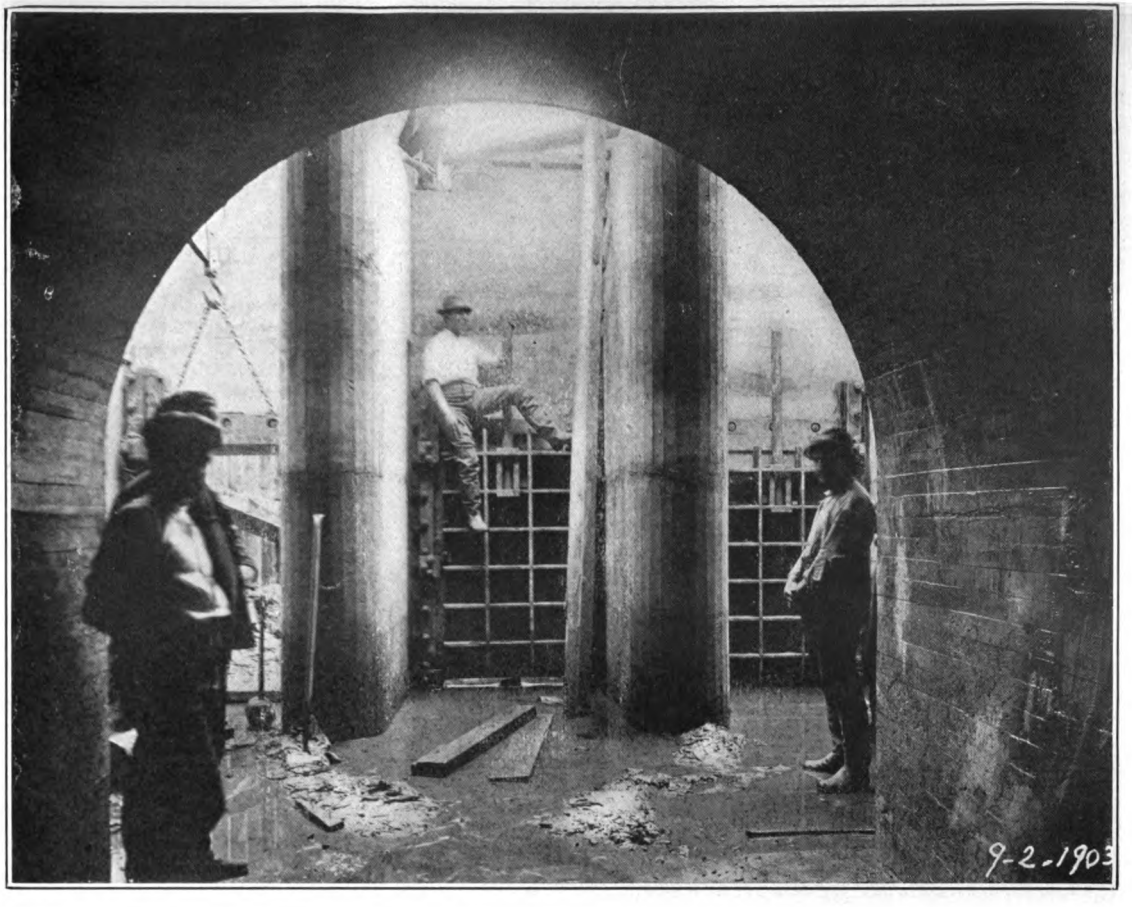
At the present time, by reason of very energetic work upon the part of the Contractor during the past three months, the difficulties of the work relating to the river connection have been nearly overcome, and with suitable weather for placing concrete, this feature of the contract can be pushed to early completion.

In all cases where the bottom of trenches has not furnished an entirely reliable foundation for heavy concrete conduits and chambers, timber grillage of ten by ten inch timbers, laid as sills and platforms, has been used.

Wherever concrete has been used in watertight work under pressure, steel bars have been imbedded in the ma-



PLAN OF LARDNER'S POINT PUMPING STATION, NO. 2.—CONTRACT NO. 29.



GATE CHAMBER, DELAWARE RIVER CONNECTION.—CONTRACT NO. 29.

sonry longitudinally and transversely to assist in resisting the tensile stresses which may occur in the construction and use of the structures.

The Delaware river bulkhead and sluice gates which control the entrance of the river water have been completed, and about 100 feet of the conduit leading to the pump well completed, and the trench backfilled. Opposite the old engine house, where during the spring and summer so much trouble was experienced in keeping water out of the trenches, a nearly watertight dam of tongue and groove piling has been driven and the inflow of water from the river under the old pump house is now easily controlled.

The boiler house, chimneys, smoke flues, boiler foundations and setting for the three additional batteries of boilers (to be purchased under Contract No. 67) have been partially completed. The window sash in the walls and ventilator have all been placed and glazed, and the doors temporarily closed for the winter.

This building is in readiness for the reception of the boilers, and when these (contracted for under Contract No. 11) have been set, and all connections below floor level in the pipe gullets made, the interior of the house can be completed by the contractor within a few weeks.

In the feed pump room the foundations for the pumps have been completed, together with all other work excepting the placing of the granolithic floor, and trimming of the electric light outlets. The dynamo room has been finished ready for the construction of the foundations for the electric lighting machinery to be obtained under Contract No. 45.

The remainder of the work in the superstructures of the contract can be finished during sixty days of good working weather. More time, however, will be required for the completion of the river connection and construction of

Valve Chambers No. 1 and No. 3, and the east conduit, which connects Valve Chamber No. 2 with Shaft No. 11, of the Torresdale Conduit.

Valve Chamber No. 2 is nearly completed, and the excavation for Valve Chamber No. 1 about one-half completed.

The contract as a whole is about 66 per cent. completed.

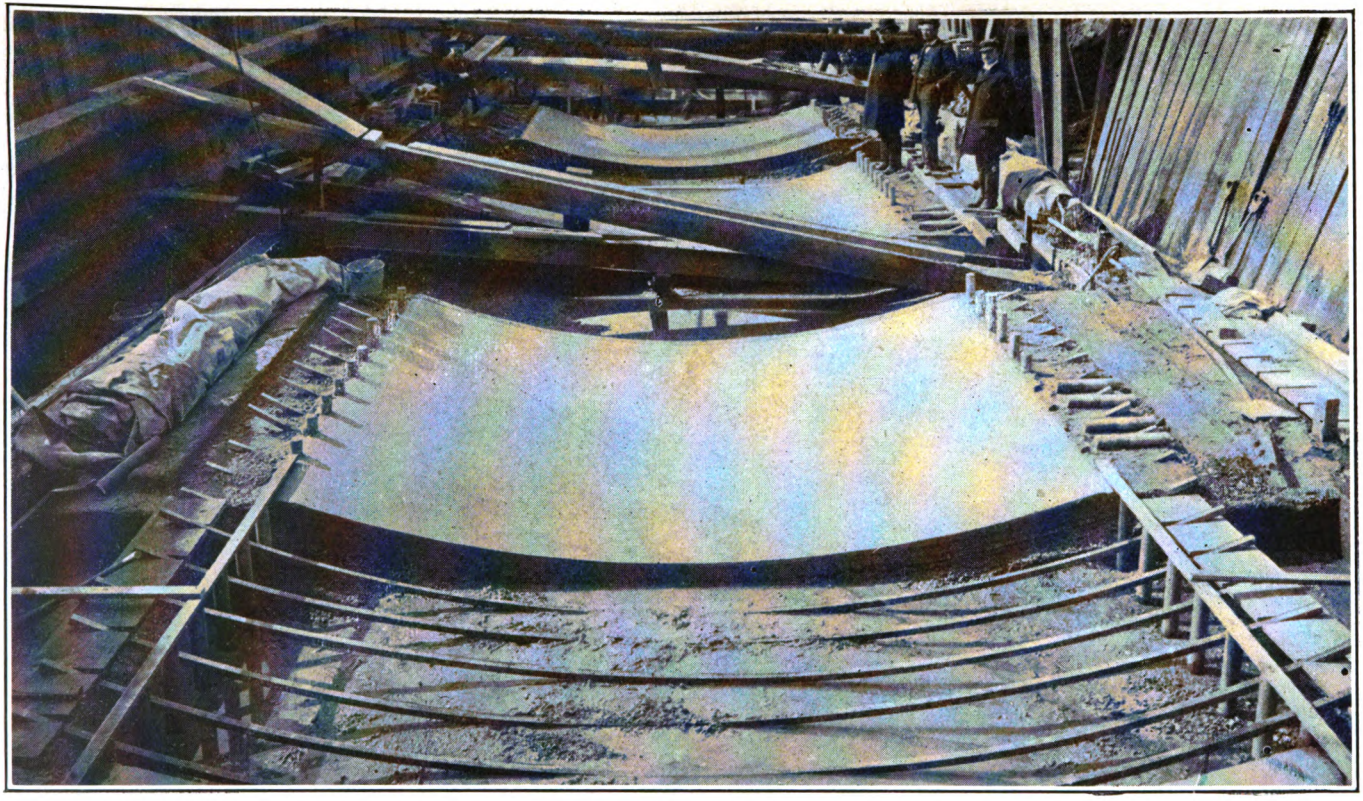
Face of contract	$532,000 00
Additions to date	28,772 59
Limit of contract	565,000 00
Payments to date	315,117 65
Architect fees	3,000 00
Salaries, inspection, supplies and expense of field corps to date	19,115 03
Percentage cost of field corps to date, 3.383.	
Land damages	9,970 02

Contracts Required for Completion of Lardner's Point Pumping Station.

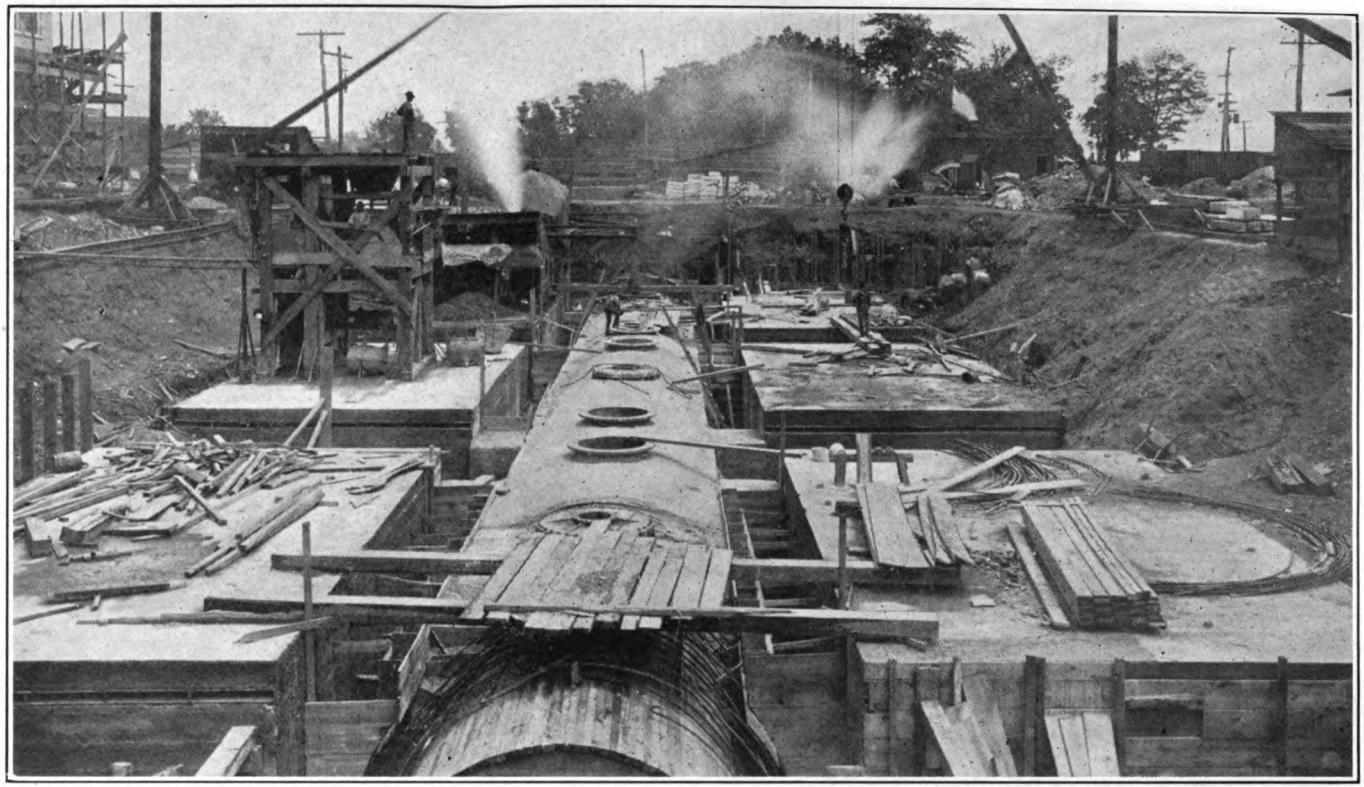
CONTRACT No. 68, LARDNER'S POINT PUMPING STATION No. 3.

This contract will embrace an engine and boiler house, feed pump room and toilet room, and two chimneys similar in style and nearly similar in dimensions to these details for Contract No. 29. The engine and boiler house will be placed on the same center lines north of engine and boiler house No. 2.

Valve Chamber No. 3, of Contract No. 29, is being constructed with a water connection to the pump well of Engine House No. 3, and the new contract above enumerated will embrace only the three principal details mentioned, and the pump well and engine and boiler and feed pump foundations.



STEEL RE-INFORCED CONCRETE, PUMP WELL.—CONTRACT NO. 29.



PUMP WELL AND ENGINE FOUNDATIONS.—CONTRACT NO. 29.

The boiler room will be provided with toilet and locker rooms for the employees about the houses.

Under this contract, in proportioning concrete, instead of following the usual method of stating it in parts by measure, the following specification was adopted:

> "Concrete shall be made in the proportions of one hundred and five and one-half (105½) pounds of Portland cement, one and one-half (1½) cubic feet of sand, and one and one-half (1½) cubic feet of limestone screenings, and five (5) cubic feet of ballast."

Provision also is made for a test of concrete cubes taken from batches of concrete used in the work under the following requirements:

> "A six (6) inch cube of concrete taken from batches used in the work shall show not less than the following crushing strengths per square inch:
> At the end of thirty days, 1,500 pounds.
> At the end of sixty days, 1,850 pounds.
> At the end of ninety days, 2,200 pounds.
> Where cubes fail to meet the strengths above noted the work of which they are samples shall be removed and rebuilt."

CONTRACT No. 31, COAL HANDLING AND STORAGE APPLIANCES.

This contract will embrace the machinery and pockets for the conveying of coal from barges or railway cars, and storage for use in pockets from which it will be drawn into iron larries for conveyance to the boiler rooms of Boiler Houses No. 2 and No. 3.

CONTRACT No. 45, ELECTRIC LIGHTING EQUIPMENT.

This contract will embrace the electrical generators, driving engines, main switchboard and wiring from the generators to the switchboard.

CONTRACT No. 48, ELECTRIC TRAVELING CRANE FOR ENGINE HOUSE No. 3.

This contract will embrace a 30-ton electric traveling crane for Engine House No. 3. The crane will be in all material respects similar to the one erected under Contract No. 11 in Engine House No. 2.

CONTRACT No. 43, SUCTION CONNECTIONS TO ENGINE HOUSE No. 1.

This contract will embrace the furnishing of materials and placing of the suction connections from Valve Chamber No. 1, Contract No. 29, to the pump wells of Engine House No. 1, present Frankford pumping station, for the supply of filtered water to the engines now in this station.

The estimated cost of contracts required to complete the Lardner's Point Pumping Station is $606,000.

HIGH SERVICE PUMPING MACHINERY.

CONTRACT No. 11, PUMPING ENGINES AND BOILERS AND ELECTRIC TRAVELING CRANE FOR LARDNER'S POINT PUMPING STATION (FRANKFORD PUMPING SERVICE).

Holly Manufacturing Co., Contractors.

This contract embraces three 20-million gallons vertical high duty, triple expansion, rotative, self-contained pumping engines, three batteries of four marine fire-box boilers each, each boiler of 200 commercial horse-power, and one 30-ton electric traveling crane.

Each engine has the following general dimensions:

H. P. steam cylinder, 32 inches diameter.
L. P. steam cylinder, 60 inches diameter.
L. P. steam cylinder, 90 inches diameter.
Plungers, single acting, 33 inches diameter.
Stroke, 66 inches.
Main shaft, $20\frac{3}{4}$ inches diameter.
Main shaft bearings, $17\frac{1}{2}$ x 32 inches.
Crank pins, 12 x 11 inches.
Suction and discharge connections, 42 inches diameter.
Fly wheels, 2 to each engine, 20 feet diameter.
Fly wheels, weight, each 30 tons.
Total weight of one engine, about 1,000 tons.

The pumps are built with independent cast steel valve decks, 12 decks to each pump (six (6) suction and six (6) discharge), each deck contains 72 4-3/16-inch rubber valves; clear waterway through valve seats 124.6 per cent. of plunger area.

Two of these engines are now completed at the shops of the contractors, Lockport, New York, awaiting shipment, and the third is well advanced towards completion.

All the boilers are completed at the shops of the I. P. Morris Co., Philadelphia, and orders have been issued to forward the setting of these, in the boiler house constructed under Contract No. 29.

The electric traveling crane has been completed in the engine room ready for the electric current.

Total cost of contract	$352,985 00
Additional suction pipes built into pump well under Contract No. 29, for the additional engines required under contract No. 67	3,500 00
Total	$356,485 00

Limit of contract	360,000 00
Paid on account (to date).....	100,152 04
Salaries, inspection, sundries and expenses (to date)	4,481 54

Required to Complete.

CONTRACT No. 67, HIGH SERVICE PUMPING MACHINERY.

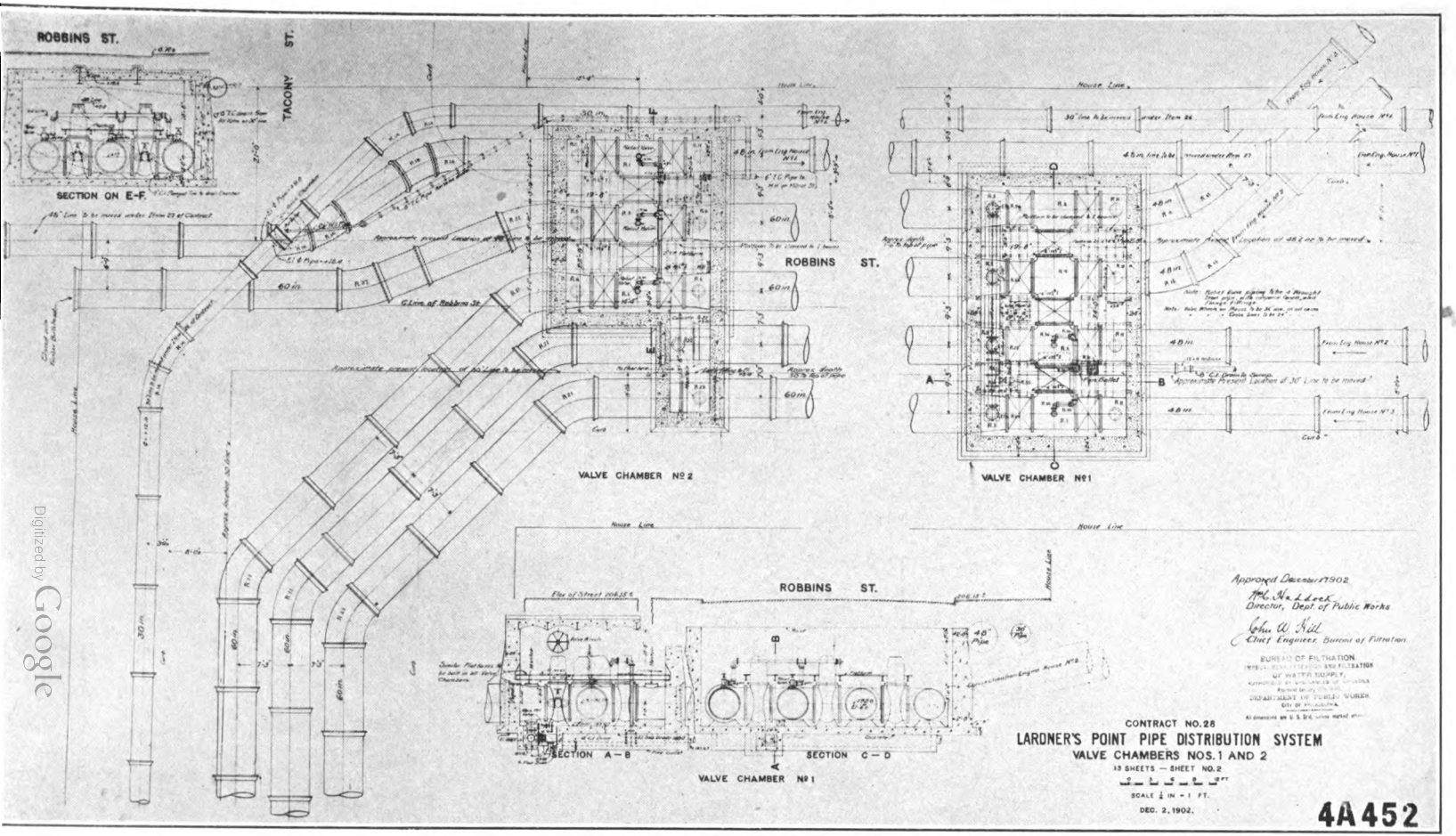
This contract will embrace three additional 20-million gallons vertical high duty triple-expansion pumping engines, and three batteries of marine fire-box boilers of same capacity as those constructed under Contract No. 11. These engines, as well as the engines embraced under Contract No. 11, will work under an actual pumping head of about 255 feet.

The engines and boilers will be erected in the Lardner's Point Pumping Station No. 2, and will complete the machinery required for this station.

CONTRACT No. 51, REMOVING PUMPING MACHINERY FROM SPRING GARDEN AND QUEEN LANE PUMPING STATIONS TO LARDNER'S POINT.

This contract will embrace the removal of two Holly vertical triple-expansion pumping engines from the Spring Garden Pumping Station, and four Southwark vertical triple-expansion pumping engines from the Queen Lane pumping station to Lardner's Point Pumping Station No. 3, to pump into the Lardner's Point pipe distribution system.

Total estimated cost of Contracts No. 67 and No. 51, $480,000.



VALVE CHAMBERS, NOS. 1 AND 2.—CONTRACT NO. 28.

LARDNER'S POINT PIPE DISTRIBUTION SYSTEM.

Contract No. 28, Lardner's Point Pipe Distribution System.

Daniel J. McNichol, Contractor.

This contract embraces the furnishing and placing of the 60-inch, 48-inch, 42-inch and smaller pipe required about the engine house of Lardner's Point Pumping Station No. 2; the furnishing and placing of all stop valves and special castings in the valve chambers and elsewhere in the distribution system; the construction of valve chambers, sewer chambers, where the lines of pipe on Tacony street intersect large sewers, the crossing of Frankford creek on the line of Torresdale avenue, between Frankford and Kensington avenues, and includes all materials and labor required for the construction of the work.

Describing the contract as written, it embraces the 42-inch and 48-inch discharge pipes of Engine House No. 2, at Lardner's Point; four lines of 60-inch cast iron water pipe on Robbins street to Tacony street, and three lines of 60-inch cast iron water pipe on Tacony street from Robbins street to Torresdale avenue, and four lines on Torresdale avenue from Valve Chamber No. 5 to Valve Chamber No. 8, at the intersection of Torresdale and Kensington avenues.

In order to secure the largest possible command of the use, examination and repairs of this system of distribution mains, valve chambers are located along the line of pipe at distances generally 4,000 feet apart, between which, in case of accident to either line of pipe the broken line can be cut out of service during the period required for repairs, and the remaining lines operated to supply water to the districts which this system of pipes will serve.

At each valve chamber is placed a system of 48-inch valves connected to the 60-inch lines of pipe by 60 to 48-inch hub and flange reducers, so arranged that either line entering the chamber may be taken out of service without interfering with the others, each reducer where it enters the valve chamber is provided with a manhole opening, closed by a cast iron cap, to admit of entrance to the line of pipe between the chambers for examination and removal of any incrustations and recoating when required.

Each line of pipe after it enters the valve chamber is provided with a 4-inch Crosby water relief valve, set to blow at 125 pounds pressure, and also with hand operated air valves for the removal of air from the lines.

The first valve chamber in this system of mains occurs in Robbins street at the point where the double line of 48-inch discharge pipe from each side of Engine House No. 2 connects with the main lines of 60-inch pipe. This chamber is provided with eleven 48-inch twin stem geared stop valves. Valve Chamber No. 2 is located on Robbins street near Tacony street, from this point the fourth line of 60-inch pipe will be laid on Robbins street to Torresdale avenue, and on Torresdale avenue to Tacony street, to complete the system when the requirements for water in the future may demand.

All cast iron water pipe, and all cast iron used in special castings, is required by the terms of the contract to show upon standard test bars, 2 inches wide and one inch thick, broken on 24 inch centers, a cross breaking load of not less than 2,280 pounds, and a center deflection of not less than 0.34 inch, with a tensile strength of the iron not less than 22,500 pounds per square inch of section. Very rarely have the cross breaking bars shown as low a cross breaking strength as that required by the contract, and whenever tensile bars have broken at lower loads, it has been due generally to flaws in the castings, and not to defects in the qual-

48-INCH PORTABLE PIPE CUTTER.—CONTRACT NO. 28.

ity of metal. The 60 to 48-inch reducers, and the 48-inch flange tees and crosses required for connection with the lines of cast iron pipe in the several valve chambers are made of cast steel, made by the Seaboard Steel Casting Company, of Chester, Pennsylvania. The metal used in the cast steel special castings showed tensile strengths averaging over 70,000 pounds per square inch of section, with an elongation of about 20 per cent. in two inches, and an elastic limit varying from 40 to 50 per cent. of the ultimate strength.

These castings were made with the same sections as cast iron castings, and are intended to take the place of those pieces which could not be made of cast iron, to obtain the required tensile strength in the material.

The conditions of this contract require that each piece of pipe and each straight special casting, which can be tested by putting it in the ordinary hydrostatic pipe press, or by bolting heads to the flanges of the casting, shall be subjected to a pressure of 300 pounds per square inch before the material is shipped; cast steel special castings were tested to 450 pounds pressure per square inch before shipment; the stop valves were tested to 300 pounds pressure per square inch, and after completion in the line the contractor is required to again test the made up pipe system to 200 pounds pressure per square inch before the trench is backfilled. In service the maximum pressure that will be put on the line cannot exceed the pressure to which the water relief valves are loaded, viz., 125 pounds per square inch.

Where the three lines of 60-inch pipe in Tacony street cross Wissinoming creek and the sewer in Wakeling street, two pipes in each line which span the concrete sewer chamber are made with flange joints at the center to convert these pipes into cylindrical cast iron beams with a

span of 14 feet 6 inches at Wissinoming creek, and a span of 16 feet at Wakeling street.

In estimating the stresses that would be developed in the barrels and flanges of the pipes, and in the bolts of the joints, the maximum ordinance load allowed on trucks was considered.

At the two points mentioned the pipes not only constitute water channels, but also assist in supporting the roadbed.

The valve chambers, of which there are ten, contain as follows:

No. 1. On Robbins street, nearly opposite the center line of Boiler House No. 2, contains eleven 48-inch stop valves.

No. 2. On Robbins near Tacony street, contains eight 48-inch stop valves.

No. 3. On Tacony near Fraley street, contains eight 48-inch stop valves.

No. 4. On Tacony, between Duncan and Church streets, contains eight 48-inch stop valves.

No. 5. At the junction of Torresdale and Frankford avenues, contains ten 48-inch stop valves.

No. 6. At the junction of Torresdale and Frankford avenues, contains six 48-inch stop valves.

No. 7. At the junction of Torresdale and Frankford avenues, contains one 48-inch stop valve.

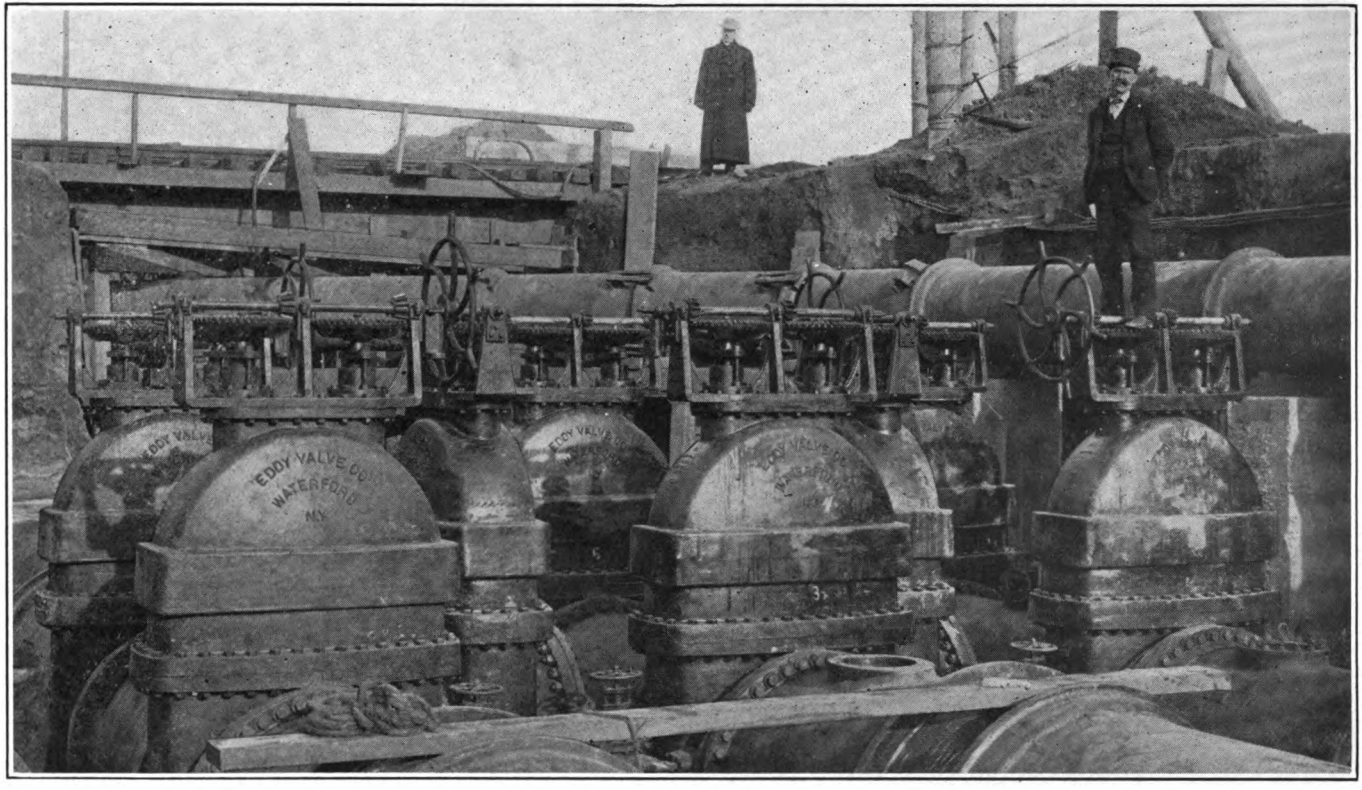
No. 8. At the junction of Torresdale and Kensington avenues, contains twelve 48-inch stop valves.

No. 9. At the junction of Torresdale and Kensington avenues, contains two 48-inch stop valves.

No. 10. At the junction of Torresdale and Kensington avenues, contains three 48-inch stop valves.

All the special castings and stop valves are made with flange joints, and unusual care is being exercised in placing these pieces to insure as perfect and durable work as it is possible to make with the materials used.

UNIVERSAL TROLLEY FOR PLACING VALVES AND FITTINGS.—CONTRACT NO. 28.



VALVE CHAMBER, NO. 2.—CONTRACT NO. 28.

The 60-inch cast iron pipe weighs per length, in round numbers 14,000 pounds.

	Steel.	Cast Iron.
60 to 48-inch hub and flange reducers weigh each about.....	7,900 lbs.	6,800 lbs.
48-inch flange stop valves weigh each about		21,500 lbs.
60-inch manhole castings, placed in the lines of pipe for entrance between valve chambers, weigh each about		6,400 lbs.

The larger part of the material required for the construction of this work has been delivered at the site of the work. The trench has been excavated from the pumping station at Delaware avenue and Robbins street to Tacony and Comly streets, and four lines of pipe in Robbins street have been placed and joints made up. The material required in Valve Chamber No. 2, at Tacony and Robbins streets, has been placed and is ready for the construction of the chamber, and a considerable portion of the pipe on Tacony street, between Robbins and Comly streets, is now in place, the delay at the present time being due to the lack of flange and spigot pipes required for the crossing of Wissinoming creek.

In order to comply with the contract requirements for the laying of this pipe, and the cutting of pipes to make closures, which compels the use of machinery instead of the hammer and chisel, the sub-contractors in charge of pipe laying, Messrs. Harmer & Quinn, have brought on the work some very efficient and ingenious machines, which admit of the cutting of the pipe, either in the ditch or in the street, to exact lengths at right angles to the axis of the bore, and leaving the cut as smooth as if the pipe had been cut in a lathe. The advantage of these machines is two-

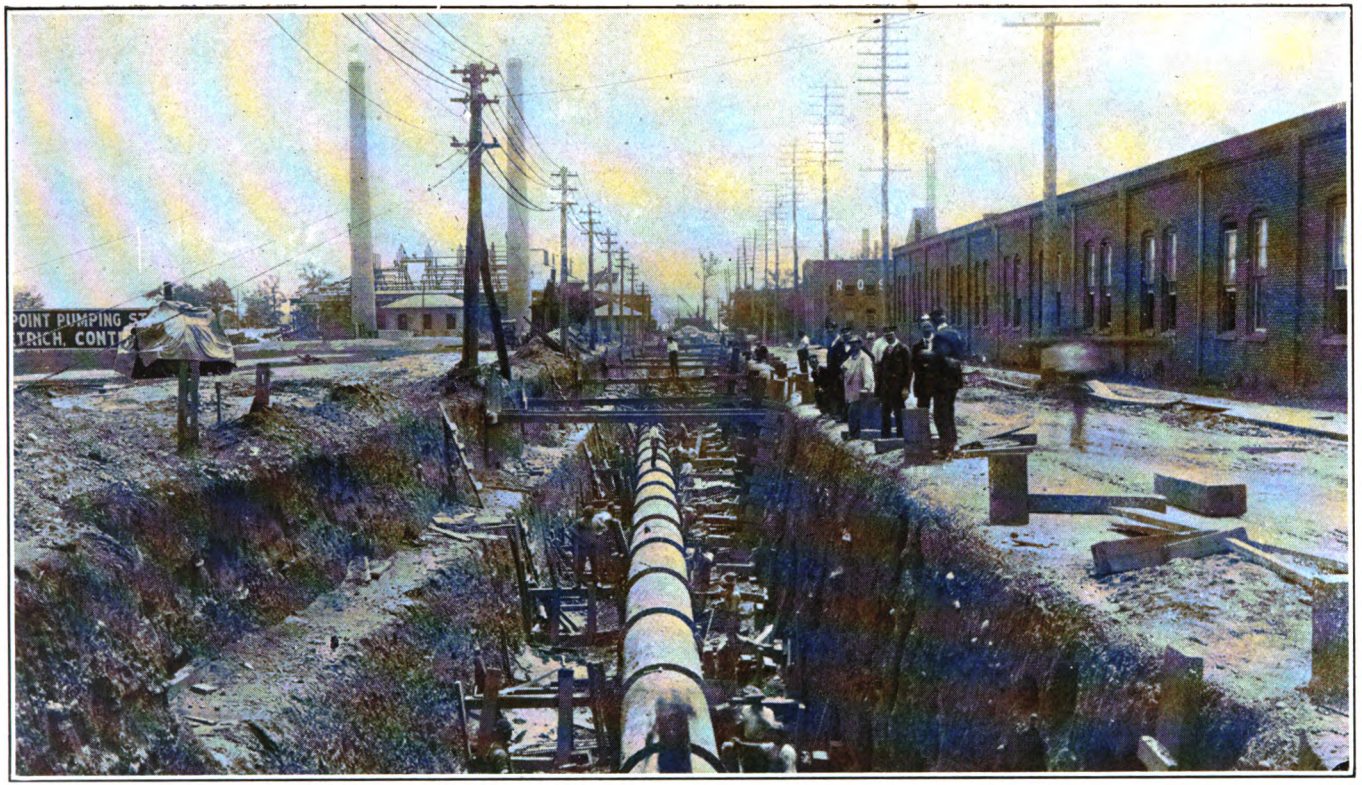
fold: first, to guard against the injury to the pipe in cutting the piece to make a closure, and next to enable the closures to be fitted with much less margin than has been customary where the cutting has been done by hand tools. Machines for the cutting of both the 60-inch and 48-inch pipe have been provided, and they do their work admirably and in less time than would be required by hand. In making a closure of 60-inch pipe, while under ordinary conditions one inch margin would be considered small, by means of the machine for cutting pipe it is possible to make the closure with less than ½-inch margin, thereby insuring a much better piece of work when the pipe has been made up in the trench.

In order to handle the heavy pipe and special castings a 20-ton crane, running on a railway track alongside the ditch, has also been provided. This crane has an adjustable boom, which permits of the putting of a pipe, special casting or stop valve at a convenient distance from the platform, lifting it from the ground, swinging it over the trench, and landing it in position to be made up in the work.

Total cost of 60-inch pipe, including discharge connections from the pumping station	$1,718,361 14
Total cost of 48-inch lines of pipe, "S" and "T"	665,875 49
Limit of contract	1,300,000 00
Payments to date	452,333 36
Salaries, inspection, supplies and expense of field corps	17,042 13

Moving a Line of 48-inch Pipe Under Pressure. Contract No. 28.

In order to provide a right of way in Robbins street for the four lines of 60-inch mains from the Lardner's Point



48-INCH RISING MAIN BEING MOVED UNDER PRESSURE.—CONTRACT NO. 28.

Pumping Station No. 2, it was necessary to relocate a line of 48-inch pipe and a line of 30-inch pipe. It was originally required that these mains should be moved while under pressure, but it was found later that the 30-inch main could be taken temporarily out of service, and the pipe was moved partly as a whole and partly in short lengths. About 40 per cent. of the pipe was removed and relaid as single lengths, and the remaining portion was moved to its new position with screw jacks.

The 30-inch pipe was cast at Gloucester, New Jersey, in 1876, and while no exact records could be obtained, it has probably been in service about twenty-six years, and is to-day in as good condition as when originally laid, and shows no deterioration by reason of tuberculation or corrosion. The tar coating is in good condition, except at joints where heat was applied in melting out the lead. The interior of the pipe was covered with a thin fungus growth, which when dry was easily reduced to powder and brushed out. This it is thought came from the combination of mud and iron in the water from the Delaware river. The deposit was nearly uniform around the interior of the pipe, and less than one-eighth ($\frac{1}{8}$) inch in thickness.

One thousand seven hundred feet of this pipe was removed and relocated, 625 feet of which was underneath the tracks of the Holmesburg and Tacony Electric Railroad, the top of the pipe averaging four feet below the rails. Where the heat used at joints in melting out the lead ring had destroyed the tar coating, a mineral paint was applied to restore as far as possible the pipe to its original condition.

Owing to the fact that about 30,000,000 gallons of water were daily being delivered through the 48-inch main, it was impossible to take the line out of service even for a short length of time, and careful preparations were made for moving it into its new location while under pressure.

No work was done on this however, until the 30-inch main had been relocated and all connections made, to have it in readiness to temporarily supply the Frankford district should an accident occur while moving the 48-inch main.

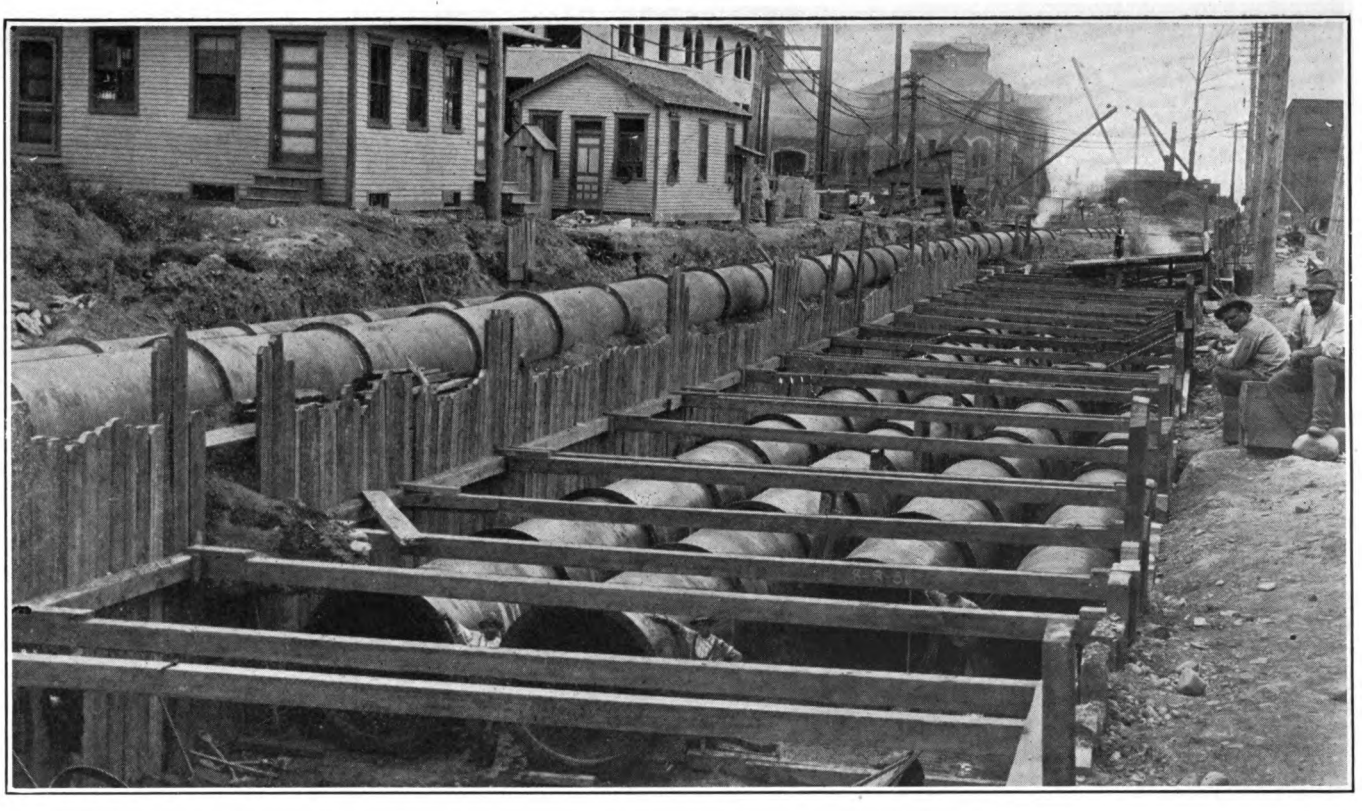
The original length of the 48-inch pipe on centre line was 1,194.45 feet. In moving it to its new location a deflection was made in the alignment of 11.5 feet, and the elevation lowered 13.17 feet. The deflection was made on the first 200 feet at each end of the line, the remaining portion being run on a tangent.

The center line distance of the main in its original position was 1.17 feet (14 inches) less than the calculated center line of its final position. After it was in place careful measurements showed that the actual draw of the joints had only been 0.93 feet, a difference of 0.24 feet. This draw was very evenly distributed through about 100 joints, and the average movement of the pipe in each joint was slightly more than 0.11 inch.

To guard against excessive pull in joints each pipe was marked, previous to moving, on the top and each side, but owing to the fact that some of the pipe rotated in some cases 100 degrees, it was impossible to make proper reductions of the plus and minus readings. Small gauges were however used continually on these marks, and whenever a joint showed an excessive draw it was relieved with the jacks. The lead rings in some cases were drawn out ½ inch or more, but these joints were not disturbed unless a leak occurred, when they were immediately recaulked.

Previous to moving the pipe, the trench for its relocation was excavated to line and grade, and excavations were then made under the pipe on about 200 feet sections, and the pipe gradually lowered to grade, meanwhile it was thoroughly braced in position to prevent lateral movement. The greatest depression was reserved until the last, thus allowing any gain to work up to this point. After the pipe

48-INCH RISING MAIN, MOVED UNDER PRESSURE, COMPLETED.—CONTRACT NO. 28.



4 Lines of 60-inch Cast Iron Pipe, Tacony Street.—Contract No. 28.

had been lowered to grade, skids upon which were secured iron strips were placed beneath each length of pipe, and the pipe was then moved laterally to position with screw jacks. To facilitate moving the pipe the iron strips were well greased.

The entire time required in moving the pipe was about one month, and with the exception of a few hours, when a cracked pipe was discovered, the line was never taken out of service and was under a uniform pressure of seventy pounds. The cracked pipe had no doubt existed since the main was originally laid, and to avoid delay steel bands were placed around the pipe and hauled up tight. In the subsequent operations this length of pipe gave no further trouble.

To avoid accidents and delays a rigid inspection was maintained both day and night, and men within easy hailing distance were placed along the line to insure the immediate closing of the valves at either end in case of accident. After the pipe had been relocated it was allowed to rest for a few days until it had assumed its final position, when all joints were thoroughly recaulked.

Contract No. 70, Pipe Lines "V" and "W," Extension of Pipe System.

This contract will embrace an extension of the Lardner's Point distribution service from Torresdale and Kensington avenues to the East Park and Queen Lane distribution district. The entire system will consist mainly of 48-inch Class "D" pipe, with a small mileage of 36-inch pipe to make connections with the supply mains intersected by the 48-inch lines running into the respective districts, as follows:

Three 48-inch lines on Torresdale and Erie avenues, from Kensington to Hunting Park avenue.

Two 48-inch lines on Hunting Park avenue, from Erie avenue to McMichael street.

Three 48-inch lines on Frankford and Glenwood avenues and Emerald street, from Frankford creek to Lehigh avenue.

Two 48-inch lines on Emerald street, from Lehigh avenue to Front street.

One 48-inch line on Lehigh avenue, Second and York streets, from Emerald to American street.

One 48-inch line on Lehigh avenue, from Emerald street to Kensington avenue.

One 48-inch line on Twenty-second street, from Hunting Park avenue to the Philadelphia & Reading Railroad.

One 48-inch line on Cumberland street, from Twenty-ninth to Thirty-third street, and on Thirty-third street, from Cumberland street to Sedgley avenue.

One 36-inch line on Lehigh avenue, from Kensington avenue to Sixth street.

One 36-inch line on York street, from American to Sixth street.

The sixteen lines of pipe above mentioned aggregate about 23.3 miles.

Total estimated cost of contract, $2,202,263.97.

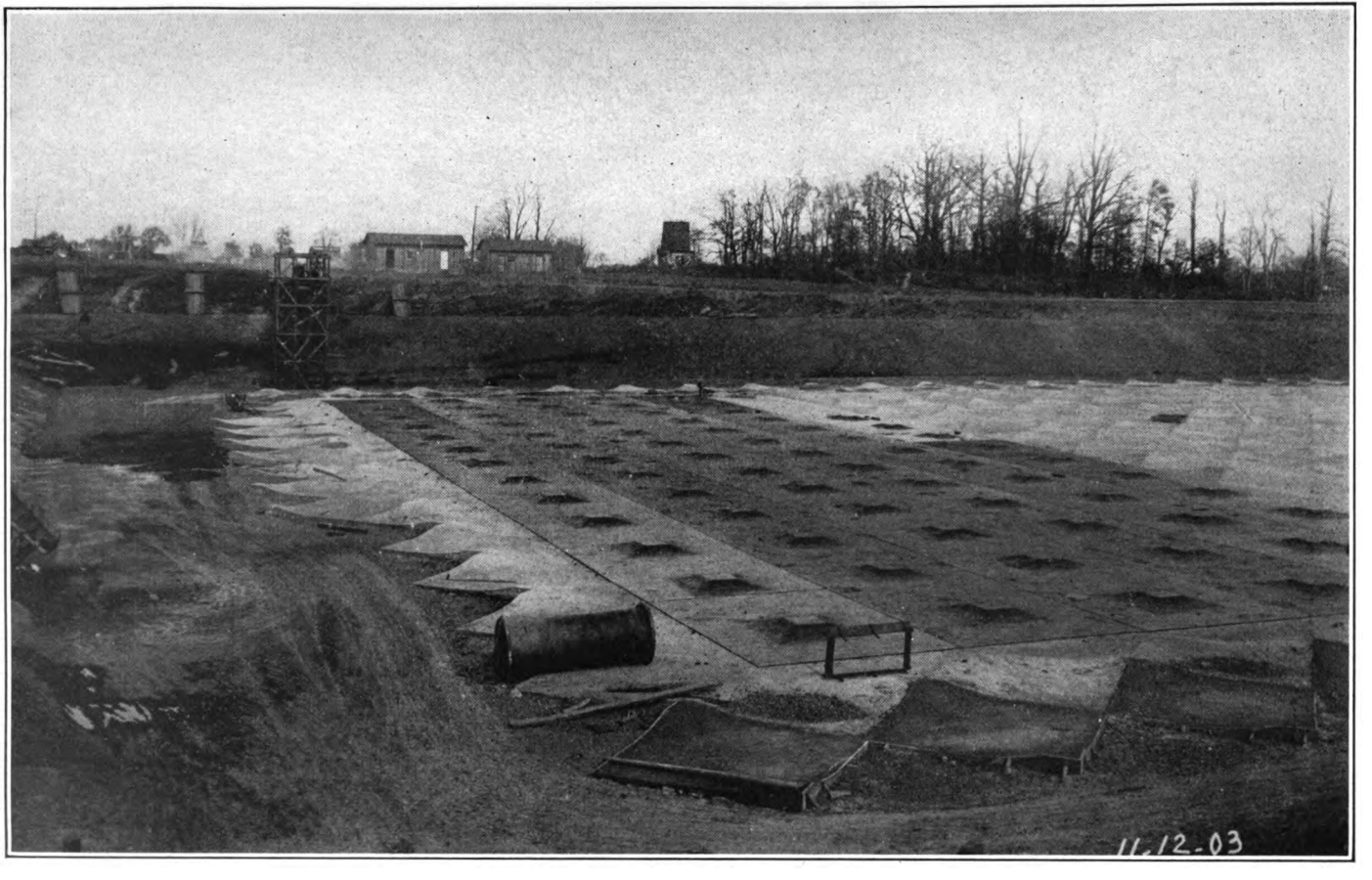
OAK LANE RESERVOIR.

Contract No. 27, Oak Lane Compensating Reservoir.

R. A. Malone & Company, Contractors.

The work embraced under this contract was fully described in the Annual Report of the Bureau of Water for 1901.

During the year practically all the excavation and em-



CONCRETE FLOOR AND ASPHALT LINING, OAK LANE, COMPENSATING BASINS.—CONTRACT NO. 27.

Principal Items in the Contracts for Improvement, Extension and Filtration of the Water Supply.

Item.	Description.	Quantity.	Lower Roxborough.	Upper Roxborough.	Torresdale Conduit.	Belmont Filters.	Torresdale Filters.	Oak Lane Reservoir.	Lardner's Point. Cont'ct No. 29.	Contract No. 17.	Contract No. 19.	Contract No. 28.	Contract No. 66.	Contract No. 70.	Total when Work is Completed.	Work during 1903.
1	Excavation	Cubic yards..	66,000	134,157	89,302	567,010	936,030	372,110	32,750	115,473	70,760.9	265,000	8,690	164,262.4	2,821,545.3	752,313.7
2	Embankment	Cubic yards..	22,000	59,500	.....	314,000	297,300	42,000	.....	.....	.....	.....	.....	.....	734,800	103,804
3	Puddle	Cubic yards..	8,750	17,060	.....	69,613	117,850	33,600	786	.....	.....	.....	.....	.....	247,659	117,029
4	Concrete	Cubic yards..	12,959	24,336	23,900	71,775	169,377	14,681	12,245	1,278	1,581	2,700	50	1,421	336,303	191,299.3
5	Brick masonry	Cubic yards..	105	302	19,402	288	325	80	*1,449	107	132	210	62	116	22,578	18,777
6	Rubble masonry	Cubic yards..	.....	.....	.....	2,230	.....	.....	15	716	275	150	50	792	4,228	62.4
7	Cast iron pipe	Tons.....	220	1,005	.....	3,068.3	7,000	94	210	15,221.5	7,386.1	38,000	1,151.9	36,007.6	109,364.1	6,994.51
8	Special castings	Tons.....	50	170	.....	878	480	43.2	51.25	593	270.7	650	31	1,404.3	4,621.45	517
9	Stop vales, 4 inches to 72 inches	Each.....	55	{ 1 sluice, 63 valves. }	.....	{ 7 sluices, 215 valves. }	{ 4 sluices, 585 valves. }	4	{ 25 sluices, 16 valves. }	210	79	91	28	233	1,616	449
10	Cast iron fixtures	Pounds.....	42,271	52,860	117,640	386,994	423,250	2,000	144,900	104,253	22,394	20,000	9,300	45,920	1,361,772	238,710
11	Structural steel	Pounds.....	70,040	131,512	346,374	587,500	961,520	7,500	1,960,400	3,790	16,200	151,000	1,000	4,200	3,327,036	1,611,298
12	Filter drains	Linear feet..	6,885	15,875	.....	33,806	103,290	.....	.....	.....	.....	.....	.....	.....	159,856	30,203
13	Filter gravel	Cubic yards..	4,298	9,490	.....	22,554	68,915	.....	.....	.....	.....	.....	.....	.....	105,257	14,755
14	Filter sand	Cubic yards..	13,247	26,367	.....	63,023	192,555	.....	.....	.....	.....	.....	.....	.....	295,192	39,626
	Pumping station	.....	1	1	.....	1	1	.....	1							
	Administration Building	.....	1	1	.....	1	1									

*This item does not include 422,500 face and fire brick

bankments have been completed; the 18 inch puddle lining has been rolled in place in the floor of the north basin and a portion of the south basin; about four-fifths of the concrete floor and asphalt lining has been placed in the north basin (as shown on photograph). The total work completed to date equals 66.38 per cent., about 40.03 per cent. of which was done during the current year.

Considerable difficulty was experienced in excavating the rock in the west ends of both basins, and heavy blasting had to be resorted to.

The two 36-inch pass pipes and valves have been placed in the division walls, and the brick valve wells completed.

The valve chamber which was shown on the original plans at the northwest corner of the north division of the reservoir, was relocated and built in the southwest corner.

On November 18th a supplemental contract was made for placing the 48-inch supply main on the west side of the reservoir from the valve chamber in the north basin to center line of Medary avenue.

Face of contract	$530,000 00	
Extras to date	26,660 47	
		$556,660 47
Limit of contract	$550,000 00	
Supplemental contract	10,000 00	
		$560,000 00
Payments to date		$282,740 02
Salaries, inspection, supplies and expenses of field corps		15,172 57
Percentage cost of field corps to date, 2.72.		
Land damages	$64,233 35	
Jurors and legal fees.....	971 63	
		$65,204 98

RECAPITULATION OF CONTRACTS REQUIRED TO COMPLETE.

In the following table is given in detail the contracts by number, station and item, also the estimated cost to complete:

Contract No. 38, Belmont Station—Preliminary filters.

Contract No. 64, Belmont Station—Preliminary filter building.

Contract No. 34, Torresdale Station—Delaware river intake.

Contract No. 35, Torresdale Station—Low service pumping machinery.

Contract No. 36, Torresdale Station—Low service pumping station.

Contract No. 39, Torresdale Station—Preliminary filters.

Contract No. 41, Torresdale Station—Sand washer and preliminary filter pumps.

Contract No. 47, Torresdale Station—Electric light system.

Contract No. 50, Torresdale Station—Filtering materials and collectors.

Contract No. 52, Torresdale Station—Coal handling machinery and pockets.

Contract No. 58, Torresdale Station—Spur from Pennsylvania Railroad for supplies.

Contract No. 61, Torresdale Station—Sand washer and shelter house.

Contract No. 69, Torresdale Station—Preliminary filter building.

Contract No. 54, Torresdale Station—Queen Lane contingent of filters and clear water basin.

Contract No. 55, Torresdale Station—Queen Lane contingent of preliminary filters.

Contract No. 56, Torresdale Station—Queen Lane contingent of sand, gravel and collectors.

Contract No. 59, Torresdale Station—Queen Lane contingent of sand washer pumps.

Contract No. 31, Lardner's Point Station—Coal handling machinery and pockets.

Contract No. 43, Lardner's Point Station—Suction connections to Engine House No. 1.

Contract No. 45, Lardner's Point Station—Electric lighting machinery.

Contract No. 48, Lardner's Point Station—Electric traveling crane.

Contract No. 51, Lardner's Point Station—Removing machinery from Spring Garden and Queen Lane Pumping Stations to Pumping Station No. 3.

Contract No. 67, Lardner's Point Station—Three additional high duty pumping engines, boilers, etc.

Contract No. 68, Lardner's Point Station—Pumping Station No. 3.

Contract No. 28, Lardner's Point Pipe Distribution System—Completion of Pipe Distribution System.

Contract No. 70, Pipe Distribution System—Lines "V" and "W" from the Lardner's Point Pipe Distribution System to the distribution mains in the East Park and Queen Lane Districts.

Contract No. 66, Roxborough Pipe Distribution System—Pipe Line "U," extension of Pipe Line "A."

Contract No. 60, Torresdale Station—Analytical Laboratory, Wentz Farm Improvement.

Total, $8,957,379.10.

CAPACITY OF FILTER WORKS.

For convenience of comparison the capacity of each filter station has been grouped in the following resume:

ROXBOROUGH WORKS—	Gallons.
Lower Roxborough	12,000,000
Upper Roxborough	20,000,000
Roxborough capacity (both stations)	32,000,000
The maximum available pumping capacity of the Shawmont Station is probably	25,000,000
Apportioning the Roxborough Filters to the capacity of the pumps at Shawmont:	
Lower Roxborough	12,000,000
Upper Roxborough	13,000,000
Roxborough available capacity (both stations)	25,000,000
BELMONT WORKS—	
Belmont (without preliminary filters)	33,500,000
Belmont (with preliminary filters)	65,000,000
Belmont Preliminary Filters (first installation, Contract No. 38)	40,000,000
TORRESDALE WORKS—	
Torresdale (55 filters)	210,000,000
Torresdale—Queen Lane contingent (10 filters)	38,000,000
Torresdale, total	248,000,000

Recapitulation.

Present capacity of Roxborough filters, due to capacity of pumps at Shawmont	25,000,000
Belmont, with Preliminary filters (present daily capacity)	40,000,000
Belmont—probable average daily consumption	35,000,000
Torresdale	248,000,000
Total	308,000,000
Add additional for Roxborough	7,000,000
Add additional for Belmont (including Preliminary filters)	5,000,000
Total	320,000,000

	Gallons.
The probable actual average daily consumption cannot be less than	280,000,000
According to the Bureau of Water (see page 100 of the Report of the Department of Public Works for the year 1902) the average consumption was	314,000,000

It will thus be seen that the total constructed and planned capacity is 40,000,000 gallons, or fourteen (14) per cent. in excess of the probable average daily present consumption.

Distribution of Filtered Water by Population.

The population to be supplied from the several filter stations is shown as follows:

The Roxborough Works, Upper and Lower, are now furnishing filtered water to Wards 21 and 22, but by the addition of Pipe Line "U" (Contract No. 66), water to the extent of about 10,000,000 gallons per day can be supplied to nearly all of Ward No. 38, and to about one-half the population of Ward No. 28. The populations are based on the census returns for June, 1900, increased by the known ratio of growth from 1890 to 1900, to July 1, 1903.

ROXBOROUGH WORKS—	
Wards 21, 22, 38 in part, 28 one-half.....	161,300
BELMONT—	
Wards 24, 27, 34 and 40.....	170,000
TORRESDALE—	
Wards 1 to 20 inclusive, Wards 23, 25, 26, 28 one-half, 29, 30, 31, 32, 33, 35, 36, 37, 38 small part, 39, 41, 42.....	1,075,000
Total July 1, 1903	1,406,300

PRINCIPAL DIMENSIONS OF FILTRATION WORKS.

Since the inception of the improvement of the water supply, many inquiries by letter and in person have come from all parts of the civilized world asking for information upon the scope, purpose and principal dimensions of the work, especially of the filters. Such inquiries have been quite frequent during the past two years from Europe, Australia, South America and Eastern Asia, as well as from the larger cities of the United States. To meet such inquiries with reference to dimensions, the following table, which furnishes a concise statement of the number, surface dimensions and dimensions of principal masonry details of the filters and clear water basins at the four stations where works of filtration have been or are now being carried out, has been prepared:

Principal Dimensions of Filters.

Filters.	Lower Roxborough.	Upper Roxborough.	Belmont.	Torresdale.
Number of filters	5	8	18	55
Area of filters	0.53 acre.	0.70 acre.	0.735 acre.	0.75 acre.
Dimensions of filters at neat lines	109 ft. x 219 ft. 10 in.	140 ft. 8 in. x 219 ft. 10 in.	8 beds, 272 ft. 8 in. x 120 ft. 2 in. 3 beds, 196 ft. 5 in. x 165 ft. 11 in. 7 beds, 242 ft. 2 in. x 135 ft. 5 in.	33 beds, 140 ft. 8 in. x 235 ft. 8 in. 22 beds, 132 ft. 2 in. x 253 ft. 2 in.
Height of piers,	9 ft. 1 in,	9 ft. 1 in.	9 ft. 1 in.	9 ft. 1 in.
Cross section of pier at top	1 ft. 10 in.	1 ft. 10 in.	1 ft. 10 in	1 ft. 10 in.
Cross section of pier at base	2 ft. 10 in.	2 ft. 10 in.	2 ft. 10 in.	2 ft. 10 in.
Height of filters in clear	12 ft. 9 in.	12 ft. 9 in.	12 ft. 9 in.	12 ft. 9 in.
Span of groined arches	14 ft.	14 ft.	13 ft. 5 in.	14 ft. and 13 ft. 2 in.
Rise of groined arches	3 ft.	3 ft.	3 ft.	3 ft.
Thickness of arch at crown	6 in.	6 in.	6 in.	6 in.
Thickness of floor at invert	6 in.	6 in.	6 in.	6 in.
Thickness of floor under pier	14 in.	14 in.	14 in.	14 in.
Thickness of end walls at base	4 ft. 2 in.	4 ft.	4 ft. 2 in.	4 ft. 3½ in.
Thickness of end walls at spring line	18 in.	1 ft. 8 in.	1 ft. 8 in.	1 ft. 8 in.
Thickness of dividing wall at top	2 ft.	1 ft. 10 in.	1 ft. 10 in.	1 ft. 10 in.
Thickness of dividing wall at base	3 ft. 9 in.	2 ft. 10 in.	2 ft. 10 in.	2 ft. 10 in.
Minimum thickness of puddle	12 in.	12 in.	12 in.	12 in.

Principal Dimensions of Filters—Continued.

Filtered Water Basins.	Lower Roxborough.	Upper Roxborough.	Belmont.	Torresdale.
Capacity	8,000,000 gals.	8,000,000 gals.	16,500,000 gals.	50,000,000 gals.
Dimensions at neat lines	159 ft. 3 in. x 190 ft. 11 in.	237 ft. 8 in. x 318 ft. 10 in.	382 ft. 2 in. x 396 ft.	601 ft. 10 in. x 762 ft. 2 in.
Normal depth of water	13 ft. 9 in.	15 ft.	15 ft.	15 ft.
Height from invert to crown	16 ft. 9 in.	18 ft.	18 ft.	18 ft.
Span of groined arches	14 ft.	14 ft.	14 ft.	14 ft.
Rise of groined arches	3 ft.	3 ft.	3 ft.	3 ft.
Dimen. of side walls at spring line	2 ft.	.....	2 ft. 6 in.	2 ft. 6 in.
Dimen. of side walls at base	5 ft. 6 in.	.....	6 ft.	6 ft.
Minimum thickness of puddle	12 in.	12 in.	12 in.	12 in.

WATERTIGHTNESS OF STRUCTURES.

Very little information is available on the watertightness of concrete masonry, structures, earthen embankments lined with concrete, or of lines of cast iron water pipe. Such tests as may have been made elsewhere are not readily accessible in publications, and the leakage assumed to be allowable is therefore entirely a matter of judgment.

It should be obvious that structures like filters made up of many separate floor sections and representing, as at Belmont, for example, 7,000 linear feet of comparatively shallow joint could not even with the utmost care in construction be expected to be entirely watertight, and that some leakage was bound to occur upon test. Excepting at Lower Roxborough, which was the first contract put under construction, and for two filters at Upper Roxborough, and two filters at Belmont, the clay used in the manufacture of puddle was of very superior quality, and calculated to render the linings of filters, clear water basin and other watertight concrete work, as nearly watertight as possible, and after the experience at Lower Roxborough, and the earlier work at Upper Roxborough and at Belmont, as much care was exercised in testing clays and supervising the proportions and mixing of puddle, as was done with cements, and proportioning materials and mixing of concrete.

In the following table are given the analyses of clays used on the work, the examinations being made by the Ulzer method:

Station.	Contract.	Clay used.	Clay Constituents. Percentage.	Quartz, mica, feldspar.
Lower Roxborough..	No. 10..	Swedeland.....	38	62
Upper Roxborough..	No. 12..	Swedeland.....	38	62
Upper Roxborough..	No. 12..	Delaware City.	51	49
Belmont.....	No. 16..	Swedeland.....	38	62
Belmont.....	No. 16..	Woodbridge ...	64	36
Torresdale.....	No. 25..	Delaware City.	51	49
Lardner's Point Pumping Station..	No. 29..	Errata.....	66	34
Oak Lane Reservoir.	No. 27..	Woodbridge ...	64	36
Oak Lane Reservoir.	No. 27..	Morris.....	32	68

Generally a clay containing at least 50 per cent. of clay constituents by the Ulzer method of analysis will make excellent puddle, provided the material is well cut up into small particles and mixed in a suitable pug mill.

The watertightness of such filters and clear water basins as have been tested to date is shown as follows:

Lower Roxborough—Swedeland Clay in Puddle.

Filter.	Duration of test, days.	Leakage, gallons per day.	Percentage Leakage.
1	6	885	0.028
2	9	3,097	0.097
3	14	1,770	0.056
4	3	4,445	0.139
5	21	1,770	0.097
Clear water basin	7	1,075	0.009

Upper Roxborough—Swedeland and Delaware City Clays in Puddle.

Filter.	Duration of test, days.	Leakage, gallons per day.	Percentage leakage.
1	21	0	0.00
2	21	0	0.00
3	24	690	0.03
4	17	0	0.00
5	14	1,150	0.05
6	12	460	0.02
7	8	1,840	0.09
8	5	1,150	0.05
Clear water basin	22	3,300	0.02

Belmont—Swedeland and Woodbridge Clays in Puddle.

Filter.	Duration of test, days.	Leakage, gallons per day.	Percentage leakage.
1	6	970	0.022
3	16	727	0 017
4	14	970	0.022
5	10	610	0.014
6	38	243	0.005
7	6	1,031	0.024
8	6	566	0.013
9	16	728	0.017
10	20	776	0.018
11	21	582	0.013
12	21	475	0.011
13	5	1,020	0.023
17	23	849	0.019
18	21	849	0.019

Torresdale—Delaware City Clay in Puddle.

Filter.	Duration of test, days.	Leakage, gallons per day.	Percentage leakage.
1	18	244	0.0054
2	16	244	0.0054
3	19	0	0.0000
4	25	0	0.0000
5	23	488	0.0108
9	21	0	0.0000
11	25	244	0.0054
31	7	488	0.0108
33	8	0	0.0000

The percentage leakage of the Lower Roxborough filters is based on a daily capacity for each filter of 3.18 million gallons, and of the clear water basin on a daily working capacity of 12,000,000 gallons.

The percentage leakage of the Upper Roxborough filters is based on a daily capacity for each filter of 2.10 million gallons, and of the clear water basin on a daily working capacity of 16,000,000 gallons.

The percentage leakage of the Belmont filters is based on a daily capacity of 4.38 million gallons, and the percentage

test of the Torresdale filters is based on a daily capacity of 4.50 million gallons.

All filters at the Belmont and Torresdale Stations have not been tested at this date, but these tests are in progress, and will be reported from time to time.

The limit of leakage for the Belmont and Torresdale filters is 1,000 gallons in twenty-four hours with water standing nine (9) feet deep over the concrete floor.

The high relative leakage of the Lower Roxborough filters, and of Filters Nos. 7 and 8 at Upper Roxborough, is due to the inferior quality of clay used in the puddle under and around the filters, and directly the superior clay in the puddle occurs under and around the other filters, excepting No. 5 at Upper Roxborough (the puddle for which was partly of Swedeland clay and partly of Swedeland and Delaware City mixed), the greater watertightness is at once apparent on test.

Asphalt Reservoir Lining.

To increase the watertightness of the subsiding basins at Belmont avenue and City line, and the Oak Lane compensating basin at Fifth and Medary avenue, a layer of asphalt $\frac{3}{4}$ inch thick was placed on the top of the concrete lining of the basins, on the floors, and on two-thirds of the slopes.

The composition of the asphalt lining called for in the specification was made of:

70 parts by weight of Neufchatel Mastic.
10 parts by weight of Bermudez Mastic.
20 parts by weight of sharp grit and sand, free from dirt—

This mass to be heated and thoroughly mixed in a kettle at about 280 degrees Farenheit, and would have given approximately 21 per cent. of bitumen.

It was found upon test that this mixture contained too

PLACING ASPHALT LINING, FLOOR OF RESERVOIR, BELMONT.—CONTRACT NO. 16.

high a percentage of bitumen, and was too soft for use on the slopes when exposed to the sun. Experiments were then made to ascertain what percentage of total bitumen in the mass would hold on the slopes without running. Concrete slabs about 2 feet wide and 4 feet long, covered with mixtures containing various percentages of bitumen were placed at an angle equivalent to the slopes in the reservoirs, and maintained at a temperature of 100 degrees Fahrenheit. Wires were placed across and above the slabs and tacks driven in the surface showed the downward movement of the asphalt. The mixtures which showed practically no movement during a period of three weeks were used, as follows:

One containing the larger percentage of bitumen was placed on the floor and first coat of $\frac{3}{8}$ inch on the slopes; a second and finishing coat of $\frac{3}{8}$ inch containing slightly less bitumen was also placed on the slopes.

The several mixtures used contained as an average the following weight of materials for each batch that went into the kettle:

Floor and First Layer of Slope.

585 pounds Seyssel mastic.
315 pounds of grit.
50 pounds of refined Trinidad asphalt.
50 pounds of refined Bermudez asphalt.

Second Layer of Slope.

598 pounds of Seyssel mastic.
332 pounds of grit.
33 pounds of refined Trinidad asphalt.
37 pounds of refined Bermudez asphalt.

The above mixtures gave an average of 15.5 per cent. of bitumen for the lining on the floor and first layer on the

slopes, and 13.2 per cent of bitumen for the second layer on the slopes, the latter, of course, requiring a stiffer mixture to prevent or limit the creeping by action of the sun's rays, and likewise, of course, to avoid cracking due to the influence of the frost.

On the floor of the basins the asphalt was laid on the smooth concrete, but on the slopes the concrete was roughened by indenting grooves ½ inch deep and ⅜ inch wide, spaced about 4 inches centers from the toe to top of the asphalt line, to secure the asphalt against slipping or creeping on the concrete.

The watertightness of the asphalt, concrete and puddle in the reservoirs is still to be tested, but I have no doubt that they will be as near watertight as structures as large as these can very well be made. Generally, of course, we cannot expect earthen embankments, however carefully they may be lined with impervious materials, to be absolutely watertight, but I anticipate that the measured leakage of these basins will show such a small percentage of loss as to indicate practically watertightness.

It is possible that the asphalt lining might have been omitted without seriously affecting the watertightness of the reservoirs; but considering the heighth to which the water is pumped from the Schuylkill river, and the nature of the surroundings, it was thought wise to omit no precautions to insure the nearest approach to absolute watertightness of the structure.

CONCRETE CUBES.

From each contract involving the use of concrete, concrete cubes have been made from day to day, or from time to time as the work progressed, showing the quality of the material used in the concrete. At the present time 945

of these cubes have been made and broken in the City Laboratory with very gratifying results as to the quality of the concrete used on the various works.

While the general run of concrete has not been superior to that used in works of like character elsewhere, occasionally some of the cubes have shown very surprising results, in some instances quite equal to the best obtained under much more favorable conditions with cubes made for test at the Watertown Arsenal, Massachusetts.

The highest quality of concrete, or at least cubes showing the greatest crushing strengths, have been obtained from material used in constructing the cradles and in packing over the arches of the lining of the Torresdale conduit.

In the following tables are given a digest of the crushing loads of the cubes for the several contracts mentioned:

Tests of Concrete Cubes used on the Improvement, Extension and Filtration of the Water Supply.

Composition in all cases—1 cement, 3 sand, 5 ballast—parts by volume.

Date.	No. of Cube.	Brand of Cement.	Contract.	Age (days).	Ultimate strength (pounds) per sq. in
September 15, 1902	90	Star Bonneville	No. 12—Upper Roxberough	60	3,027
September 15, 1902	91	Star Bonneville	No. 12—Upper Roxborough	59	3,382
October 15, 1902	88	Star Bonneville	No. 12—Upper Roxborough	90	3,701
October 21, 1902	119	Star Bonneville	No. 12—Upper Roxborough	60	3,114
October 24, 1902	145	Star Bonneville	No. 12—Upper Roxborough	30	3,088
November 11, 1902	87	Star Bonneville	No. 12—Upper Roxborough	120	3,459
November 18, 1902	139	Star Bonneville	No. 12—Upper Roxborough	60	3,103
November 18, 1902	140	Star Bonneville	No. 12 - Upper Roxborough	59	2,996
November 20, 1902	120	Star Bonneville	No. 12—Upper Roxborough	90	3,633
December 8, 1902	151	Star Bonneville	No. 12—Upper Roxborough	60	3,752
December 18, 1902	141	Star Bonneville	No. 12—Upper Roxborough	90	4,012
December 18, 1902	142	Star Bonneville	No. 12—Upper Roxborough	90	3,115
December 22, 1902	122	Star Bonneville	No. 12—Upper Roxborough	120	3,214
December 22, 1902	123	Star Bonneville	No. 12—Upper Roxborough	119	3,959
December 30, 1902	80	Whitehall	No. 12—Upper Roxborough	181	3,603
December 30, 1902	81	Star Bonneville	No. 12—Upper Roxborough	180	3,162

Tests of Concrete Cubes—Continued.

Date.	No. of Cube.	Brand of Cement.	Contract.	Shaft.	Age (days).	Ultimate trength (pounds) per sq. in.
February 24 1903	125	Star Bonneville	No. 12—Upper Roxborough	.....	179	3,312
April 21, 1903	19	Star Bonneville	No. 14—Torresdale Conduit	.....	60	3,363
July 8, 1903	3	Star Bonneville	No. 14—Torresdale Conduit	.....	120	3,713
July 10, 1903	4	Star Bonneville	No. 14—Torresdale Conduit	5 & 6	120	3,221
July 21, 1903	26	Lehigh	No. 14—Torresdale Conduit	5	60	3,292
July 31, 1903	54	Star Bonneville	No. 14—Torresdale Conduit	10	59	3,104
August 13, 1903	17	Star Bonneville	No. 14—Torresdale Conduit	9	181	3,735
August 17, 1903	17	Lehigh	No. 14—Torresdale Conduit	8	90	3,422
September 18, 1903	4	Lehigh	No. 14—Torresdale Conduit	3	88	3,463
September 18, 1903	9	Star Bonneville	No. 14—Torresdale Conduit	5	179	3,026
September 25, 1903	5	Star Bonneville	No. 14—Torresdale Conduit	3	90	3,512
September 25, 1903	9	Lehigh	No. 14—Torresdale Conduit	4	120	3,486
October 8, 1903	5	Star Bonneville	No. 14—Torresdale Conduit	2	61	3,286
October 8, 1903	6	Star Bonneville	No. 14—Torresdale Conduit	2	59	3,982
October 8, 1903	12	Star Bonneville	No. 14—Torresdale Conduit	4	92	3,128
October 8, 1903	20	Star Bonneville	No. 14—Torresdale Conduit	4	61	3,013
October 8, 1903	12	Star Bonneville	No. 14—Torresdale Conduit	5	181	3,278

Tests of Concrete Cubes—Continued.

Date.	No. of Cube.	Brand of Cement.	Contract.	Shaft.	Age (days).	Ultimate strength (pounds) per sq. in.
October 5, 1903	19	Star Bonneville	No. 14—Torresdale Conduit	4	60	3,628
October 10, 1903	82	Star Bonneville	No. 14—Torresdale Conduit	11	58	3,000
October 14, 1903	26	Star Bonneville	No. 14—Torresdale Conduit	8	90	3,820
October 16, 1903	27	Star Bonneville	No. 14—Torresdale Conduit	8	90	4,964
October 16, 1903	11	Lehigh	No. 14—Torresdale Conduit	8	180	3,794
October 17, 1903	37	Star Bonneville	No. 14—Torresdale Conduit	8	58	4,951
October 20, 1903	25	Star Bonneville	No. 14—Torresdale Conduit	4	59	3,524
October 20, 1903	10	Star Bonneville	No. 14—Torresdale Conduit	3	90	3,286
October 20, 1903	38	Star Bonneville	No. 14—Torresdale Conduit	8	59	3,281
October 23, 1903	76	Star Bonneville	No. 14.—Torresdale Conduit	11	89	4,112
October 23, 1903	22	Star Bonneville	No. 14—Torresdale Conduit	8	119	3,419
October 28, 1903	77	Star Bonneville	No. 14—Torresdale Conduit	11	91	3,253
November 5, 1903	4	Star Bonneville	No. 14—Torresdale Conduit	2	90	3,622
November 9, 1903	80	Star Bonneville	No. 14—Torresdale Conduit	11	91	3,119
November 9, 1903	25	Star Bonneville	No. 14—Torresdale Conduit	8	118	3,334
November 12, 1903	35	Star Bonneville	No. 14—Torresdale Conduit	8	90	3,429
November 18, 1903	24	Star Bonneville	No. 14—Torresdale Conduit	4	90	3,441

Tests of Concrete Cubes—Continued.

Date.	No. of Cube.	Brand of Cement.	Contract	Shaft.	Age (days.)	Ultimate strength (pounds) per sq. in.
November 19, 1903	12	Star Bonneville	No. 14—Torresdale Conduit	2	60	3,506
November 19, 1903	18	Star Bonneville	No. 14—Torresdale Conduit	3	60	3,112
November 25, 1903	14	Star Bonneville	No. 14—Torresdale Conduit	2	60	3,557
November 28, 1903	78	Star Bonneville	No. 14—Torresdale Conduit	10	119	3,618
December 2, 1903	13	Star Bonneville	No. 14—Torresdale Conduit	3	90	5,119
December 2, 1903	87	Giant	No. 14—Torresdale Conduit	9	90	3,047
December 2, 1903	95	Star Bonneville	No. 14—Torresdale Conduit	9	60	3,314
December 5, 1903	89	Giant	No. 14—Torresdale Conduit	9	89	3,494
December 14, 1903	92	Giant	No. 14—Torresdale Conduit	9	89	3,145
December 16, 1903	93	Star Bonneville	No. 14—Torresdale Conduit	9	90	4,067
December 16, 1903	19	Star Bonneville	No. 14—Torresdale Conduit	8	180	5,053
December 21, 1903	39	Star Bonneville	No. 14—Torresdale Conduit	7	90	3,281
June 3, 1903	63	Lehigh	No. 16—Belmont Filters	.....	180	3,493
September 16, 1903	115	Lehigh	No. 16—Belmont Filters	.....	91	3,516
June 3, 1903	64	Lehigh	No. 16—Belmont Filters	.....	180	3,177
December 2, 1902	42	Star Bonneville	No. 25—Torresdale Filters	.....	122	3,021
December 2, 1902	.....	Star Bonneville	No. 25—Torresdale Filters	.....	122	3,061

Test of Concrete Cubes—Continued.

Date	No. of Cube.	Brand of Cement.	Contract.	Age (days.)	Ultimate strength (pounds) per sq. in.
December 2, 1902	.....	Star Bonneville	No. 25—Torresdale Filters	90	3,047
December 2, 1902	49	Star Bonneville	No. 25—Torresdale Filters	61	3,200
April 21, 1903	84	Star Bonneville	No. 25—Torresdale Filters	120	3,586
June 2, 1903	70	Giant	No. 25—Torresdale Filters	180	3,804
June 19, 1903	82	Giant	No. 25—Torresdale Filters	180	3,028
June 19, 1903	83	Star Bonneville	No. 25—Torresdale Filters	180	3,071
July 15, 1903	108	Giant	No. 25—Torresdale Filters	31	3,037
September 2, 1903	98	Giant	No. 25—Torresdale Filters	92	3,189
September 2, 1903	99	Giant	No. 25—Torresdale Filters	91	3,285
September 4, 1903	148	Star Bonneville	No. 25—Torresdale Filters	29	4,028
September 25, 1903	94	Giant	No. 25—Torresdale Filters	120	3,467
September 25, 1903	95	Giant	No. 25—Torresdale Filters	119	3,159
September 25, 1903	96	Star Bonneville	No. 25—Torresdale Filters	119	3,095
October 20, 1903	137	Giant	No. 25—Torresdale Filters	91	3,038
October 20, 1903	138	Lehigh	No. 25—Torresdale Filters	90	3,328
November 5, 1903	191	Giant	No. 25—Torresdale Filters	60	3,739
November 9, 1903	176	Lehigh	No. 25—Torresdale Filters	59	3,979

Test of Concrete Cubes—Continued.

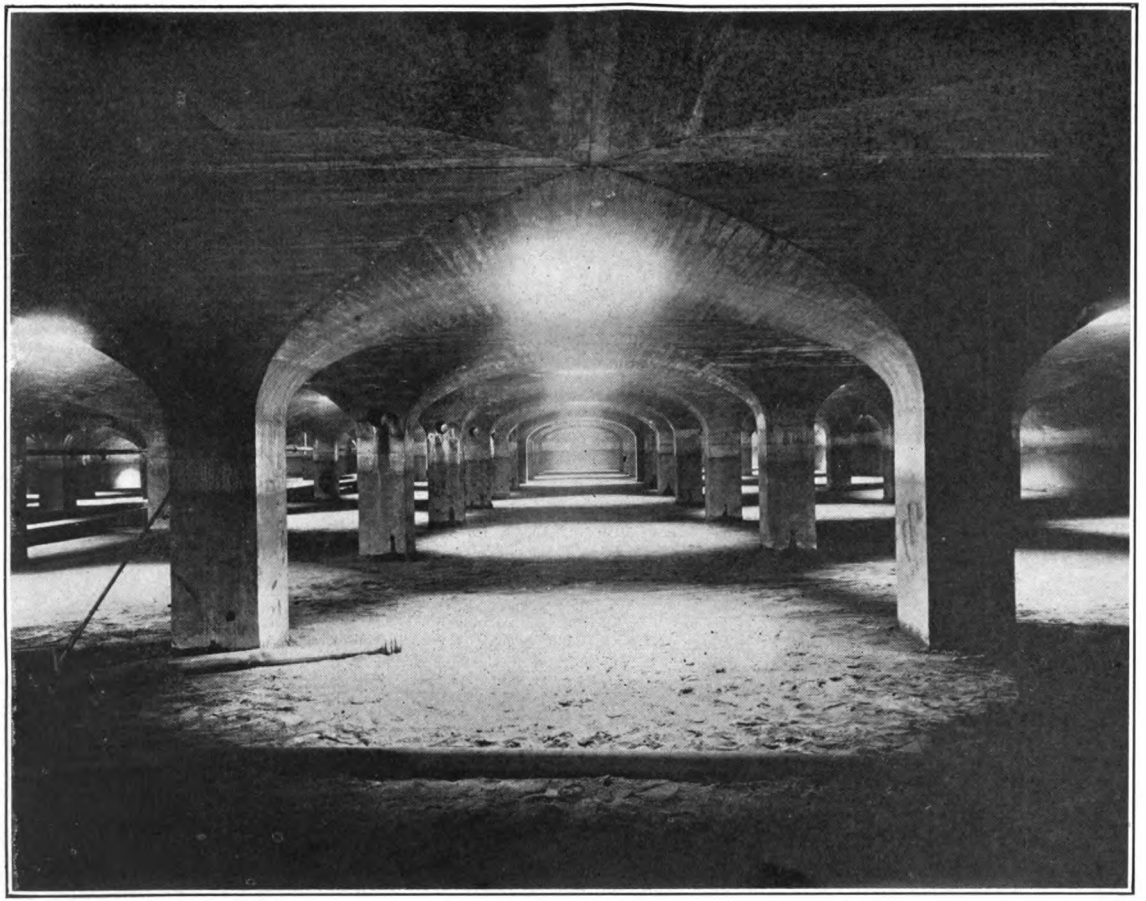
Date.	No. of Cube.	Brand of Cement.	Contract.	Age (days.)	Ultimate strength (pounds) per sq. in
November 13, 1903	180	Lehigh	No. 25—Torresdale Filters	60	3,540
November 16, 1903	196	Star Bonneville	No. 25—Torresdale Filters	30	3,174
November 16, 1903	195	Lehigh	No. 25—Torresdale Filters	30	3,135
December 16, 1903	111	Giant	No. 25—Torresdale Filters	180	3,833
December 17, 1903	112	Star Bonneville	No. 25—Torresdale Filters	180	3,001
December 17, 1903	113	Star Bonneville	No. 25—Torresdale Filters	180	3,353
December 21, 1903	164	Lehigh	No. 25—Torresdale Filters	119	3,430
December 21, 1903	115	Lehigh	No. 25—Torresdale Filters	180	3,336
December 21, 1903	114	Star Bonneville	No. 25—Torresdale Filters	180	3,837
December 23, 1903	166	Giant	No. 25—Torresdale Filters	120	4,484
December 28, 1903	168	Lehigh	No. 25—Torresdale Filters	121	3,095
December 30, 1903	170	Lehigh	No. 25—Torresdale Filters	120	3,843
November 13, 1903	4	Alpha	No. 27—Oak Lane Reservoir	60	3,126

ROXBOROUGH FILTERS OPERATION.

The Upper and Lower Roxborough filter stations are managed by an assistant engineer, with headquarters at Upper Roxborough. Each station is provided with three filter attendants standing eight hour watches, with a labor roll of eleven men who are worked as required by the sand scrapings, restoring sand, etc., mutually at both stations. Lower Roxborough is provided with a night watchman, and Upper Roxborough with a day watchman. The Upper and Lower Roxborough offices are connected by special telephone with the pump room at the Roxborough Auxiliary Station to control the operation of the centrifugal pumps which supply water from the Upper Roxborough reservoir to the filters and the electric lighting machinery. The three engineers in charge of the low service pumping machinery and electric lighting equipment constitute a part of the working force of the Roxborough system.

At Upper Roxborough an engineer is employed to run the sand washer and ejector pumps, and a mechanic is employed to make pipe repairs and adjustment of working appliances who works as occasion requires at each station, and when the filters are started will perform the same duties at the Belmont station.

The total force of employees regularly on the work is 25, including the assistant engineer in charge. An additional force of laborers is required when sand is being restored to the filters, and when the Belmont working force has been organized it is intended to combine the labor force at any station for this purpose, and thus dispense with the occasional employment of outside or irregular labor. In the early operations the extra labor for replacing sand at Lower Roxborough was obtained from the contractor at Upper Roxborough, but since Contract No. 12 and its appurtenances were finished this extra labor has been obtained from the



LOWER ROXBOROUGH FILTER, DRAINED FOR SCRAPING SAND.

regular force of the Water Bureau, bills for which were rendered against this Bureau.

Lower Roxborough Filters.

The total quantity of water filtered at Lower Roxborough for the year ending December 1, 1903, was 2,257,000,000, equivalent to a daily yield of 6,183,600 gallons. During this period the filters have been supplied with subsided water from the Upper Roxborough reservoir. Since December the filters have been receiving water from the preliminary filters, and when these have been properly adjusted to the work, it is expected to raise the capacity of the station to balance the capacity of the pumps which supply to the Lower Roxborough reservoir. At present this station is filtering at the rate of 9,800,000 gallons per day.

The filtered water is delivered to Manayunk, Ward 21, and the lower part of Germantown, Ward 22.

During the first two and one-half months of the year the scraped sand was wheeled from the filters to the washers, but since March all sand has been transported to the washers by means of a Korting ejector, operated in a portable hopper, and connected up from place to place in the filter, with the water pressure and sand discharge pipe lines.

During the year the aggregate number of scrapings of filters was 51, an average of 10 to each filter, giving an average period of operation of 35.8 days.

Each filter is equipped with electric lights which permits the scraping and transportation of sand in the coldest weather without opening the ventilators in the the roof or keeping the entrance door long open. This operation has already been successfully conducted with the temperature at low as 11 degrees Fahrenheit, the sand going through the discharge pipes of the ejectors, through the washers and being stored in the courts, without interruption or hindrance by reason of the low temperature.

test of the Torresdale filters is based on a daily capacity of 4.50 million gallons.

All filters at the Belmont and Torresdale Stations have not been tested at this date, but these tests are in progress, and will be reported from time to time.

The limit of leakage for the Belmont and Torresdale filters is 1,000 gallons in twenty-four hours with water standing nine (9) feet deep over the concrete floor.

The high relative leakage of the Lower Roxborough filters, and of Filters Nos. 7 and 8 at Upper Roxborough, is due to the inferior quality of clay used in the puddle under and around the filters, and directly the superior clay in the puddle occurs under and around the other filters, excepting No. 5 at Upper Roxborough (the puddle for which was partly of Swedeland clay and partly of Swedeland and Delaware City mixed), the greater watertightness is at once apparent on test.

Asphalt Reservoir Lining.

To increase the watertightness of the subsiding basins at Belmont avenue and City line, and the Oak Lane compensating basin at Fifth and Medary avenue, a layer of asphalt $\frac{3}{4}$ inch thick was placed on the top of the concrete lining of the basins, on the floors, and on two-thirds of the slopes.

The composition of the asphalt lining called for in the specification was made of:

70 parts by weight of Neufchatel Mastic.
10 parts by weight of Bermudez Mastic.
20 parts by weight of sharp grit and sand, free from dirt—

This mass to be heated and thoroughly mixed in a kettle at about 280 degrees Farenheit, and would have given approximately 21 per cent. of bitumen.

It was found upon test that this mixture contained too

PLACING ASPHALT LINING, FLOOR OF RESERVOIR, BELMONT.—CONTRACT NO. 16.

high a percentage of bitumen, and was too soft for use on the slopes when exposed to the sun. Experiments were then made to ascertain what percentage of total bitumen in the mass would hold on the slopes without running. Concrete slabs about 2 feet wide and 4 feet long, covered with mixtures containing various percentages of bitumen were placed at an angle equivalent to the slopes in the reservoirs, and maintained at a temperature of 100 degrees Fahrenheit. Wires were placed across and above the slabs and tacks driven in the surface showed the downward movement of the asphalt. The mixtures which showed practically no movement during a period of three weeks were used, as follows:

One containing the larger percentage of bitumen was placed on the floor and first coat of $\frac{3}{8}$ inch on the slopes; a second and finishing coat of $\frac{3}{8}$ inch containing slightly less bitumen was also placed on the slopes.

The several mixtures used contained as an average the following weight of materials for each batch that went into the kettle:

Floor and First Layer of Slope.

585 pounds Seyssel mastic.
315 pounds of grit.
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50 pounds of refined Bermudez asphalt.

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332 pounds of grit.
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37 pounds of refined Bermudez asphalt.

The above mixtures gave an average of 15.5 per cent. of bitumen for the lining on the floor and first layer on the

slopes, and 13.2 per cent of bitumen for the second layer on the slopes, the latter, of course, requiring a stiffer mixture to prevent or limit the creeping by action of the sun's rays, and likewise, of course, to avoid cracking due to the influence of the frost.

On the floor of the basins the asphalt was laid on the smooth concrete, but on the slopes the concrete was roughened by indenting grooves ½ inch deep and ⅜ inch wide, spaced about 4 inches centers from the toe to top of the asphalt line, to secure the asphalt against slipping or creeping on the concrete.

The watertightness of the asphalt, concrete and puddle in the reservoirs is still to be tested, but I have no doubt that they will be as near watertight as structures as large as these can very well be made. Generally, of course, we cannot expect earthen embankments, however carefully they may be lined with impervious materials, to be absolutely watertight, but I anticipate that the measured leakage of these basins will show such a small percentage of loss as to indicate practically watertightness.

It is possible that the asphalt lining might have been omitted without seriously affecting the watertightness of the reservoirs; but considering the heighth to which the water is pumped from the Schuylkill river, and the nature of the surroundings, it was thought wise to omit no precautions to insure the nearest approach to absolute watertightness of the structure.

CONCRETE CUBES.

From each contract involving the use of concrete, concrete cubes have been made from day to day, or from time to time as the work progressed, showing the quality of the material used in the concrete. At the present time 945

of these cubes have been made and broken in the City Laboratory with very gratifying results as to the quality of the concrete used on the various works.

While the general run of concrete has not been superior to that used in works of like character elsewhere, occasionally some of the cubes have shown very surprising results, in some instances quite equal to the best obtained under much more favorable conditions with cubes made for test at the Watertown Arsenal, Massachusetts.

The highest quality of concrete, or at least cubes showing the greatest crushing strengths, have been obtained from material used in constructing the cradles and in packing over the arches of the lining of the Torresdale conduit.

In the following tables are given a digest of the crushing loads of the cubes for the several contracts mentioned:

Tests of Concrete Cubes used on the Improvement, Extension and Filtration of the Water Supply.

Composition in all cases—1 cement, 3 sand, 5 ballast—parts by volume.

Date.	No. of Cube.	Brand of Cement.	Contract.	Age (days).	Ultimate strength (pounds) per sq. in.
September 15, 1902	90	Star Bonneville	No. 12—Upper Roxborough	60	3,027
September 15, 1902	91	Star Bonneville	No. 12—Upper Roxborough	59	3,382
October 15, 1902	88	Star Bonneville	No. 12—Upper Roxborough	90	3,701
October 21, 1902	119	Star Bonneville	No. 12—Upper Roxborough	60	3,114
October 24, 1902	145	Star Bonneville	No. 12—Upper Roxborough	30	3,088
November 11, 1902	87	Star Bonneville	No. 12—Upper Roxborough	120	3,459
November 18, 1902	139	Star Bonneville	No. 12—Upper Roxborough	60	3,108
November 18, 1902	140	Star Bonneville	No. 12 - Upper Roxborough	59	2,996
November 20, 1902	120	Star Bonneville	No. 12—Upper Roxborough	90	3,633
December 8, 1902	151	Star Bonneville	No. 12—Upper Roxborough	60	3,752
December 18, 1902	141	Star Bonneville	No. 12—Upper Roxborough	90	4,012
December 18, 1902	142	Star Bonneville	No. 12—Upper Roxborough	90	3,115
December 22, 1902	122	Star Bonneville	No. 12—Upper Roxborough	120	3,214
December 22, 1902	123	Star Bonneville	No. 12—Upper Roxborough	119	3,950
December 30, 1902	80	Whitehall	No. 12—Upper Roxborough	181	3,603
December 30, 1902	81	Star Bonneville	No. 12—Upper Roxborough	180	3,162

Tests of Concrete Cubes—Continued.

Date.	No. of Cube.	Brand of Cement.	Contract.	Shaft.	Age (days).	Ultimate trength (pounds) per sq. in.
February 24 1903	125	Star Bonneville	No. 12—Upper Roxborough	.....	179	3,312
April 21, 1903	19	Star Bonneville	No. 14—Torresdale Conduit	.....	60	3,363
July 8, 1903	3	Star Bonneville	No. 14—Torresdale Conduit	.....	120	3,713
July 10, 1903	4	Star Bonneville	No. 14—Torresdale Conduit	5 & 6	120	3,221
July 21, 1903	26	Lehigh	No. 14—Torresdale Conduit	5	60	3,292
July 31, 1903	54	Star Bonneville	No. 14—Torresdale Conduit	10	59	3,104
August 13, 1903	17	Star Bonneville	No. 14—Torresdale Conduit	9	181	3,735
August 17, 1903	17	Lehigh	No. 14—Torresdale Conduit	8	90	3,422
September 18, 1903	4	Lehigh	No. 14—Torresdale Conduit	3	88	3,463
September 18, 1903	9	Star Bonneville	No. 14—Torresdale Conduit	5	179	3,026
September 25, 1903	5	Star Bonneville	No. 14—Torresdale Conduit	3	90	3,512
September 25, 1903	9	Lehigh	No. 14—Torresdale Conduit	4	120	3,486
October 8, 1903	5	Star Bonneville	No. 14—Torresdale Conduit	2	61	3,286
October 8, 1903	6	Star Bonneville	No. 14—Torresdale Conduit	2	59	3,982
October 8, 1903	12	Star Bonneville	No. 14—Torresdale Conduit	4	92	3,128
October 8, 1903	20	Star Bonneville	No. 14—Torresdale Conduit	4	61	3,013
October 8, 1903	12	Star Bonneville	No. 14—Torresdale Conduit	5	181	3,278

Tests of Concrete Cubes—Continued.

Date.	No. of Cube.	Brand of Cement.	Contract.	Shaft.	Age (days).	Ultimate strength (pounds) per sq. in.
October 5, 1903	19	Star Bonneville	No. 14—Torresdale Conduit	4	60	3,628
October 10, 1903	82	Star Bonneville	No. 14—Torresdale Conduit	11	58	3,000
October 14, 1903	26	Star Bonneville	No. 14—Torresdale Conduit	8	90	3,820
October 16, 1903	27	Star Bonneville	No. 14—Torresdale Conduit	8	90	4,964
October 16, 1903	11	Lehigh	No. 14—Torresdale Conduit	8	180	3,794
October 17, 1903	37	Star Bonneville	No. 14—Torresdale Conduit	8	58	4,951
October 20, 1903	25	Star Bonneville	No. 14—Torresdale Conduit	4	59	3,524
October 20, 1903	10	Star Bonneville	No. 14—Torresdale Conduit	3	90	3,286
October 20, 1903	38	Star Bonneville	No. 14—Torresdale Conduit	8	59	3,281
October 23, 1903	76	Star Bonneville	No. 14.—Torresdale Conduit	11	89	4,112
October 23, 1903	22	Star Bonneville	No. 14—Torresdale Conduit	8	119	3,419
October 28, 1903	77	Star Bonneville	No. 14—Torresdale Conduit	11	91	3,253
November 5, 1903	4	Star Bonneville	No. 14—Torresdale Conduit	2	90	3,622
November 9, 1903	80	Star Bonneville	No. 14—Torresdale Conduit	11	91	3,119
November 9, 1903	25	Star Bonneville	No. 14—Torresdale Conduit	8	118	3,334
November 12, 1903	35	Star Bonneville	No. 14—Torresdale Conduit	8	90	3,429
November 18, 1903	24	Star Bonneville	No. 14—Torresdale Conduit	4	90	3,441

Tests of Concrete Cubes—Continued.

Date.	No. of Cube.	Brand of Cement.	Contract	Shaft.	Age (days.)	Ultimate strength (pounds) per sq. in.
November 19, 1903	12	Star Bonneville	No. 14—Torresdale Conduit	2	60	3,506
November 19, 1903	18	Star Bonneville	No. 14—Torresdale Conduit	3	60	3,112
November 25, 1903	14	Star Bonneville	No. 14—Torresdale Conduit	2	60	3,557
November 28, 1903	78	Star Bonneville	No. 14—Torresdale Conduit	10	119	3,618
December 2, 1903	13	Star Bonneville	No. 14—Torresdale Conduit	3	90	5,119
December 2, 1903	87	Giant	No. 14—Torresdale Conduit	9	90	3,047
December 2, 1903	95	Star Bonneville	No. 14—Torresdale Conduit	9	60	3,314
December 5, 1903	89	Giant	No. 14—Torresdale Conduit	9	89	3,494
December 14, 1903	92	Giant	No. 14—Torresdale Conduit	9	89	3,145
December 16, 1903	93	Star Bonneville	No. 14—Torresdale Conduit	9	90	4,067
December 16, 1903	19	Star Bonneville	No. 14—Torresdale Conduit	8	180	5,053
December 21, 1903	39	Star Bonneville	No. 14—Torresdale Conduit	7	90	3,281
June 3, 1903	63	Lehigh	No. 16—Belmont Filters	.....	180	3,493
September 16, 1903	115	Lehigh	No. 16—Belmont Filters	.....	91	3,516
June 3, 1903	64	Lehigh	No. 16—Belmont Filters	.....	180	3,177
December 2, 1902	42	Star Bonneville	No. 25—Torresdale Filters	.....	122	3,021
December 2, 1902	.....	Star Bonneville	No. 25—Torresdale Filters	.....	122	3,061

Test of Concrete Cubes—Continued.

Date	No. of Cube.	Brand of Cement.	Contract.	Age (days.)	Ultimate strength (pounds) per sq. in.
December 2, 1902	.....	Star Bonneville	No. 25—Torresdale Filters	90	3,047
December 2, 1902	49	Star Bonneville	No. 25—Torresdale Filters	61	3,200
April 21, 1903	84	Star Bonneville	No. 25—Torresdale Filters	120	3,586
June 2, 1903	70	Giant	No. 25—Torresdale Filters	180	3,804
June 19, 1903	82	Giant	No. 25—Torresdale Filters	180	3,028
June 19, 1903	83	Star Bonneville	No. 25—Torresdale Filters	180	3,071
July 15, 1903	108	Giant	No. 25—Torresdale Filters	31	3,037
September 2, 1903	98	Giant	No. 25—Torresdale Filters	92	3,189
September 2, 1903	99	Giant	No. 25—Torresdale Filters	91	3,285
September 4, 1903	148	Star Bonneville	No. 25—Torresdale Filters	29	4,028
September 25, 1903	94	Giant	No. 25—Torresdale Filters	120	3,467
September 25, 1903	95	Giant	No. 25—Torresdale Filters	119	3,159
September 25, 1903	96	Star Bonneville	No. 25—Torresdale Filters	119	3,095
October 20, 1903	137	Giant	No. 25—Torresdale Filters	91	3,038
October 20, 1903	138	Lehigh	No. 25—Torresdale Filters	90	3,328
November 5, 1903	191	Giant	No. 25—Torresdale Filters	60	3,739
November 9, 1903	176	Lehigh	No. 25—Torresdale Filters	59	3,979

Test of Concrete Cubes—Continued.

Date.	No. of Cube.	Brand of Cement.	Contract.	Age (days.)	Ultimate strength (pounds) per sq. in
November 13, 1903	180	Lehigh	No. 25—Torresdale Filters	60	3,540
November 16, 1903	196	Star Bonneville	No. 25—Torresdale Filters	30	3,174
November 16, 1903	195	Lehigh	No. 25—Torresdale Filters	30	3,135
December 16, 1903	111	Giant	No. 25—Torresdale Filters	180	3,833
December 17, 1903	112	Star Bonneville	No. 25—Torresdale Filters	180	3,001
December 17, 1903	113	Star Bonneville	No. 25—Torresdale Filters	180	3,353
December 21, 1903	164	Lehigh	No. 25—Torresdale Filters	119	3,430
December 21, 1903	115	Lehigh	No. 25—Torresdale Filters	180	3,336
December 21, 1903	114	Star Bonneville	No. 25—Torresdale Filters	180	3,837
December 23, 1903	166	Giant	No. 25—Torresdale Filters	120	4,484
December 28, 1903	168	Lehigh	No. 25—Torresdale Filters	121	3,095
December 30, 1903	170	Lehigh	No. 25—Torresdale Filters	120	3,843
November 13, 1903	4	Alpha	No. 27—Oak Lane Reservoir	60	3,126

ROXBOROUGH FILTERS OPERATION.

The Upper and Lower Roxborough filter stations are managed by an assistant engineer, with headquarters at Upper Roxborough. Each station is provided with three filter attendants standing eight hour watches, with a labor roll of eleven men who are worked as required by the sand scrapings, restoring sand, etc., mutually at both stations. Lower Roxborough is provided with a night watchman, and Upper Roxborough with a day watchman. The Upper and Lower Roxborough offices are connected by special telephone with the pump room at the Roxborough Auxiliary Station to control the operation of the centrifugal pumps which supply water from the Upper Roxborough reservoir to the filters and the electric lighting machinery. The three engineers in charge of the low service pumping machinery and electric lighting equipment constitute a part of the working force of the Roxborough system.

At Upper Roxborough an engineer is employed to run the sand washer and ejector pumps, and a mechanic is employed to make pipe repairs and adjustment of working appliances who works as occasion requires at each station, and when the filters are started will perform the same duties at the Belmont station.

The total force of employees regularly on the work is 25, including the assistant engineer in charge. An additional force of laborers is required when sand is being restored to the filters, and when the Belmont working force has been organized it is intended to combine the labor force at any station for this purpose, and thus dispense with the occasional employment of outside or irregular labor. In the early operations the extra labor for replacing sand at Lower Roxborough was obtained from the contractor at Upper Roxborough, but since Contract No. 12 and its appurtenances were finished this extra labor has been obtained from the

LOWER ROXBOROUGH FILTER, DRAINED FOR SCRAPING SAND.

regular force of the Water Bureau, bills for which were rendered against this Bureau.

Lower Roxborough Filters.

The total quantity of water filtered at Lower Roxborough for the year ending December 1, 1903, was 2,257,000,000, equivalent to a daily yield of 6,183,600 gallons. During this period the filters have been supplied with subsided water from the Upper Roxborough reservoir. Since December the filters have been receiving water from the preliminary filters, and when these have been properly adjusted to the work, it is expected to raise the capacity of the station to balance the capacity of the pumps which supply to the Lower Roxborough reservoir. At present this station is filtering at the rate of 9,800,000 gallons per day.

The filtered water is delivered to Manayunk, Ward 21, and the lower part of Germantown, Ward 22.

During the first two and one-half months of the year the scraped sand was wheeled from the filters to the washers, but since March all sand has been transported to the washers by means of a Korting ejector, operated in a portable hopper, and connected up from place to place in the filter, with the water pressure and sand discharge pipe lines.

During the year the aggregate number of scrapings of filters was 51, an average of 10 to each filter, giving an average period of operation of 35.8 days.

Each filter is equipped with electric lights which permits the scraping and transportation of sand in the coldest weather without opening the ventilators in the the roof or keeping the entrance door long open. This operation has already been successfully conducted with the temperature at low as 11 degrees Fahrenheit, the sand going through the discharge pipes of the ejectors, through the washers and being stored in the courts, without interruption or hindrance by reason of the low temperature.

The total amount of sand scraped and washed at Lower Roxborough for the year was 4,514.7 cubic yards, with an expenditure of 14,416,000 gallons of water to transport and wash, which with water at $25 per million gallons for pumpage and filtration charges, represent a cost of $360.40, or about eight cents per cubic yard of sand washed.

The average expenditure of water per cubic yard of sand transported and washed was about 3,200 gallons.

During the year 2,442.8 cubic yards of scraped and washed sand was replaced in filters Nos. 2 and 5, and in the early spring the remainder of the washed sand now stored in the courts at Lower Roxborough will be replaced in Filters No. 3 and No. 4.

The total cost of operating the Lower Roxborough filters during the year was $9,168.48, equivalent to a cost of $4.06 per million gallons filtered. Considering the fact that this station with the same labor charges, excepting cost of replacing sand, can supply easily 12,000,000 gallons per day, it will be seen that when the pumpage to the Lower Roxborough reservoir will admit of steadily maintaining a rate of 10,000,000 to 12,000,000 gallons per day that the cost of filtration per million gallons will be materially reduced. It is probable that with this station working at an average rate of not less than 10,000,000 gallons per day, the cost of filtration will not exceed $3.00 per million gallons.

Upper Roxborough Filters.

The first six filters at Upper Roxborough were started in service July 3, 1903, another filter was started July 25, and the last filter was started August 8th. This station therefore has been in service about six months.

The total quantity of water filtered since starting to December 1st, is 1,601,920,000 gallons, at a total cost of $5,523.47, or at the rate of $3.45 per million gallons. The

average daily rate of work was 10,608,000 gallons; this is about one-half the easy capacity of the filters, and with an increased daily rate of work the per million gallon cost of filtration will be very materially reduced.

The total scrapings of sand at this station were 17, aggregating 1,740.2 cubic yards, and an average thickness of scraping of 1.0625 inch.

By the combined washing of the scraped sand in the ejector and one hopper only of the sand washer, the turbidity of the sand is reduced quite 99 per cent.

The ejector and washer apparatus at this station is of later design and more efficient than that at Lower Roxborough, and the work of cleaning a filter can be performed more expeditiously. Scrapings amounting to 125 cubic yards have been removed in 10 hours with a working force of eight men. At this station no sand has ever been removed from the filters by wheelbarrows. The sand washers and ejectors are supplied with filtered water at 80 to 90 pounds pressure per square inch.

The easy capacity of the Upper Roxborough filters is 20,000,000 gallons per day, provided the Upper Roxborough reservoir can be kept full and the water drawn off to the filters with from six to seven days subsidence. The cost of running this station will be but slightly greater if the yield is 20,000,000 gallons than it is at the present work of 11,000,00 gallons per day. The force of men necessarily employed is equal to the work required by the larger volume of water with the possible exception of three helpers to the engineers at the low service pumping station, the increased consumption of fuel for pumping to the sand washers and ejectors, and the increased consumption of electric current used in the work of scraping filters after daylight hours; there will also be a small increase in the cost of oil, waste and small stores. This increased cost for nearly double the capacity of the station will be materially

overcome by the reduced cost per million gallons of water filtered.

The excess quantity of water can readily be utilized in the higher levels of Germantown, now receiving water from Lower Roxborough filters, and the quantity thus diverted from Lower Roxborough can profitably be utilized in Wards 38 and 28, two wards which at this date are showing the highest typhoid fever rates in the City. These two wards, lying next to Wards 21 and 22, and differing from them in no other respect than the quality of water supplied through the City mains, are at this date showing typhoid fever rates from six to nine times those of the two wards which are receiving the Roxborough filtered water.

Summary of Operations of Roxborough filters.

Tables showing the weekly summary of bacterial and turbidity contents of applied and filtered water for Lower and Upper Roxborough are given herewith.

Considering Lower Roxborough, where the filters were worked until December 1, 1903, with water from the Upper Roxborough reservoir, in which at times of large consumption during the winter, when the amount of subsidence of suspended matters and reduction of turbidity is very small, for the four weeks ending January 31, 1903, the quality of the effluents was not up to the required standard. After this date, with a reduced bacterial content of applied water and increased watchfulness in the handling of the filters, a marked change will be observed in the bacterial condition of the filters effluents, as shown by the following table:

Lower Roxborough.	Bacteria per c. c. of water sampled. Four weeks, January.	Four weeks, February.
Applied water	36,250	7,000
All filters	1,225	65
Clear water basin	1,275	69
Percentage reduction	96.5	99.0

The average performance for the 51 weeks to December 19, 1903, is as follows:

Source of sample.	Bacteria per c. c.	Turbidity by silica standard parts per 1,000,000.
Applied water	5,330	24
Filter No. 1.....	185	1
Filter No. 2.....	157	1
Filter No. 3.....	187	1
Filter No. 4.....	132	1
Filter No. 5.....	175	1
Clear water basin	153	1
Percentage reduction	97.13	96

Omitting the four weeks January 4 to 31, inclusive, which for the reasons given are not representative of the work of the filters, the remaining 47 weeks in the table show the following results:

Source of sample.	Bacteria per c. c.	Turbidity by silica standard parts per 1,000,000.
Applied water	2,392	23
Filter No. 1.....	59	1
Filter No. 2.....	69	1
Filter No. 3.....	87	1
Filter No. 4.....	64	1
Filter No. 5.....	79	1
Average of all filters	71	1
Clear water basin	61	1
Percentage reduction	97.45	96

Considering the Upper Roxborough filters, the first of these, Filters No. 1, 3, 5, 6, 7 and 8, were started July 3rd, and Filters No. 2 and 4 were started July 18th and August 8th, respectively. Omitting the first three weeks operation of each filter, during which time some ripening of the sandbed was going on, the following table shows the performance as an average of the summary by weeks:

Source of sample.	Period of operation weeks.	Bacteria per c. c.	Turbidity by silica standard parts per 1,000,000.
Applied water	24	3660	,11
Filter No. 1.....	24	18	0+
Filter No. 2.....	22	32	1
Filter No. 3.....	24	40	0+
Filter No. 4.....	19	79	0+
Filter No. 5.....	24	29	1
Filter No. 6.....	24	44	1
Filter No. 7.....	24	52	1
Filter No. 8.....	24	15	0+
Clear water basin.....	22	48	1
Percentage reduction ...		98.9	90.9

Considering that the filter attendents have had a very limited training in their duties, that the filters are new, that some of the mechanical appliances are not yet working perfectly, but will with more use, and that the irregular manner in which the filters have been at times operated to adapt the yield to the wide variations in daily consumption of water in the districts supplied, it is thought that these filters are doing remarkably well.

Lower Roxborough Filters.

	WEEK ENDING.					
	JAN. 3, 1903.		JAN. 10, 1903.		JAN. 17, 1903.	
	Bact.	Turb.	Bact.	Turb.	Bact.	Turb.
Applied water	6200	22	30000	50	23000	15
Filter No. 1	74	2	44	2	4600	3
Filter No. 2	170	1	3400	3	1100	1
Filter No. 3	94	1	150	2	2100	1
Filter No. 4	190	1	680	2	200	0
Filter No. 5	250	2	2000	3	300	1
Average of all filters	160	1	1250	2	1660	1
Filtered water basin	120	2	1600	3	1000	2

	WEEK ENDING.					
	JAN. 24, 1903.		JAN. 31, 1903.		FEB. 7, 1903.	
	Bact.	Turb.	Bact.	Turb.	Bact.	Turb.
Applied water	40000	34	52000	60	14000	65
Filter No. 1	1900	2	150	2	170	3
Filter No. 2	140	1	53	1	39	1
Filter No. 3	1800	1	1400	3	83	3
Filter No. 4	1500	1	1300	2	63	2
Filter No. 5	1000	2	1300	3	56	2
Average of all filters	1270	1	840	2	82	2
Filtered water basin	1400	1	1100	2	100	2

	WEEK ENDING.					
	FEB. 14, 1903.		FEB. 21, 1903.		FEB. 28, 1903.	
	Bact.	Turb.	Bact.	Turb.	Bact.	Turb.
Applied water	6200	110	5100	80	2700	23
Filter No. 1	59	4	74	5	49	3
Filter No. 2	36	3	70	3	38	1
Filter No. 3	64	3	96	3	42	2
Filter No. 4	53	3	120	3	34	2
Filter No. 5	51	4	50	3	51	2
Average of all filters	53	3	82	3	43	2
Filtered water basin	65	3	65	3	46	2

Lower Roxborough Filters—Continued.

	WEEK ENDING.					
	MAR. 7, 1903.		MAR. 14, 1903.		MAR. 21, 1903.	
	Bact.	Turb.	Bact.	Turb.	Bact.	Turb.
Applied water	4800	110	3000	60	2800	24
Filter No. 1	30	2	31	6	120	3
Filter No. 2	24	1	97	2	240	1
Filter No. 3	69	1	130	6	380	4
Filter No. 4	48	2	37	4	590	3
Filter No. 5	55	2	89	4	380	2
Average of all filters	45	2	77	4	340	3
Filtered water basin	48	2	52	5	93	3

	WEEK ENDING.					
	MAR. 28, 1903.		APRIL 4, 1903.		APRIL 11, 1903.	
	Bact.	Turb.	Bact.	Turb.	Bact.	Turb.
Applied water	4000	22	2700	28	1200	16
Filter No. 1	39	2	55	2	40	1
Filter No. 2	110	1	66	1	44	1
Filter No. 3	310	1	390	1	230	1
Filter No. 4	100	2	41	1	23	1
Filter No. 5	1,100	1	150	1	50	1
Average of all filters	330	1	140	1	77	1
Filtered water basin	140	1	140	1	90	1

	WEEK ENDING.					
	APRIL 18, 1903.		APRIL 25, 1903.		MAY 2, 1903.	
	Bact.	Turb.	Bact.	Turb.	Bact.	Turb.
Applied water	1300	19	1500	28	1400	18
Filter No. 1	45	1	51	2	34	1
Filter No. 2	.....	.....	1200	1	150	2
Filter No. 3	160	1	100	1	90	1
Filter No. 4	39	1	28	1	22	1
Filter No. 5	44	1	20	1	15	1
Average of all filters	72	1	280	1	62	1
Filtered water basin	100	1	98	1	56	1

Lower Roxborough Filters—Continued.

	WEEK ENDING					
	MAY 9, 1903.		MAY 16, 1903.		MAY 23, 1903.	
	Bact.	Turb.	Bact.	Turb.	Bact.	Turb.
Applied water	5200	13	810	6	1500	5
Filter No. 1	200	1	56	1	20	1
Filter No. 2	29	1	28	1	19	1
Filter No. 3	110	1	170	1	35	1
Filter No. 4	27	1	30	1	.....	.....
Filter No. 5	28	1	69	1	56	1
Average of all filters	79	1	71	1	32	1
Filtered water basin	54	1	64	1	31	1

	WEEK ENDING					
	MAY 30, 1903.		JUNE 6, 1903.		JUNE 13, 1903.	
	Bact.	Turb.	Bact.	Turb.	Bact.	Turb.
Applied water	1200	8	310	9	350	10
Filter No. 1	67	1	17	1	12	1
Filter No. 2	38	1	45	1	21	1
Filter No. 3	39	1	100	1	190	1
Filter No. 4	240	1	31	1	22	1
Filter No. 5	52	1	87	1	62	1
Average of all filters	87	1	56	1	61	1
Filtered water basin	100	1	40	1	43	1

	WEEK ENDING					
	JUNE 20, 1903.		JUNE 27, 1903.		JULY 4, 1903.	
	Bact.	Turb.	Bact.	Turb.	Bact.	Turb.
Applied water	810	36	490	30	690	18
Filter No. 1	12	1	52	1	74	1
Filter No. 2	14	1	12	1	28	1
Filter No. 3	66	1	79	1	74	1
Filter No. 4	57	1	17	1	17	1
Filter No. 5	51	1	59	1	73	1
Average of all filters	40	1	44	1	53	1
Filtered water basin	32	1	46	1	56	1

Lower Roxborough Filters—Continued.

	WEEK ENDING.					
	JULY 11, 1903.		JULY 18, 1903.		JULY 25, 1903.	
	Bact.	Turb.	Bact.	Turb.	Bact.	Turb.
Applied water	620	32	520	19	2900	40
Filter No. 1	28	1	20	1	80	1
Filter No. 2	13	1	11	1	15	1
Filter No. 3	70	1	19	1	19	1
Filter No. 4	13	1	17	1	19	1
Filter No. 5	34	1	19	1	24	1
Average of all Filters	32	1	17	1	21	1
Filtered water basin	35	1	22	1	25	1

	WEEK ENDING.					
	AUG. 1, 1903.		AUG. 8, 1903.		AUG. 15, 1903.	
	Bact.	Turb.	Bact.	Turb.	Bact.	Turb.
Applied water	290	14	260	13	740	15
Filter No. 1	32	1	18	1	12	1
Filter No. 2	14	1	12	1	15	1
Filter No. 3	26	1	68	2	21	1
Filter No. 4	18	1	47	1	63	0
Filter No. 5	17	1	16	1	15	1
Average of all Filters	21	1	32	1	25	1
Filtered water basin	21	1	24	1	22	1

	WEEK ENDING.					
	AUG. 22, 1903.		AUG. 29, 1903.		SEPT. 5, 1903.	
	Bact.	Turb.	Bact.	Turb.	Bact.	Turb.
Applied water	640	9	1500	9	1400	16
Filter No. 1	20	1	36	1	53	1
Filter No. 2	16	1	13	1	18	1
Filter No. 3	18	1	35	1	53	1
Filter No. 4	54	1	30	1	30	1
Filter No. 5	24	1	26	1	19	1
Average of all Filters	16	1	28	1	35	1
Filtered water basin	28	1	28	1	43	1

Lower Roxborough Filters—Continued.

	WEEK ENDING.					
	SEPT. 12, 1903.		SEPT. 19, 1903.		SEPT. 26, 1903.	
	Bact.	Turb.	Bact.	Turb.	Bact.	Turb.
Applied water	890	13	770	12	950	11
Filter No. 1	31	1	15	0+	16	0+
Filter No. 2	23	1	12	0+	19	0+
Filter No. 3	41	1	25	0+	25	0+
Filter No. 4	41	1	27	0+	71	0+
Filter No. 5	33	1	17	0+	34	1
Average of all Filters	34	1	19	0+	33	0+
Filtered water basin	38	1	30	0+	28	0+

	WEEK ENDING.					
	OCT. 3, 1903.		OCT. 10, 1903.		OCT. 17, 1903.	
	Bact.	Turb.	Bact.	Turb.	Bact.	Turb.
Applied water	1500	9	2600	11	2800	28
Filter No. 1	17	0+	120	0.5	86	1
Filter No. 2	18	0+	16	0+	65	0.5
Filter No. 3	37	1	10	0+	11	0+
Filter No. 4	37	0+	30	0+	240	1
Filter No. 5	17	0+	14	0+	18	0.5
Average of all Filters	25	0+	38	0+	84	0.5
Filtered water basin	29	0+	28	0+	77	0.5

	WEEK ENDING.					
	OCT. 24, 1903.		OCT. 31, 1903.		NOV. 7, 1904.	
	Bact.	Turb.	Bact.	Turb.	Bact.	Turb.
Applied water	780	16	1300	8	440	2
Filter No. 1	15	1	11	0.5	15	0.5
Filter No. 2	21	0.5	12	0+	12	0+
Filter No. 3	11	0+	11	0+	11	0+
Filter No. 4	19	0.5	11	0+	12	0+
Filter No. 5	15	0+	13	0+	8	0+
Average of all Filters	16	0.5	12	0+	12	0+
Filtered water basin	22	0.5	13	0+	13	0.5

Lower Roxborough Filters—Continued.

	WEEK ENDING.					
	Nov. 14, 1903.		Nov. 21, 1903.		Nov. 28, 1903.	
	Bact.	Turb.	Bact.	Turb.	Bact.	Turb.
Applied water	250	8	580	8	1700	8
Filter No. 1	15	0+	86	0+	89	0+
Filter No, 2	11	0+	18	0+	11	0+
Filter No. 3	14	0+	35	0+	36	0.5
Filter No. 4	13	0+	15	0+	12	0+
Filter No. 5	.....	.....	.....	.....	.....	.....
Average of all filters	13	0+	38	0+	24	0+
Filtered Water Basin	26	0+	23	0.5	25	0+

	WEEK ENDING.					
	Dec. 5, 1903.		Dec. 12, 1903.		Dec. 19, 1903.	
	Bact.	Turb.	Bact.	Turb.	Bact.	Turb.
Applied water	1000	4	3800	8	16000	6
Filter No. 1	32	0+	34	0+	590	0.5
Filter No. 2	11	0+	19	0+	240	0+
Filter No. 3	23	0.5	57	0+	330	0.5
Filter No. 4	12	0+	35	0+	240	0+
Filter No. 5	.....	.....	.....	.....	.....	.....
Average of all filters	20	0+	36	0+	350	0+
Filtered water basin	19	0.5	40	0.5	340	0+

Upper Roxborough Filters.

	WEEK ENDING.					
	JULY 4, 1903.		JULY 11, 1903.		JULY 18, 1903.	
	Bact.	Turb.	Bact.	Turb.	Bact.	Turb.
Applied water	1800	16	660	30	360	20
Filter No. 1	680	4	670	2	34	2
Filter No. 2	.....	.....	.....	.....	3300	5
Filter No. 3	360	2	240	2	15	2
Filter No. 4	.....	.....	.....	.....	.....	.....
Filter No. 5	390	5	410	6	38	4
Filter No. 6	1500	4	740	6	42	5
Filter No. 7	160	4	550	6	31	5
Filter No. 8	1000	2	2400	4	23	2
Average of all filters	680	4	840	4	500	4
Filtered water basin	.....	.....	.....	.....	.....	.....

	WEEK ENDING.					
	JULY 25, 1903.		AUG. 1, 1903.		AUG. 8, 1903.	
	Bact.	Turb.	Bact.	Turb.	Bact.	Turb.
Applied water	510	22	2300	14	550	13
Filter No. 1	13	1	19	1	9	1
Filter No. 2	63	5	37	4	13	3
Filter No. 3	16	1	12	1	9	2
Filter No. 4	.....	.....	.....	.....	1600	6
Filter No. 5	18	3	10	3	10	2
Filter No. 6	21	4	14	3	27	2
Filter No. 7	25	3	17	5	13	3
Filter No. 8	6	1	7	1	6	1
Average of all filters	23	3	17	3	210	2
Filtered water basin	340	3	250	3	34	3

Upper Roxborough Filters—Continued.

	WEEK ENDING.					
	AUG. 15, 1903.		AUG. 22, 1903.		AUG. 29, 1903.	
	Bact.	Turb.	Bact.	Turb.	Bact.	Turb.
Applied water	860	14	830	8	540	7
Filter No. 1	6	1	13	1	8	1
Filter No. 2	10	2	12	1	8	1
Filter No. 3	9	1	5	1	7	1
Filter No. 4	110	9	70	7	31	2
Filter No. 5	8	2	12	1	21	1
Filter No. 6	11	1	10	1	10	1
Filter No. 7	8	2	10	2	180	1
Filter No. 8	7	1	8	1	4	1
Average of all filters	21	2	18	2	34	1
Filtered water basin	24	3	19	2	140	1

	WEEK ENDING					
	SEPT. 5, 1903.		SEPT. 12, 1903.		SEPT. 19, 1903.	
	Bact.	Turb.	Bact.	Turb.	Bact.	Turb.
Applied water	860	14	820	13	750	11
Filter No. 1	21	1	22	0	26	0+
Filter No. 2	33	1	21	1	170	0
Filter No. 3	19	1	30	0+	14	0+
Filter No. 4	12	2	12	1	29	1
Filter No. 5	18	1	.....	.....	99	1
Filter No. 6	59	1	220	1	21	0+
Filter No. 7	23	1	8	1	6	1
Filter No. 8	32	1	8	1	19	0+
Average of all filters	27	1	46	1	48	0+
F ltered water basin	20	1	41	1	42	1

Upper Roxborough Filters—Continued.

	WEEK ENDING					
	SEPT. 26, 1903.		OCT. 3, 1903.		OCT. 10, 1903.	
	Bact.	Turb.	Bact.	Turb.	Bact.	Turb.
Applied water	780	11	1200	7	2500	8
Filter No. 1	55	0+	10	0+	11	0+
Filter No. 2	17	0+	9	0+	7	0+
Filter No. 3	29	0+	14	0	99	0+
Filter No. 4	32	0+	170	0+	35	0+
Filter No. 5	7	0+	6	0+	7	0+
Filter No. 6	6	0+	7	0+	10	0+
Filter No. 7	9	1	7	1	6	0.5
Filter No. 8	23	0+	23	0+	18	0+
Average of all filters	22	0+	31	0+	24	0+
Filtered water basin	24	0+	15	0+	21	0.5

	WEEK ENDING					
	OCT. 17, 1903.		OCT. 24, 1903.		OCT. 31, 1903.	
	Bact.	Turb.	Bact.	Turb.	Bact.	Turb.
Applied water	3100	28	600	14	590	9
Filter No. 1	23	0+	30	0+	15	0+
Filter No. 2	18	0.5	8	0+	7	0+
Filter No. 3	32	0.5	7	0+	4	0+
Filter No. 4	26	1	8	0 5	5	0+
Filter No. 5	10	0.5	6	1	22	0.5
Filter No. 6	11	0.5	10	0.5	7	0+
Filter No. 7	7	0.5	46	2	8	0.5
Filter No. 8	24	0+	14	0+	14	0+
Average of all filters	19	0+	16	0+	10	0+
Filtered water basin	23	0.5	12	0.5	12	0+

Upper Roxborough Filters—Continued.

	WEEK ENDING.					
	Nov. 7, 1903.		Nov. 14, 1903.		Nov. 21, 1903.	
	Bact.	Turb.	Bact.	Turb.	Bact.	Turb.
Applied water	310	6	450	8	1200	7
Filter No. 1	6	0+	3	0+	5	0+
Filter No. 2	20	0+	7	0+	6	0+
Filter No. 3	3	0+	3	0	3	0+
Filter No. 4	5	0+	3	0+	7	0+
Filter No. 5	5	0.5	3	0+	3	0+
Filter No. 6	6	0+	4	0+	31	0+
Filter No. 7	3	0.5	3	0+	7	0+
Filter No. 8	12	0+	4	0+	3	0+
Average of all filters	8	0+	4	0+	8	0+
Filtered water basin	8	0+	5	0+	6	0+

	WEEK ENDING.							
	Nov. 28, 1903.		Dec. 5, 1903.		Dec. 12, 1903.		Dec. 19, 1903.	
	Bact.	Turb.	Bact.	Turb.	Bact.	Turb.	Bact.	Turb.
Applied water	5200	9	4600	7	14000	5	38000	10
Filter No. 1	5	0+	8	0+	22	0+	70	0+
Filter No. 2	9	0+	7	0+	30	0+	230	0+
Filter No. 3	100	0.5	44	0.5	87	0.5	330	0.5
Filter No. 4	86	0+	89	0.5	220	0.5	570	0.5
Filter No. 5	5	0+	7	0+	33	0+	290	0+
Filter No. 6	18	0+	17	0+	79	0+	370	0.5
Filter No. 7	9	0+	13	0+	150	0+	590	0.5
Filter No. 8	9	0+	10	0+	26	0+	44	0+
Av. of all filters	30	0+	24	0+	81	0+	310	0+
Filt. water basin	22	0+	23	0+	80	0.5	390	0.5

TURBIDITY OF FILTER EFFLUENTS.

Considering turbidity by the silica standard, clear water not thoroughly sparkling will show a turbidity between six and seven parts per million.

Considering the operation of the old established plain sand filters abroad, the newest of which, those at Hamburg, Germany, have been running more than ten years, the bacterial reports for these filters rarely show results equal to those from the Upper and Lower Roxborough filters tabled above. No tests for turbidity are made abroad, and therefore no comparison in numbers for the removal of suspended matter can be made. The general theory of the water works engineers, especially in Germany, is that so long as the bacterial content of the water satisfies the requirements of the Imperial Institute of Hygiene in Berlin, it is immaterial what the water may be with reference to clearness. Here, however, it is necessary not only to render the water practically pure, but to so deal with it as to make it look pure, and experience has demonstrated that it is easier to reduce the bacterial content to a satisfactory point than it is to remove the finely divided clay, coal dust and other suspended matter which imparts turbidity to the water.

More important perhaps than the reduction of bacteria in point of numbers by the Roxborough filters, is the fact that the B. Coli Communi, which is the most easily differentiated bacterium of a sewage polluted water, is seldom, if ever, found in the filter effluents, while the tests rarely fail to disclose its presence in the applied water even with the best conditions of the Schulykill river.

FILTER SCRAPINGS AND COST OF CLEANING FILTERS PER MILLION GALLONS OF WATER FILTERED.

In the following table the material data with reference to the scraping and washing of sand from the Upper Roxborough filters will be found. Since these filters have always been operated with the ejector, representing the least cost for handling sand, they are offered as showing the probable depth of sand to be scraped; the cubic yards scraped per million gallons of water filtered; the cost of handling sand per cubic yard, not including refilling the filters, and finally, the cost of cleaning filters per million gallons of water filtered.

The respective columns are explained by their headings. The fourth column contains the yield in million gallons for the run of the filter, and the fifth column the yield per acre for the run of the filter.

Filter.	Run.	Days run.	Yield of run mil. gals.	Yield per acre mil. gals.	Depth of scraping.	Cubic yards scraped.	Cost per cu. yd. to scrape and wash.
No. 1	1	74.62	85.52	122.17	1.24	116.5	$0.60
	2	28.85	51.92	74.17	0.90	84.8	0.85
No. 2	1	59.79	66.82	95.46	0.95	90.0	0.82
	2	40.58	76.56	108.00	0.73	69.0	0.87
No. 3	1	90.06	119.60	170.86	1.43	134.6	0.49
	2	43.56	65.68	93.83	0.88	76.2	1.12
No. 4	1	45.28	89.58	127.97	1.60	150.4	0.74
	2	48.85	60.36	86.23	1.18	110.8	0.91
No. 5	1	66.12	95.51	136.44	1.94	173 0	0.68
	2	38.63	69.02	98.60	0.97	91.6	0 77
No. 6	1	60.88	79.54	113.63	0.72	67.9	0.98
	2	62.67	75.80	108.29	1.02	96.1	0.96

Sand Ejector in Operation at Lower Roxborough Filters.

Filter	Run.	Days run.	Yield of run mil. gals.	Yield per acre mil. gals.	Depth of scraping.	Cubic yards scraped.	Cost per cu. yd. to scrape and wash.
No. 7	1	51.00	107.60	153.71	0.60	56 6	0.63
	2	47.71	79.60	113.71	0.94	58.2	0.68
No. 8	1	56.12	92.71	132.44	0.84	90.5	0.54
	2	56.75	87.82	125.46	1.25	117.6	0.63
Totals	.....	871.47	1,303.64	1,860.97	17.19	1,613.8	$12.27
Average	.....	54.47	81.48	116.31	1.074	100.86	0.767

Average cost for scraping, transporting and washing sand per million gallons of water filtered..... $0.95

DESCRIPTION OF MODE OF OPERATING THE FILTERS AT LOWER AND UPPER ROXBOROUGH.

When the filter tank has been supplied with the collector pipes at the bottom, the gravel underdrains, and the sand filled in to the proper depths, all is in readiness for putting it in operation. The first step is to fill the filter from below with filtered water, if it be available, until the level of the water stands four (4) or five (5) inches above the surface of the sand. It is left in this condition for a period of one week or ten days until the sand has thoroughly set and assumed its natural elevation in the tank.

In starting the first filter of any series of filters, of course filtered water is not available, and the first filter must necessarily be filled with subsided water at Upper Roxborough, or with water coming direct from the Schuylkill river, as at Lower Roxborough when the first filter at this station was started last August.

After the filter has been backfilled, working from below

upwards to the surface of the sand bed, to the depth mentioned, raw water is then cautiously drawn into the filter until the elevation of the water above the sand is about three (3) feet. The filter is then allowed to rest for from six to twelve hours until a "Schmutzdecke" or mud membrane is formed at the surface of the sand. The effluent valve connecting the filter with the clear water basin is then opened and the filter started at a slow rate. For the first two or three days of service the filter is run at from one-third to one-half the normal rate. At the end of three or four days the water is such that the filter can be rapidly raised to the full normal rate at which it will be used for the period of service.

Between the time of starting the filter and stopping it the period of operation will represent from twenty (20) to eighty (80) days, the shorter period, of course, occurring with the more turbid condition of the applied water, and the longer period with the condition of the water that usually subsists during the late spring, summer and early fall months. The average period of operation as determined by the last year's experience of the Lower Roxborough filters is 32 days.

At the end of the period of service of the filter the inflow is entirely stopped, and the water above the sand level allowed to slowly percolate through the sand bed until the level has subsided to a depth of about one (1) foot below the surface of the sand bed, when the outflow is stopped, the filter opened, and the upper dirty layer of sand, containing the mud and other suspended matter, carefully scraped off. The depth of this scraping is regulated by the depth of the layer of discolored sand, and will vary from one-half ($\frac{1}{2}$) to one (1) inch when the applied water is bad or the period of operation of the filter longer than usual.

In operating a series of filters it is customary to fix the

total amount of water to be filtered from day to day, varied of course by the season of the year, being greatest in summer and least in winter, and by the influence of Sundays and other holidays, when the consumption of water for manufacturing purposes is largely reduced or wholly intermitted.

With reference to the number of filters actually in service from day to day, of the five (5) filters at Lower Roxborough, and eight (8) filters at Upper Roxborough, only one filter in each case is taken out of service for the purpose of scraping the sand bed, and the rates of operation on the remaining filters are correspondingly increased to maintain the normal daily yield of water from the filters.

The period that each filter is out of service for the purpose of scraping the sand, transporting the sand to the sand washer, and washing and storing the sand in the courts is usually two (2) days, although when the scrapings are unusually heavy, an additional day for the purpose of scraping may be required. Ordinarily, however, a filter will be out of service between the time when it is stopped for scraping and the time when it is again backfilled to be started in operation, as described, not more than two (2) days.

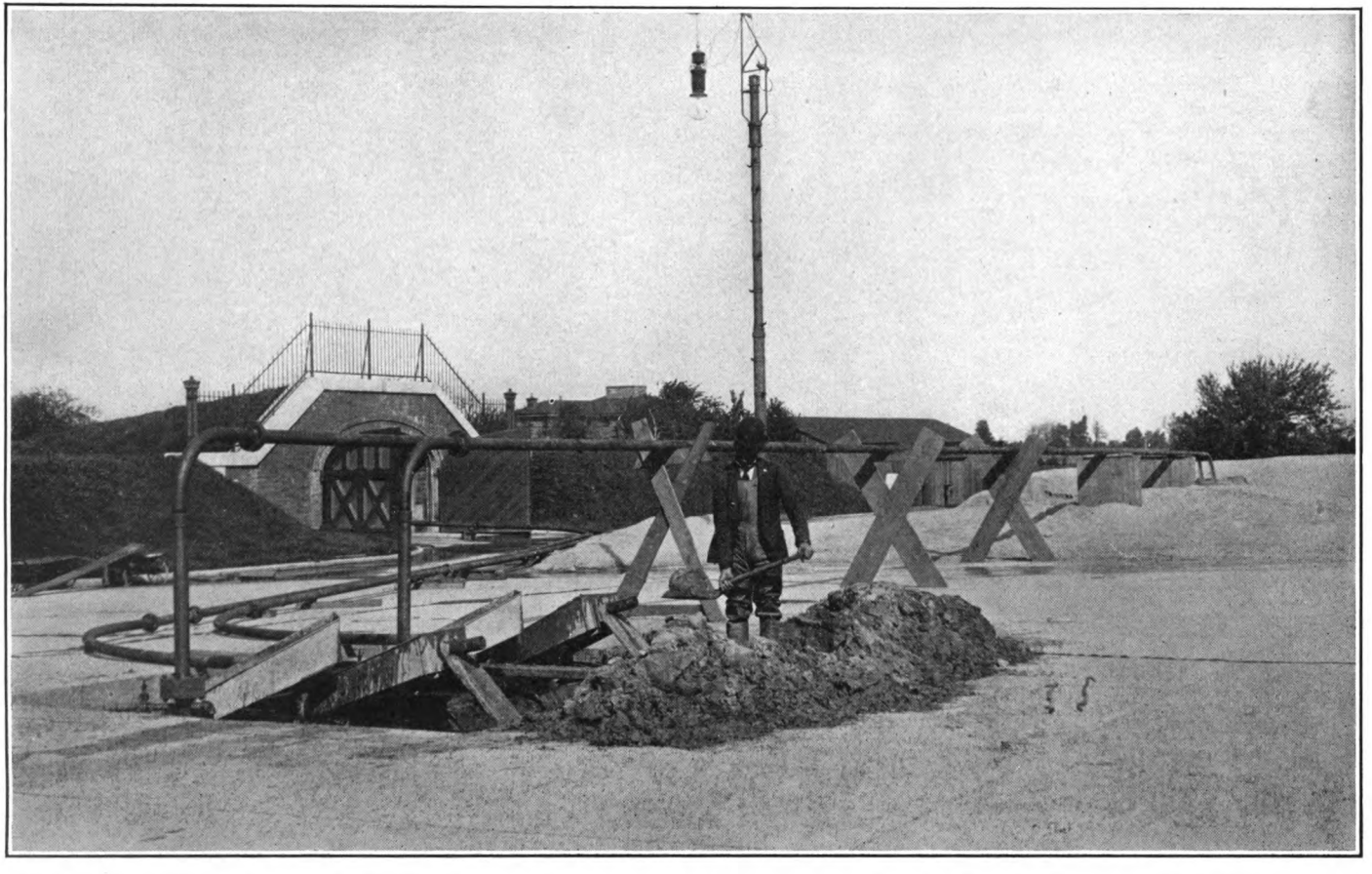
After a series of filters have been started in service the backfilling before mentioned is always done with filtered water, and it is only when the first filter of a series is started that unfiltered water is used for this purpose. By this it will be seen that after the operation of the first filter of the series, the only water that ever permeates the underdrains and the sand bed, is filtered water, either refilled from below, or percolating in the operation of the filter through the sand bed from above.

When a filter is temporarily taken out of service, the first step is to scrape the upper layer of dirty sand into little piles or hillocks. The area scraped into each hillock

is about fifteen (15) feet square, i. e., in each bay of the filter one little hillock of dirty sand is heaped up. After the scraping has been accomplished, a portable ejector, weighing about 150 pounds, and easily transported by two men, is carried into the filter, the inlet of which is connected with a water supply pipe, and the outlet connected with a discharge pipe, conveying the mixed sand and water from the ejector to the sand washer in the court in front of the filters. After the stream of water has been started through the portable sand ejector the little heaps or hillocks of sand are shovelled into the hopper of the ejector, and the mixed sand and water carried through the discharge pipe, and delivered into the first hopper of the sand washer, automatically passed through the sand washer, and from the last hopper of the washer discharged into convenient piles on the court in front of the filters. The only manual work connected with the transportation and washing of the sand is represented by the shovelling of the little hillocks of sand into the ejector. The remainder of the work is accomplished entirely by a stream of water acting under a pressure varying from sixty to ninety pounds per square inch.

The Lower Roxborough filters, which have been in service for the past sixteen months, are operating at the present time at the rate of 9 million gallons per day of twenty-four hours. With the preliminary filters at this station, all of which are about ready to go into service, the capacity will be raised to 12 million gallons per day of twenty-four hours, provided it will be possible to pump this amount of water to the Lower Roxborough reservoir, and secure a proper distribution of the filtered water.

The eight filters at Upper Roxborough can deliver from 20 to 22 million gallons of water per day of twenty-four hours. The combined capacity of the Upper and Lower stations at the present time is 26 million gallons per day of



SAND WASHER IN OPERATION AT UPPER ROXBOROUGH FILTERS.

twenty-four hours, and in due time will be raised to from 32 to 34 million gallons per day of twenty-four hours.

All the water now supplied from the Shawmont pumping station, on the Schuylkill river, above Flat Rock dam, is now being passed through the filters at Upper and Lower Roxborough, and the water purveying district represented by this pumpage is being supplied with filtered water.

Each filter station is provided with a clear water basin into which the mixed effluents from all the filters is delivered, and the quality of water passing to the consumers is represented not by the quality of water from any one filter of the series, but by the mixed water from all the filters. It so happens, therefore, that while some of the filters, but a few hours or days in service, may not be quite up to the standard quality, the effect of this is modified by the effluents from the other filters which have been longer in service, and are furnishing water which from a bacterial and æsthetic standpoint complied with the established standards.

TESTING STATIONS.

The work at the Spring Garden Testing Station has been mainly devoted to the examination of water samples from the Upper and Lower Roxborough plain sand filters and from the preliminary filters at Lower Roxborough. The Torresdale Testing Station was abandoned September 1st, as all the experiments that were desired on the Delaware river water had then been completed.

The equipment for the experimental and analytical work at this station was fully described in the Annual Report of the Bureau of Water for 1901, since which time very little has been added, except such as was done with a view to increasing the efficiency of the apparatus.

Samples were collected daily from the effluents of all filters at the Upper and Lower Roxborough stations, and from the Schuylkill and Delaware rivers. These were tested for bacterial content per c. c. Tests were also made for the B. Coli Communis several times each week of the raw water and the effluents from the Roxborough filters. The above samples were examined daily for turbidity (silica standard), and at intervals were examined chemically, but owing to the large amount of routine work it is impossible to make complete daily chemical analyses, and schedules are arranged so that especial attention can be given to these determinations, which are most important from a sanitary standpoint.

The following table shows approximately the work of the station for the year:

BACTERIOLOGICAL LABORATORY:

Samples tested for whole number of bacteria.....	23,136
Samples tested for B. Coli Communis, using one c. c. of water	2,662
Samples tested for B. Coli Communis using 50 c. c. of water	2,050
Control Culture tests made for B. Coli Communis	10,000
Special sand, conduit water, etc., samples.....	400

CHEMICAL LABORATORY:

Samples collected from various sources, examined for turbidity and sediment.....	13,700
Samples examined for chlorine, free and albuminoid ammonia, nitrites and nitrates, and oxygen consuming power	5,300
Special samples, etc.	272

Aside from the daily investigation of water samples from the Roxborough filters, and anaylses of materials of construction during the past year, the experimental work conducted at the testing station has been limited almost entirely to further experiments with the preliminary fil-

ters at Spring Garden on the Schuylkill water, and at Torresdale on the Delaware water.

Filter No. 11 (Spring Garden Testing Station) which is a Warren mechanical filter, 10 feet diameter tank, has been run much of the time without using the agitating rake, to determine the effect of washing the sand bed by a reverse current of water without agitation, the rake being resorted to only when a general stirring up and cleaning of the sand bed became desirable to restore the filter to its original working condition.

Filters Nos. 21 and 22 (Torresdale Testing Station) were reconstructed during the early spring on the lines of the preliminary filters for Lower Roxborough, Contract No. 37, and so operated with applied Delaware river water until this station was permanently abandoned September 1st.

The general results of nearly three years investigation of several kinds of rough filters to be used instead of, or to aid the sedimentation basins in the preparation of the Schuylkill and Delaware waters, for plain sand filters, show that excepting upon very rare occasions the reduction of turbidity will range from 60 to 70 per cent., often reaching 80 per cent., and sometimes the reduction has been over 90 per cent. While the percentage bacterial reduction by the roughing filters is usually greater than the reduction of turbidity, no serious consideration is given to the bacterial changes, because it is not thought that the bacteria in the applied water to plain sand filters has a very large influence in clogging the sand bed, or in shortening the term of service, while the mud and vegetable and animal detritus in the water, and to some extent the coal dust, unless the quantity is in some manner materially restricted, does have a marked effect in clogging the filter and shortening the term of service.

The excellent work of the technical staff at the testing

stations, and the various preliminary filters devised by the Bureau, has abundantly proven that the Schuylkill and Delaware waters can be filtered through beds of sand at rates of over 6,000,000 gallons per acre per day, with terms of service from 18 to 40 days, or more, with effluents uniformly satisfactory, provided a rough filtration sufficient to remove the grosser matters in suspension from the water is first resorted to. The same results could be accomplished by settling basins of great capacity, but in our case the cost of these, at least when compared with the cost of preliminary filters, would be prohibitive.

The chemical laboratory at the testing station is required to conduct any special analyses on puddle clays, asphalts, etc. During the year quite a number of clay samples, used in puddle, were examined to determine total available clay, and about 140 samples of mixtures of asphalt for reservoir linings were examined for total bitumen, and in some instances were analysed for petrolene, asphaltene and organic matters.

During the coming year it is intended to transfer the Spring Garden Testing Station to the Administration Building at the Belmont filters, on Belmont avenue. Ample space has been provided in the building to accommodate the apparatus now in use at the present station.

The total cost of the testing stations at the Spring Garden pumping station and the Harrison Mansion, Torresdale, to date, has been as follows:

Contracts Nos. 1, 2, 3, 4, 6, 8 and 26, for mechanical filters, subsiding basins, machinery and technical apparatus	$26,215 50
Salaries of staff	72,583 00
Supplies and expense	38,578 53
Total	$137,377 03

Wm. R. Copeland, Bacteriologist, in charge since September 1, 1903.

W. W. DeBerard, Assistant Engineer, in charge to September 1, 1903.

George H. Thomas, Chemist.

EXPERIMENTS WITH FLOATS TO DETERMINE THE ACTION OF THE TIDES ON SEWAGE MATTERS ENTERING THE DELAWARE RIVER AT AND BELOW LARDNER'S POINT PUMPING STATION.

The floats consisted of air-tight Mason fruit jars, in each of which was placed a postal card directed to the Bureau requesting the finder of the bottle to return the card, filling in the date and the place where it was picked up. Forty-eight bottles were despatched, partly at Lardner's Point and partly at the foot of Market and Vine streets. Many of these have been returned, but no opportunity has offered to collate the data and draw conclusions from this experiment. This investigation will be continued during the coming year, mainly to determine the probability of sewage effluents south of Lardner's Point finding their way as far up stream as the intake of the Torresdale filtration works.

CHANGES IN THE STAFF.

During the year the following changes occurred in the staff:

Mr. Richard I. D. Ashbridge, First Assistant Engineer, resigned January 31, 1903, to engage in the contracting business, and owing to the satisfactory organization of the field corps no appointment was made to the vacancy.

Mr. W. W. DeBerard, Assistant Engineer, in charge of the Testing Stations, resigned August 31, 1903, and took service with the City of Harrisburg as engineer in charge of the construction of a system of filters for the water works of that city.

Since the resignation of Mr. DeBerard, the work of the Testing Station has been in charge of Mr. William R. Copeland, Bacteriologist.

Mr. George T. Prince, First Assistant Engineer, resigned September 15, 1903, to take an engagement as Assistant Engineer with the Denver Union Water Company, Denver, Colorado.

Mr. Charles P. Bower, Second Assistant Engineer on Contract No. 14, Torresdale Conduit, resigned May 11, 1903, to accept a position of a similar character with the Philadelphia Rapid Transit Company.

Mr. Frank R. Fisher, Assistant Engineer in charge of the construction of the Upper and Lower Roxborough filters and auxiliaries, resigned February 28, 1903, to accept a position as Assistant Engineer in charge of the Philadelphia Rapid Transit Company's Subway.

Mr. Frederick E. Field, who succeeded Mr. Frank R. Fisher as Assistant Engineer in charge of the Roxborough works, resigned May 2, 1903, to accept a position with Knowles & Chapin, Pittsburg, Penna.

Mr. Glenn D. Holmes, Second Assistant Engineer on the Roxborough works, resigned March 14, 1903, to accept a position with the City of New York.

Mr. Henry B. Hughes, Second Assistant Engineer, resigned August 8, 1903, to engage in business as a civil engineer.

Mr. S. M. Purdy, Second Assistant Engineer on Contract No. 14, Torresdale Conduit, resigned June 20, 1903, to accept a similar position with the Philadelphia Rapid Transit Company.

Promotions.

Mr. La Monte Lloyd, Assistant Engineer in charge of Contract No. 16, Belmont Filters and Reservoirs, was advanced to First Assistant Engineer and assigned to office duty in charge of plans, the change taking effect March 1, 1903.

Mr. Charles H. Paul was promoted to the position of Assistant Engineer in charge of the Belmont works upon the transfer of Mr. Lloyd to office duty, and Mr. Robley A. Warner was promoted to the position of Second Assistant Engineer on this work to succeed Mr. John L. Allen, who resigned August 20, 1903, to accept a position with the Vulcanite Paving Company, Chicago, Ill.

Mr. Seth M. Van Loan, formerly Second Assistant Engineer on the Belmont works, was promoted March 1, 1903, to assistant Engineer in charge of Contract No. 28, Lardner's Point Pipe Distribution System.

Mr. William I. Klein succeeded Mr. Frederick E. Field as Assistant Engineer in charge of the construction work at Roxborough upon the date of the latter's resignation.

Since the completion of the Upper and Lower Roxborough filters the operation of these filters has been in charge of Mr. Howard W. Underwood, Assistant Engineer.

Mr. D. Jones Lucas was Assistant Engineer in charge of Contract No. 27, Oak Lane Reservoir, and Contract No. 29, Lardner's Point Pumping Station No. 2, until July 15, 1903, but finding the duties of the two positions too onerous he was placed in charge of Contract No. 27, and Mr. S. M. Swaab, formerly a First Assistant Engineer in this Bureau, but who resigned July 31, 1902, to accept a position with the Philadelphia Rapid Transit Company, was reappointed July 15, 1903, and placed in charge of Contract No. 29.

WORK OF OFFICE AND FIELD FORCE.

During the past year there have been employed as an average 182 men in the office and field force for the preparation of plans and specifications and clerical work connected with the executive duties of the Bureau, and in the supervision and inspection of materials and workmanship entering into contracts, and in giving lines and grades for construction work.

Since the inception of the work the following drawings and photographs have been prepared by the office force:

1,250 approved contract drawings.

2,500 drawings representing studies pertaining to the various features of the work.

1,650 photographs of construction work have been taken to show progress.

In addition to the above the field force on the several contracts have prepared 3,921 approved construction sheets and diagrams showing progress and studies of working details.

Contractors have submitted 3,000 miscellaneous blue prints and sketches pertaining to working details.

All the above have been labeled, checked and filed for reference in connection with the respective contracts to which they applied.

In the appendices submitted herewith will be found a list of all the contracts completed or under construction, with the total cost and payments on same, together with a list of the unit prices paid upon all contracts entered into to date.

TYPHOID FEVER EPIDEMIC, WARD 21.

Referring to the epidemic of typhoid fever in Ward 21 during August and the early part of September, a careful

investigation has been made by this Bureau to determine the probability of this being in any manner attributable to the public water supply, which since September, 1902, has been obtained from the Lower Roxborough filters. The result of this investigation shows that quite half of the water consumed in this ward is drawn from other sources than the City mains. Gaugings of the flow of sewage in the Manayunk intercepting sewer, which is presumably as near watertight as a structure of this character can be made, and receives only the unsanitary sewage, indicate that the flow of the sewage at the manhole next north of Wissahickon creek was more than twice the total consumption of water from the Roxborough filters in this ward.

Inquiring into the probable cause of the typhoid fever in one particular locality, viz., Rochelle avenue, authentic evidence was obtained to show that drinking water was obtained from a spring on the Bridle Path west of Wissahickon creek, and used by the residents of this avenue. An examination of this water revealed the fact that it was probably largely leachings of cesspools and vaults connected with the houses on Rochelle avenue, and from the technical investigations, as well as the conditions surrounding the spring, it was probably wholly unfit for drinking purposes. This water I have reason to believe was largely used as a beverage by the residents living on Rochelle avenue.

With reference to the possibility of the filtered water from Roxborough being in any manner the cause of typhoid fever, this is wholly impossible, as the tests that are made to determine the influence of filtration on water are of such a nature as to exclude the probability of serious error in arriving at the percentage reduction of bacteria and of the exclusion of the *Colon Bacillus* from filter effluents. Considering the facts which have been submitted to you from week to week in the reports of the testing station showing

the performance of the filters, these indicate a reduction of very rarely less than 99 per cent., and sometimes nearly 100 per cent. of the bacteria in the applied water.

While direct tests to prove the absence of the typhoid bacillus in the filtered water cannot, in the light of our present knowledge, be made, tests can be made to show the partial or complete exclusion of another organism of about the same dimensions, having many of its characteristics, and coming from the same source as the typhoid organism. I refer to the *Bacillus Coli Communis,* which is slightly thinner and slightly longer in dimensions than the *Bacillus Typhosis,* and it is fair to assume that the total, or almost total, removal of the former organism, should carry with it the conclusion that the typhoid organism was removed from the water in the same proportions.

Bi or tri-weekly tests are made to determine the presence of the *Bacillus Coli Communis* in the applied water to the filters, and to demonstrate if possible its presence in the filter effluents, and upon very rare occasions does it exist in any of the effluents, even from comparatively new filters, and after the filters have been in service for a few weeks or months, our records show the total exclusion of the *Bacillus Coli Communis* from the effluents, and if this organism, which is hardier and will live under conditions which would destroy the *Bacillus Typhosis,* can be entirely removed, it is fair to infer the same exclusion of the typoid bacillus.

As a matter of fact I do not believe that the filtered water can ever be the cause of typhoid fever, and I further believe that taking the chances of occasionally drinking an infected water, but with the general use of the filtered water, that the reduction in the typhoid fever rates within the course of two years after the entire water supply is filtered will be so large as to excite comment, not only here but in other large cities where the subject of the quality of the water supply is a matter of public concern.

As a further argument in behalf of the filtered water supply to Ward 21, during August and September, attention should be drawn to the very low rates of typhoid fever which then prevailed in Ward 22, which was receiving exactly the same kind of water as that supplied to Ward 21. If the filtered water, as claimed by one of the daily newspapers, was in any manner concerned in maintaining the relatively high rates in Ward 21 it should have had the same effect on the people who drank it in Ward 22, but while Ward 21 showed a high rate, the rate in Ward 22 was low, and during the past few months the rates for this ward have been the lowest in many years.

TORRESDALE LABORATORY.

In the original scheme of contracts for the completion of the work prepared more than two years ago, Contract No. 60 was assigned to a Technical Laboratory at the Torresdale Filter Station, but it is now thought, at least in the early history of the works, that one of the rooms in the Engineer's office can very well be adapted for this purpose during the early years of operation, and as this building is located upon City property it may be continued as a laboratory until such time as a more permanent building will be required.

I wish to thank each and every member of the staff in the office and field for their faithful, diligent and intelligent assistance in the conduct of the work during the past year. Several of the members have shown unusual energy and aptitude in the discharge of their respective duties, and I wish to express my gratitude to these and all others who have contributed so largely by their labors to the advancement of the work in my charge.

Very respectfully,

JOHN W. HILL,
Chief Engineer.

APPENDICES

List of Contracts for the Improvement, Extension and Filtration of the Water Supply.

Contract No	Description of Contract	Contractor.	Date of Letting.	Date of Contract.	Limit of Contract.	Payment.	Date of Final Payment.
1 1 Sup.	A Testing Station..... Extension to Testing Station.	Thomas Parker..... Thomas Parker.....	Feb. 27, 1900..	Mar. 6, 1900... May 7, 1900...	$9,000 00 5,000 00	$11,653 54	July 13, 1900.
2	Ice Refrigerating Machine....	Newb'g Ice Machine & Eng. Co	July 20, 1900..	Aug. 20, 1900..	800 00	800 00	Nov. 19, 1900.
3	Filtering Sand and Gravel for Testing Station.....	Norcross & Edmunds.....	July 20, 1900..	Sept. 4, 1900...	2,500 00	1,016 54	Nov. 2, 1900.
4	Platinum Ware for Testing Station.....	Chas. Lentz & Sons.	July 20, 1900..	July 27, 1900..	674 50	649 50	Oct. 31, 1900.
5	Test Borings.....	Flaghouse & Beeson	Aug. 7, 1900...	Sept. 6, 1900...	9,750 00	8,833 30	March 9, 1901.
6	Platinum Ware for Testing Station.....	Arthur H. Thomas Co.....	Dec. 12, 1900..	.....	444 95	444 95	Feb. 6, 1901.
7	Lower Roxborough Filters...	.....	Dec. 12, 1900..	No award made. Readvertised as Contract No. 10.			
8	Sand Ejector.....	Patrick Gormly....	Apr. 17, 1901..	May 6, 1901...	1,800 00	1,712 03	August 7, 1901.

List of Contracts for the Improvement, Extension and Filtration of the Water Supply—Continued.

Contract No.	Description of Contract.	Contractor.	Date of Letting.	Date of Contract.	Limit of Contract.	Payment.	Date of Final Payment.
9	Cast Iron Water Pipe, Special Castings Stop Valves, Pipe-laying, etc.....	Bids rejected on Pipe Lines "A" to "J" inclusive. See Contracts "9 A," "9 B" and "9 C" for rest of contract.					
9A	Cast Iron Stop Boxes.....	J. Alfred Clark.....	Feb. 11, 1901..	May 14, 1901..	$2,100 00	$1,563 80	Dec. 21, 1901.
9B	Stop Valves.....	Eddy Valve Co.....	Feb. 11, 1901..	May 3, 1901...	17,000 00	14,403 06	Dec. 21, 1901.
9C	Cast Iron Water Pipe and Special Castings for Lower Roxborough Filters.....	Daniel J. McNichol.	Feb. 11, 1901..	May 8, 1901...	7,500 00	7,488 14	Dec. 20, 1901.
10	Lower Roxborough Filters...	Daniel J. McNichol.	Feb. 11, 1901..	Mar. 20, 1901..	250,000 00	230,880 20	March 1, 1902.
11	Pumping Engines and Boilers and Electric Traveling Crane for Lardner's Point Pumping Station.....	Holly Mfg. Co.....	May 1, 1901...	June 6, 1901...	360,000 00	100,152 04	Not completed.
12	Upper Roxborough Filters...	Daniel J. McNichol.	Apr. 17, 1901..	May 8, 1901...	552,000 00	550,911 59	Nov. 11, 1903.
13	Rotary Stop Valves, Patterns and Core Boxes.....	Eddy Valve Co.....	Apr. 17, 1901..	June 1, 1901..	13,000 00	12,825 00	Nov. 22, 1902.

List of Contracts for the Improvement, Extension and Filtration of the Water Supply—Continued.

Contract No.	Description of Contract.	Contractor.	Date of Letting.	Date of Contract.	Limit of Contract.	Payment.	Date of Final Payment.
14	Torresdale Conduit.....	Daniel J. McNichol.	May 28, 1901..	Oct 4, 1901....	$1,350,000 00	$1,194,304 08	Not completed.
15	A Test Pit at Lardner's Point.	Contract abandoned. Work done by Water Bureau.					
16	Belmont Sedimentation Reservoir, Filters and Clear Water Basin.....	Ryan & Kelley.....	May 28, 1901..	Aug. 7, 1901...	2,000,000 00	1,758,007 44	Not completed.
17	Extension of Distribution Pipe System.....	Daniel J. McNichol.	April 17, 1901.	June 4, 1901...	750,000 00	749,455 01	Oct. 24, 1902.
18	Low Service Pumping Machinery for Upper Roxborough Filters.....	Henry R. Worthington, Inc.....	July 29, 1901..	Aug. 22, 1901..	23,500 00	20,982 09	Not completed.
19	Belmont Rising Mains, Upper Roxborough Connection Pipes and Extension of Distribution Pipe System...	Daniel J. McNichol.	Dec. 18, 1901..	Jan. 30, 1902..	500,000 00	499,805 18	Feb. 7, 1903.
20	Triplex Pumps and Gasoline Driving Engines for Upper Roxborough Filters.....	Fairbanks, Morse & Co.....	Dec. 18, 1901..	Mar. 1, 1902...	10,800 00	8,916 50	Not completed.

List of Contracts for the Improvement, Extension and Filtration of the Water Supply—Continued.

Contract No.	Description of Contract.	Contractor.	Date of Letting.	Date of Contract.	Limit of Contract.	Payment.	Date of Final Payment.
21	Low Service Pumping Station for Upper Roxborough Filters	Henderson & Co., Ltd	Sept. 25, 1901..	Oct. 21, 1901..	$21,000 00	$18,636 42	Not completed.
22	Hand Traveling Crane for Low Service Pumping Station, Upper Roxborough Filters	Alfred Box & Co	July 29, 1901..	Dec. 19, 1901..	2,900 00	2,800 00	Aug. 14, 1902.
23A	Administration Building and Pumping Station. Upper Roxborough Filters	Daniel J. McNichol.	June 25, 1902.	Aug. 6, 1902..	43,000 00	38,440 60	Aug. 19, 1903.
24	Filtering Materials and Collectors for Upper and Lower Roxborough Filters and Sand Washers for Lower Roxborough Filters	Daniel J. McNichol.	Dec. 18, 1901..	Jan. 30, 1902..	290,000 00	280,358 53	Aug. 24, 1903.
25	Torresdale Filters and Clear Water Basin	Daniel J. McNichol.	Dec. 18, 1901..	Jan. 18, 1902..	5,000,000 00	3,555,846 42	Not completed.
26	Torresdale Testing Station	Patrick Gormly	July 29, 1901..	Aug. 20, 1901..	9,000 00	8,643 00	Dec. 19, 1901.

List of Contracts for the Improvement, Extension and Filtration of the Water Supply—Continued.

Contract No.	Description of Contract.	Contractor.	Date of Letting.	Date of Contract.	Limit of Contract.	Payment.	Date of Final Payment.
27	Oak Lane Reservoir.....	R. A. Malone & Co..	Dec. 18, 1901..	Mar. 14, 1902..	$550,000 00	$282,740 02	Not completed
28	Lardner's Point Distribution.	Daniel J. McNichol.	Feb. 16, 1903..	Mar. 4, 1903...	1,300,000 00	452,373 36	Not completed.
29	Lardner's Point Pumping Station, No. 2.....	Geo. C. Deitrich.....	Sept. 17, 1902.	Oct 4. 1902 ...	565,000 00	315,117 65	Not comp'eted.
30	Lardner's Point Pumping Station, No. 2.....	.....	Feb. 26, 1902..	Readvertised as Contract No. 29.			
32	Addition to Testing Station at Spring Garden Pumping Station.....	.....	Sept. 25, 1901 .	No Award Made.			
33	Sand Washers for Upper Roxborough Filters.....	E. M. Nichols.....	Mar. 24, 1903 .	Apr. 4, 1903...	4,000 00	3,849 00	Sept. 4, 1903.
37	Preliminary Filters, Lower Roxborough.....	Maignen Filtration Co.....	Sept. 23, 1902.	Oct. 27, 1902...	49,800 00	.....	No payments made.

List of Contracts for the Improvement, Extension and Filtration of the Water Supply—Continued.

Contract No.	Description of Contract.	Contractor.	Date of Letting.	Date of Contract.	Limit of Contract.	Payment.	Date of Final Payment.
37A	Foundation and Superstructure for the Lower Roxborough Preliminary Filters...	Daniel J. McNichol.	Feb. 16, 1903..	Mar. 4, 1903...	$50,000 00	$39,714 96	Not completed.
40A	Low Service Drainage for the Belmont Filters.....	Camden Iron Wks..	June 30, 1903..	July 27, 1903..	7,000 00	.....	No payments made.
40B	Sand Washer, Pumps and Boilers for Belmont Filters.	I. P. Morris Co.....	June 30, 1903..	July 24, 1903..	29,000 00	.....	No payments made.
42	Administration Building and Pumping Station at Belmont Filters.....	H. B. Shoemaker & Co.....	June 30, 1903..	July 17, 1903..	55,000 00	24,150 74	Not completed.
44	Electric Lighting System for the Upper and Lower Roxborough Filters.....	Pa. Equipment Co..	Mar. 24, 1903..	Apr. 22, 1903..	15,500 00	8,356 99	Not completed.
46	Electric Lighting System for the Belmont Filters.....	Pa. Equipment Co..	June 30, 1903 .	July 21, 1903..	20,000 00	.....	No payments made.

List of Contracts for the Improvement, Extension and Filtration of the Water Supply—Concluded.

Contract No.	Description of Contract.	Contractor.	Date of Letting.	Date of Contract.	Limit of Contract.	Payment.	Date of Final Payment.
49	Filtering Materials and Underdrains for the Belmont Filters.....	Daniel J. McNichol.	Feb. 16, 1903..	March 4, 1903.	$365,000 00	$84,677 26	Not completed.
50	Filtering Materials and Underdrains for the Torresdale Filters.....	Daniel J. McNichol	Feb. 16, 1903..	March 4, 1903.	500,000 00	.....	No payments made.
62	Baffles for the Lower Roxborough Reservoir.....	.....	June 25, 1902.	No award made.			
63	Sand washers for the Belmont Filters.....	Patrick Gormley...	June 30, 1903.	July 16, 1903..	6,800 00	6,595 00	Dec. 8, 1903.
65	Hand Travelling Crane for the Low Service Pumping Station, Belmont Filters....	Alfred Box Co.....	June 30, 1903.	July 16, 1903..	2,700 00	.....	No payments made.
66	Pipe Line "U"—Extension of the Roxborough Distribution System.....	.....	Sept. 4, 1903..	No award made.			

CONTRACT PRICES.

Improvement, Extension and Filtration of Water Supply.

Ordinances of January 12, 1900.

Contract No. 1 and No. 1 Sup.

A TESTING STATION.

Thomas Parker, Contractor.

Awarded, February 27, 1900. Completed, June 11, 1900.

Building	$2,504 00	lump sum.
Excavation, including refilling	0 15	per cu. yd.
Concrete	5 78	per cu. yd.
Brick masonry	9 72	per cu. yd.
Additional Y. P. lumber	32 50	per M. ft. B. M.
Additional W. P. barn boards	32 50	per M. ft. B. M.
Additional hemlock lumber	22 50	per M. ft. B. M.
Lumber for retaining bank, etc	20 00	per M. ft. B. M.

Contract No. 2.

ICE REFRIGERATING MACHINE FOR TESTING STATION.

Newburg Ice Machine and Eng. Co., Contractors.

Awarded, July 25, 1900. Completed, October 15, 1900.

Refrigerating machine and motor ..... $800 00 lump sum.

Contract No. 3.

FILTER SAND AND GRAVEL FOR TESTING STATION.

Norcross and Edmunds, Contractors.

Awarded, July 23, 1900. Completed, November 1, 1900.

63 millimeter gravel	$3 85	per cu. yd.
21 millimeter gravel	3 85	per cu. yd.
8 millimeter gravel	3 85	per cu. yd.

3 millimeter gravel	3 85 per cu. yd.
1 millimeter gravel	2 65 per cu. yd.
0.08 to 0.15 millimeter sand	2 65 per cu. yd.
0.15 to 0.25 millimeter sand	2 65 per cu. yd.
0.25 to 0.35 millimeter sand	2 65 per cu. yd.
0.35 to 0.45 millimeter sand	2 65 per cu. yd.
0.45 to 0.55 millimeter sand	2 65 per cu. yd.

Contract No. 4.

PLATINUM WARE FOR TESTING STATION.

Chas. Lentz & Sons, Contractors.

Awarded, July 20, 1900. Completed, October 31, 1900.

Platinum Ware for Testing Station ..... $674 50 lump sum.

Contract No. 5.

TEST BORINGS.

Flaghouse & Beeson, Contractors.

Awarded August 8, 1900. Completed, February 27, 1901.

Boring through drift	$2 75 per vert. ft.
Boring through rock	5 96 per vert. ft.
Permanent water seals	2 00 each.
Temporary water seals	3 00 each.

Contract No. 6.

PLATINUM WARE FOR TESTING STATION.

Arthur H. Thomas Co., Contractors.

Awarded December 12, 1900. Completed, February 6, 1901.

Platinum Ware for Testing Station ..... $444 95 lump sum.

Contract No. 8.

SAND EJECTOR.

Patrick Gormley, Contractor.

Awarded April 19, 1901. Completed July 6, 1901.

Sand Ejector	$1,106 00 lump sum.
Four inch wrought iron pipe	0 60 per lin. ft.
Additional Y. P. timber and planking	55 00 M. ft. B. M.
Excavation	2 25 per cu. yd.

Contract No. 9A.

GREY IRON CASTINGS FOR STOP BOXES, FRAMES AND COVERS.

J. Alfred Clark, Contractor.

Awarded, February 28, 1901. Completed, December 1, 1901.

Grey Iron Castings for Stop Boxes, Frames and Covers	$0.015 per lb.

Contract No. 9B.

STOP VALVES AND CHECK VALVES, INDICATOR STANDS, EXTENSION STEMS, STOP BOXES, FRAMES AND COVERS.

The Eddy Valve Co., Contractors.

Awarded March 18, 1901. Completed, December 1, 1901.

48 inch hub end stop valves, geared to lay on side, with bye pass	$1,100 00 each.
48 inch hub end stop valves, geared to lay on side without bye pass	1,050 00 each.
48 inch hub end stop valves, geared to stand upright, with bye pass	1,085 00 each.
48 inch hub end stop valves, geared to stand upright, without bye pass	1,035 00 each.
48 inch hub end stop valves, without gearing, with bye pass	1,035 00 each.
48 inch hub end stop valves, without gearing, without bye pass	985 00 each.
36 inch hub end stop valves, geared to lay on side, with bye pass	450 00 each.
36 inch hub end stop valves, geared to lay on side, without bye pass	415 00 each.
36 inch hub end stop valves, geared to stand upright, with bye pass	440 00 each.
36 inch hub end stop valves, geared to stand upright, without bye pass	405 00 each.
36 inch hub end stop valves, without gearing, with bye pass	425 00 each.
36 inch hub end stop valves, without gearing, without bye pass	385 00 each.

30 inch hub end stop valves, geared to lay on side, with bye pass	$250 00 each.
30 inch hub end stop valves, geared to lay on side, without bye pass	225 00 each.
30 inch hub end stop valves, geared to stand upright, with bye pass	240 00 each.
30 inch hub end stop valves, geared to stand upright, without bye pass	215 00 each.
30 inch hub end stop valves, without gearing, with bye pass	225 00 each.
30 inch hub end stop valves, without gearing, without bye pass	210 00 each.
24 inch hub end stop valves, geared to lay on side, with bye pass	175 00 each.
24 inch hub end stop valves, geared to lay on side, without bye pass	150 00 each.
24 inch hub end stop valves, geared to stand upright, with bye pass	165 00 each.
24 inch hub end stop valves, geared to stand upright, without bye pass	145 00 each.
24 inch hub end stop valves, without gearing, with bye pass	155 00 each.
24 inch hub end stop valves, without gearing, without bye pass	139 00 each.
20 inch hub end stop valves, geared to lay on side, without bye pass	95 00 each.
20 inch hub end stop valves, geared to stand upright, without bye pass	95 00 each.
20 inch hub end stop valves, without gearing, without bye pass	90 00 each.
16 inch hub end stop valves	60 00 each.
12 inch hub end stop valves	32 00 each.
10 inch hub end stop valves	23 00 each.
8 inch hub end stop valves	18 00 each.
6 inch hub end stop valves	11 00 each.
30 inch flange stop valves, without bye pass	225 00 each.
30 inch flange stop valves, with bye pass	240 00 each.
24 inch flange stop valves, without bye pass	145 00 each.
24 inch flange stop valves, with bye pass	165 00 each.
20 inch flange stop valves, without bye pass	90 00 each.
16 inch flange stop valves, without bye pass	60 00 each.
12 inch flange stop valves, without bye pass	32 00 each.
6 inch flange stop valves, without bye pass	12 40 each.
4 inch flange stop valves, without bye pass	7 50 each.
Indicator stands, with hand wheels and spindles, for 30 inch stop valves	10 00 each.

Indicator stands, with hand wheels and spindles, for 24 inch stop valves	$10 00 each.
Indicator stands, with hand wheels and spindles, for 20 inch stop valves	10 00 each.
Indicator stands, with hand wheels and spindles, for 16 inch stop valves	10 00 each.
Indicator stands, with hand wheels and spindles, for 12 inch stop valves	10 00 each.
W. I. Extension Stems for stop valves, all sizes,	0 04 pr. lb.
20 inch flange check valves	120 00 each.
12 inch flange check valves	35 00 each.

Contract No. 9C.

CAST IRON WATER PIPE, SPECIAL CASTINGS AND FLANGE PIPE AND FLANGE SPECIAL CASTINGS FOR THE LOWER ROXBOROUGH FILTERS, AND FOR HYDRANT CONNECTIONS AND MISCELLANEOUS PIPE.

Daniel J. McNichol, Contractor.

Awarded March 18, 1901. Completed, December 1, 1901.

30 inch Cast Iron Water Pipe, Class "C"	$25 00 per ton.
24 inch Cast Iron Water Pipe, Class "C"	25 00 per ton.
20 inch Cast Iron Water Pipe, Class "C"	26 00 per ton.
16 inch Cast Iron Water Pipe, Class "C"	26 00 per ton.
12 inch Cast Iron Water Pipe, Class "C"	26 00 per ton.
10 inch Cast Iron Water Pipe, Class "C"	26 00 per ton.
6 inch Cast Iron Water Pipe, Class "C"	26 00 per ton.
4 inch Cast Iron Water Pipe, Class "C"	26 00 per ton.
3 inch Cast Iron Water Pipe, Class "C"	26 00 per ton.
Special castings, 20 inch diameter and larger	48 00 per ton.
Special castings under 20 inch diameter	48 00 per ton.
Breeches pipes, including drilling, bolts and nuts	103 00 per ton.
Quarter turns, 10 inches diameter and larger	48 00 per ton.
Quarter turns under 20 inches diameter	48 00 per ton.
Cast Iron flange pipe and specials, 30 inch to 3 inch	38 00 per ton.

Contract No. 10.

WATER FILTER PLANT AT LOWER ROXBOROUGH RESERVOIR.

Daniel J. McNichol, Contractor.

Awarded, February 20, 1901. Completed, March 15, 1902.

Filter Plant and Basin, complete.....	$227,983 29	lump sum.
Additional concrete	10 00	per cu. yd.
Additional steel or cast iron	0 10	per lb.

Contract No. 11.

PUMPING ENGINES AND BOILERS AND ELECTRIC TRAVELING CRANE FOR THE FRANKFORD PUMPING SERVICE AT LARDNER'S POINT.

Holly Mfg. Co., Contractors.

Awarded May 24, 1901.

Three pumping engines and twelve marine fire box boilers, and one electric traveling crane, complete, ready for service	$352,985 00	lump sum.

Contract No. 12.

WATER FILTER PLANT AT UPPER ROXBOROUGH RESERVOIR.

Daniel J. McNichol, Contractor.

Awarded, April 19, 1901. Completed, September 1, 1903.

Filter Plant and Basin, complete.....	$527,594 00	lump sum.
Additional concrete	10 00	per cu. yd.
Additional steel or cast iron	0 10	per lb.

Contract No. 13.

PATTERNS, CORE BOXES AND MANUFACTURE OF BELL END, GATE AND ROTARY STOP VALVES.

The Eddy Valve Co., Contractor.

Awarded, April 18, 1901. Completed, October 1, 1902.

48 inch Bell end stop valves, without gearing...	$1,100 00	each.
48 inch Bell end stop valves, with horizontal gearing	1,100 00	each.

48 inch Bell end stop valves, with vertical gearing	$1,100 00	each.
30 inch Bell end stop valves, without gearing...	325 00	each.
30 inch Bell end stop valves, horizontal gearing,	325 00	each.
30 inch Bell end stop valves, vertical gearing...	325 00	each.
20 inch Bell end stop valves, without gearing...	150 00	each.
20 inch Bell end stop valves, horizontal gearing,	158 00	each.
20 inch Bell end stop valves, vertical gearing...	158 00	each.
48 inch Bell end rotary stop valves	950 00	each.
36 inch Bell end rotary stop valves	675 00	each.
30 inch Bell end rotary stop valves	430 00	each.
20 inch Bell end rotary stop valves	275 00	each.
Patterns and core boxes, 48 inch geared bell end stop valves	400 00	each.
Patterns and core boxes, 30 inch geared bell end stop valves	325 00	each.
Patterns and core boxes, 20 inch geared bell end stop valves	225 00	each.
Patterns and core boxes, 48 inch bell end rotary stop valves	400 00	each.
Patterns and core boxes, 36 inch bell end rotary stop valves	400 00	each.
Patterns and core boxes, 30 inch bell end rotary stop valves	300 00	each.
Patterns and core boxes, 20 inch bell end rotary stop valves	200 00	each.

Contract No. 14.

A FILTERED WATER CONDUIT FROM TORRESDALE FILTER PLANT TO FRANKFORD PUMPING STATION.

Daniel J. McNichol, Contractor.

Awarded, August 28, 1901.

Filtered water conduit, complete	**$1,274,000 00**	**lump sum.**
Additional shaft excavation	12 25	per cu. yd.
Additional tunnel excavation	5 95	per cu. yd.
Additional brick masonry	12 50	per cu. yd.
Additional concrete	8 00	per cu. yd.
Additional steel	0 09	per lb.
Additional cast iron	0 07	per lb.
Additional conduit	96 00	per lin. ft.
Additional depth permanent shaft	300 00	per lin. ft.
Additional depth working shaft	105 00	per lin. ft.

Contract No. 16.

UPPER BELMONT RESERVOIR AND WATER FILTER PLANT.

Ryan & Kelley, Contractors.

Awarded June 26, 1901. Completed December 1, 1903.

Reservoir, complete	$670,000 00	lump sum.
Filter Plant, complete	999,000 00	lump sum.
Filtered water basin, complete	260,000 00	lump sum.
Additional excavation	1 50	per cu. yd.
Additional sodding	0 50	per sq. yd.
Additional granolithic pavement	2 25	per sq. yd.
Additional terra cotta pipe, 12 inches and less	0 50	per lin. ft.
Additional cast iron water pipe	40 00	per ton.
Additional special castings	90 00	per ton.
Additional flange pipe and flange special castings	140 00	per ton.
Additional wrought iron, steel or cast iron	0 10	per lb.

Contract No. 17.

CAST IRON WATER PIPE, SPECIAL CASTINGS, TRENCHING AND PIPE LAYING.

Daniel J. McNichol, Contractor.

Awarded April 29, 1901. Completed September 8, 1902.

Furnishing and laying 48 inch cast iron pipe, any class	$34 10	per ton.
Furnishing and laying 36 inch cast iron pipe, any class	34 10	per ton.
Furnishing and laying 30 inch cast iron pipe, any class	34 10	per ton.
Furnishing and laying 24 inch cast iron pipe, any class	34 10	per ton.
Furnishing and laying 20 inch cast iron pipe, any class	34 10	per ton.
Furnishing and laying 16 inch cast iron pipe, any class	34 10	per ton.
Furnishing and laying 12 inch cast iron pipe, any class	34 10	per ton.

Furnishing and laying 10 inch cast iron pipe, any class	$34 10	per ton.
Furnishing and laying 8 inch cast iron pipe, any class	34 10	per ton.
Furnishing and laying 6 inch cast iron pipe, any class	34 10	per ton.
Furnishing and laying 48 inch cast iron pipe, hub and flange	103 40	per ton.
Furnishing and laying special castings, 20 inches and larger	70 40	.per ton.
Furnishing and laying special castings under 20 inches	70 40	per ton.
Furnishing and laying breeches pipes	141 90	per ton.
Furnishing and laying quarter turns, 20 inches diameter and larger	70 40	per ton.
Furnishing and laying quarter turns, under 20 inches diameter	70 40	per ton.
Earth excavation not more than 6½ feet deep	0 83	per cu. yd.
Earth excavation not more than 10 feet deep	0 88	per cu. yd.
Earth excavation not more than 14 feet deep	1 10	per cu. yd.
Earth excavation not more than 18 feet deep	1 38	per cu. yd.
Earth excavation more than 18 feet deep.	2 20	per cu. yd.
Rock excavation, any depth	2 48	per cu. yd.
Hard burned brick in Portland cement mortar	19 80	per M.
Natural cement concrete in place	6 60	per cu. yd.
Rubble masonry in natural cement mortar	5 50	per cu. yd.
Yellow pine timber, in place, complete	53 90	per M. ft. B. M.
Hemlock timber in trench foundations	27 50	per M. ft. B. M.
Wrought iron straps, bars and bolts in place	0 10	per lb.
Repaving asphalt on concrete foundations	3 00	per sq. yd.
Repaving asphalt on broken stone	3 00	per sq. yd.

Contract No. 18.

LOW SERVICE PUMPING MACHINERY FOR THE UPPER ROXBOROUGH FILTERS.

Henry R. Worthington, Inc., Contractor.

Awarded August 14, 1901.

For three (3) low service pumps and compound condensing engines and all pipes, valves and appurtenances, furnished, delivered, erected and completed ready for service	$21,700 00 **lump sum.**

Contract No. 19.

CAST IRON WATER PIPE AND SPECIAL CASTINGS, EXCAVATION OF WATER PIPE TRENCHES AND PIPE LAYING, STOP VALVES, STOP BOXES, ETC.—FOR PIPE LINES K, L, M, N, O, P, Q and R.

Daniel J. McNichol, Contractor.

Awarded December 23, 1901. Completed January 31, 1903.

Furnishing, delivering and laying 48 inch C. I. water pipe, any class.....	$38 00 per ton.
Furnishing, delivering and laying 36 inch C. I. water pipe, any class.....	38 00 per ton.
Furnishing, delivering and laying 30 inch C. I. water pipe, any class.....	38 00 per ton.
Furnishing, delivering and laying 24 inch C. I. water pipe, any class.....	38 00 per ton.
Furnishing, delivering and laying 20 inch C. I. water pipe, any class.....	38 00 per ton.
Furnishing, delivering and laying 16 inch C. I. water pipe, any class.....	38 00 per ton.
Furnishing, delivering and laying 12 inch C. I. water pipe, any class.....	38 00 per ton.
Furnishing, delivering and laying 10 inch C. I. water pipe, any class.....	38 00 per ton.
Furnishing, delivering and laying 8 inch C. I. water pipe, any class.....	38 00 per ton.
Furnishing, delivering and laying 6 inch C. I. water pipe, any class.....	38 00 per ton.

48 inch, 36 inch, 30 inch hub and flange and flange special castings, including bolts and gaskets, furnished, delivered and placed	$125 00	per ton.
Breeches pipes, including drilling and bolts and nuts, all sizes and both classes, furnished, delivered and placed	149 00	per ton.
Hub and spigot special castings, all sizes and any class, furnished, delivered and placed	79 00	per ton.
Earth excavation in trenches not more than 6½ feet deep	0 96	per cu. yd.
Earth excavation in trenches not more than 10 feet deep	1 09	per cu. yd.
Earth excavation in trenches not more than 14 feet deep	1 88	per cu. yd.
Earth excavation in trenches not more than 18 feet deep	3 13	per cu. yd.
Earth excavation in trenches more than 18 feet deep	4 50	per cu. yd.
Rock excavation, any depth	2 96	per cu. yd.
Hard burned brick, in Portland cement mortar	25 00	per cu. yd.
Natural cement concrete	8 50	per cu. yd.
Rubble masonry in natural cement mortar, including excavation	10 00	per cu. yd.
Hemlock timber in pipe trench foundations	40 00	per M. ft. B. M.
Wrought iron straps, bars and bolts in place	0 10	per lb.
48 inch hub end stop valves, geared and with bye pass	1,265 00	each.
48 inch flange end stop valves, geared and with bye pass	1,265 00	each.
36 inch hub end stop valves, geared and with bye pass	543 00	each.
36 inch flange end stop valves, geared and with bye pass	543 00	each.
30 inch hub end stop valves, geared and with bye pass	345 00	each.
30 inch flange end stop valves, geared and with bye pass	345 00	each.
24 inch hub end stop valves, geared and with bye pass	200 00	each.

24 inch flange end stop valves, geared and with bye pass	$200 00 each.
20 inch hub end stop valves	110 00 each.
16 inch hub end stop valves	70 00 each.
12 inch hud end stop valves	39 00 each.
10 inch hub end stop valves	30 00 each.
8 inch hub end stop valves	23 00 each.
6 inch hub end stop valves	13 00 each.
Grey iron castings for stop box frames and covers	0 04 per lb.
Cutting out and removing to pipe yard: pipes, special castings, breeches pipes and stop valves	18 00 per ton.
Steel rolled I beams	0 10 per lb.

Contract No. 20.

TRIPLEX PUMPS AND GASOLINE DRIVING ENGINES FOR THE UPPER ROXBOROUGH FILTERS.

Fairbanks, Morse & Co., Contractors.

Awarded February 17, 1902.

For two (2) vertical triplex, double acting piston pumps and two (2) gasoline driving engines, including all pipes, valves and appurtenances, furnished, delivered, erected and completed	$10,490 00 lump sum.

Contract No. 21.

LOW SERVICE PUMPING STATION FOR UPPER ROXBOROUGH FILTERS.

Henderson & Co., Contractors.

Awarded September 27, 1901.

Addition to Roxborough Auxiliary Pumping Station	$15,997 00 lump sum.
Additional concrete for engine foundations	7 50 per cu. yd.
Additional cut granite masonry for engine foundations	3 25 per cu. ft.

Contract No. 22.

HAND TRAVELING CRANE FOR THE LOW SERVICE PUMPING STATION OF THE UPPER ROXBOROUGH FILTERS.

Alfred Box & Co., Contractors.

Awarded October 28, 1901. Completed August 9, 1902.

Hand traveling crane complete, ready for service	$2,800 00 lump sum.

Contract No. 23A.

ADMINISTRATION BUILDING AND PUMPING STATION AT UPPER ROXBOROUGH FILTERS.

Daniel J. McNichol, Contractor.

Awarded July 7, 1902. Completed July 1, 1903.

Administration Building and Pumping Station	$37,800 00 lump sum.
Additional excavation	0 90 per cu. yd.
Additional embankment	1 50 per cu. yd.
Additional brick masonry	18 00 per cu. yd.
Additional concrete	10 00 per cu. yd.
Cut granite copings	4 75 per cu. ft.
Additional cast iron, wrought iron or steel	0 10 per lb.
Additional yellow pine lumber as interior finish	50 00 per M. ft. B. M.

Contract No. 24.

FILTERING MATERIALS AND UNDERDRAINS FOR UPPER AND LOWER ROXBOROUGH WATER FILTER PLANTS AND SAND WASHERS FOR LOWER ROXBOROUGH.

Daniel J. McNichol, Contractor.

Awarded December 23, 1901. Completed July 25, 1903.

Filtering materials and underdrains for Lower Roxborough Filters, Nos. 1 and 5, Plan "A," complete	$34,555 00

Filtering materials and underdrains for Lower Roxborough Filters, Nos. 2 and 4, Plan "B," complete	$36,248 00	
Filtering materials and underdrains for Lower Roxborough Filter, No. 3, Plan "C," complete	17,891 00	
Filtering materials and underdrains for Upper Roxborough Filters (all filters), Plan "A," complete	179,348 00	
Filtering materials and underdrains for Upper Roxborough Filters (all filters), Plan "B," complete	179,249 00	
Filtering materials and underdrains for Upper Roxborough Filters (all filters), Plan "C," complete	179,656 00	
Additional No. 1 filter gravel	4 60	per cu. yd.
Additional No. 2 filter gravel	4 68	per cu. yd.
Additional No. 3 filtered gravel	4 72	per cu. yd.
Additional No. 4 filter gravel	4 80	per cu. yd.
Additional No. 5 filter gravel	4 90	per cu. yd.
Additional filter sand	3 65	per cu. yd.
Sand washers and buildings for Lower Roxborough filters, complete	10,000 00	

Contract No. 25.

WATER FILTER PLANT AT TORRESDALE.

Daniel J. McNichol, Contractor.

Awarded December 23, 1901.

Filter Plant, complete	$3,734,000 00	lump sum.
Filtered Water Basin, complete	1,146,000 00	lump sum.
Additional excavation	3 00	per cu. yd.
Additional sodding	5 00	per sq. yd.
Additional granolithic pavement	2 50	per sq. yd.
Additional terra cotta pipe, 12 inches and less	1 50	per lin. ft.
Additional cast iron water pipe	40 00	per ton.
Additional special castings	70 00	per ton.
Additional flange pipe and flange special castings	110 00	per ton.
Additional wrought iron or steel	0 10	per lb.
Additional cast iron	0 08	per lb.

Additional embankment	$1 00 per cu. yd.
Additional straight curbing	2 00 per lin. ft.
Additional curved curbing	2 50 per lin. ft.
Additional expanded metal.....	0 15 per sq. ft.
Additional concrete	10 00 per cu. yd.
Additional brick masonry	18 00 per cu. yd.
Additional yellow pine timber.....	60 00 per M. ft. B. M.
Additional piles	10 00 each.

Contract No. 26.

TESTING STATION AT TORRESDALE FILTER PLANT.

Patrick Gormly, Contractor.

Awarded August 2, 1901. Completed December 19, 1901.

Gasoline engine with connections, foundations and other appurtenances, ready for operation.....	$645 00
Two (2) triplex power pumps, with connections, foundations and other appurtenances.....	858 00
Pipe lines and connections 6,020 00	
Pump house and carpenter work.....1,070 00	

Contract No. 27.

OAK LANE RESERVOIR.

R. A. Malone & Co., Contractors.

Awarded December 23, 1901.

Reservoir, complete $530,000 00	lump sum.
Additional excavation	2 00 per cu. yd.
Additional embankment	0 60 per cu. yd.
Additional sodding	0 60 per sq. yd.
Additional wrought iron or steel.....	0 05 per lb.
Additional cast iron fixtures	0 04 per lb.
Additional concrete	8 00 per cu. yd.
Additional cast iron pipe	40 00 per ton.
Additional special castings	150 00 per ton.
Additional brick masonry	12 00 per cu. yd.
Additional puddle	3 00 per cu. yd.
Additional asphalt lining	3 00 per sq. yd.

Contract No. 28.

LARDNER'S POINT PIPE DISTRIBUTION SYSTEM.

Daniel J. McNichol, Contractor.

Awarded February 18, 1903.

60 inch cast iron hub and spigot water pipe, Class "A"	$42 50	per ton.
60 inch steel riveted water pipe	20 00	per lin. ft.
48 inch cast iron hub and spigot water pipe, anv class	42 50	per ton.
Cast iron hub and spigot water pipe smaller than 48 inch, any class	42 50	per ton.
60 inch and 48 inch cast iron flauge special castings	120 00	per ton.
60 inch and 48 inch cast iron hub and spigot special castings	95 00	per ton.
Cast iron hub and spigot special castings smaller than 48 inch, any class.	158 00	per ton.
Cast iron breeches pipe	200 00	per ton.
12 inch flange pipe and special castings.	180 00	per ton.
Semi-steel special castings	251 00	per ton.
Semi-steel breeches pipe	251 00	per ton.
Excavation	1 87	per cu. yd.
Hard burned brick masonry in valve wells and manholes on pipe lines	15 00	per cu. yd.
Portland cement concrete	11 00	per cu. yd.
Rubble masonry in Portland cement concrete	9 00	per cu. yd.
Hemlock timber in pipe trench foundations	24 50	per M. ft. B. M.
Wrought iron straps, bars and bolts	0 08	per lb.
Structural steel	0 08	per lb.
(*a*) 48 inch vertical geared hub end stop valves, 8 inch by-pass	1,525 00	each.
(*b*) 48 inch vertical geared flange end stop valves, 8 inch by-pass	1,525 00	each.
(*a*) 48 inch hub end stop valves, geared to lay on side, 8 inch by-pass	1,525 00	each.
(*b*) 48 inch flange end stop valves, geared to lay on side, 8 inch by-pass	1,525 00	each.
36 inch hub end stop valves, geared to lay on side, 6 inch by-pass	750 00	each.

30 inch hub or flange end stop valves, geared to lay on side, 4 inch by-pass.	$550 00	each.
12 inch hub or flange end stop valves....	105 00	each.
8 inch hub or flange end stop valves.....	48 00	each.
Double seat 6 inch stop valves, with hub or flange ends	33 00	each.
4 inch relief valves	58 00	each.
2½ inch air valves	19 00	each.
Cast iron stop boxes and other gray iron castings	0 05	per lb.
Cast iron pipe, special castings and stop valves, to be cut out, removed, or replaced	24 80	per ton.
Moving 30 inch rising main.....	3 50	per lin. ft.
Moving 48 inch rising main.....	4 22	per lin. ft.
Furnishing all new materials required to reconstruct the following brick and terra cotta sewers:		
4 feet by 2 feet 8 inch brick sewer.....	$11 80	per lin. ft.
3 feet 6 inch x 2 feet 4 inch brick sewer.....	5 10	per lin. ft.
3 feet 3 inch brick sewer.....	6 50	per lin. ft.
3 feet 3 inch x 2 feet 2 inch brick sewer.....	4 70	per lin. ft.
3 feet x 2 feet brick sewer.....	4 55	per lin. ft.
2 feet 6 inch x 1 foot 8 inch brick sewer.....	4 30	per lin. ft.
2 feet 3 inch x 1 foot 6 inch brick sewer.....	2 70	per lin. ft.
15 inch terra cotta sewer.....	2 60	per lin. ft.
Relocated sewer manholes.....	82 50	each.
6 inch terra cotta sewer.....	0 55	per lin. ft.
Straight yellow pine piles.....	0 44	per lin. ft.

Contract No. 29.

LARDNER'S POINT PUMPING STATION NO. 2.

George C. Dietrich, Contractor.

Awarded September 18, 1903.

Engine house, boiler house, chimneys, smoke tunnels, pump well, water conduits, river connections, pipes, sewers, etc.	$532,000 00	lump sum.
Additional excavation	1 35	per cu. yd.
Additional concrete	7 50	per cu. yd.
Additional puddle	2 50	per cu. yd.
Additional common brick masonry...	9 50	per cu. yd.
Additional fire-brick masonry	52 00	per M.

Additional cut granite masonry.....	85 00	per cu. yd.
Additional rubble masonry	7 50	per cu. yd.
Additional steel bars, placed in concrete	0 10	per lb.
Additional dredging	0 45	per cu. yd.
Additional yellow pine straight piles.	0 50	per lin. ft.
Yellow pine battered or inclined piles	1 00	per lin. ft.
Pile shoes	1 50	each.
Additional yellow pine lumber.....	65 00	per M. ft. B. M.
Additional cast iron fixtures.....	0 07	per lb.
Additional hub and spigot cast iron water pipe	65 00	per ton.
Additional hub and spigot special castings	85 00	per ton.
Additional wrought iron or steel.....	0.055	per lb.
Additional 12 inch terra cotta pipe...	0 40	per lin. ft.
Additional sodding	1 20	per sq. yd.
Additional granolithic paving	1 80	per sq. yd.

Contract No. 33.

SAND WASHERS FOR UPPER ROXBOROUGH FILTERS.

E. M. Nichols, Contractor.

Awarded March 27, 1903. Completed July 1, 1903.

For four (4) sand washers.....$3,849 00 lump sum.

Contract No. 37.

PRELIMINARY FILTERS FOR LOWER ROXBOROUGH FILTERS.

Maignen Filtration Company, Contractors.

Awarded October 3, 1902.

For preliminary filters, complete.....$49,800 00 lump sum.

Contract No. 37A.

FOUNDATION AND SUPERSTRUCTURE FOR THE LOWER ROXBOROUGH PRELIMINARY FILTERS.

Daniel J. McNichol, Contractor.

Awarded February 18, 1903. Completed December 31, 1903.

Superstructure	$28,700 00	lump sum.
Excavation	1 00	per cu. yd.

Rolled embankment	$0 50 per cu. yd.
Concrete	9 00 per cu. yd.
Puddle	4 75 per cu. yd.
Brick masonry	18 00 per cu. yd.
Granolithic pavement	1 75 per cu. yd.
Top soil	0 60 per cu. yd.
Sodding	0 45 per sq. yd.
Rolled cinder walks	0 40 per sq. yd.

Contract No. 40A.

LOW SERVICE DRAINAGE PUMPS FOR THE BELMONT FILTERS.

Camden Iron Works, Contractors.

Awarded July 13, 1903.

For two (2) centrifugal pumps and driving engines, complete ..... $6,800 00 lump sum.

Contract No. 40B.

SAND WASHER PUMPS AND BOILERS FOR THE BELMONT FILTERS.

I. P. Morris Company, Contractors.

Awarded July 13, 1903.

For three (3) duplex direct acting pumps, complete ..... $6,390 00 lump sum.
For four (4) internally fired return tubular marine boilers, complete ..... $21,690 00 lump sum.

Contract No. 42.

ADMINISTRATION BUILDING AND PUMPING STATION FOR THE BELMONT FILTERS.

Harry B. Shoemaker & Co., Contractors.

Awarded July 13, 1903.

Administration building and pumping station, complete	$49,890 00 lump sum.
Additional excavation	1 00 per cu. yd.
Additional rolled embankment	1 00 per cu. yd.

Additional stretcher brick masonry..	$26 00	per cu. yd.
Additional fire brick masonry	45 00	per M.
Additional concrete	7 00	per cu. yd.
Cut granite coping	3 50	per cu. ft.
Additional cast iron, wrought iron, or steel	0 05	per lb.
Additional yellow pine lumber, interior finish	60 00	per M. ft. B. M.

Contract No. 44.

ELECTRIC LIGTING SYSTEM FOR UPPER AND LOWER ROXBOROUGH.

Pennsylvania Equipment Company, Contractors.

Awarded March 30, 1903.

Driving engines, electric generator, switch board, instruments, etc	$5,220 00	lump sum.
Poles, brackets, crossarms, insulators, wire, lamp holders, fixtures, lamps, etc., completed, in place	$9,545 00	lump sum.
Additional 35 foot chestnut poles, set complete, with 2-pin cross-arms and insulators	9 35	each.
Additional No. 0000 B. & S. insulated stranded copper wire, strung.....	0 20	per ft.
Additional No. 4 B. & S. insulated copper wire, strung	0 06	per ft.
Additional No. 6 B. & S. insulated copper wire, strung	0 05	per ft.
Additional No. 10 B. & S. insulated copper wire, strung	0 03	per ft.
Additional No. 14 B. & S. insulated copper wire, strung	0.025	per ft.
Additional 16-candle power, 55 volt incandescent lamps, including keyless sockets, completed, in place	0 65	each.
Additional 16-candle power, 220-volt incandescent lamps, including key sockets, complete, in place	0 70	each.
Additional 110-volt arc lamps, completed, in place	20 25	each.

Contract No. 46.

ELECTRIC LIGHTING SYSTEM FOR BELMONT FILTERS.

Pennsylvania Equipment Company, Contractors.

Awarded July 2, 1903.

Two (2) driving engines, two (2) electrical generators, switchboards, instruments, etc.	$5,027 00	lump sum.
Poles, brackets, cross-arms, insulators, wire, lamp holder, fixtures, lamps, etc., completed, in place	$12,433 20	lump sum.
Additional 40 foot chestnut poles, set complete, with 2-pin cross-arms and insulators	15 00	each.
Additional No. 10 B. & S. insulated copper wire, strung	0.035	per ft.
Additional No. 14 B. & S. insulated copper wire, strung	0.025	per ft.
Additional 16-candle power, 220-volt incandescent lamps, including keyless socket, in place	0 80	each.
Additional 25 foot iron arc lamp poles	37 50	each.
Additional 220-volt inclosed arc lamps, complete, in place	19 50	each.
Additional 16-candle power, 55-volt incandescent lamps, including keyless sockets, in place	0 70	each.

Contract No. 49.

FILTERING MATERIALS AND UNDERDRAINS FOR THE BELMONT FILTERS.

Daniel J. McNichol, Contractor.

Awarded February 18, 1903.

Filtering materials and underdrains, Plan "A," all filters	$346,626 00
Filtering materials and underdrains, Plan "B," all filters	350,312 00
Filtering materials and underdrains, Plan "C," all filters	361,147 00

Additional No. 1 filter gravel.....	$4 25 per cu. yd.
Additional No. 2 filter gravel.....	4 30 per cu. yd.
Additional No. 3 filter gravel.....	4 35 per cu. yd.
Additional No. 4 filter gravel.....	4 40 per cu. yd.
Additional No. 5 filter gravel.....	4 50 per cu. yd.
Additional filter sand	3 30 per cu. yd.

Contract No. 50.

FILTERING MATERIALS AND UNDERDRAINS FOR THE TORRESDALE FILTERS.

Daniel J. McNichol, Contractor.

Awarded February 18, 1903.

Filtering materials and underdrains as follows:

For Filters No. 1, 22 and 23, Plan "A".....	$18,430 00 each.
For Filters No. 1, 22 and 23, Plan "B".....	18,604 00 each.
For Filters No. 1, 22 and 23, Plan "C".....	18,650 00 each.
For Filters No. 2 to 21 and 24 to 33, inclusive, Plan "A"	18,400 00 each.
For Filters No. 2 to 21 and 24 to 33, inclusive, Plan "B"	18,564 00 each.
For Filters No. 2 to 21 and 24 to 33, inclusive, Plan "C"	18,610 00 each.
For Filters No. 34 to 43 and 46 to 55, inclusive, Plan "A"	18,568 00 each.
For Filters No. 34 to 43 and 46 to 55, inclusive, Plan "B"	18,744 00 each.
For Filters No. 34 to 43 and 46 to 55, inclusive, 'Plan "C"	18,790 00 each.
For Filters No. 44 and 45, Plan "A".....	18,568 00 each.
For Filters No. 44 and 45, Plan "B".....	18,744 00 each.
For Filters No. 44 and 45, Plan "C".....	18,790 00 each.
Additional No. 1 filter gravel.....	4 35 per cu. yd.
Additional No. 2 filter gravel.....	4 40 per cu. yd.
Additional No. 3 filter gravel.....	4 45 per cu. yd.
Additional No. 4 filter gravel.....	4 45 per cu. yd.
Additional No. 5 filter gravel.....	4 35 per cu. yd.
Additional filter sand	2 85 per cu. yd.

Contract No. 63.

SAND WASHERS FOR THE BELMONT FILTERS.

P. Gormley, Contractor.

Awarded July 2, 1903. Completed November 1, 1903.

Eight (8) sand washers, complete.....$6595 00 lump sum.

Contract No. 65.

HAND TRAVELING CRANE FOR THE BELMONT FILTERS.

Alfred Box Company, Contractors.

Awarded July 2, 1903.

One hand traveling crane, complete.....$2,700 00 lump sum.

ANNUAL REPORT

OF THE

BUREAU OF HIGHWAYS

FOR THE YEAR 1903

OFFICERS

OF THE

BUREAU OF HIGHWAYS

Chief of Bureau.

WILLIAM H. BROOKS.

Assistant to Chief.

FRANK E. SMITH.

District Assistants.

JOHN K. MYERS, First District.

ELIAS ABRAMS, Second District.

CHARLES E. VOGDES, Third District.

GEORGE STERR, JR., Fourth District.

CHARLES T. PRESTON, Fifth District.

OSCAR NOLL, Seventh District.

JOHN L. FLOOD, Eighth District.

Superintendent of Bridges.

JOSEPH H. COFRODE.

Assistant Superintendent of Bridges.

FRANK C. WATSON.

Inspector of Sewer Repairs.

JOHN D. HEVENER.

Chief Clerk.

MALCOLM M. COPPUCK.

ASSISTANT TO CHIEF CLERK—BENJ. B. BRANNAN.
CONTRACT CLERK—M. L. FINCKEL, JR.
BILL CLERK—WALTER R. BERRY.
ASSISTANT BILL CLERK—PHILIP A. ALLEN.
LICENSE CLERK—RICHARD D. WESTPHAL.
MISCELLANEOUS CLERK—HENRY A MACREADY.
MISCELLANEOUS CLERK—T. WALLIS AITKEN.
MISCELLANEOUS CLERK—JAMES C. MATEER.
MISCELLANEOUS CLERK—THOMAS J. BARR.
REFERENCE AND COMPLAINT CLERK—JOHN A. WOLFF.
STENOGRAPHER, TYPEWRITER AND CLERK—SAMUEL COLLINS.
MESSENGER—ANDREW W. COSTELLO.

District Inspectors.

GEORGE W. MINK, First District.
GEORGE W. EVANS, First District.
WILLIAM A. FREDERICK, First District.
SAMUEL J. SHANNON, Second District.
WILLIAM GODFREY, Second District.
WILLIAM L. CORYELL, Third District.
J. HENRY GERCKE, Third District.
R. W. FAGAN, Fourth District.
R. J. BARR, Fourth District.
JOHN E. MANSHIP, Fifth District.
JOSEPH R. ASH, Fifth District.
JOSEPH FRANKLIN, Fifth District.
WILLIAM B. SCOTT, Sixth District.
R. LINCOLN ROBERTS, Sixth District.
GEORGE T. HOOVER, Seventh District.
RICHARD WILDEY, Seventh District.
HENRY T. STACKHOUSE, Eighth District.
ALONZO KNIGHT, Eighth District.

Inspectors of Electrical Connections.

GEORGE E. TAYLOR.
ANDREW KEISER.
GEORGE BETTS.
THOMAS McKAY.

Inspectors of Repairs to Asphalt Pavements.

WILLIAM LAMOND
MILTON G. BRIGGS.

Special Inspectors.

SAMUEL J. YOUNG.
JOHN R. LLOYD.
SAMUEL C. WAGNER.
CHARLES J. MORRISON.
GEORGE A. BULLOCK.
HENRY S. MOORE.
WILLIAM G. HOUSTON.
GEORGE W. MOONEY.
GEORGE H. DeHAVEN.
GEORGE J. FIELITZ.
JOHN PHILLIPS.
GEORGE W. SPIELMAN.
CHARLES S. WHITING.
ELMER E. FLOOD.
BENJAMIN L. TAYLOR.
CHARLES BOUB, Jr.
HARRY KEFFER.
ALBERT C. McEWEN.
WILLIAM H. SIEGEL.

ANNUAL REPORT

OF THE

BUREAU OF HIGHWAYS

FOR THE YEAR 1903

Philadelphia, January 2, 1904.

PETER E. COSTELLO, ESQ.,
Director, Department of Public Works.

DEAR SIR:—I herewith present report on the work of the Bureau of Highways for the year ending December 31st, 1903

The amount of money available for all purposes for the year 1903 was $2,650,332.60, which included the appropriations and amounts brought forward from previous years, of which sum $2,234,462.89 was paid out on warrants countersigned, $1,508.27 merged at the end of the year, and $414,361.44 was carried forward to 1904.

The receipts of the Bureau, representing the amounts paid to the Receiver of Taxes on account of licenses, permits, etc., were $179,188.49, and the number of permits issued was 18,757.

The business of the Bureau was covered by 540 contracts, of which 137 were for grading, 180 for paving, 34 for repaving, 160 for macadamizing, and 29 of a miscellaneous character, besides the supervision of the various other classes of work coming under the jurisdiction of the Bureau.

Summary of work for the year 1903.

New paving (by the City), 92,374 linear feet, equal to 17.50 miles.
New macadamizing (by City and property owners), 141,888 linear feet, equal to 26.87 miles.
Repaving with improved pavement (by the City), 24,725 linear feet, equal to 4.68 miles.
New paving (by passenger railway companies, between tracks), 134,580 square yards.
Grading streets and sidewalks, 1,097,522 cubic yards.
New footway paving, 57,443 square yards.
Gutter stone laid, 4,930 linear feet.
Crossing stone laid, 8,394 linear feet.
Wooden trunks constructed, 12,467 linear feet.
Brick and stone drains constructed, 1,981 linear feet.
Hand rails constructed, 4,900 linear feet.
New curbstone set, 175,921 linear feet.
Curved curb set, 10,247 linear feet.
Repairs to paved streets, 391,064 square yards.
Repairs to permit ditches, 50,329 square yards.
Footway repairs, 18,491 square yards.
Curbstone reset, 106,244 linear feet.
Vitrified brick and stone gutters, 5,670 linear feet.
Resurfacing with sheet asphalt, 10,672 square yards.
Resurfacing with broken stone, 132,809 linear feet, equal to 25.15 miles.
Footway, curb, railway, and other notices served, 25,732.

Grading.

During the year 1903, 25 miles of streets were opened and graded to the established grades by the City and builders having large operations, the latter doing the work without cost to the City. The total work amounted to 1,097,522 cubic yards.

New Paving.

17.50 miles of new streets, covering 282,571 square yards, were paved by the City with sheet asphalt, granite blocks and vitrified bricks upon six-inch concrete foundation. The value of these new pavements is, approximately, $850,000, of which $153,097.26 was paid by the City for paving intersections and in front of unassessable property.

Repaving with Improved Pavements.

There being but a very small amount available for repaving with improved pavements during the year, and Councils having made no appropriation, there was but a small amount of repaving done during the year 1903. The total amount of work done was 4.68 miles, covering 76,125 square yards.

The locations and lengths of streets paved and repaved, together with the number of square yards, will be found in the tabulated forms appended hereto.

Unpaved and Macadamized Public Highways.

The unpaved and macadamized roads of the City were cared for and maintained in excellent condition during the year.

Some of the macadam roads, notably the Bustleton and Somerton turnpike and the Bensalem pike which recently came into the possession of the City in deplorable condition, required entire resurfacing.

25.15 miles of macadam roads were resurfaced with broken stone for their entire width, making practically new roads.

The Bustleton and Somerton pike was resurfaced and rolled to its full width for its entire length, approximately nine miles, and the Bensalem pike was put in very fair condition, the appropriation not being sufficient to entirely resurface it also.

The sprinkling of macadamized roads was continued during 1903, the work commencing May 1st and ending October 1st.

Brick and stone gutters were also constructed on many macadamized roads to their great benefit.

26.87 miles of dirt roads were macadamized and large stretches of new roads built with connecting links to roads already macadamized.

Repairs to Paved Streets.

The paved streets of the City were kept in good repair during the year. The work was let for a lump sum for repairs to all the paved streets, except asphalt and granolithic, the contract price being $145,600, and it was done in a satisfactory manner.

The Keystone and Bell Telephone Companies, the United Gas Improvement Company, and the different Electric Light Companies made a large number of openings for laying pipes, conduits, connections etc.

The following is a statement of the work done by the Telephone and U. G. I. Companies:

Keystone Telephone Company.

Streets opened for laying conduits.....	22½	miles.
Repaving over openings—Granite blocks	15,976	sq. yds.
Sheet asphalt	13,522	sq. yds.
Vitrified bricks	2,094	sq. yds.
Granolithic	591	sq. yds.
Cobble and rubble.....	3,348	sq. yds.

Bell Telephone Company.

Streets opened for laying conduits.....	16.9	miles.
Repaving over openings—Granite blocks	31,473	sq. yds.
Sheet asphalt	13,075	sq. yds.
Vitrified bricks	6,834	sq. yds.

United Gas Improvement Company.

Streets opened for laying mains.....	41	miles.
Number of openings for house connections.....	19,000	
Number of openings for overhauling.....	10,000	
Number of openings for leaks and repairs.....	4,000	
Repaving over openings—Granite blocks	68,499	sq. yds.
Sheet asphalt	17,275	sq. yds.
Vitrified bricks	9,378	sq. yds.

Resurfacing with Sheet Asphalt.

No appropriation was made for resurfacing with sheet asphalt during the year, and the unexpended balance from

1902 was used in resurfacing 10,672 square yards on streets which were rapidly disintegrating and were in dangerous condition.

Repairs to Sewers.

The ordinary work of cleaning and repairing sewers and repairing manholes and inlets was done in a very thorough manner and in every way satisfactory.

There were several serious collapses of sewers, due to the partial demolition of bulkheads on the Schuylkill river, which would come under the Bureau of City Property.

The most serious break for which this Bureau was responsible, was the break of the sluice under the tracks of the Pennsylvania R. R. Co., at Delaware Avenue and Christian Street, necessitating the entire rebuilding of the sewer from a point west of Delaware Avenue to the end of the river bulkhead.

This work was done by the contractors for emergency work in connection with repairs to sewers, and was an extremely difficult and arduous undertaking, owing to the tides and the necessity for cutting through bulkheads below low water mark. The work was completed in a skillful manner, without any interference with railroad or street traffic, and a substantial stone and cement structure takes the place of a dilapidated sluice which had been a source of danger for several years.

Repairs to Bridges.

The bridges of the City are in a very poor condition, many of them being dangerous to travel. The small appropriation made for this class of work did not permit of extensive repairs. Several important bridges are in danger of collapsing and some are now closed to travel. Needed repairs and renewals cannot be made unless Councils shall make sufficient appropriation.

For details as to the work done in 1903 I would respectfully refer to the report of the Superintendent of Bridges, hereto attached.

Correspondence.

The correspondence with this Bureau has assumed very large proportions, communications being received concerning every class of work coming under its jurisdiction, not only from residents of the City but from all over the country. 25,316 letters and communications were received and over 26,000 replies and communications were sent out from this office during the year, which, with the necessary references and reports on various matters, make a total of over 85,000 papers of record as the correspondence for the year 1903.

The thousands of police reports and reports on work of the various Companies having privileges on the highways are also all entered of record.

Miscellaneous.

The Passenger Railway Companies made extensive repairs to streets occupied by their tracks, aggregating 555,300 square yards, apportioned as follows:

Repairs to granite block pavements.....	316,000 sq. yds.
Repairs to sheet asphalt pavements.....	148,000 sq. yds.
Repairs to vitrified brick pavements.....	46,300 sq. yds.
Repairs to macadam pavements.....	45,000 sq. yds.

The Philadelphia Rapid Transit Company removed the old paving from between rails and substituted therefor Granite Blocks, the total amount of such work being 134,580 square yards.

They also extended their trackage 30.59 miles, making a total of 430.46 miles of streets occupied by Passenger Railway tracks in this City.

All of this work was done under the supervision of this Bureau.

In conclusion, I desire to express my thanks to the officials in this Bureau for the assistance given me in the prosecution of the work of this Bureau during the year, and to yourself and your able Assistant Mr. Baker, there is due not only thanks but gratitude for the great interest taken by you in the affairs of this Bureau, and the kindly manner in which advice and assistance was given me.

Respectfully,

WM. H. BROOKS,
Chief, Bureau of Highways.

ANNUAL REPORT

OF THE

CHIEF CLERK

FOR THE YEAR 1903

Philadelphia, December 31, 1903.

WILLIAM H. BROOKS, ESQ.,
Chief, Bureau of Highways.

DEAR SIR:—Accompanying please find report of the appropriations to the Bureau of Highways, with the expenditures and amounts merging and not merging, for the year 1903.

Very truly,

MALCOLM M. COPPUCK,
Chief Clerk.

Item.	For.	Appropriation.	Countersigned.	Merging.	Not Merging
1	Officers' salaries	$75,273 61	$75,213 61	$0 60	
2	Paving intersections and unassessable property	39,244 97	31,069 97	.....	$8,175 00
2¼	Paving intersections and unassessable property	200,000 00	122,027 29	.....	77,972 71
3	Repairs to paved streets	169,366 95	169,364 74	2 21	
4	Repairs to unpaved streets, roads, drains, etc	291,470 00	291,235 66	234 34	
5	Repairs to sewers, inlets, etc	40,300 00	40,298 90	1 10	
6	Grading streets and roads	119,404 59	102,779 32	.....	16,625 27
Loan. 6½	Grading streets and roads	207,848 49	160,979 25	.....	46,869 24
7	General repairs to bridges	53,800 00	53,799 97	03	
7½	Reconstructing fenders Penrose ferry bridge	2,745 00	2,745 00		
7¾	Reconstructing fenders Gray's ferry bridge	8,300 00	3,652 00	.....	4,648 00
8	Expenses of the Board of Highway Supervisors	11,370 00	11,369 83	17	
9	Printing, advertising and stationery	5,000 00	5,000 00		
10	Insurance on bridges	800 00	756 25	43 75	
10½	Rent of district offices	1,100 00	1,099 00	1 00	
11	Incidentals and office expenses	2,000 00	2,000 00		
11½	Hauling and yard expenses	2,500 00	2,500 00		
12	Repairs to meadow banks	2,000 00	1,984 06	15 94	

Report of Appropriations and Expenditures of the Bureau of Highways for the Year 1903—Continued.

Item.	For.	Appropriation.	Countersigned.	Merging.	Not Merging.
13	Salaries of bridge watchmen and engineers	$33,176 00	$33,030 38	$145 62	
14	Repaving and repairing footways	7,000 00	7,000 00		
15	Repaving small and tramway streets	14,568 76	13,224 62	.....	$1,344 14
16	Keep of horses for Chief, Assistants and Inspectors	13,322 20	13,322 20		
17	Curved curbing	10,000 00	10,000 00		
18	Oil, coal and engineers' stores for bridges	1,400 00	1,400 00		
19	Salaries of temporary Inspectors	16,625 00	16,622 32	2 68	
20	Emergencies	30,145 30	30,145 30		
21	Surfacing and resurfacing unpaved streets and roads	160,719 33	117,400 36	.....	43,318 97
Loan 21½ Loan.	Surfacing and resurfacing unpaved streets and roads	22,858 67	6,387 42	.....	16,471 25
21¾	Surfacing and resurfacing unpaved streets and roads	241,894 82	213,621 51	.....	28,273 31
21¾	Surfacing and resurfacing unpaved streets and roads	52,500 00	31,726 15	.....	20,773 85
22	Improving waterways in the Fortieth Ward	11,709 47	4,996 15	6 12	6,707 20
23	Repairs to asphalt streets and breaks in footways	50,000 00	49,599 97	400 03	
24	Repaving Tulip street	215,000 00	212,665 21	.....	2,334 79
25	Retaining wall, Lombard and Meadland streets	15,000 00	15,000 00		
26	Reimburse parties for paving on Fifty-second street	357 07	357 07		

Report of Appropriations and Expenditures of the Bureau of Highways for the Year 1903—Continued.

Items.	For	Appropri-tion.	Counter-signed,	Merging.	Not Merging.
26½	**Bring Moyer, Almond, Sergeant** and Gaul streets to revised grade	$30,082 20	$30,034 90	.....	$47 30
27	**Repaving with improved pavement**	100,005 39	95,745 20	$594 69	3,665 50
28	**Extending contract for resurfacing** Grant street	2,921 90	.....	.....	2,921 90
29	**Abolishing grade crossing**	7.015 80	7,015 21	59	
30	**Retained percentage on certain** contracts for repairing	441 85	.....	.....	441 85
31	**Retained percentage on certain** contracts for repairing	3,933 51	.....	.....	3,933 51
32	**Retained percentage on certain contracts for repairing**	131 72	.....	.....	131 72
33	To improve the Boulevard from Broad street northeastward	300,000 00	228,580 47	.....	71,419 53
34	Change grade of Market street, bet. Twenty-eighth and Thirtieth sts	69,000 00	17,000 00	.....	52,000 00
35	Opening Mingo creek, etc	8,000 00	1,713 60	.....	6,286 40
	Total	$2,650,332 60	$2,234,462 89	$1,508 27	$414,361 44

MALCOLM M. COPPUCK,
Chief Clerk.

ANNUAL REPORT

OF THE

LICENSE CLERK

FOR THE YEAR 1903

Philadelphia, December 31, 1903.

WILLIAM H. BROOKS, ESQ.,
Chief, Bureau of Highways.

DEAR SIR:—The following items represent the permits and licenses issued by this Bureau for the year ending December 31, 1903:

Permits for removal of street pavements	$37,101 75
Permits for placing building material on the street	1,016 25
Permits for constructing vaults under sidewalks	2,415 20
Licenses for drays, carts, wagons, and barrows	1,218 50
Licenses for hotel, private and hackney coaches	1,035 00
Licenses for passenger railway cars	105,707 00
Licenses for awnings	801 00
Licenses for drivers	2 50
Miscellaneous	29,891 29
Total	$179,188 49
Permits issued	18,757

Respectfully submitted,

R. D. WESTPHAL,
License Clerk.

Passenger Railway Car Licenses.

		1903.		
		Bridge.	Full.	Special.
Catharine and Bainbridge	Union Traction Co. Philadelphia Rapid Transit Co.			
Empire				
Philadelphia and Gray's Ferry				
Philadelphia City				
Ridge Avenue				
Thirteenth and Fifteenth				
West Philadelphia				
Union				
PHILADELPHIA TRACTION CO		225	1840	36
PEOPLE'S PASSENGER RAILWAY CO				
Hestonville, M. & F. P. Ry. Co				
Citizens'				
Fifth and Sixth Streets				
Lombard and South				
Second and Third				
ELECTRIC TRACTION CO				
LEHIGH AVENUE P. R. W. CO				
HOLMESBURG, TACONY AND FRANKFORD E. R. W. CO		.....	13	188
WISSAHICKON E. P. R. W. CO		.....	26	71
ROXBORO', CHESTNUT HILL AND N. P. R. W. CO.				
SOUTHWESTERN STREET RY. CO		.....	8	183
Total		225	1887	428

ANNUAL REPORT

OF THE

SUPERINTENDENT OF BRIDGES

FOR THE YEAR 1903

Philadelphia, December 31, 1903.

MR. WILLIAM H. BROOKS,
Chief, Bureau of Highways.

DEAR SIR:—I herewith submit report of work done on repairs to Bridges and emergency cases during the year ending December 31, 1903:

A.

The amounts expended for repairs and emergency work upon Bridges was:

For labor, tools and machinery, per contract		$52,733 64
For lumber		11,382 66
For sand, cement, paint, bricks, etc		2,847 06
Total expenditure		$66,963 36
The appropriation and transfers to Item 7, made by Ordinance of Councils	$53,800 00	
Emergency work paid for from Item 20	13,163 39	
	66,963 39	
Balance on Item 7 merging	03	
Total payments		$66,963 36

B.

The expenditures charged to Items 1, 10, 13 and 18 were as follows:

For salaries to Superintendent, Assistant Superintendent and Draughtsman	$3,525 00
For salaries and uniforms to bridge engineers, operators and watchmen	33,176 00
For miscellaneous supplies	1,395 40
For insurance	756 25
Total	$38,852 65

C.

There was expended for account of Construction of work not included in above:

For construction of new fenders at Penrose Ferry Bridge	$2,745 00
For construction of new fenders at Gray's Ferry Bridge*	8,300 00
Delaware river banks, northeast of Venango street	2,084 91
For repairs to Delaware river banks, south of Oregon avenue	1,075 00
Total	$14,204 91

The permanent repair work done during the year consisted of the following:

Renewal of stairways at Silverwood, Cotton, Roxborough, Rector, Sumac, and Huntingdon streets, at an aggregate cost of	$7,800 00
Renewal of two wooden pile bridges on Island Road, south of Penrose Ferry	2,500 00
Construction of foot-bridge at Merion road, over Cobb's creek	400 00
Partial reconstruction of stone and brick arch bridge at Bustleton pike, over Shady Run	3,750 00
Rebuilding retaining wall at Frankford avenue, oyer Pennypack creek	4,500 00
Total	$18,950 00

* Work on Gray's Ferry fenders in progress but not fully completed.

Owing to the small sum appropriated the available moneys were necessarily generally used for making temporary repairs, and to provide against immediate accidents, and a large sum of money is now required to repair and put in safe condition a number of badly impaired bridges.

The following exhibit gives location of bridges that now need attention, the character of repairs required, and the estimated cost of the same:

A.

Bustleton pike, near Somerton, to rebuild stone arch and retaining walls	$3,000 00
Bustleton pike, near Tomlinson road, to repair abutments and wing walls	750 00
Tomlinson's road, at Sidebottom's farm, to reconstruct stone arch	1,500 00
Bustleton pike, over Pennypack creek, to repair and rebuild retaining walls	10,000 00
Welsh road, near Verree road, to rebuild retaining walls	6,000 00
Blue Grass road, near Bustleton Railroad, and Blue Grass road, near Grant street, to rebuild two bridges	5,000 00
Bustleton pike, east of Axe Factory road, to rebuild arch and wing walls	3,800 00
Axe Factory road, over Pennypack creek, to renew superstructure and repair masonry	6,000 00
Tabor road, over Tacony creek, to repair superstructure and masonry	2,500 00
Spring Garden street, over Schuylkill river, to repair superstructure, balustrade, and cracked masonry	10,000 00
Market street bridge, over Schuylkill river, to renew railings and repair metal work	7,500 00
Academy road, south of Comly road, for new concrete bridge	7,000 00
Six wooden pile bridges at Island road, 84th, 86th, and 87th streets, over ditches and creeks	7,500 00
Total	$70,550 00

B.

Painting.

City avenue, over Schuylkill river	$1,500 00
Falls Bridge	3,500 00
Girard Avenue Bridge	4,500 00
Spring Garden Street Bridge	7,500 00
Market Street Bridge	4,000 00
Chestnut Street Bridge	4,000 00
Walnut Street Bridge	8,500 00
Broad street, over Philadelphia & Reading Railway. (This includes scraping and renewal of metal work and sheathing.)	12,000 00
Broad street, over Richmond Branch of P. & R. R. R.	500 00
Huntingdon street, over P. & R. R. R.	1,500 00
Second street, over P. & R. R. R.	700 00
Front street, over P. & R. R. R.	700 00
Somerset street, over P. & R. R. R.	700 00
Manayunk avenue, over Shurz lane	500 00
Kensington avenue, over Frankford creek	500 00
State road, over Pennypack creek	1,000 00
Thirty-fourth street, over P. R. R.	1,000 00
Oxford street, over P. R. R.	500 00
Sixty-third street, over P., B. & W. R. R.	500 00
Other small bridges, less than $500	5,000 00
Total	$58,600 00

C.

There will be required for tools, labor, and machinery, for repairs and emergencies other than the above enumerated	$50,000 00
For lumber	15,000 00
For miscellaneous items	10,000 00
Total	$75,000 00

Summary.

A	$70,550 00
B	58,600 00
C	75,000 00
Total	$204,150 00

Number of men:—Bridge engineers, watchmen, etc., employed at close of year 1903:

Engineers and operators on drawbridges	6
Watchmen	41
Total	47

The number of City Bridges under care of the Bureau of Highways is as follows:

Class A—Steel and iron structures	150
Class B—Concrete structures	10
Class C—Stone and brick structures	79
Class D—Wooden and stone structures	91
Total	330

In addition to the work above mentioned, repairs were made to the Inter-county Bridge at Green Lane, Manayunk, over the Schuylkill River, at a cost of $252.96, one-half of which is borne by Montgomery County, and bill has been rendered for same.

The total estimated value of City Bridges is $20,500,000.

In conclusion, I desire to express my appreciation of the valuable assistance rendered by Mr. Frank C. Watson, Assistant Superintendent, who is deserving of commendation for careful and intelligent attention given to the performance of his duties.

I desire also to express my sincere thanks to you for your continuous courtesy and valuable aid extended to myself and Assistant.

Yours truly,

JOS. H. COFRODE,
Superintendent of Bridges.

Detailed statements of quantities and character of work done during the year 1903, classified and arranged for ready reference, together with classification of all pavements and sidewalks laid, and the average cost of each class of pavements for the years 1902 and 1903.

New Paving.

Granite Blocks.

Second District	629	sq. yds.	or	108	lin. ft.
Fourth District	2,684	sq. yds.	or	944	lin. ft.
Sixth District	16,281	sq. yds.	or	3,673	lin. ft.
Total	19,594	sq. yds.	or	4,725	lin. ft.

Sheet Asphalt.

First District	81,566	sq. yds.	or	25,895	lin. ft.
Second District	34,967	sq. yds.	or	11,942	lin. ft.
Fourth District	24,762	sq. yds.	or	7,227	lin. ft.
Fifth District	3,570	sq. yds.	or	850	lin. ft.
Sixth District	11,709	sq. yds.	or	4,105	lin. ft.
Seventh District	67,138	sq. yds.	or	22,748	lin. ft.
Eighth District	5,218	sq. yds.	or	1,686	lin. ft.
Total	228,930	sq. yds.	or	74,453	lin. ft.

Vitrified Bricks.

First District	4,229	sq. yds.	or	2,120	lin. ft.
Second District	1,765	sq. yds.	or	823	lin. ft.
Fourth District	3,907	sq. yds.	or	1,091	lin. ft.
Fifth District	22,107	sq. yds.	or	8,532	lin. ft.
Eighth District	2,039	sq. yds.	or	630	lin. ft.
Total.	34,047	sq. yds.	or	13,196	lin. ft.

Macadamizing.

First District	57,685	sq. yds.	or	32,570	lin. ft.
Second District	3,521	sq. yds.	or	1,980	lin. ft.
Fourth District	8,175	sq. yds.	or	3,470	lin. ft.
Fifth District	17,927	sq. yds.	or	9,629	lin. ft.
Seventh District	22,044	sq. yds.	or	9,780	lin. ft.
Eighth District	159,845	sq. yds.	or	84,459	lin. ft.
Total	269,197	sq. yds.	or	141,888	lin. ft.

New Paving by Substituting Improved Pavement for Cobble and Rubble.

Granite Blocks.

Third District	2,045	sq. yds.	or.....	2,410	lin. ft.
Sixth District	41,158	sq. yds.	or.....	8,788	lin. ft.
Total.	43,203	sq. yds.	or.....	11,198	lin. ft.

Sheet Asphalt.

First District	10,890	sq. yds.	or.....	2,170	lin. ft.
Second District	432	sq. yds.	or.....	334	lin. ft.
Third District	3,828	sq. yds.	or.....	2,369	lin. ft.
Sixth District	12,961	sq. yds.	or.....	5,418	lin. ft.
Total	28,111	sq. yds.	or.....	10,291	lin. ft.

Vitrified Bricks.

Second District	1,417	sq. yds.	or.....	939	lin. ft
Third District	566	sq. yds.	or.....	1,345	lin. ft.
Seventh District	2,828	sq. yds.	or.....	952	lin. ft.
Total	4,811	sq. yds.	or.....	3,236	lin. ft.

Summary of New Work.

Granite blocks	19,594	sq. yds.	or.....	4,725	lin. ft.
Granite blocks, sub..	43,203	sq. yds.	or.....	11,198	lin. ft.
Total	62,797	sq. yds.	or.....	15,923	lin. ft.
Sheet asphalt 228,930		sq. yds.	or.....	74,453	lin. ft.
Sheet asphalt, sub...	28,111	sq. yds.	or.....	10,291	lin. ft.
Total. 257,041		sq. yds.	or.....	84,744	lin. ft.
Vitrified bricks	34,047	sq. yds.	or.....	13,196	lin. ft.
Vitrified bricks, sub..	4,811	sq. yds.	or.....	3,236	lin. ft.
Total	38,858	sq. yds.	or.....	16,432	lin. ft.
Macadamizing 269,197		sq. yds.	or.....	141,888	lin. ft.

Total amount of new paving, 627,893 square yards, or 258,987 linear feet, equal to 49.05 miles.

Repairs to Paved Streets.

First District	40,837 sq. yds.
Second District	81,400 sq. yds.
Third District	84,538 sq. yds.
Fourth District	31,102 sq. yds.
Fifth District	22,107 sq. yds.
Sixth District	85,500 sq. yds.
Seventh District	12,900 sq. yds.
Eighth District	32,680 sq. yds.
Total	391,064 sq. yds.

Connections, Water and Drain Ditches Repaved.

First District	3,650 sq. yds.
Second District	3,700 sq. yds.
Third District	11,200 sq. yds.
Fourth District	8,834 sq. yds.
Fifth District	8,170 sq. yds.
Sixth District	8,880 sq. yds.
Seventh District	2,206 sq. yds.
Eighth District	3,689 sq. yds.
Total	50,329 sq. yds.

Footway Breaks Repaired.

First District	2,421 sq. yds.
Second District	339 sq. yds.
Third District	4,100 sq. yds.
Fourth District	2,480 sq. yds.
Fifth District	124 sq. yds.
Sixth District	8,171 sq. yds.
Seventh District	325 sq. yds.
Eighth District	531 sq. yds.
Total	18,491 sq. yds.

Grading.

First District	213,399 cu. yds.
Second District	96,246 cu. yds.
Fourth District	56,190 cu. yds.
Fifth District	112,891 cu. yds.
Sixth District	122,325 cu. yds.
Seventh District	345,494 cu. yds.
Eighth District	150,977 cu. yds.
Total	1,097,522 cu. yds.

New Crossing Stone.

Third District	122 lin. ft.
Fourth District	464 lin. ft.
Sixth District	7,808 lin. ft.
Total	8,394 lin. ft.

Curbstone Reset.

First District	14,439 lin. ft.
Second District	23,458 lin. ft.
Third District	17,209 lin. ft.
Fourth District	9,328 lin. ft.
Fifth District	12,228 lin. ft.
Sixth District	19,840 lin. ft.
Seventh District	3,330 lin. ft.
Eighth District	6,412 lin. ft.
Total	106,244 lin. ft.

New Curbstone Set.

First District	66,179 lin. ft.
Second District	22,855 lin. ft.
Third District	4,358 lin. ft.
Fourth District	14,835 lin. ft.
Fifth District	19,501 lin. ft.
Sixth District	12,688 lin. ft.
Seventh District	27,267 lin. ft.
Eighth District	8,238 lin. ft.
Total	175,921 lin. ft.

Wooden Trunks.

First District	1,814 lin. ft.
Second District	1,059 lin. ft.
Fourth District	96 lin. ft.
Fifth District	1,713 lin. ft.
Sixth District	68 lin. ft.
Seventh District	1,545 lin. ft.
Eighth District	6,172 lin. ft.
Total	12,467 lin. ft.

New Footway Paving.

First District	3,228	sq. yds.
Second District	15,319	sq. yds.
Fourth District	2,488	sq. yds.
Fifth District	29,867	sq. yds.
Sixth District	4,096	sq. yds.
Seventh District	22,294	sq. yds.
Eighth District	151	sq. yds.
Total	57,443	sq. yds.

Hand Railings.

First District	396	lin. ft.
Fourth District	549	lin. ft.
Fifth District	777	lin. ft.
Sixth District	1,666	lin. ft.
Seventh District	852	lin. ft.
Eighth District	660	lin. ft.
Total	4,900	lin. ft.

Footway, Curb, Railway and Drainage Notices Served.

First District	3,051
Second District	3,354
Third District	7,984
Fourth District	1,850
Fifth District	1,112
Sixth District	5,207
Seventh District	2,244
Eighth District	930
Total	25,732

Brick and Stone Drains.

First District	290	lin. ft.
Fifth District	740	lin. ft.
Eighth District	951	lin. ft.
Total	1,981	lin. ft.

Vitrified Brick and Stone Gutters Constructed on Macadamized Roads.

Eighth District	5,670	lin. ft.

Curved Curb Corners.

First District	1,851 lin. ft.
Second District	876 lin. ft.
Third District	1,849 lin. ft.
Fourth District	673 lin. ft.
Fifth District	578 lin. ft.
Sixth District	2,712 lin. ft.
Seventh District	962 lin. ft.
Eighth District	746 lin. ft.
Total	10,247 lin. ft.

Resurfacing with Sheet Asphalt.

Third District	8,833 sq. yds.
Sixth District	1,455 sq. yds.
Seventh District	384 sq. yds.
Total	10,672 sq. yds.

Resurfacing with Broken Stone.

First District	31,243 sq. yds.	or	14,930 lin.	ft.
Second District	17,697 sq. yds.	or	10,577 lin.	ft.
Fourth District	7,166 sq. yds.	or	6,450 lin.	ft.
Fifth District	41,780 sq. yds.	or	23,502 lin.	ft.
Seventh District	5,440 sq. yds.	or	3,000 lin.	ft.
Eighth District	130,161 sq. yds.	or	64,350 lin.	ft.
Total	233,487 sq. yds.	or	132,809 lin.	ft.

Old Gutter Stone Taken from Streets Repaved, and Placed in Other Streets.

Third District	530 lin. ft.
Sixth District	3,300 lin. ft.
Eighth District	1,100 lin. ft.
Total	4,930 lin. ft.

Old Crossing Stones Taken from Streets Repaved, and Placed in Other Streets.

Sixth District	1,300 lin. ft.
Seventh District	250 lin. ft.
Eighth District	700 lin. ft.
Total	2,250 lin. ft.

Asphalt Filled Manhole Covers Placed by This Bureau in Streets Repaved.

Third District	13
Sixth District	11
Eighth District	5
Total	29

Asphalt Filled Manhole Covers Placed by This Bureau in Other Streets.

First District	22
Second District	16
Third District	12
Fourth District	6
Seventh District	11
Total	67

Number of Inlets Constructed and Reconstructed Under This Bureau.

First District	5
Third District	10
Fourth District	5
Fifth District	5
Sixth District	119
Seventh District	1
Eighth District	4
Total	149

Repaving by Passenger Railway Companies.

Granite Blocks.

Second District	1,249	sq. yds.	or	388	lin. ft.
Third District	14,516	sq. yds.	or	21,374	lin. ft.
Fifth District	4,807	sq. yds.	or	2,704	lin. ft.
Sixth District	1,444	sq. yds.	or	500	lin. ft.
Eighth District	37,371	sq yds.	or	27,035	lin. ft.
Total	59,387	sq. yds.	or	52,001	lin. ft.

Resurfacing With Sheet Asphalt by Passenger Railway Companies.

Third District	37,742	sq. yds.	or	7,200	lin. ft.

By Passenger Railway Companies.

Old Granite Blocks Relaid.

First District	65,540	sq. yds.	or.....	18,640	lin. ft.
Second District	7,443	sq. yds.	or.....	2,928	lin. ft.
Third District	117,138	sq. yds.	or.....	44,600	lin. ft.
Fourth District	22,330	sq. yds.	or.....	10,427	lin. ft.
Sixth District	20,832	sq. yds.	or.....	5,966	lin. ft.
Total	233,283	sq. yds.	or.....	82,561	lin. ft.

Old Vitrified Bricks Relaid.

First District	10,447	sq. yds.	or.....	2,860	lin. ft.
Second District	4,527	sq. yds.	or.....	1,325	lin. ft.
Fourth District	888	sq. yds.	or.....	400	lin. ft.
Fifth District	51,478	sq. yds.	or.....	11,170	lin. ft.
Total	67,340	sq. yds.	or.....	14,755	lin. ft.

Average Cost of New Paving.

	1902.	1903.
	Cost per Square Yard.	Cost per Square Yard.
Granite blocks on concrete base	2 84	3 38
Sheet asphalt on concrete base — Trinidad lake	2 57	2 18
Sheet asphalt on concrete base — Bermudez lake	2 57	2 18
Vitrified brick on concrete base	2 10	2 23

Classification of Pavements, December 31, 1903.

	Cobble and Rubble.	Granite Blocks.	Vitrified Bricks.	Asphalt.		Macadam.	Granolithic.	Slag Blocks.	Total Miles.
				Sheet.	Block.				
Miles	73.12	367.80	141.73	337.69	19.30	262.66	12.77	9.82	1,224.89
Percentage	5.97	30.03	11.67	27.56	1.57	21.44	1.05	.81	
							Less Turnpikes		7.00
							Total		1,217.89

Total length of streets and roads opened and in use:

Paved	1,224.89 miles.
Dirt roads	437. miles.
Total	1,661.89 miles.

Classification of Sidewalks.

	Brick.	Brick and Stone Combined.	Stone.	Concrete.	Asphalt.	Wood.	Total Miles.
Miles	1,150	30	165	528	1	6	1,880

Name of street, location of work and character of pavement of all streets paved and repaved by the City, and new macadam work.

New Paving, 1903.

Sheet Asphaltum—Trinidad Lake.

Arch street, from Farson street to Fifty-first street.
Arch street, from Vogdes street to Fifty-sixth street.
Allegheny avenue, from Eighth street to Ninth street.
Allegheny avenue, from Second street to Fifth street.
Boudinot street, from Allegheny avenue to Clearfield street.
Callowhill street, from Fifty-eighth street to Sixtieth street.
Callowhill street, from Sixty-first street to Robinson street.
Callowhill street, from Robinson street to Horton street.
Cambridge street, from Fifty-seventh street to Fifty-eighth street.
Catharine street, from Fifty-second street to Fifty-third street.
Conestoga street, from Girard avenue to Poplar street.
Clarissa street, from Hunting Park avenue to the Richmond Branch of the Philadelphia and Reading Railway.
"C" street, from Westmoreland street to Ontario street.
Daly street, from Eighteenth street to Nineteenth street.
"D" street, from Allegheny avenue to Clearfield street.
Ditman street, from Orthodox street to Plum street.
Eighteenth street, from Porter street to Shunk street.
Emerald street, from Venango street to Erie avenue.
Filbert street, from Fifty-eighth street to Salford street.
Fifty-eighth street, from Springfield avenue to Whitby avenue.
Fifty-third street, from Media street to Warren street.
Fifty-eighth street, from Wyalusing avenue to Girard avenue.
Forty-sixth street, from Locust street to Spruce street.
Ferry road, from Ridge avenue to Park drive.
Fairhill street, from Luzerne street to Lycoming street.
Fifty-ninth street, from Arch street to Race street.
Fiftieth street, from Race street to Haverford avenue.
Glenmore street, from Sixty-fourth street to Sixty-fifth street.
Glenmore street, from Sixty-first street to Sixty-second street.
Glenwood avenue, from Park avenue to Cambria street.
Glenwood avenue, from Allegheny avenue to Ninth street.
Gillingham street, from Tackawanna street to Ditman street.
Gillingham street, from Ditman street to Race street.

Hobart street, from Arch street to Race street.
Harmer street, from Fifty-fifth street to Fifty-sixth street.
Harmer street, from Fifty-seventh street to Fifty-eighth street.
Hollywood street, from Wharton street to Oakford street.
"H" street, from Kensington avenue to Tioga street.
Howard street, from Westmoreland street to Ontario street.
Hawthorne street, from Harrison street to Wakeling street.
Jackson street, from Eighteenth street to Passyunk avenue.
Jasper street, from Clearfield street to north line of Franklin Cemetery.
Juniata street, from Germantown avenue to Sixteenth street.
Kip street, from Ontario street to Tioga street.
Lewis street, from Race street to Haverford avenue.
Ludlow street, from Fifty-ninth street to Sixtieth street.
Louden street, from Broad street to Bellfield avenue.
Lycoming street, from Sixth street to Reese street.
Luzerne street, from Fifth street to Sixth street.
Mifflin street, from Twentieth street to Point Breeze avenue.
Mascher street, from Ontario street to Tioga street.
McClellan street, from Twenty-second to Twenty-third street.
Noble street, from Sixty-first street to Sixty-second street.
Ninth street, from Moyamensing avenue to Ritner street.
Oakford street, from Twenty-ninth street to Thirtieth street.
Ontario street, from "A" street to "G" street.
Pearl street, from Fifty-seventh street to Fifty-eighth street.
Peach street, from Market street to Arch street.
Pennsgrove street, from Thirty-ninth street to Fortieth street.
Pine street, from Fifty-second street to Fifty-third street.
Poplar street, from Fifty-seventh street to Fifty-eighth street.
Potter street, from "G" street to Allegheny avenue.
Palethorp street, from Berks to Fitler street.
Park avenue, from Butler street to Pike street.
Pike street, from Broad street to Park avenue.
Plum street, from Mulberry street to Josephine street.
Palethorp street, from Ontario street to Tioga street.
Percy street, from Venango street to Erie avenue.
Pacific street, from Emerald street to Jasper street.
Robinson street, from Vine street to Noble street.
Race street, from Farson street to Fifty-second street.
Ranstead street, from Fifty-first street to Fifty-second street.
Reed street, from Thirty-fourth street to eighty-four feet west of Shedwick street.
Rising Sun avenue, from Germantown avenue to Tioga street.
Rorer street, from Allegheny avenue to Westmoreland street.
Salford street, from Chestnut street to Sansom street.

Sansom street, from Sixtieth street to Sixty-first street.
Sixty-second street, from Haverford avenue to Master street.
Sickels street, from Poplar street to Girard avenue.
Shunk street, from Sixteenth street to Seventeenth street.
Siegel street, from Twenty-second street to Twenty-third street.
Stiles street, from Twenty-seventh street to Taney street.
Sixth street, from Luzerne street to Lycoming street.
Twenty-third street, from Mifflin street to McKean street.
Thirty-ninth street, from Poplar street to Pennsgrove street.
Thompson street, from Fifty-sixth street to Sixty-seventh street.
Tasker street, from Twenty-third street to Twenty-seventh street.
Tree street, from Eighteenth street to Nineteenth street.
Twenty-second street, from Moore street to Mifflin street.
Twenty-third street, from Point Breeze avenue to Mifflin street.
Twenty-seventh street, from Reed street to Tasker street.
Wanamaker street, from Arch street to Race street.
Willard street, from Kensington avenue to Emerald street.
Westmoreland street, from Second street to west side of Third street.
Westmoreland street, from Front street to "D" street.
Yewdall street, from Girard avenue to Poplar street.

Sheet Asphaltum—Bermudez Lake.

Blavis street, from Sixteenth street to Eighteenth street.
Carlisle street, from Hunting Park avenue to Cayuga street.
Forty-ninth street, from Market street to Haverford avenue.
Fifteenth street, from Wingohocking street to Hunting Park avenue.
Gratz street, from Westmoreland street to Ontario street.
Harold street, from Twenty-second street to Twenty-third street.
Hollywood street, from Jefferson street to Oxford street.
Morris street, from Point Breeze avenue to Twenty-eighth street.
Myrtlewood street, from Jefferson street to Oxford street
Napa street, from Huntingdon street to Lehigh avenue.
Ontario street, from Germantown avenue to Park avenue.
Race street, from Sixty-second street to Gross street.
Sixtieth street, from Market street to Vine street.
Twenty-ninth street, from Lehigh avenue to Hunting Park avenue.
Thirteenth street, from Venango street to Erie avenue.

Vintage street, from Thirty-fourth street to Walls of the Insane Department of the Philadelphia Hospital.
Westmoreland street, from Thirteenth street to Germantown avenue.

Sheet Asphaltum—Alcatraz.

Catharine street, from Forty-ninth street to Fifty-first street.

Vitrified Bricks.

Arch street, from Paxon street to Fifty-second street.
Bouvier street, from Ritner street to Roseberry street.
Berdan street, from Weaver street to Good street
Cross street, from Twenty-fourth street to a point sixty feet eastward.
Clarissa street, from Juniata street to Bristol street.
Deacon street, from King street to Wissahickon avenue.
Funston street, from Fifty-first street to Fifty-second street.
Greenwich street, from Twenty-fourth street to a point sixty feet eastward.
Good street, from Germantown avenue to Berdan street.
Longshore street, from Keystone street to the Pennsylvania Railroad.
Manayunk avenue, from Krams avenue to Dupont street.
Nineteenth street, from Ritner street to Porter street.
Ogden street, from Fifty-first street to Fifty-second street.
Pastorius street, from Greene street to Wayne avenue.
Reno street, from Fifty-first street to Fifty-second street.
Rockland street, from Germantown avenue to Greene street.
Ross street, from Walnut lane to Tulpehocken street.
Royal street, from Logan street to Seymour street.
Righter street, from Hermit street to Osbourne street.
Stenton avenue, from Wyoming avenue to Fisher's lane.
Sharpnack street, from Germantown avenue to Berdan street.
Seville street, from Ridge avenue to Pechin street.
Washington street, from Keystone street to the Pennsylvania Railroad.

Granite Blocks.

Aramingo street, from Somerset street to Clearfield street.
Hazzard street, from Gaul street to Moyer street.
Krail street, from Queen lane to Crawford street.
Master street, from Thirty-first street to Thirty-second street.
Westmoreland street, from Richmond street to Belgrade street.
Wolf street, from three hundred feet west of Eighteenth street to Nineteenth street.

Repaving, 1903.

Sheet Asphaltum—Trinidad Lake.

Brandywine street, from Thirteenth street to Ridge avenue.
Chestnut street, from Forty-eighth street to Fifty-second street.
Clymer street, from Twenty-first street west to Dead End.
Clementine street, from Emerald street to Frankford avenue.
Clifton street, from Neff street to Allegheny avenue.
Elkhart street, from Frankford avenue to Collins street.
Edgemont street, from Allegheny avenue to Westmoreland street.
Gaul street, from Norris street to Montgomery avenue.
Livingston street, from Columbia avenue to Earl street.
Marvine street, from Melon street to Fairmount avenue.
Myrtle street, east and west of Warnock street.
Manning street, from Twenty-second street to Twenty-third street.
Manning street, from Twelfth street to Quince street.
Stoughton street, from Hart lane to Cambria street.
Sophia street, from Vanhorn street to Wildey street.
Sartain street, from Locust street to Manning street.
Tilton street, from Neff street to Allegheny avenue.
Taney street, from Christian street to Catharine street.
Vanhorn street, from Hancock street to Germantown avenue.
Warnock street, from Parrish street north to dead end.

Sheet Asphaltum—Bermudez Lake.

Lawrence street, from Germantown avenue to Oxford street.
Shackamaxon street, from Frankford avenue to Girard avenue.
Vineyard street, from Perkiomen street to Nineteenth street.

Vitrified Bricks.

Bodine street, from Buttonwood street to Green street.
Kimball street, from Nineteenth street to Twenty-first street.
Kauffman street, from Twenty-third street to Twenty-fourth tsreet.
Madison street, from Frankford avenue to Jasper street.
Perth street, from Addison street to Lombard street.
Watts street, from Cypress street to Pine street.
Watts street, from Lombard street to dead end.

Granite Blocks.

Almond street, from Moyer street to Cumberland street.
Allegheny avenue, from Frankford avenue to Thompson street.
Beach street, from Susquehanna avenue to Dyott street.

Belgrade street, from Somerset street to William street.
Chatham street, from Clearfield street to Allegheny avenue.
Gaul street, from Huntingdon street to Hazzard street.
Moyer street, from Aramingo street to Cedar street.
Mildred street, from Spring street to Summer street.
Percy street, from Urbanna street northward.
Sergeant street, from Gaul street to Almond street.
Sophia street, from Edward street to Vanhorn street.
Shamokin street, from Eighteenth street to Nineteenth street.
Sansom street, from Front street to Second street.
Strawberry street, from Market street to Chestnut street.
Tulip street, from Somerset street to William street.
Urbanna street, from Ninth street westward.
York street, from Second street to Fourth street.

Macadamizing.

Ashton road, from Willets road to Grant avenue.
Axe Factory road, from Welsh road west.
Atkinson or Knights road, from Byberry road to Mechanicsville road.
Benner street, from Torresdale avenue to Cottage street.
Byberry road, from Southampton road to Dunk's Ferry road.
Byberry road, from Academy road to Knights road.
Blabon street, from Hunting Park avenue to the Richmond Branch of the Philadelphia and Reading Railway.
Cottage street, from Disston street to Unruh street.
Cottage street, from Dark Run lane to Higbee street.
Comly road, from Bensalem pike to Academy road.
Cottage street, from Naple street to Hartel street.
Cottage street, from Rhawn street east.
Comly street, from Tacony street to Delaware avenue.
Columbia avenue, from Sixty-first street to Sixty-third street.
City avenue, from Haverford avenue to Cobb's Creek.
Chester avenue, from Fifty-fourth street to Sixtieth street.
Comly road (east), from Academy road to Byberry road.
Cheltenham avenue, from Lakeside avenue to Seventieth street.
Dark Run lane, from Frankford avenue to Oxford pike.
Ditman street, from Vankirk street to Benner street
Ditman street, from Vankirk street to Dark Run lane.
Dick's avenue, from Sixty-third street to Sixty-fifth street.
Edmund street, from Vincent street to Knorr street.
Erdrick street, from Comly street to Dark Run lane.
Edmund street, from Unruh street to Magee street.
Eighty-seventh street, from the Philadelphia and Reading Railway to Vance street.

Elmwood street, from Fifty-sixth street to Gibson street.
Eastwick avenue, from Island road to Eighty-seventh street.
Friendship street, from Keystone street to Hagerman street.
Ford road, from Monument avenue to Fairmount Park line.
Fisher's avenue, from Ella street to Clinton street.
Front street, from Sommerville street to Wellens street.
Grant street, from Academy road to Bustleton pike.
Green lane, from the Philadelphia and Reading Railway to Second street pike.
Glenlock street, from Knorr street to Magee street.
Glenlock street, from Knorr street to Tyson street.
Gibson avenue, from Island road to Eighty-second street.
Gibson avenue, from Fifty-fourth street to Sixty-third street.
Grant street, east and west from Bristol pike.
Hartwell avenue, from Twenty-fifth street to Park line.
Hagerman street, from Dark Run lane to three hundred feet east of Benner street.
Higbee street, from Torresdale avenue to Walker street.
Hoffnagle street, from Glenlock street to Torresdale avenue.
Hartel street, from Cottage street to Walker street.
Hagerman street, from the end of macadam to Cottman street.
Jackson street, from Knorr to Unruh street.
Keystone street, from Funk street to Faust street.
Keystone street, from Comly street to Benner street.
Keystone street, from Cottman street to Princeton street.
Luzerne street, from Rising Sun avenue to Third street.
Mechanicsville road, from Dunk's Ferry road north.
Newtown road (Old), from Welsh road southwest of Jackson street.
Nedro avenue, from Old York road to Tenth street.
Overbrook avenue, from Bryn Mawr avenue to Fifty-fourth street.
Oak Lane, from Seventh street to Ninth street.
Pine road, from Shady lane to County Line.
Pennypack lane, from the F. and B. turnpike to State road.
Red Lion road, from the present stoning to west of Bensalem pike.
Rising Sun lane, from Fifth street to Luzerne street.
Second street, from Tabor street to Chew street.
Stone House lane, south from Stamper's lane.
Southampton road, from Byberry road to Bensalem pike.
Sixty-second street, from Lancaster avenue to Woodbine avenue.
Sixty-seventh street, from Haverford avenue to Lansdowne avenue.
Seventy-seventh street, from Island road to Laycock avenue.

Sixty-first street, from Oxford street to Lebanon avenue.
Suffolk avenue, from Island road to Eightietn street.
Southampton or Knight's road, from the present macadam to Byberry road.
Sixty-second street, from P., W. & B. R. R. to Elmwood avenue.
Tulip street, from Benner street to Faust street.
Torresdale avenue, from end of macadam to Hoffnagle street.
Third street, from Chew street to Grubbtown lane.
Tenth street, from Nedro street to Green lane.
Third street, from Luzerne street to Rising Sun lane.
Vankirk street, from State road to Erdrick street.
Vandyke street, from Decatur street to Rhawn street.
Vandyke street, from Tyson street to Unruh street.
Walker street, from Vankirk street to Benner street.
Walker street, from Vankirk street to Dark Run lane.
Wissinoming street, from Cottman street to Penn street.
Welsh road, from Walker street to Mill street.
Wayne avenue, from one hundred feet north of Lincoln avenue to Carpenter street.
Water street, from Tabor street to Fisher's avenue.

ANNUAL REPORT

OF THE

BOARD OF HIGHWAY SUPERVISORS

FOR THE YEAR 1903.

BOARD OF HIGHWAY SUPERVISORS

President,

PETER E. COSTELLO,
Director, Department of Public Works.

WILLIAM H. BROOKS, Chief, Bureau of Highways.

FRANK L. HAND, Chief, Bureau of Water.

GEORGE G. PIERIE, Chief, Bureau of City Property.

JOHN C. SAGER, Chief, Electrical Bureau.

GEORGE S. WEBSTER, Chief Engineer, Bureau of Surveys.

Secretary,

MALCOLM M. COPPUCK.

Chief Draughtsman,

WILLIAM M. McFADDEN..

Draughtsmen,

FREDERIC WHITE,
M. M. STRINGFIELD,
WILLIAM K. RANDOLPH,
ARTHUR E. BUCHHOLZ,
H. OSCAR SMITH,
EDWARD J. DAUNER,
JOHN H. BROOMALL,
HENRY D. HOSBACH,
J. MILTON RITCHIE,
J. EDWARD ZAUN.

Clerk,

THOMAS A. DUNN.

ANNUAL REPORT

OF THE

BOARD OF HIGHWAY SUPERVISORS

FOR THE YEAR 1903

Philadelphia, January 7, 1904.

MR. PETER E. COSTELLO,
Director, Department of Public Works.

DEAR SIR:—I have the honor of herewith presenting the annual report of the Board of Highway Supervisors for the year 1903.

The revenue from the work in the Draughting Department was $24,098.56, being $12,728.73 in excess of expenditures.

While our records are the most complete of their kind of any city in the country, it is to be regretted that the staff of draughtsmen is inadequate to record and plot the underground structures sufficiently fast to keep pace with their rapid accumulation. It is hoped that the frequent suggestions of the Chief Draughtsman in his annual reports, for an increase of the force, may receive attention in the near future.

Asking consideration of the report of the Chief Draughtsman, Mr. William M. McFadden, and testifying to his able and conscientious attention to the duties incident to his position, I remain,

Very truly,
MALCOLM M. COPPUCK,
Secretary.

REPORT OF CHIEF DRAUGHTSMAN

Philadelphia, January 7, 1904.

PETER E. COSTELLO, ESQ.,
President, Board of Highway Supervisors.

DEAR SIR:—The annual report of the operations of the drafting room of the Board for the year ending December 31, 1903, is herewith submitted:

The appropriation made to this office for the year 1903, was $11,220.00, and a further appropriation of $150.00, making in all a sum of $11,370, of which amount the sum of 17 cents merged.

The earnings for the year were $18,382.98, and the amount outstanding from previous years was $19,372.97, which makes $37,775.95 to be accounted for. Our receipts for the year were $24, 098.56, leaving $13,657.39 yet to be received. The net receipts for the year was $12,728.73 in excess of the expenditures.

During the year eighty-five plans of substructures have been added, being equal to about seventeen miles, and making a total of three hundred and seven miles of finished plans on file.

These plans are becoming more valuable each year and are constantly being examined by the City Departments and the several companies having underground work. They have proven of great value to the engineers of the Market Street Subway, in furnishing data of the underground structures on its route.

The force of draughtsmen now employed is totally inadequate, and I would earnestly recommend that the matter be brought to the attention of Councils, so that a sufficient

force may be procured to keep our present plans up to date and to further increase them.

The Bell Telephone Company laid during the year about seventeen miles of conduit, or forty-eight miles of duct.

The Keystone Telephone Company laid during the year about twenty-two miles of conduit, or about one hundred and three miles of duct.

The Philadelphia Rapid Transit Company laid during the year eighteen miles of conduit.

The Philadelphia Electric Company laid during the year about one mile of conduit, or sixty-one miles of duct.

The Edison Electric Light Company laid during the year 5883 feet of duct.

The United Gas Improvement Company laid during the year forty-one miles of pipe of various sizes.

Concluding, I wish to thank the members of the Board and the Secretary for their kind and valued assistance.

The following list will show for whom work was done and the amounts charged against each:

Bell Telephone Company	$6,790 28
Keystone Telephone Company	1,256 05
Philadelphia Rapid Transit Company	5,958 87
United Gas Improvement Company	2,798 09
Edison Electric Light Company	310 00
Philadelphia Cold Air Supply Company	302 23
Philadelphia Cooling Company	686 36
Philadelphia Electric Company	211 10
Brush Electric Light Company	10 50
J. S. Cornell & Son	10 00
Women's Pennsylvania Society Prevention Cruelty to Animals	15 00
Pneumatic Transit Company	24 50
D. H. Watts	5 00
H. H. Roelofs & Company	5 00
Grand total	$18,382 98

Respectfully submitted,

WM. M. McFADDEN,
Chief Draughtsman.

ANNUAL REPORT

OF THE

BUREAU OF SURVEYS

FOR THE

YEAR ENDING DECEMBER 31, 1903

Department of Public Works

BUREAU OF SURVEYS

OFFICERS, 1903

Chief Engineer,

GEORGE S. WEBSTER.

Principal Assistant Engineer,

GEORGE E. DATESMAN.

Recording Clerk—Joseph R. Scott.

Sewer Registrar—William Calvert.

Assistant Recording Clerk—Robert McFadden, Jr.

District Surveyors and Regulators.

1st—John M. Nobre.
2d—Charles W. Close.
3d—William C. Cranmer.
4th—Frits Bloch.
5th—Walter Brinton.
6th—Joseph Mercer.
7th—William K. Carlile.
8th—C. A. Sundstrom.
9th—Joseph C. Wagner.
10th—John H. Webster, Jr.
11th—Joseph Johnson.
12th—J. Harvey Gillingham.
13th—H. M. Fuller.
14th—Clement B. Webster.

ENGINEERING DIVISION

SEWERS (Construction).

Assistant Engineer—Charles H. Ott.

Sewer Clerk—Robert M. Downing.

BRIDGES.

Assistant Engineer—Henry H. Quimby.

Chief Draughtsman—James W. Phillips.

SEWERS (Plans).

Assistant Engineer—Hugo Trik.

Chief Draughtsman—Charles Jacobsen.

DELAWARE AVENUE IMPROVEMENT.
IMPROVEMENT OF RIVER CHANNELS.

Assistant Engineer—Norman L. Stamm.

GENERAL PLANS.

Assistant Engineer—Benjamin A. Haldeman.

SPECIAL CORPS.

Assistant Engineer—N. J. Witmer.

TESTING LABORATORY.

Assistant Engineer—W. P. Taylor.

REGISTRY DIVISION

Registrar,
JOHN W. FRAZIER.

Registry Clerk,
JAMES H. ROBERTS.

Search Clerk,
CHARLES W. WAGNER.

ANNUAL REPORT

OF THE

BUREAU OF SURVEYS

FOR THE YEAR 1903

Philadelphia, January 1, 1904.

PETER E. COSTELLO, ESQ.,
Director, Department of Public Works.

DEAR SIR:—The annual report of the operations of the Bureau of Surveys for the year ending December 31, 1903, is respectfully submitted.

The appropriations and expenditures were as follows:

Appropriations for 1903		$885,160 00
Balance available from former years		2,378,911 58
Additional appropriations and transfers		286,910 83
Expenditures	$1,835,704 88	
Balance available in 1904	1,562,094 31	
Balance merged	1,468 39	
Transfers from	151,714 83	
	$3,550,982 41	$3,550,982 41

The receipts were:

In general office	$26,735 34
In registry division	1,270 60
Total receipts, District Surveyors	102,396 61
	$130,402 55

Board of Surveyors and Regulators.

The business of the Board of Surveyors was conducted at twenty-three (23) sessions covering the times fixed for stated meetings and twelve special sessions, which latter were made necessary to dispose of business of special importance, or to more completely familiarize the members with the conditions bearing upon matters before the board, by visits to various localities. Road days were held on the occasion of five of these stated meetings, at which time opportunity was given to interested property owners, to express opinions upon proposed plans or changes of plans in street development. Upon these road days, hearings were given upon 160 plans, 15 of these being sectional plans of the Northeast or Torresdale Boulevard and 3 of the Parkway, from City Hall to Fairmount Park. One hundred and thirteen plans were finally confirmed by the board and 4 rejected. Of the plans submitted by the street passenger railway companies, providing for extensions, improvements in rail sections, relocation of tracks and curves, etc., 112 were acted upon and approved by the board.

Of ordinances referred from the Survey Committee of Councils for report, petitions for the construction of main and branch sewers, placing of new streets upon the City plan, striking off and vacation of streets, establishment and revision of the lines and grades of streets, etc., there were 442 of these considered and acted upon.

Deeds of dedication and releases of property owners abutting on the lines of streets, conveying to the City the beds of streets or releasing rights for damages in contemplated improvements, were acted upon by the board, to the number of 100.

Work amount to $150,593.33 was done for the various departments and bureaus of the City, the combined cash receipts and credits for work so performed being $67,-

Recapitulation by Districts.

	Districts.	Size in Inches. 3	4	6	8	10	12	16	20	*20	30	36	48	Feet.	Pounds.
New pipe or feet added.	First	17	20	5,127	4,390	2,639	688	.....	1,512	.....	.....	.....	.....	14,393	785,331
	Second	119	87	1,472	.....	.....	.....	.....	.....	1,500	.....	.....	.....	3,178	652,101
	Third	79	118	21,687	16,602	1,717	3,085	.....	.....	.....	.....	.....	.....	43,288	1,742,310
	Fourth	86	74	807	8,201	311	408	.....	.....	.....	.....	.....	.....	9,887	421,548
	Fifth	2	13	1,537	2,010	2,853	814	.....	.....	.....	14	.....	.....	7,243	358,016
	Sixth	82	.....	10,025	7,754	1,581	2,665	.....	.....	.....	.....	.....	.....	22,107	944,553
	Seventh	22	115	21,449	5,408	8,143	1,035	.....	123	.....	.....	.....	.....	36,295	1,482,138
	Total — Feet	407	427	62,104	44,365	17,244	8,695	.....	1,635	1,500	14	.....	.....	136,391	.....
	Total — Pounds	6,105	8,540	2,049,432	1,863,330	948,420	652,125	.....	253,425	600,000	4,620	.....	.....	.....	6,385,997
Pipe used but adding nothing to feet in ground.	First	5	134	490	100	88	1,373	.....	.....	.....	.....	.....	.....	2,190	130,940
	Second	270	75	2,865	66	32	13	.....	.....	.....	3	.....	.....	3,324	106,592
	Third	.....	3,045	4,719	2,350	325	722	24	.....	.....	8	211	.....	11,404	481,372
	Fourth	.....	34	931	358	133	457	5	17	.....	82	.....	.....	2,012	118,089
	Fifth	.....	28	82	.....	26	39	8	372	.....	63	14	133	765	179,321
	Sixth	.....	.....	2,924	178	1,564	303	.....	13	.....	744	.....	.....	5,726	460,248
	Seventh	.....	.....	2,069	223	1,057	32	.....	15	.....	.....	19	.....	3,419	148,563
	Total — Feet	275	3,320	14,080	3,270	3,225	2,939	37	417	.....	900	244	133	28,840	.....
	Total — Pounds	4,125	66,400	464,640	137,340	177,375	220,425	4,255	64,635	.....	297,000	102,480	86,450	.....	1,625,125
	Total handled — Feet	682	3,747	76,184	47,635	20,469	11,634	37	2,052	1,500	914	244	133	.....	165,231
	Total handled — Pounds	10,230	74,940	2,514,072	2,000,670	1,125,795	872,550	4,255	318,060	600,000	301,620	102,480	86,450	.....	8,011,122
	Pipe cut off and abandoned	1,670	1,951	2,108	.....	30	133	.....	.....	.....	.....	.....	.....	.....	5,892

*High Pressure Fire Main.

993.84 more than the combined expenses of the survey districts.

The figures given above as compared with those of the year before indicate by the increase that there was no abatement in the demands upon the district offices for information to be furnished the various bureaus and departments of the City, and to the legislative bodies.

The familiarity of the district officer with affairs in his district makes of him the practical arbiter in many cases of dispute, and the one who by his plans is responsible for the harmonious working out of all parts of a completed street improvement when undertaken by the City, the work of which is contributed to by the various bureaus and departments.

Commission to Establish the Boundary Line between Philadelphia and Delaware Counties.

The Commission appointed in 1902 under authority of an Act of Assembly of June 14, 1897, to fix the location of the line dividing Philadelphia and Delaware Counties in the vicinity of Cobb's creek, at Market street, west of Sixty-third street, as well as other portions of the said dividing line, reports progress.

The surveys have been continued, the field work being practically completed. Sixteen boundary land marks have been set on various portions of the line, principally on the line of Bow creek, and the line has been connected with the projected City streets and with the line on the Back Channel.

The boundary line along what was formerly known as Clearview has been staked and located from the stone range line of Buist avenue.

The portion of the line from the Marshall road to Merion avenue has been located and tied in with the adjacent streets.

One set of plans of this section has been practically completed, and it is expected that all the work will be completed and approved by April next.

The Commission has adopted United States standard measurements in the location of the line and has located all buildings of a permanent character along either side of the line. Considerable difficulty has been experienced in obtaining reliable data from which to re-establish the original boundary. Numerous old deeds, briefs of title, maps, and papers have been examined, consuming considerable time.

As worthy of note it may be mentioned, that on the back of an old deed there was found a description of a change made in the creek bed more than a century ago, in which the courses and distances were marked with the explanation "that owing to this change being made and that no dispute might arise hereafter as to the boundary line, the old creek bed should be located by courses and distances," showing a care and foresight hardly to be expected at that early day.

This instrument furnished evidence of value to the Commission, which had no knowledge of a change in the creek bed when beginning its work.

Main Sewers.

The following amounts were appropriated for the construction of main sewers during the year 1903:

By ordinance approved December 29, 1902:

For main sewers	**$100,000 00**
For McKean street relief sewer	**25,000 00**
For Cohocksink relief	**100,000 00**
For sewer in Market street	**100,000 00**

By ordinance of May 15, 1903:

For sewer in Shunk street	**40,869 83**

By ordinance of May 21, 1903:

For extension of Cresheim Creek intercepting system	$27,000 00
By Ordinance of December 11th, 1903	46,000 00
	$438,869 83

The sum of $100,000 appropriated in the annual appropriation ordinance was apportioned by ordinance approved March 9, 1903, as follows:

Extension of Pratt street sewer from Frankford avenue northwestwardly.

Extension of sewer in Orthodox street, from terminus near Balfour street to Richmond street.

Extension of sewer in Luzerne street, from terminus east of Second street northeasterly across City property to Wingohocking creek.

Relief sewer in York street, from American street to Fifth street, and on Fifth street, from York street to Cumberland street.

The sum of $46,000 appropriated by ordinance approved December 11, 1903, was used for the purpose of completing the work under the contracts for the following main sewers, work on which was under way:

McKean street relief sewer.

Cresheim creek intercepting sewer.

York and Fifth streets relief sewer.

With the exception of the Market street sewer all of the main sewers, for which the appropriations named above were made, have been placed under contract. Orthodox street sewer has been completed and the others are in a fair way for early completion.

Careful plans and studies were made for the Market street sewer, but the proposed construction of the Market street subway necessitated a radical revision of the same and a modification of the estimates. This sewer and the

subway are so closely related to each other, that it was deemed impracticable to decide upon and complete any detailed plan until the Philadelphia Rapid Transit Company is in a position to submit definite and complete details of its proposed structure in Market street east of Broad street.

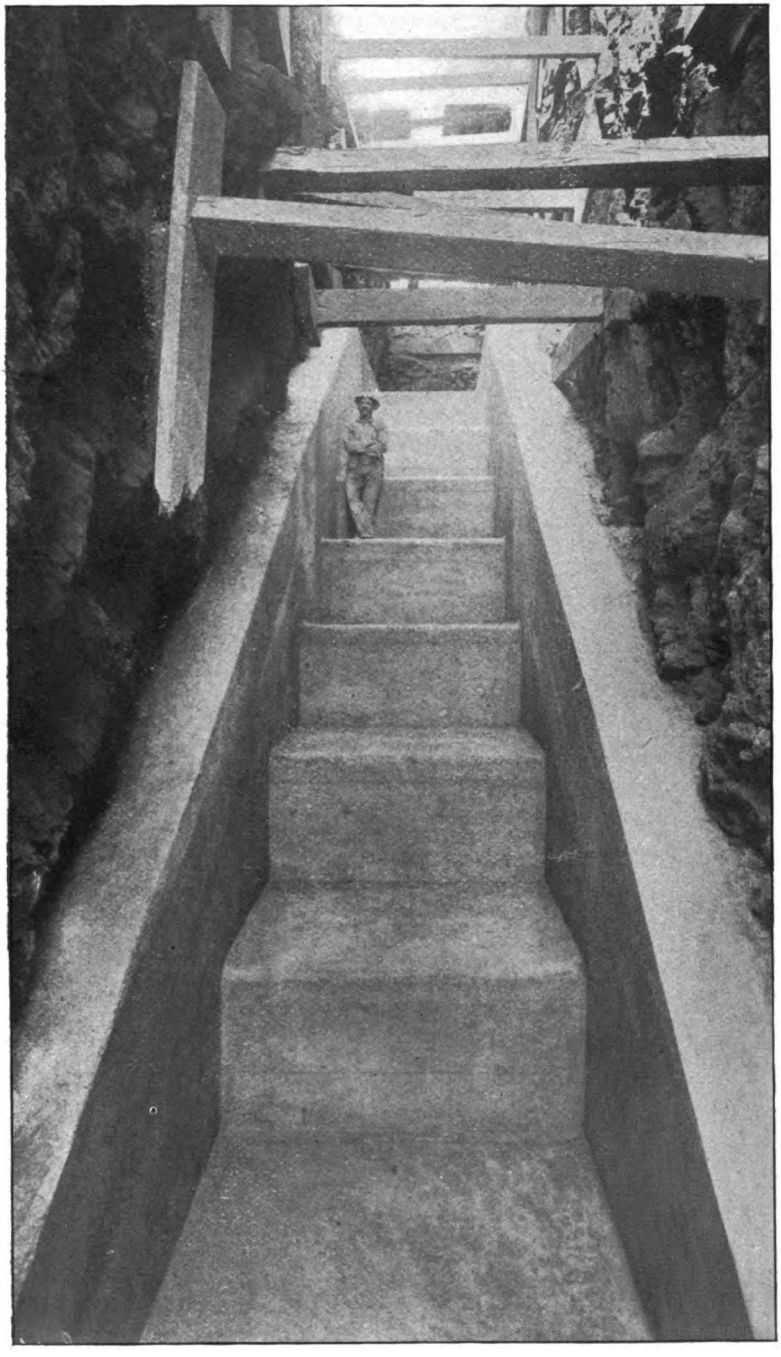
A detailed statement of the work of the above main sewers, completed and as far as advanced, also of work commenced or contracted for in the previous year, and carried on during 1903 where not included under other headings is as follows:

Disston street, from Mason street to Keystone street. Length built in 1903, 351.30 feet of 4-feet diameter sewer, 261.17 feet of 3-feet 6-inches diameter sewer. Total cost of the work, $12,382.34, of which $4,800.00 was paid on account in 1902, and $7,582.34 in 1903. Final estimate paid April 21, 1903. Contractor, John McMenamy. Inspector, John Hare.

Georges Run sewer extension in Bryn Mawr avenue, from terminus north of Wynnewood avenue to Woodbine avenue, thence to Fifty-first street, thence to City Line avenue. Lengths built, 633 linear feet of 6-feet 6-inches diameter sewer, 600 linear feet of 5-feet 6-inches diameter sewer, 1,139.43 linear feet of 5-feet diameter sewer. Total cost of the work, $43,532.25, of which $9,240.00 was paid on account in 1902 and $34,292.25 in 1903. Final estimate was paid September 21, 1903.

The major portion of the 6-feet 6-inches diameter sewer was constructed in tunnel. Contractor, Daniel Dooley. Inspector, J. W. Gillett.

Indian Run sewer in sixty-sixth street, from City avenue to Sherwood street and Sixty-eighth street, thence to Malvern avenue and on Malvern avenue to creek at Sixty-ninth street. Length built 482.75 feet of 6-feet diameter sewer, 919.72 feet of 5-feet 3-inches diameter sewer, 1,193.60



INDIAN RUN SEWER. STEPPED INCLINE.

feet of 4-feet 9-inches sewer, 763.77 feet of 2-feet 6-inches diameter sewer and 61 feet of special concrete section sewer. There has been paid to the contractor on account the sum of $30,848.00. Work is still in progress. Contractor, The Haddington Quarry and Construction Co. Inspectors, F. D. Morris, J. D. Henderson.

Orthodox street, from terminus near Delaware avenue towards Richmond street. All of the masonry work upon this contract was completed in 1902. The work of placing embankment over this sewer was in progress in 1903. Total cost of the work, $39,971.11, of which $30,720.00 was paid to the contractor on account in 1902, and $9,-251.11 in 1903. Final estimate paid February 3, 1903. Contractor, David Peoples. Inspector, J. N. Brown.

Orthodox street, from Balfour street to Richmond street. Lengths built, 538.65 feet of 4-feet 6-inches diameter, 646.12 feet of 4-feet diameter sewer. Total cost of the work, $13,865.64. Final estimate paid December 14, 1903. The larger size of this sewer was built in full cradle on pile and platform foundation. Contractor, John McMenamy. Inspector, John Hare.

Princeton street, from Delaware river to Hegerman street. Lengths built, 1,059.25 feet of 6-feet diameter, 827 feet of 5-feet diameter, 934 feet of 4-feet diameter sewer, and an outlet retaining wall. Total cost of the work, $44,421.24. Final estimate paid December 30, 1903. Contractor, Richard P. Bennis. Inspectors, George Warner, T. W. Harvey, B. H. Foulkrod.

Princeton street, from Hegerman street to the northwesterly side of Torresdale avenue. Work is in progress. Contractor, Richard P. Bennis. Inspector, B. H. Foulkrod.

Rosehill street, from Allegheny avenue to the Connecting Railway. Length built, 99.84 feet of 5-feet diameter sewer. Total cost of the work, $34,407.12, of which there

was paid to the contractor on account in 1901, $7,840.00, in 1902, $18,200.00, and in 1903, $8,367.12. Final estimate paid February 5, 1903. Contractor, J. H. Wallace & Co. Inspector, T. D. Hooper.

Thomas Run sewer extension on Fifty-seventh street, from Florence avenue to Beaumont avenue, thence south on Beaumont avenue to a point near Fifty-ninth street, thence across private property to Cobb's creek. Lengths built, 985.88 feet of 11-feet diameter, 102.80 feet of 10-feet diameter, 35.84 feet of 6-feet diameter sewer, and a junction chamber 32.9 feet long. Total cost of the work, $42,843.57, of which $8,280.00 was paid to the contractor on account in 1902, and $34,563.57 in 1903. Final estimate was paid September 10, 1903. Contractor, Robert Higgins. Inspectors, J. D. Henderson, C. E. Preston.

Thomas Run sewer extension (west branch) in Pine street, from Conestoga street to Allison street, on Allison street to Locust street, and on Locust street to Fifty-ninth street. Length built, 411.01 feet of 6-feet diameter sewer. Total cost of the work, $22,157.31, of which $12,880.00 was paid to the contractor on account in 1902, and $9,277.31 in 1903. Final estimate paid April 7, 1903. Contractor, Daniel Dooley. Inspector, C. E. Preston.

Intercepting System.

Fair progress was made on the extension of the main intercepting sewer from its terminus at Nixon's Mills northeast of Fountain street, between the Schuylkill canal and the river, under the canal by an inverted syphon to and along the eastern bank of the Schuylkill river to Shawmont avenue, and along Shawmont avenue to a point near Eva street.

This is an important extension of this system, as it provides an outlet for drainage for the sandwashers of the Lower and Upper Roxborough filter plants, as well as for the houses in a considerable area.

MAIN INTERCEPTING SEWER ALONG SCHUYLKILL CANAL.

Work was also commenced upon the extension of the Cresheim creek intercepting system, which is a branch of the main intercepting system. Contract was entered into for this work in December, 1902. The sewer is located in Germantown avenue, from Cresheim creek to Moreland avenue, and on Moreland avenue, from Germantown avenue to proposed drainage street. The amount set aside in this contract, $25,000, was inadequate to complete the work, and Councils by ordinance of May 21, 1903, appropriated $27,000, and $10,000 additional by ordinance of December 11, 1903.

Considerable difficulty was encountered in the construction of the sewer in Germantown avenue, between Cresheim creek and Moreland avenue, on account of the numerous underground structures, and a double line of street railway tracks, all confined in a narrow roadway. These, however, were overcome, without inconvenience to public or private interests, and the work is rapidly nearing completion. One of the distinctive features of this work was the necessity, owing to lack of depth, of adopting for a portion of its length, a rectangular concrete section, with curved invert and steel beams and arches of concrete for the top.

The work on the extension of the Dobson's run system contracted for during the previous year was carried on during 1903, and is now near completion. This is a branch of the main stem of the Dobson's run sewer, and is located in Thirty-third street, from Dobson's run to Allegheny avenue, and on Allegheny avenue, from Thirty-third street to Twenty-ninth street.

Considerable difficulty was encountered at the intersection of Twenty-ninth street and Allegheny avenue, owing to the hard rock through which the sewer trench was excavated, upon which rested, spanning the sewer trench, four lines of 48-inch water mains, constituting the distribu-

tion system from the Queen Lane Reservoir. The work was carried on with extreme caution, and without injury to these mains.

An outlet for the sewage sewer of the Thirty-third street and Allegheny avenue sewer was also constructed in Allegheny avenue, from Thirty-third street to Ridge avenue, and on Ridge avenue, from Allegheny avenue to Scott's lane. This was constructed as a branch sewer, and a detailed statement of the work will be found in the alphabetical list of branch sewers constructed during the year.

In addition to the above principal extensions of the Intercepting system, several smaller branches were completed. These were paid for out of the branch sewer item.

Further extensions of this system should be constantly made to prevent pollution of the Schuylkill river, and to meet requirements for additional drainage in developing sections.

A particularly urgent extension needed is the Wissahickon high level intercepting sewer to Rex avenue, to intercept drainage from the western side of Chestnut Hill.

The construction of the Wissahickon high level cut-off is urgently needed. This is to divert the flow of sewage from Germantown and Chestnut Hill from the Schuylkill river through the divide into the Delaware river, thus relieving the main interceptor. It is again urgently recommended that liberal appropriations be made to enable the Bureau of Health to compel property owners to make connections and to rearrange existing house drainage systems, to exclude roof and yard stormwater from the intercepting sewer, which now tends to cause overflows and consequent damage to property.

It is gratifying to be able to report that, after a house to house canvass, and the placing in the hands of the Chief of the Health Bureau a list of all properties on the inter-

STORM-WATER CONDUIT IN GERMANTOWN AVENUE. U-SHAPED CONCRETE SECTION.

cepting area, where adequate sewer facilities had been provided, but no connections made therewith for drainage, the insistence of that Bureau was responsible for the drainage of 237 properties not heretofore connected to the intercepting sewers. I can also report that the Manayunk main intercepting sewer was cleaned at various times during the year and now has a comparatively slight amount of deposit.

As this system has become more extended, the proper patrolling of it, together with the inspection of connections, in order to remove possibility of the pollution of the water supply, is too much for one supervisor. For that reason it is recommended for the good of the service that an assistant supervisor be provided.

The following is a detailed report of the work done upon sewers in the intercepting system:

Cresheim creek intercepting sewer on Germantown avenue, from Cresheim creek to Moreland avenue, on Moreland avenue, from Germantown avenue to proposed drainage street. Lengths built, 404.28 feet of special rectangular concrete section, with steel beam and concrete arch top, 7 feet 6 inches horizontal by 5 feet vertical diameter, 493.19 feet of 6-feet diameter sewer with appurtenant 12-inch terra cotta sewer, 290.29 feet of 6-feet diameter sewer, and 130 feet of 5-feet 3-inches diameter sewer. The contractor has been paid on account the sum of $55,238.40. Work is still in progress. Contractor, David McMahon. Inspector, F. D. Morris.

Dobson's run sewer in Thirty-third street, from Scott's run to Allegheny avenue, on Allegheny avenue, from Thirty-third street to Twenty-ninth street. Lengths built, 418 feet of 4-feet diameter with appurtenant 15-inch diameter terra cotta pipe sewer, 1,041.72 feet of 4-feet 9-inches diameter sewer with appurtenant 15-inch diameter terra cotta pipe sewer, 855 feet of 4-feet 6-inches diameter sewer

with appurtenant 15-inch diameter terra cotta pipe sewer. There has been paid to the contractor on account the sum of $27,072.00. Work is still in progress. Contractor, The Haddington Quarry and Construction Company. Inspectors, Daniel Walsh, J. W. Harmer.

Intercepting sewer (main stem) extension from present terminus at Nixon's Mills northeast of Fountain street, thence on private property to Shawmont avenue, and on Shawmont avenue to Eva street. Length built, 2020 feet of 2-feet 9-inches diameter sewer, 3,451 feet of 2-feet 6-inches diameter sewer, 3,139 feet of 15-inches diameter terra cotta pipe sewer, and 255 feet of 12-inches diameter terra cotta pipe sewer. There has been paid to the contractor on account the sum of $57,760.00. Work is still in progress. Contractor, J. H. Wallace & Co. Inspectors, J. M. Hipple, J. W. Harmer, E. H. Sickels, P. F. McGough.

Wingohocking Creek System.

This system contains the largest area in the city to be drained by a sewer, and work has been carried on for a number of years at such places as the development of the land demanded. The Wingohocking creek discharges into the Frankford creek near Wingohocking street, and extends generally in a westerly direction to Eighteenth street and Fisher's lane, where it divides into the east branch and west branch. The west branch which extends northwestwardly through Germantown and Chestnut Hill is now entirely completed. The east branch extending generally in a northerly direction through Sommerville and eastern section of Germantown to the City line, is completed as far as Crittenden and Haines streets, with the exception of a portion between Fisher's lane and Twenty-first street. This, however, is now under construction, and under the present contract will extend on Ogontz avenue,

COURTLAND STREET SEWER.

from Fisher's lane to Olney avenue. This should be extended so as to close the gap between Olney avenue and Twenty-first street, and thus do away with a highly polluted open stream.

The main stem is completed to within a short distance of the North Penn Railroad.

Another sewer tributary to the Wingohocking creek extended along Luzerne street, with terminus east of Second street. In order to properly develop property recently acquired by the City for a Municipal Hospital site, this sewer was extended through city property terminating at the Wingohocking creek.

The following is a detailed statement of the work accomplished on this system:

Luzerne street sewer extension, from terminus east of Second street, northeastwardly across City property to the Wingohocking creek. Length built, 1,475 feet of 7-feet diameter sewer and an outlet wall. The contractor has been paid on account the sum of $21,280.00. Work is still in progress. Contractor, John McMenamy. Inspector, J. J. MacVeigh.

Wingohocking creek sewer extension (east branch) in Ogontz avenue, from Eighteenth street and Bellfield avenue to Olney avenue. Lengths built, 1,655 feet of 10-feet 6-inches diameter, 975 feet of 10-feet diameter sewer and a junction chamber 47.63 feet long.

There has been paid to the contractor on account the sum of $53,760.00. Work is still in progress. Contractor, David McMahon. Inspector, John McCormick.

Wingohocking creek sewer extension (east branch) on Anderson street, from north of Chelten avenue to Price street; on Price street to Crittenden street, and on Crittenden street to Haines street. Length built, 542.92 feet of 8-feet 6-inches diameter sewer. Total cost of the work, $42,818.18, of which $21,160.00 was paid to the contrac-

tor on account in 1902, and $21,658.18 in 1903. Final estimate paid June 9, 1903. Contractor, David McMahon. Inspector, E. S. DeHaven.

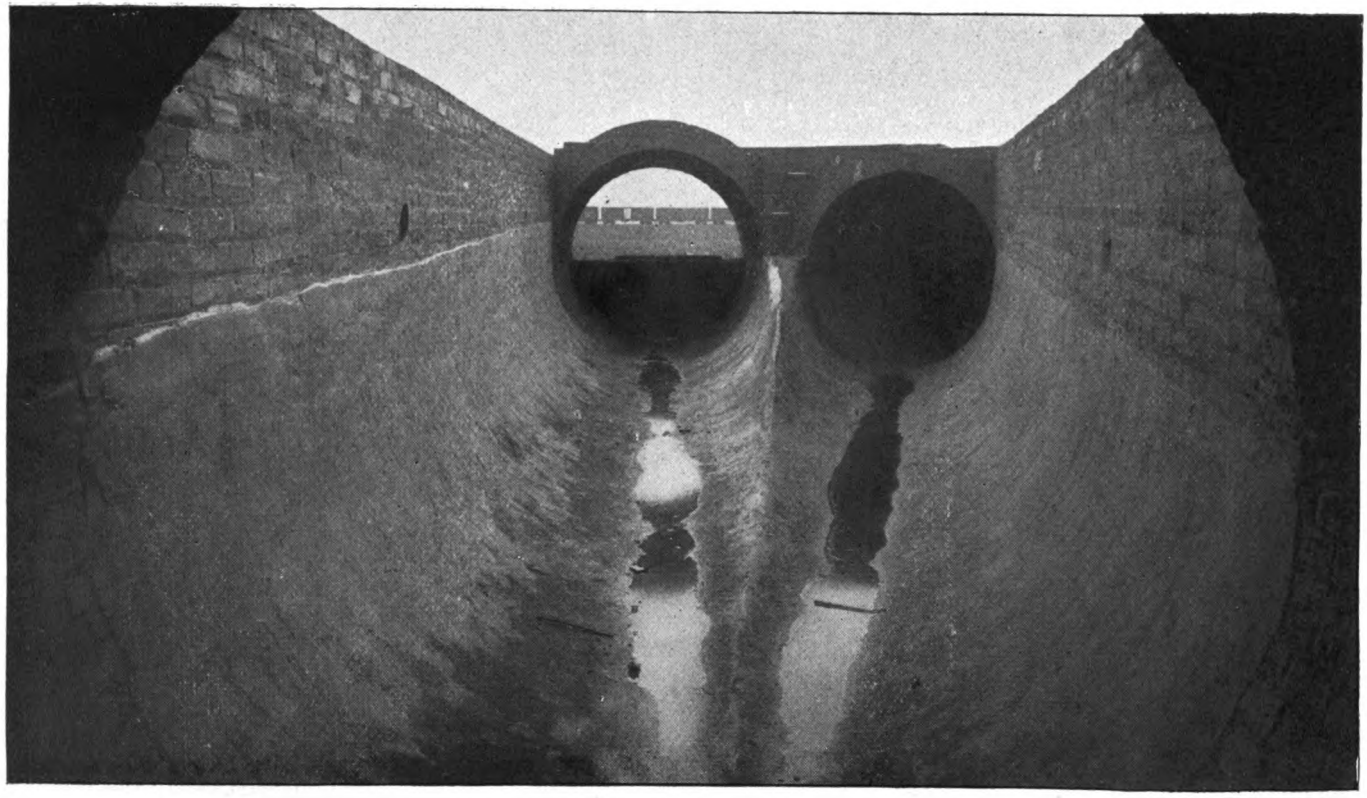
Wingohocking creek sewer extension on Courtland street, from west of Seventh street to Seventh and Ansbury streets, on Ansbury street to the North Pennsylvania branch of the Philadelphia and Reading Railway. Length built, 398.3 feet of 17-feet 3-inches diameter sewer. Total cost of the work, $22,499.97. Final estimate paid November 2, 1903. Contractor, David McMahon. Inspector, J. M. Hipple.

Drainage in the First, Twenty-sixth Thirty-sixth, and Thirty-ninth Wards.

Work on the McKean street relief sewer commenced in 1902, was continued and completed to Ninth street. A new contract for a further extension of this sewer was entered into. This contemplated the construction of the sewer from Ninth to Twelfth street, but the appropriation made for this purpose was insufficient until an additional appropriation of $20,000 made by ordinance of December 11, 1903, became available. This enabled the City to carry on the work to great advantage and without interruption. Additional funds, however, should be provided, to extend this relief sewer to its objective terminus.

Work was also continued on the extension of the Shunk street system, contracted for and commenced during 1902, and is now nearing completion. This work was made possible by an additional appropriation to the amount of $40,869.83, made by ordinance approved May 15, 1903.

Additional funds should be provided to continue this work and reach the objective point at Broad street, where all development and improvement is retarded by the lack of drainage.



Separating Chamber at Front and Porter Streets.

The sewer in Jackson street, from Schuylkill river eastwardly, contracted for during 1902, was commenced and completed as far as available funds would permit during 1903. The appropriation made for this sewer ($15,000) permitted only of a small beginning and additional appropriation should be made to enable the City to continue this work and accomplish the desired results.

A detailed statement of the work completed during the year on the above contracts is as follows:

Jackson street, from the Schuylkill river eastwardly. Length built, 289.78 feet of 7-feet 6-inches diameter sewer and an outlet wall. The entire length of this sewer is in full cradle on piles and timber platform. Total cost of the work, $14,988.94. Final estimate paid May 25, 1903. Contractor, D. J. McNichol. Inspectors, J. E. Peters, John Barlow.

McKean street relief sewer extension, from Third street to Ninth street. Length built, 1,170.74 feet of 7-feet 6-inches diameter sewer and a connecting chamber of concrete at Third street 15.20 feet long. Total cost of the work, $76,629.96, of which there was paid to the contractor on account in 1902 the sum of $37,400.00, and in 1903 the sum of $39,229.96. Final estimate paid August 25, 1903. Contractor, J. H. Louchheim. Inspector, P. D. Brown.

McKean street, from Ninth street to Twelfth street. Length built, 921.46 feet of 7-feet diameter sewer. There has been paid to the contractor on account the sum of $29,120. Work is still in progress. Contractor, George A. Vare. Inspector, P. D. Brown.

Shunk street sewer system extension on Shunk street, from west of Shelby street to Front street; on Front street to Porter street, and on Porter street westwardly. Lengths built, 1,871.38 feet of 7-feet 6-inches diameter and 1,077 feet of 6-feet 6-inches diameter sewer. A separating cham-

ber was built at Front and Porter streets and a junction chamber at Front and Shunk streets, each having a length of 34 feet. The entire construction is in full cradle with pile and platform foundation. Work is still in progress. There has been paid to the contractor on account the sum of $98,100.02. Contractor, George A. Vare. Inspector, Joseph Hunter.

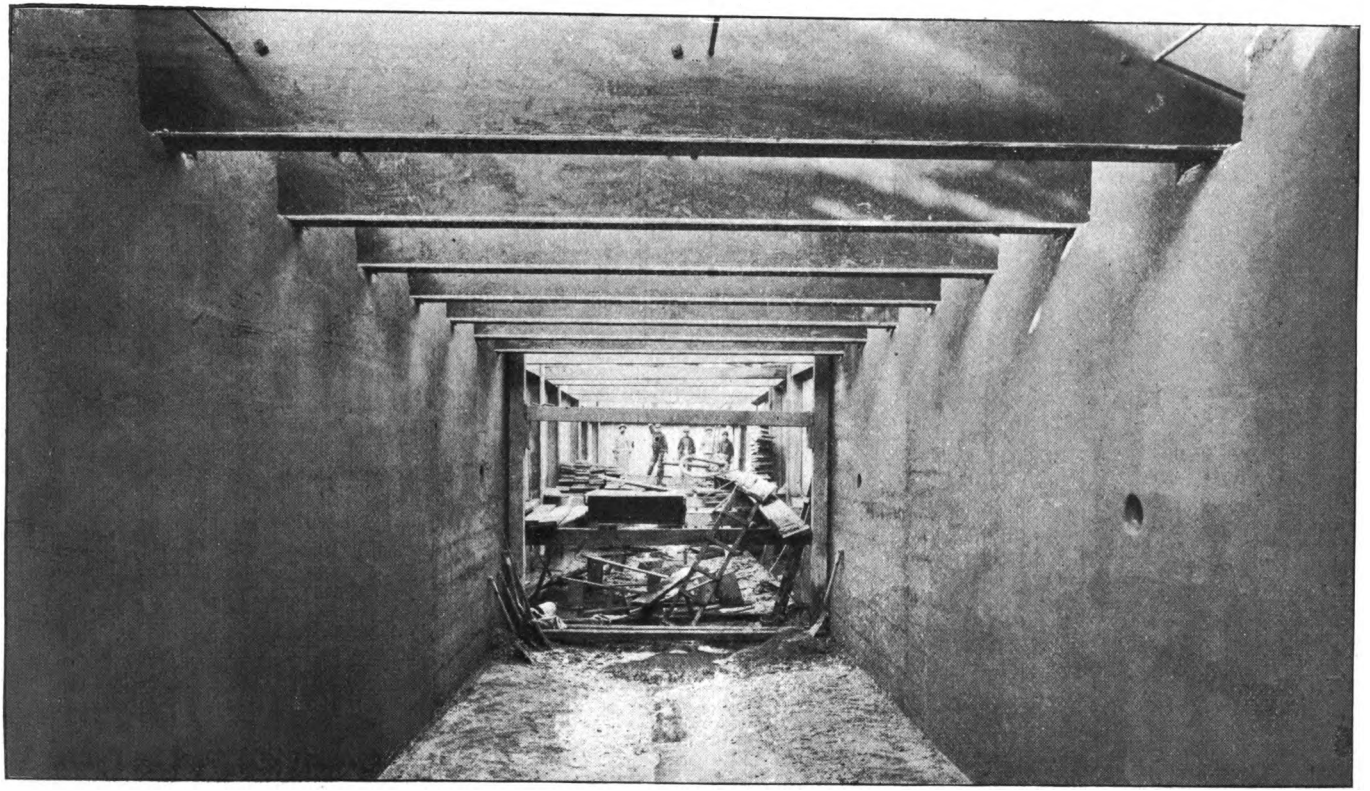
Frankford Intercepting System.

Work was commenced on the contract made in 1902, for the construction of the sewer in Wakeling street, from Frankford creek northwestwardly, and fair progress was made promising an early completion, as far as available funds will permit.

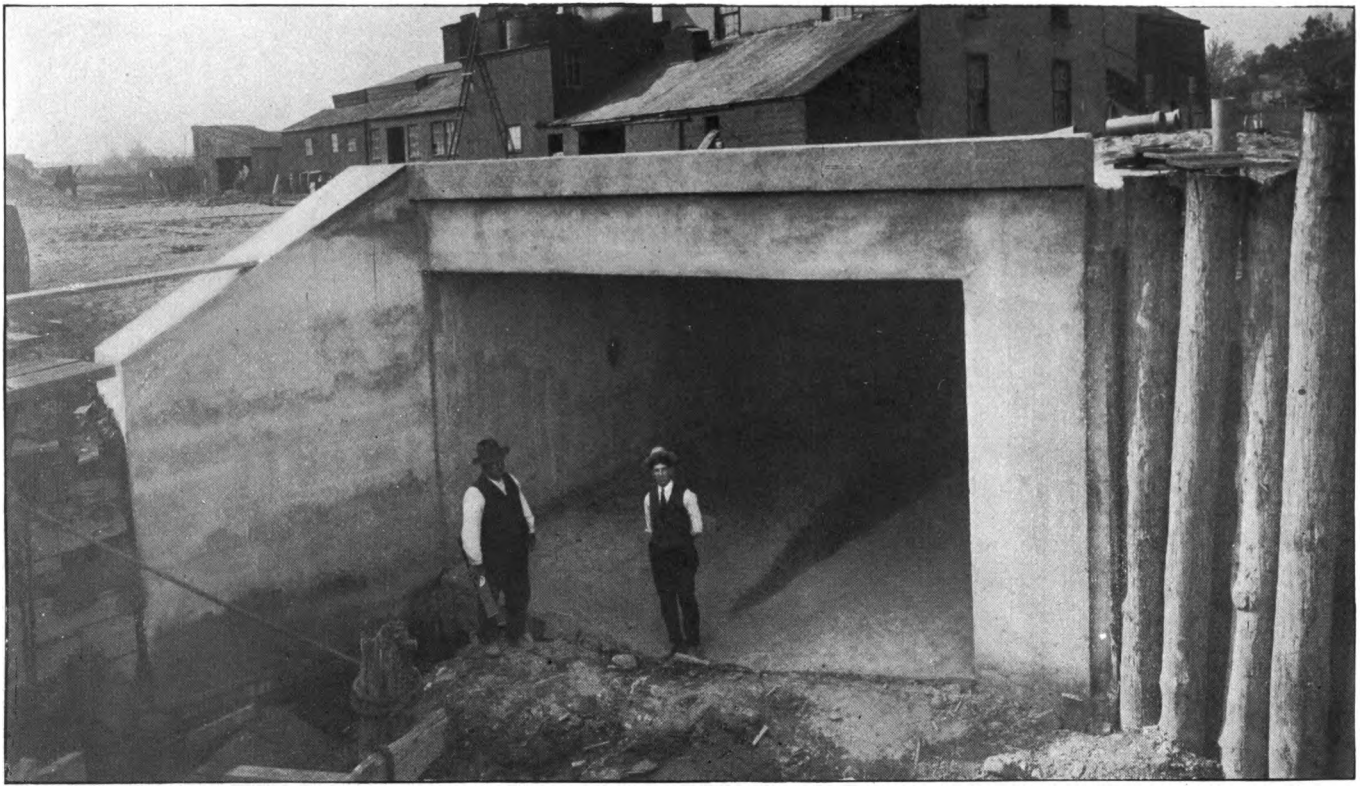
This sewer is remarkable in that it is the largest concrete sewer in the City. The invert consists of two planes slightly inclined, forming a trough along the center line of the sewer. The side walls are vertical, and the roof is composed of steel beams with concrete arches between. The span is 16 feet and height 10½ feet. A number of details of the construction, and the forms were of some interest. Some idea of the work may be obtained from the accompanying view.

Extensions should be made to this system continuously, particularly to the sewer in Wakeling street, so that the connection will be made with the upper section now terminating at Valley street near Haworth street. This is essential before anything can be done towards enclosing the Little Tacony creek which now flows through the heart of Frankford. Liberal appropriations are urged for this purpose, as well as for the enclosing of the creek.

A contract was also made and work carried to completion on the main sewer extension in Pratt street, from Frankford avenue northwestwardly. This sewer enabled the development of a large tract of land upon which the



WAKELING STREET SEWER.



OUTFALL OF WAKELING STREET SEWER.

Philadelphia Rapid Transit Company has erected large car barns.

A detailed statement of the work completed on the above contracts is as follows

Frankford intercepting sewer system on Wakeling street, from Frankford creek northwestwardly. Length built, 525 feet of special rectangular section concrete and steel sewer of 16 feet horizontal and 10 feet 6 inches vertical dimensions, 160 feet of rectangular section concrete and steel sewer of 11 feet 6 inches horizontal and 10 feet 6 inches vertical dimensions, all with steel beam and concrete arch top. There has been paid to the contractor on account the sum of $33,936.00. Work is still in progress. Contractor, Richard P. Bennis. Inspector, G. W. Myers. Inspecting Engineer of steel work, J. A. Colby.

Pratt street, from Frankford avenue northwestwardly. Length built, 847 feet of 11 feet diameter sewer and an intake retaining wall. There has been paid to the contractor on account the sum of $19,200. Work is still in progress. Contractor, John McMenamy. Inspector, B. H. Smithson.

Aramingo System.

The only work in the Aramingo system consisted in the extension of the sewer in York street, from Tulip street to Emerald street, and also from American street to Fifth street, and on Fifth street, from York street to Cumberland street.

This completes the York street relief system, doing away with the unsatisfactory conditions existing for a number of years at Sergeant and Amber streets and vicinity, where in times of heavy rainfall, streets were flooded and water backed into cellars, with consequent damage to property. Since its completion the effectiveness of this improvement has been several times severely tested by extraordinary

rainfalls, and found entirely adequate, with no complaints of floods from citizens.

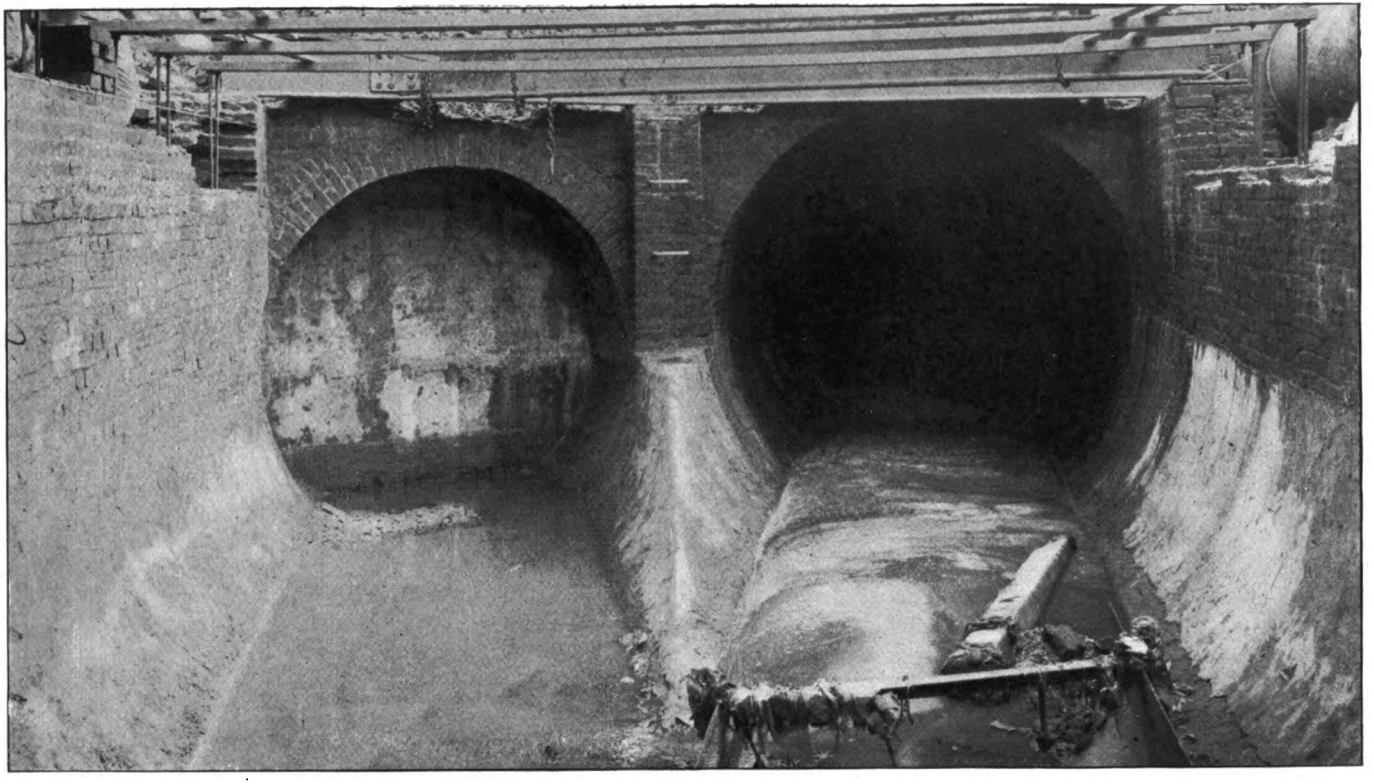
York street sewer extension, from Tulip street to Emerald street. Length built, 562.64 feet of 7- feet diameter sewer and a concrete connecting chamber with steel beam and concrete arch top 140 feet long. Total cost of the work, $59,557.40, of which $30,720.00 was paid to the contractor on account in 1902, and $28,837.40 in 1903. Final estimate paid August 18, 1903. Contractor, J. H. Louchheim. Inspectors, T. W. Harvey, George Warner, W. W. Brinkworth.

York street, from American street to Fifth street, and on Fifth street, from York street to Cumberland street. Length built, 849 feet of 4-feet 9-inches diameter sewer. There has been paid to the contractor on account the sum of $13,600. Work is still in progress. Contractor, G. A. Vare. Inspector, W. W. Brinkworth.

Cohocksink System.

Two breaks occurred in the old Cohocksink sewer, one on Dauphin street east of Broad street, and one on Montgomery street east of Eighth street. Both of these breaks were repaired in a substantial manner by entirely reconstructing not only the broken sections but also short sections immediately above and below the breaks where the condition of the sewer indicated danger of further breaks. This work was done under the annual contract for repairs, reconstruction and improvement of old sewers.

The systematic reconstruction of the old Cohocksink sewer was also continued under this contract and the work commenced during 1902, on Ninth street was extended northwardly and is now completed to Norris street, including the reconstruction of a separating chamber at this point. The reconstruction on Norris street west of Ninth street was completed some years ago.



COHOCKSINK RELIEF SEWER, SEPARATING CHAMBER AT NINTH AND BERKS STREETS.

There are still some sections on this sewer which are revealed by examinations to be in a dangerous condition. These should be rebuilt at the earliest opportunity to prevent accidents and damage to property.

A detailed report of the work performed under the contract for repairs, reconstruction and improvement of old sewers during the year is as follows:

Cohocksink sewer reconstruction on Montgomery street, from a point east of Ninth street to Ninth street, on Ninth street, from Montgomery street to Norris street.

Length built in 1903, 166.33 feet of 9-feet 6-inches diameter, enlarging a sewer of 9 feet former diameter, 494.46 feet of 10-feet diameter sewer, enlarging a sewer of 9 feet former diameter, 4 feet of 8-feet 6-inches diameter sewer and 5 feet of 8-feet diameter sewer. Also a separating chamber 35 feet in length in the intersection of Ninth and Berks streets, and a separating chamber 26 feet in length in the intersection of Ninth and Norris streets.

All of the work embraced the removal of an old sewer in service. The total cost of the work, which was paid for by items, was $70,194.74, of which $19,010.34 was paid to the contractor in 1902, and $51,184.40 in 1903. Final estimate paid December 30, 1903. Contractor, Robert Higgins. Inspector, John Vicary.

Cohocksink sewer reconstruction on Dauphin street east of Broad street. This work was necessitated by the break which occurred at this point on July 24, 1903. Length reconstructed, 41 feet of 13-feet diameter sewer enlarging the old sewer of 12 feet diameter. The work was paid for by items and was done at a total cost of $2,818.29. Final estimate paid December 30, 1903. Contractor, Robert Higgins. Inspectors, Henry M. Smith, C. A. Crossin.

Cohocksink sewer reconstruction on Montgomery avenue east of Eighth street. This work was necessitated by

the break which occurred at this point on September 4, 1903. Length reconstructed, 41 feet of 10-feet diameter sewer, enlarging the old sewer of 9 feet in diameter. The work was paid for by items and was done at a total cost of $2,683.23. Contractor, Robert Higgins, Inspectors, Henry M. Smith, C. A. Crossin.

Miscellaneous work in connection with the contract for repairs, reconstruction and improvements of old sewers amounts to $631.36.

Cohocksink Relief Sewer.

The construction of this system was undertaken to relieve the old sewer, which, traversing as it does a closely built up area with impermeable pavement, was largely overtaxed and overflowed after every heavy rain, resulting in frequent breaks and damage to properties.

For some years appropriations have been made specifically for the betterment of these conditions.

Rapid progress has been made in the work of construction, funds sufficient to complete the project have been provided and before the heavy rains of summer are upon us, it is probable that it will be in operation. The total appropriation for this work amounted to $460,000.

The system presents some novel features in design, notably the methods of automatically securing a separation of sewage and storm water, to avoid pollution of the Shackamaxon street ferry slip, and the four chambers at the intersection of Mascher street and Thompson street, which gave rise to some interesting problems in hydraulics, also in methods of construction. The chambers are described in detail and illustrated in the last report.

The progress upon the contracts on this system is given below.

Cohocksink relief sewer in Germantown avenue, from Thompson street to Montgomery street. Length built in

1903, 2,103.18 feet of 8-feet 6-inches diameter sewer, with an overflow chamber between the old Cohocksink sewer and this sewer at Germantown avenue and Thompson street. Total cost of the work, $98,502.48, of which $18,240.00 was paid prior to, and $80,262.48 was paid in 1903. Final estimate paid October 27, 1903. Contractor, George A. Vare. Inspector, Thomas MacElwee.

Cohocksink relief sewer on Shackamaxon street, between the Delaware river and Thompson street. The masonry work of this sewer was completed in 1902. The work done in 1903 consisted in the repaving of street and in cleaning out the outfall section. Total cost of work, $97,326.16, of which $77,460.48 was paid to the contractor on account prior to 1903, and $19,865.68 was paid in 1903. Final estimate paid January 23, 1903. Contractor, David Peoples. Inspector, E. H. Sickles.

Cohocksink relief sewer on Thompson street, between Shackamaxon street and Germantown avenue. Lengths built in 1903, 502.53 feet of 9-feet diameter sewer, with appurtenant 2 feet 3 inches by 1 foot 6 inches sewer, 131 feet of 9-feet diameter sewer, 6.35 feet of 8-feet diameter and 129 feet of 12-inch terra cotta pipe sewer. Also two separating chambers and two junction chambers, with the appurtenant sub sewers and overflow sewers, aggregating a length of 258 feet, in the intersection of Mascher and Thompson streets.

Total cost of the work, $114,684.49, of which $49,600.00 was paid to the contractor on account prior to 1903, and $65,084.49 in 1903. Final estimate paid September 8, 1903. Contractor, George A. Vare. Inspectors, Thomas MacElwee and W. E. Haley.

Cohocksink relief sewer on Germantown avenue, from Montgomery avenue to Berks street, and on Berks street, from Germantown avenue to Ninth street. Length built, 1,450 feet of 8-feet 6-inches diameter sewer. Work upon

this sewer is still in active progress. The completion of work upon this contract, which may be anticipated in the early spring of 1904, will complete the system of relief sewers, built from the Delaware river at Shackamaxon street to the drainage basin at the intersection of Ninth and Berks streets. There has been paid to the contractor on account the sum of $55,200.00. Contractor, George A. Vare. Inspectors, W. E. Haley, Thomas MacTlwee.

Reconstruction of Sewers in Connection with the Subway on Market Street.

The construction of the Market street subway of the Philadelphia Rapid Transit Company begun on Market street, immediately east of the Schuylkill river early in the year, involved the relocation and reconstruction of a number of old sewers on Market street and intersecting streets between Fifteenth street and the Schuylkill river. This sewer work has been done without any expenditure upon the part of the City for construction or inspection.

The new sewer construction which has been completed to date as a substitute for the former drainage system is in detail as follows:

Market street, south side, from the Schuylkill river to Twenty-first street. Lengths built, 1,356 feet of 4-feet 9-inches diameter sewer, 284 feet of 15-inches diameter terra cotta pipe sewer.

Market street, north side, from Twenty-second to Fifteenth street. Lengths built, 979 feet of 3-feet by 2-feet diameter sewer, 800 feet of 2-feet 3-inches by 1-foot 6-inches diameter sewer 1,225 feet of 18-inches diameter terra cotta pipe sewer.

Twenty-second street, from Market to Arch street. Lengths built, 720 feet of 3-feet 6-inches by 2-feet 4-inches diameter sewer, and 9 feet of 3-feet 6-inches diameter sewer.

Twenty-third street, from Ludlow street 205 feet southward. Length built, 205 feet of 2-feet 3-inches by 1-foot 6-inches diameter sewer. Contractors, The E. E. Smith Construction Co. Inspector for the City of Philadelphia, E. S. DeHaven.

Total length of sewers constructed, 5,758 linear feet, equal to 1.09 miles.

History of the Development of the Present Drainage System.

Prior to the year 1855, in which year the various districts and townships of the County of Philadelphia, in accordance with an Act of 1854, were incorporated into the City of Philadelphia, there were but 18 miles of main sewers, consisting principally of culverts over old streams, except in the old City, and but 19 miles of branch sewers.

Between the years 1855 and 1880 there were added to the main drainage system 26 miles, and to the branch system 131 miles.

During this period, between the years 1855 and 1880, principally between 1860 and 1870, the Cohocksink sewer, the Hart creek sewer, portions of the Mill Creek sewer, and others of large size were constructed to meet the growing demands of an increasing population which had learned to realize the importance of sanitary improvements.

Some of these constructions built many years ago before hydraulic cement was in use have become worn out by constant abrasion, the bottoms give way and eventually breaks occur.

In addition to making extensions to the main drainage system, therefore, the repair and rebuilding of worn out portions of old sewers devolves upon the City. In these reconstructions the substitution of vitrified brick bottom in masonry cradle and the use of hydraulic cement will reduce the possibility of future repairs to a minimum.

About 1880 considerable interest was awakened upon the sewer question, and as a result examinations of drainage methods were made in many foreign cities, and during the next few years or until 1884 comprehensive plans for the drainage of all parts of the City were outlined.

Prior to 1884 there had been built 46 miles of main sewers and 172 miles of branch sewers, under contract with the Bureau of Highways.

Since 1884 the modern system of the City may be said to have been constructed, comprising 160 miles of main sewers and 730 miles of branch sewers.

The work of constructing a main intercepting sewer along the eastern bank of the Schuylkill river to intercept the drainage of the Falls of Schuylkill, Manayunk, Roxborough, Germantown and Chestnut Hill, was begun in 1883 and has continued with comparatively small annual appropriations to the present time.

The cost of the main intercepting sewer has been upwards of $1,000,000, and with the branches constitutes a system which has been effective in removing from the Schuylkill river above Fairmount dam the drainage from an area of which the estimated population is 75,000.

That which has been done by comparatively small appropriations carried over a long period of years to eliminate the drainage from the water shed of the Wissahickon creek and the Schuylkill river above Fairmount dam, can be done in other places.

As an improvement in general municipal affairs, projects have been prepared in more or less detail for intercepting the sewage from the Schuylkill river below Fairmount dam; from Cobbs creek, between City avenue and Seventy-third street; the diversion of the drainage of the Wingohocking creek area from the Frankford creek; the extension of the same system to cover the Rock run area; the diversion of drainage from the Pennypack creek, and from

MAIN SEWERAGE SYSTEMS
— OF —
THE CITY OF PHILADELPHIA.

TOTAL MILEAGE OF MAIN SEWERS CONSTRUCTED AND UNDER CONTRACT 161.08 MILES.

EXPLANATION

——— MAIN SEWERS CONSTRUCTED PRIOR TO 1903.

▬▬ " " " AND UNDER CONTRACT 1903.

- - - - - PROPOSED MAIN SEWER EXTENSIONS.

DEPT. OF PUBLIC WORKS.
BUREAU OF SURVEYS.
DEC. 31ST 1903.

SCALE. 0 1/2 1 2 3 MILES.

● PLUVIOMETER STATION.

■ STREAM GAUGE STATION.

the Little Tacony creek, which latter system has been begun. Eventually an intercepting sewer along the Delaware river may be demanded, but its necessity is more remote than some of the others.

The methods of construction and improvement in building materials in recent years have secured for the City structures a permanence which in all probability will fulfil the demands upon them for centuries.

Improvements in the methods of disposal may be demanded by public opinion dominated by a higher order of civic pride. This will be more of a financial than an engineering question.

After having had opportunities for examining systems of sewerage and methods of disposal in other cities, it appears that the system here so far as constructed can be adopted to any future method of disposal that may be determined upon. The improvements recommended above can be carried out in order of importance, leaving the final method of disposal to the future.

Urgent Main Sewers.

The following is a list of main sewers for which appropriations are urged:

Extension of Sixty-third and Market streets to Cobb's creek.

Extension of Shunk street system on Porter street to Broad street.

Extension of Ogontz avenue north of Olney avenue.

Extension of Frankford intercepting system (Wakeling street and Torresdale avenue).

Extension of Courtland street to North Penn R. R.

Extension of McKean street relief sewer.

Extension of Jackson street east of Twenty-ninth street.

Extension of Wissahickon high level sewer to Rex avenue.

Reconstruction of Front and Girard avenue sewer.

Wissahickon high level cut-off.

Indiana avenue relief to Broad and Allegheny avenue.

Rock run system on Ashdale street west of Philadelphia and Newtown Railroad.

Reconstruction of Christian street, Taney to Twenty-first street.

Branch Sewers and Inlets.

There was appropriated in the annual appropriation ordinance approved December 29, 1902, for branch sewers and inlets, the sum of $60,000, to which was added at various times during the year the sum total of $99,891, making available the sum of $159,891.

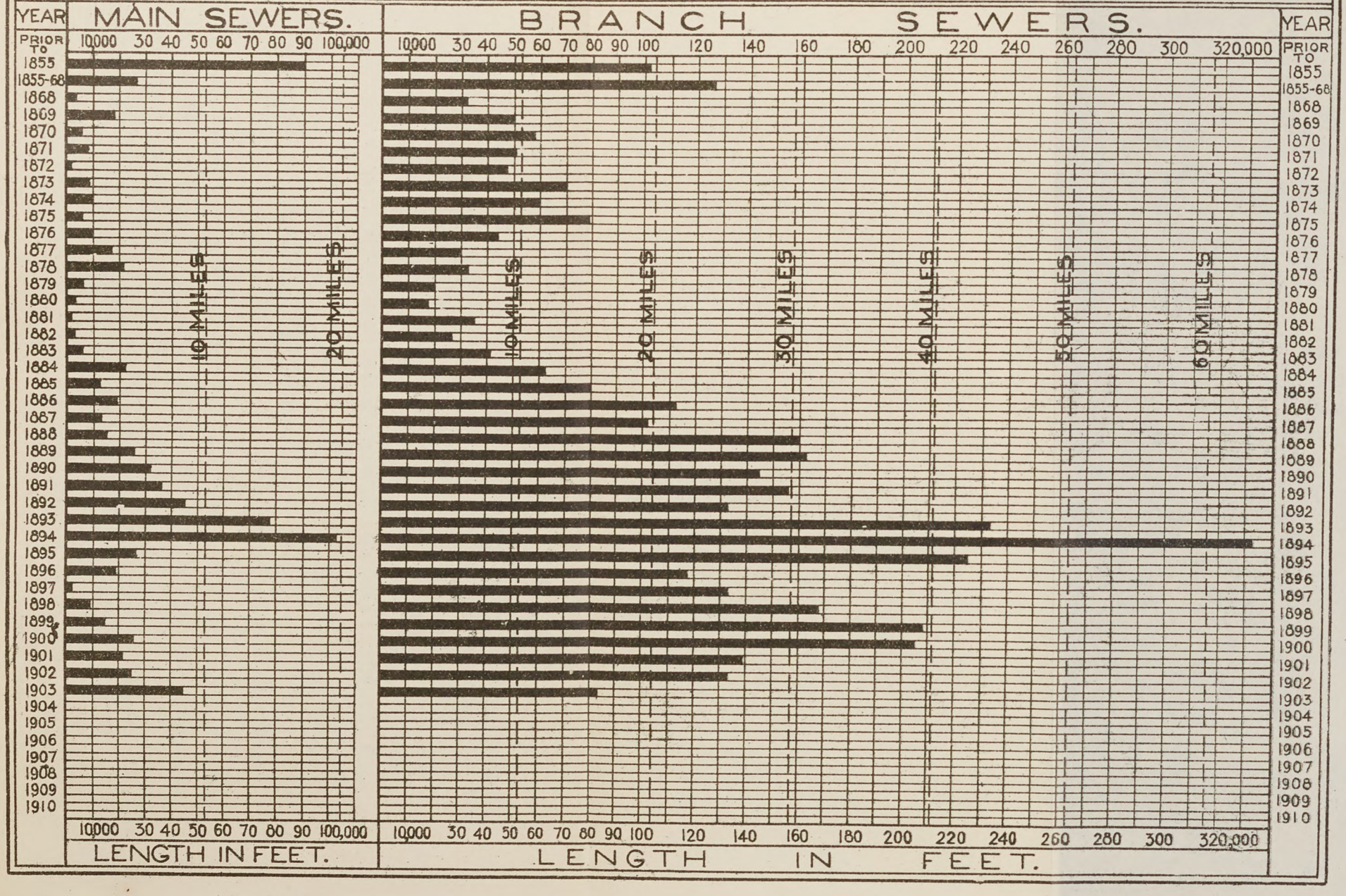
The contracts drawn for branch sewers numbered 77 and 103 contracts were completed. In the year just closed there were constructed 15.64 miles of branch sewers at public expense at a total cost as follows:

In warrants	**$167,760 33**
Assessment bills	**144,218 33**
Inspection	**27,776 35**
Total	**$339,755 01**

There was appropriated for the reconstruction of inlets the sum of $5,000. This was placed under contract. Contracts were also entered into for the construction of new inlets, curved curbing appurtenant thereto, laterals, manholes, etc., to the amount of $15,000, charged against the item for branch sewers.

There were in all five contracts, the work under which included the construction and reconstruction of 190 inlets not included in sewer contracts, the placing of 1,803 feet of curved and straight curbing in connection therewith, and the laying of 6,287 feet of lateral sewer connections. Most of this work was done preparatory to the paving or repaving of streets. A detailed statement of this work will be found in the appendix of this report.

DIAGRAM SHOWING LENGTH OF COMPLETED SEWERS.



Summary of Work Upon Sewers.

The total number of main sewers under construction, some of which were carried over from last year, was 32. Total length of all sewers built and inspected during 1903 was 27.92 miles, divided as follows:

Main sewers	42,431.41 ft.	8.225 miles.
Branch sewers	82,588.89 ft.	15.642 miles.
Sewers built at private expense	21,421.00 ft.	4.057 miles.
Total	147,441.30 ft.	27.924 miles.

Total length of sewers constructed:

Main sewers	160.407 miles.
Branch sewers	732.694 miles.
Sewers at private expense	85.882 miles.
	798.983 miles.

There was expended for main sewers during 1903:

In City warrants	$1,006,479 38
Cost of inspection	22,386 50
Total cost	$1,028,865 88

Sewer Connections and Records.

Sewer connections of 4709 buildings were authorized during the year, which involved the issuing of 2,604 permits (a decrease of 382 from the year 1902), with the usual inspection, draughting and return of the reports, as required by ordinance of April 3, 1883 (not including about 2,810 buildings connected to sewers built at private cost during 1903.)

The permits issued in each month were as follows:

January	43	**July**	270
February	44	**August**	234
March	272	**September**	240
April	259	**October**	288
May	289	**November**	269
June	326	**December**	70

The number in each ward:

First	63	Twenty-second	175
Second	71	Twenty-third	108
Third	75	Twenty-fourth	52
Fourth	14	Twenty-fifth	161
Fifth	25	Twenty-sixth	65
Sixth	20	Twenty-seventh	64
Seventh	41	Twenty-eighth	24
Eighth	41	Twenty-ninth	65
Ninth	24	Thirtieth	87
Tenth	23	Thirty-first	95
Eleventh	8	Thirty-second	32
Twelfth	16	Thirty-third	149
Thirteenth	1	Thirty-fourth	173
Fourteenth	6	Thirty-fifth	3
Fifteenth	59	Thirty-sixth	130
Sixteenth	35	Thirty-seventh	31
Seventeenth	18	Thirty-eighth	74
Eighteenth	59	Thirty-ninth	42
Nineteenth	111	Fortieth	50
Twentieth	85	Forty-first	16
Twenty-first	158	Forty-second	24

The character of drainage was:

Water closets	7,007	Slaughter houses	4
Surface	4,709	Ice houses	10
Sinks	3,662	Markets	12
Cellars	2,308	Breweries	6
Stables	200	For future use	576
Factories	64	Miscellaneous	1,924

Three hundred and seventy-one (371) drains were connected with the Manayunk intercepting sewer and its branches, all of which were inspected by the Supervisor of the Intercepting Sewer and inspectors of drain connections.

The Bureaus of Water, Highways and Health have as usual been furnished with a daily list of all permits issued.

Fifty-eight (58) sewers have been built at private cost, varying in size from 12 inches T. C. pipes to 3 feet 6 inches by 2 feet 4 inches brick sewers.

Two hundred and nine (209) plans of main and branch sewers were received from the District Surveyors, which were duly registered and platted on the drainage sheets and atlases. Forty (40) plans of lateral pipes put in old sewers were also returned.

The indexing of the Inspectors' books has been continued; the number received during the year was 170, making the total now in use 6,281.

Three inspectors of drain connections and one supervisor of the Manayunk intercepting sewer have been continuously on duty during the year, and their weekly and monthly returns were promptly made.

All moneys for permits, searches, balances, etc., were paid at the office of the Receiver of Taxes (ordinance of December 30, 1886), taking his receipt therefor.

The receipts of the Bureau from all sources (except District Surveyors) during the year were $28,005.94 (a decrease of $3,536.78 from 1902), as follows:

January	$1,930 93	July	$1,921 42
February	2,378 92	August	2,334 24
March	3,581 88	September	3,103 21
April	1,918 95	October	3,147 02
May	1,735 17	November	1,681 67
June	3,222 29	December	1,050 24

Recapitulation.

For sewer permits	$10,321 75
For sewer bills	14,845 55
For sewer balances	113 90
For removing footway gutters	1,454 14
For searches	1,054 00
For miscellaneous receipts	216 60
Total	$28,005 94

Miscellaneous Projects for Improvement.

Various projects for improvement, brought to the attention of the City authorities, both legislative and executive,

have been examined or elaborated by the Bureau, upon some of which exhaustive reports have been made, upon others perfected plans and estimates, or alterations to adapt them to existing conditions or future requirements for development of the City.

Studies for the development of the street system in suburban and outlying sections of the City have been continued.

The subject of providing enlarged facilities for communication between the center of the City and outlying suburban sections or parks has been receiving unusual attention. This is in keeping with the interest aroused in other cities upon the same subject.

Boulevard.

First in order of importance is the Boulevard leading through the northeastern section of the City.

On December 24, 1902, an ordinance was approved authorizing the Board of Surveyors to place upon the City plan an avenue 300 feet wide, commencing at Broad and Cayuga streets and extending in a northeasterly direction to Torresdale on the Delaware river, a distance of about 10½ miles. Provision was made for a connection with Fairmount Park by way of Hunting Park avenue and with Germantown by way of Belfield avenue. This ordinance also authorized the revision of the lines and grades of streets upon 23 sectional City plans and the projection of streets in such parts of the City as have not yet been plotted upon the City plan along and adjacent to the route of the proposed avenue.

Except for a distance of about a mile, the entire route of the avenue lies through an undeveloped section, principally farming land. When completed, with its contemplated extensions and connections it will open up for improvement, territory including approximately one-third of

the area of the City, a large part of which at the present time, has no direct or convenient means of transit to the center of the City.

Six lines of steam railways will be crossed, all by overhead bridges, except the New York division of the Pennsylvania Railroad at Torresdale, which will be an undergrade crossing. Viaducts from 300 to 600 feet long and about 40 feet high will be required to cross the valleys of the Tacony and Pennypack creeks. It is proposed that the valleys of both these streams shall be acquired by the City for park purposes, in which event the proposed avenue will afford convenient means of access to them from all parts of the City. An ordinance to acquire about 1,000 acres in the valley of the Pennypack creek is under discussion.

Work was commenced upon the plans of the avenue immediately upon the approval of the ordinance and has been carried steadily forward during the year.

The plans of the first section, from Broad street to Second street, a distance of about $1\frac{1}{4}$ miles, with the necessary revision of adjacent streets covering about 625 acres, were completed and confirmed by the Board of Surveyors March 2, 1903. This section was authorized to be opened by ordinance approved March 28, 1903. A contract for its improvement was awarded and the work is now in progress.

The plans of the second section, from Second street to Vankirk street, a distance of about $2\frac{3}{4}$ miles, with the necessary revision of adjacent streets covering about 1,280 acres, were completed and confirmed October 19th, 1903.

The plans of the third section, from Vankirk street to Strahle street, near Pennypack creek, a distance of about 3 miles, with the necessary revision of adjacent streets, covering about 1,400 acres, are nearly completed and ready for confirmation.

Topographical surveys have been made and some preliminary work done upon the plans for the remaining 3½ miles of the avenue.

The revision carried on in connection with this work involves some radical changes in the former projected street systems, the widening of many streets and the laying out of wide avenues connecting Torresdale, Bustleton, Fox Chase, Holmesburg, Tacony, Wissinoming, Frankford and Lawndale with the 300-foot wide avenue.

In addition to 15 sectional City plans made in duplicate, 80 miscellaneous drawings have been made covering preliminary working sheets, surveys, computation sheets, profiles, etc. A field corps has been constantly employed upon the work.

The Parkway.

The history of the Parkway dates back to 1891, when Councils by resolution requested that preliminary plans and estimates of cost be prepared for a Boulevard from City Hall to Fairmount Park. Several studies were submitted to Councils and the "Park Boulevard" was placed upon the City plan June 12, 1893, under authority of an ordinance approved April 12, 1892. In 1895 this Boulevard was stricken from the City plan, but the project to secure a convenient and appropriate entrance to the park was not abandoned. Plans covering different routes were prepared and ordinances presented to Councils but nothing definite was accomplished until the matter was taken in hand by the Parkway Association, an organization of citizens prominent in mercantile, professional and civic circles, through whose influence an ordinance was passed by Councils and approved March 28, 1903, authorizing the placing of the parkway upon the City plan. The plans were given a public hearing on December 7, and are now ready for confirmation.

As projected, the parkway extends in a direct line from the City Hall to Fairmount reservoir. Upon the completion of the filtration works it is suggested to abandon this reservoir and erect a Museum of Art upon the site. From the City Hall to Logan Square, the width is 160 feet, with ample space provided at the City Hall end for an imposing entrance and plaza; from Logan Square to Twenty-second street, the width is 300 feet; at Twenty-second street, the width is about 560 feet, gradually increasing to Twenty-fourth street, from which point to the park its northern boundary is Fairmount avenue, and its southern boundary Callowhill street.

The cross-section from the City Hall to Twenty-third street will be similar to that of the avenue of the Champs Elysees, beyond Twenty-third street no surface development has yet been decided upon.

The plan includes and utilizes what was once the bed of a railroad, Pennsylvania avenue, between Twenty-second and Twenty-fifth streets, improved as a boulevard under the work of abolishing grade crossings on Pennsylvania avenue, completed in 1900.

League Island Park.

With a view of raising the grade of League Island Park, a tract of 300 acres, immediately north of League Island Navy Yard, both east and west of Broad street, the existing contract for dredging in the Schuylkill river provides that all dredged material shall be placed within the limits of League Island Park. Under the present contract about 800,000 cubic yards of material can be placed, which with upwards of 900,000 cubic yards placed there under a prior contract, will serve to raise the grade of the park, so as to permit of future development, at a great saving to the City. Considerable work has been done in the way of excavating lakes and raising the grade of the por-

tion of the park west of Broad street, under contract with the Bureau of City Property.

The widening of Broad street to the width of 160 feet, south of Johnson street, was done with a view to providing a fitting approach to the park, the improvement of the avenue to be done in such a manner as practically to extend the entrance of the park to Johnson street.

Other wide avenues have been projected in various parts of the City, either to connect the smaller parks with each other, or to furnish fitting connecting avenues from the more populous outlying districts to the new Boulevard.

Pennypack Park.

In the northeastern section of the City the Pennypack creek flows from the Montgomery County line to the Delaware river, traversing a picturesque country second only to that along the Wissahickon creek in point of beauty. In order to preserve this territory in its original state, and to provide fitting park advantages to the populous northeast section, it is proposed to acquire about 1,000 acres along this creek, lay out drives, and develop it in a manner similar to the portion of Fairmount Park along the the Wissahickon creek.

Plans were prepared and visits made to the tract by the Board of Surveyors, and a careful report made to Councils.

Railroad Projects.

Some of the railroad projects to which attention was called in the last report have been completed, or are under construction, others have not progressed beyond the point where all adjustments of City streets have been made to make them practicable.

Among the latter are the proposed plan of the Pennsylvania Railroad to construct a line from Front street near

Erie avenue, on the line of the Connecting Railway, to Church street, Frankford, a distance of 2½ miles.

This work would result in the avoidance of a sharp curve and heavy grades, and the carrying of 17 opened or projected streets under the railroad.

The work of the removal of grade crossings by the Pennsylvania Railroad Company on the Philadelphia and Trenton branch on Trenton avenue, between Butler street and Norris street. No progress has been made and the conditions remain as heretofore.

The question of the elevation of the tracks of the Philadelphia, Germantown and Norristown Railroad on Ninth street, from Spring Garden street to Broad street, has been agitated anew and has given rise to a number of conferences between the officials of the Reading Railway Company and the City.

The introduction of an Item of $1,000,000 in the proposed loan for the purpose of abolishing grade crossings indicates an intention to begin the work in the near future.

The changes in the Richmond branch of the Philadelphia and Reading Railway to provide for the opening of a number of streets under the railroad and the abolishment of grade crossings at Frankford avenue and Kensington avenue have also been considered, but are dependent upon appropriations in order that they may be carried out.

A project for abolishing the grade crossings at Chelten avenue and Baynton street, on the line of the Germantown and Chestnut Hill branch of the Philadelphia and Reading Railway has been under discussion. The project has been studied, several plans prepared, and the ground visited. The work awaits legislation, proper appropriation and agreements with the Railroad Company.

New York Short Line Railroad.

The Philadelphia and Reading Railway Company contemplates the construction of a branch line, to be known as the New York Short Line Railroad, from Cheltenham, on the Philadelphia, Newtown and New York Railroad, to Neshaminy Falls, on the Bound Brook Division.

From Cheltenham northeastward to Poquessing creek, a distance of about seven miles, the proposed line lies within the Thirty-fifth Ward.

The plans filed by the Railway Company provide for undergrade or overhead crossings at all public highways.

An ordinance to authorize the construction of the road is under consideration.

Railroad and Railway Improvements.

A number of railroad improvements which are more or less intimately connected with municipal development, and which heretofore have been mentioned as projects have been completed or are under construction.

The double track elevated freight road built by the Pennsylvania Railroad Company diverges from the main line tracks near Thirty-fourth street bridge, is built on walls of stone masonry or carried on brick arches to the north side of Spring Garden street bridge, thence by steel viaduct over the latter bridge, the shops, tracks and yard of the Company to Market street, near the West Philadelphia station.

Bridges have been constructed over Spring Garden, Market, Chestnut, Ludlow, Walnut, and South streets, with viaducts between. The tracks will connect with the Arsenal bridge, giving an outlet to freight to the terminals in the lower end of the City.

The extensive improvements by the same company at and near Fifty-second street have been completed, which

consisted among other things of the widening and lengthening of the Fifty-second street bridge under the railroad; which is also true of the alterations in the vicinity of Powelton avenue station, and the lengthening of the Spring Garden street bridge to the westward, 100 feet, and the new yard arrangement west of the Schuylkill river in the vicinity of West Philadelphia station.

There is now in process of construction a low grade connection between the Junction Railroad near the Zoological Garden and the main line tracks.

A new street called Zoological street has been located in the rear of the Zoological Garden buildings, and has been graded, curbed and paved for a portion of its length by the Pennsylvania Railroad as a part of this latter improvement.

The improvements completed by the Philadelphia and Reading Railway have been principally along the river front, in the construction of river piers and the improvement of river terminal facilities.

This company has also completed a bridge on the line of Clarissa street over its Richmond branch, which complies with a condition imposed by Councils when Pulaski avenue, below the Midvale Steel Works, was vacated.

Rapid Transit Subway:

In connection with this improvement the City Councils by ordinance of December 24, 1902, authorized the raising of the grade of Twenty-third street, between Chestnut street and Filbert street, and of Market street, between Twenty-second street and the Schuylkill river, also all streets affected by said change in order to permit of the construction of the Subway under Twenty-third street, also the widening of Market street.

By ordinance of March 19, 1903, an appropriation of $80,000.00 was made to the Bureau of Highways for

making the physical changes as provided by the plans prepared by the Bureau of Surveys.

The contract was awarded to Mr. C. P. Weaver, representing the Philadelphia Rapid Transit Company, and is being carried on in connection with other work upon the Subway in that vicinity.

The work which was commenced the 1st week in April last, has consisted in the construction in a new location, of a sewer on the north side of Market street, from Fifteenth street to Twenty-second street, and on Twenty-second street, from Market street to Arch street; and a deeper sewer on the south side of Market street, from Twenty-third to Nineteenth street, with an outlet to the north of Market street, from Twenty-third street to the Schuylkill river.

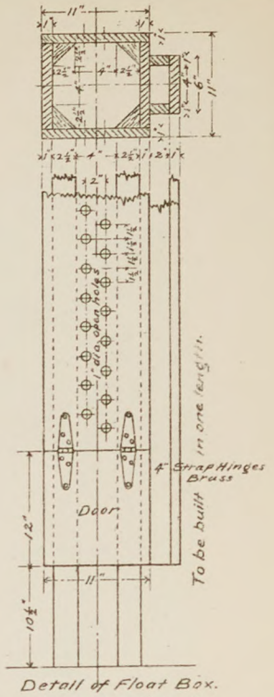
The wing walls to the south side of Market street bridge have been strengthened, widened and raised; one-half of Market street, between Twenty-second street and the Schuylkill river has been raised to the new grade; Twenty-third and other streets south of Market street have been raised and paved.

The south wall of the Subway, between Twenty-third street and Nineteenth street, has been built, and the side walls of the approaches to the portal west of Twenty-third street nearly completed.

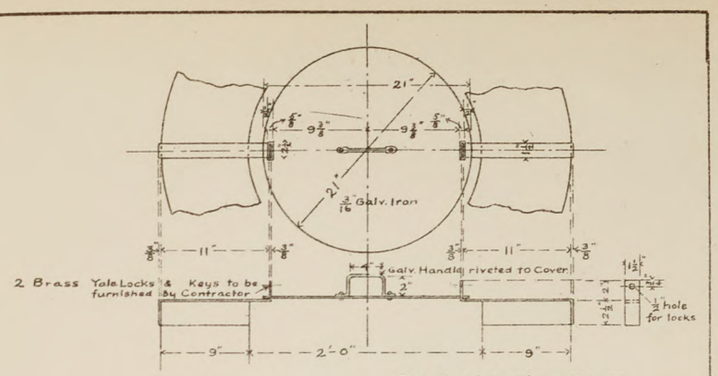
Work is in progress upon the two river piers and the west shore pier of the Schuylkill river bridge, and the east shore pier and east abutment have been completed.

Various plans for carrying on the work of construction have been presented, examined and approved, all upon the section of the Subway between Fifteenth street and the Schuylkill river.

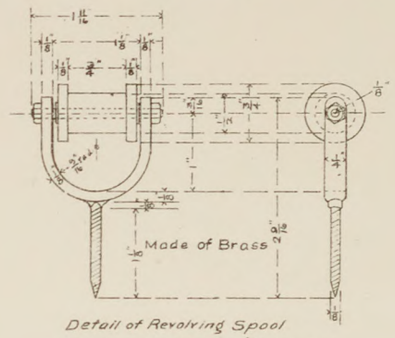
Detail of Flagstone-A.
1-Required Scale 1½"=1'-0"



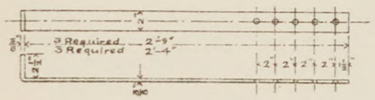
Detail of Float Box.
Scale 1½"=1'-0"
1-Required of Y.P., Planed on Inside.



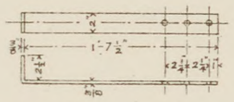
Detail of Locking Cover
1-Required Scale 1½"=1'-0"



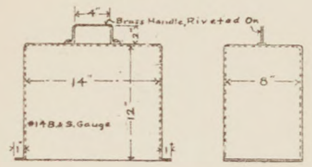
Detail of Revolving Spool
1-Required Scale 12"=1'-0"



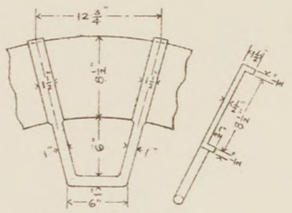
Bent Flats for Float Box Supports
3 Required 2'-9" long of W.I.
3 " 2'-4" " " "
Scale 1½"=1'-0"



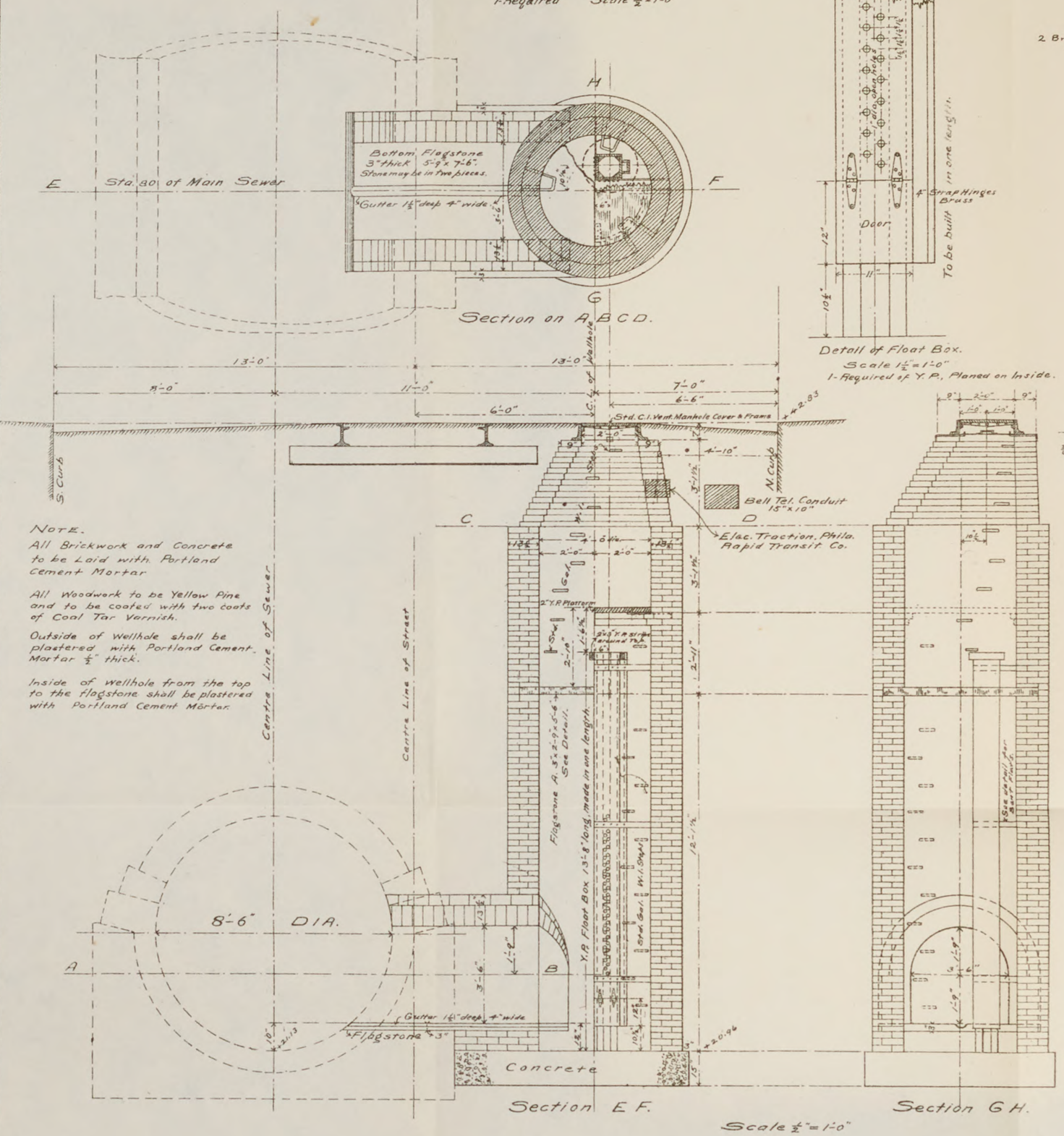
Bent Flats for Platform
3 Required of W.I.
Scale 1½"=1'-0"



Cover for Instrument
1 Required of Galv. Iron.
Scale 1½"=1'-0"



Std. M.H. Steps.
Detail of Steps.
20 Required, of Galv. W.I.
Scale 1½"=1'-0"



NOTE.

All Brickwork and Concrete to be Laid with Portland Cement Mortar

All Woodwork to be Yellow Pine and to be coated with two coats of Coal Tar Varnish.

Outside of Wellhole shall be plastered with Portland Cement Mortar ½" thick.

Inside of wellhole from the top to the flagstone shall be plastered with Portland Cement Mortar.

WELLHOLE

FOR

AUTOMATIC STREAM GAUGE

IN

BERKS ST.

BETWEEN

MARSHALL ST. AND 7TH ST.

At Sta. 80.

Dept. of Public Works
Bureau of Surveys
Philadelphia.

B. Stingfield
Asst. Engineer.

Approved, Nov. 18th 1903

D. McN. Webster
Chief Engineer.

P.T.O. Nov. 1903.

Rainfall, Discharge and Tide Observations.

Prior to 1895 this Bureau relied solely upon the reports from outside sources for its records of precipitation in Philadelphia. In that year two automatic pluviometers were set up, one in the Second District, and one in the Seventh District. These, however, were found to give unreliable and unsatisfactory results, and were shortly replaced by an improved type of instrument, made by Richard Bros., Paris. They work automatically and have given the utmost satisfaction. The two instruments have since been increased to six.

These cover widely separated sections of the City, i. e., South Philadelphia, North Philadelphia, Manayunk, Germantown, Frankford and West Philadelphia. It is therefore fair to assume that the mean of the precipitation recorded by these instruments represents the rainfall in the City of Philadelphia, which for the year 1903 is 50.97 inches, more than 10 inches in excess of the normal determined by the United States Weather Bureau.

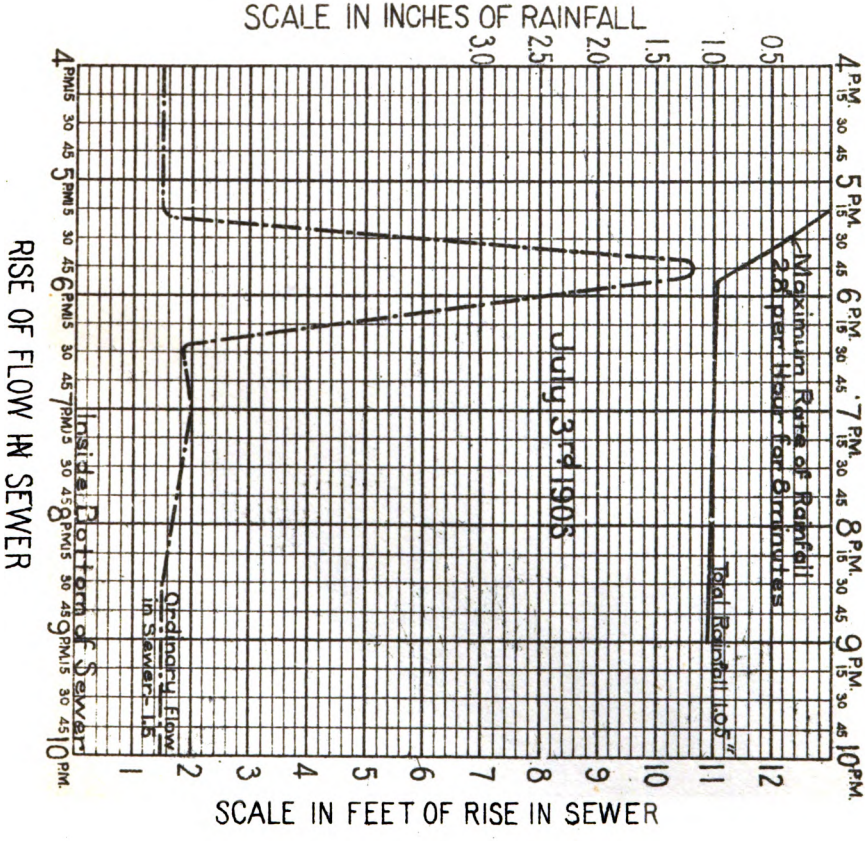
The following table shows the rainfall in each district during each month of the year, with a mean for the entire City.

Rainfall in Inches.

1903	Second District.	Seventh District.	Eighth District.	Ninth District.	Tenth District.	Eleventh District.	Average Rainfall.	U. S. Weather Bureau, Post Office Building.
January	3.62	3.95	5.02	*4.20	3.67	4.01	4.08	3.52
February	3.94	4.01	5.14	*4.34	4.05	4.24	4.29	4.29
March	4.49	4.76	5.95	4.64	4.35	4.63	4.80	4.38
April	3.43	4.30	5.56	4.71	4.48	4.29	4.46	3.00
May	.69	1.85	1.36	1.71	1.00	1.88	1.41	.93
June	6.46	5.60	5.39	4.79	4.77	5.13	5.36	5.48
July	4.24	5.85	7.00	6.50	6.11	5.44	5.86	3.84
August	6.39	5.83	5.91	5.51	4.59	6.28	5.75	5.57
September	2.74	3.53	3.46	3.36	3 04	3.33	3.24	2.31
October	6.99	7.21	7.64	7.94	7.35	6.64	7.30	3.86
November	1.00	1.14	1.18	.72	1.15	1.11	1.05	1.03
December	3.33	3.21	4.35	2.90	*3.24	3.20	3 37	3.29
Total	47.32	51.24	57.96	51.32	47.80	50.18	50.97	41.50

*Estimated.

DIAGRAM SHOWING RAINFALL
AND THE
RESULTANT RISE OF WATER IN SEWER



SEWER 13 FT. DIAM.

LOCATION OF STREAM GAUGE AT 12th & DIAMOND

LOCATION OF PLUVIOMETER AT 15th & MONTGOMERY

The heaviest rainfall, having a high rate and long duration occurred on June 10th, when 2.60 inches fell in 1¼ hours, indicating a mean rate of 2.08 inches per hour. The maximum rate of this storm was 6 inches per hour, which lasted for 5 minutes. A very severe rainstorm of long duration occurred on October 8th and 9th. This lasted 35 hours, during which 6.24 inches fell. The maximum rate of this storm was only 2.4 inches and continued a few minutes only. The highest rate of precipitation occurred during the storm of July 3d, when the rain fell at a rate of 7.20 inches per hour for 5 minutes. A table showing the amount of precipitation, duration and mean rate per hour of the most severe storms is given below. This also shows the maximum rate and duration of these storms.

Date.	Precipitation.	Duration.	Mean rate per hour.	Maximum rate per hour.	
	Inches.	Hours.	Inches.	Inches.	Mins.
April 14th, 1903	2.22	23	.10	.72	5
June 10th, 1903	2.60	1¼	2.03	6.00	5
June 20th, 1903	1.28	5	.26	2.40	10
July 3d, 7th Survey district	1.02	3	.34	2.80	8
July 3d, 11th Survey district	1.24	3	.41	7.20	5
July 18th, 1903	2.99	13	.23	3.20	8
August 4th, 1903	1.6	7¾	.21	3.10	3
August 7th, 1903	.50	2	.25	4.20	5
August 28th, 1903	2.35	17	.14	1.00	10
September 5th, 1903	.62	2½	.25	4.80	5
September 16th, 1903	1.06	6	.17	4.00	3
October 8th and 9th, 1903	6.24	35	.18	2.40	3

Observations of the flow in sewers were continued, and several good records of storm flow have been obtained.

There are now four stream gauges located on important main sewers, as follows:

Lombard street sewer at Third street (sewer 6 feet diameter).

Montgomery street sewer at Tenth street (sewer 6 feet diameter).

Cohocksink sewer at Twelfth and Diamond streets (sewer 13 feet diameter).

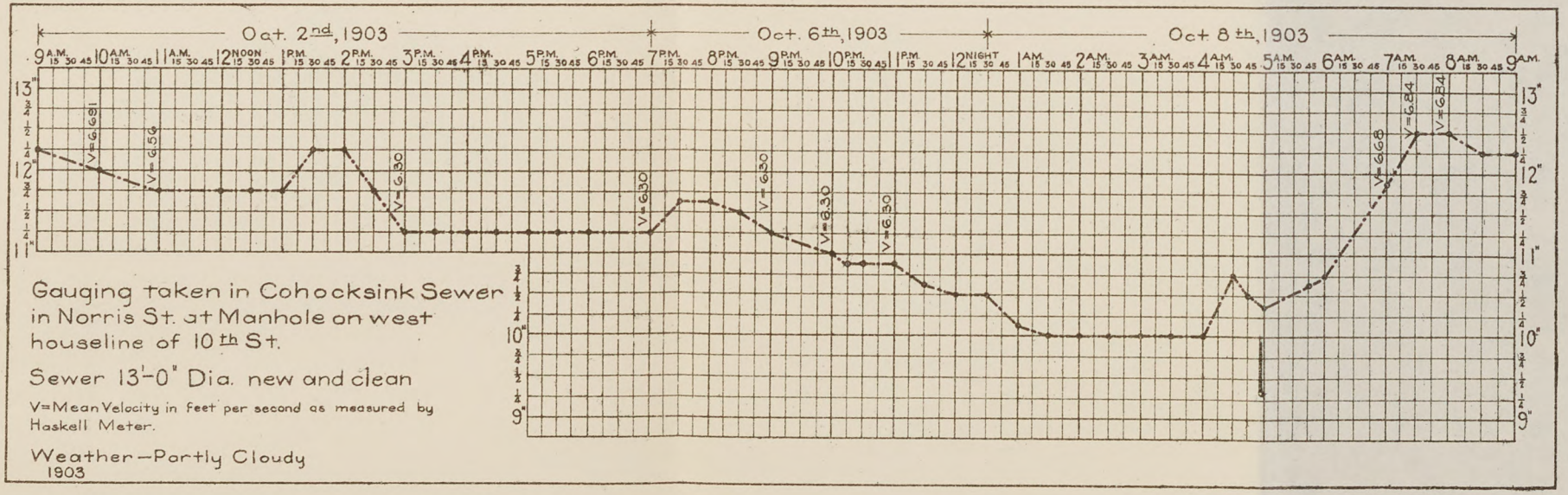
Norris street sewer east of Eighth street (sewer 8 feet 6 inches diameter).

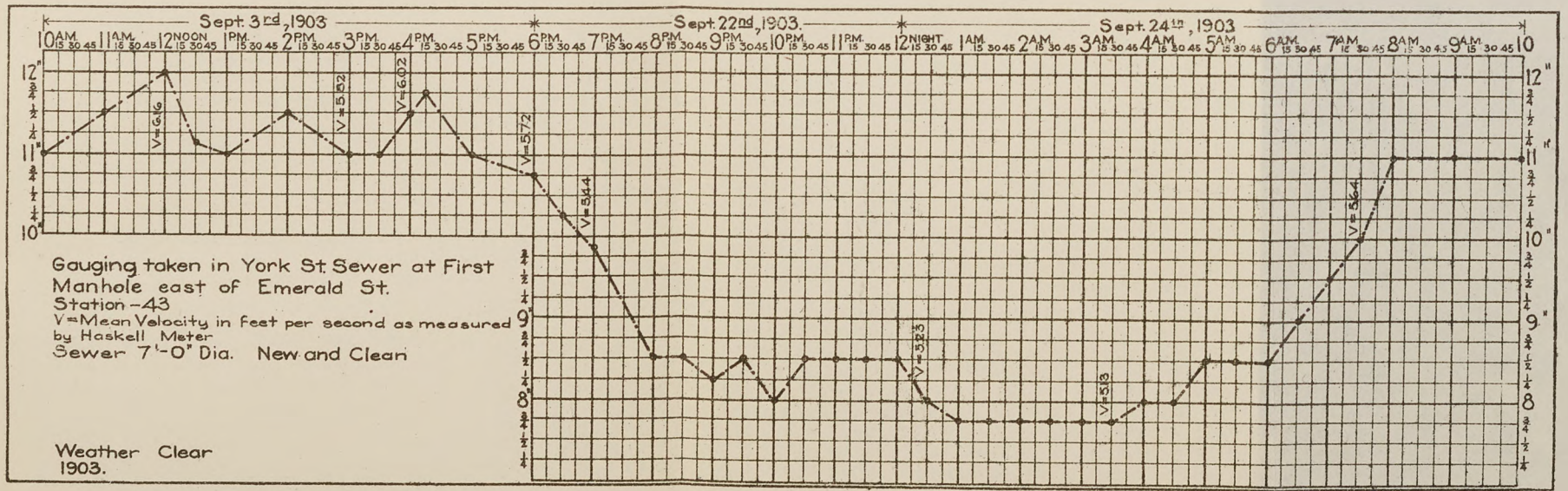
A chamber for another gauge is now under construction on the Cohocksink relief sewer (8 feet 6 inches in diameter) at Berks street near Marshall street. This gauge with those located on the Cohocksink sewer at Twelfth and Diamond streets and on Norris street east of Eighth street will be of especial value in obtaining data for the determination of the actual run off of the Cohocksink system in particular, and systems covering large areas, solidly built up and paved with impermeable pavement, in general.

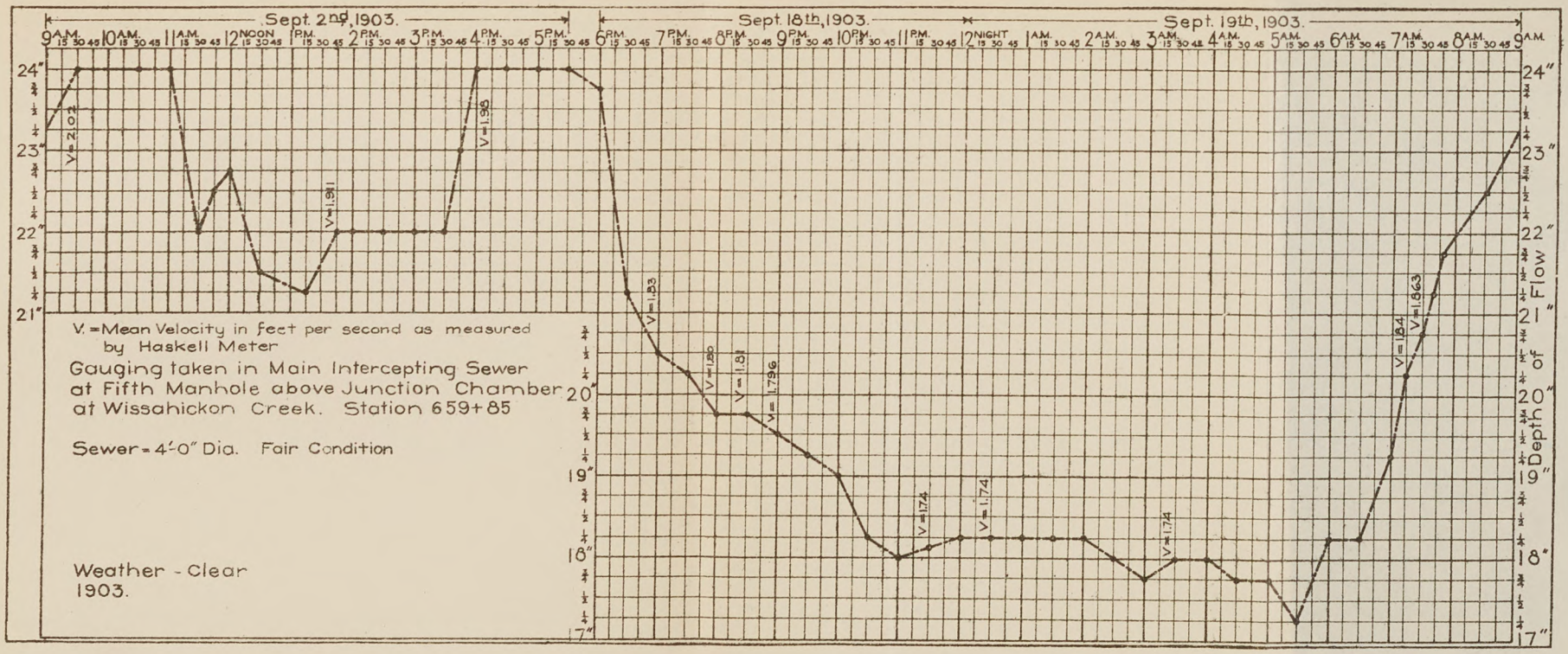
The instruments now in use are made by Richard Bros., Paris, and are automatic, simple of construction, and easily kept in repair. They require attention once a week, when the records are removed from the cylinders and the clocks wound.

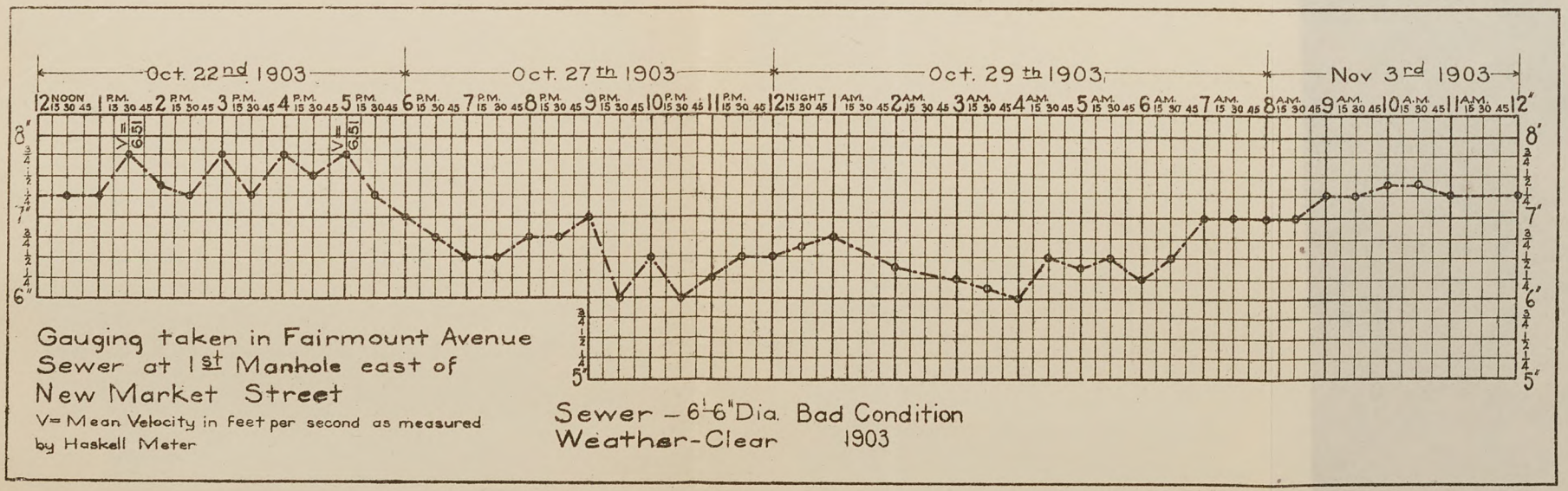
The stream gauge is set up in a chamber or wellhole constructed for this purpose, as shown in accompanying illustrations.

Measurements of depth of flow and velocity were also made during the fall of the year in several of the larger main sewers, and in the main intercepting sewer, to determine the volume of dry weather flow. The measurements of depth of flow were made at 30 minutes intervals during 24 hours; and velocity measurements were made with the Haskell meter at convenient intervals. Interesting results have been obtained and diagrams showing









graphically time and flow, are inserted in this report. By the following it will be noticed that the times of maximum and minimum flows vary greatly in the different sewers:

Sewer.	Time of maxium flow.	Time of minimum flow.
Fairmount Avenue..	1.30 P. M., 3 P. M., 4 P. M., 5 P. M.	9.30 P. M., 10.30 P. M. and 4 A. M.
Cohocksink	7.30 A. M to 8 A. M. 11.30 A. M. to 12	1.30 A.M. to 4 A.M. 2 A.M. to 4.30 A.M.
Hart Creek	noon, 2 P. M. and 3 P. M. to 5 P. M.	
Main Intercepting..	9.30 A. M. to 11 A. M., 4 P. M. to 5.30 P. M.	5.30 A. M.
Willow Street	8.30 A. M.	9.30 P. M.
York Street	12 noon.	1 A.M. to 3.30 A.M.

Even though due allowance be made for the difference in shape, size and slope of the drainage areas, it is evident that the time and extent of these fluctuations are principally due to the different occupations of the population and the character of the industries within the drainage areas. These must be fully considered in the design of sewerage systems, where it is intended to dispose of the sewage independent of the storm flow. It is the intention of this Bureau to continue these investigations and to profit by them in future designs.

Tidal observations were continued at Arch street wharf, and the usual good results were obtained.

There were both very high and low tides. The highest tides recorded occurred on October 10th at 2.30 P. M., when Delaware river rose to +1.64, and on October 11th at 3.15 P. M. it rose to +1.88. Low tides corresponding to these were extremely high, viz., October 10th at 11.30 P. M. —2.20, and October 11th at 11.15 A. M. —1.64, or about $\frac{3}{4}$ of a foot above the City standard plane —2.25 for mean high water. An extreme low water occurred

January 13th at 9 A. M., —10.54, and the corresponding high water, the lowest recorded, was on January 13th at 1.30 A. M., —6.50, or only about one foot above the mean low water computed for the year 1903. These extreme low figures for high and low water were due to a heavy northwest wind.

The mean high water recorded during the year 1903 is —2.08; the mean low water is —7.35.

The mean high water recorded during the years 1900, 1901, 1902 and 1903 is —2.28; low water —7.51.

This establishes the fact that the present established low water plane, —8.52, is one foot lower than the actual mean low water plane. Only once during the year did the weekly mean low tide go near or below the established low water plane, —8.52, as shown on accompanying chart.

The variation between the tides in this City for the year 1900 was 5.22 feet; for the year 1901, 5.06 feet; for the year 1902, 5.33 feet, and for the year 1903, 5.27 feet.

The average variation for the 4 years was 5.22 feet instead of 6.27 feet as shown by the arbitrary high and low water planes.

Laboratory for Testing Cements and Building Materials.

A large amount of public work has been under way, and owing to the increased use made of the laboratory by the various departments and bureaus, the demands upon it have been greater than in any other year. Although there has been an addition of some new apparatus and assistants, resulting in a considerable increase in its output, the cost of testing has been reduced.

The value of the cement alone used by the City during the year is approximately $600,000 and the values of iron and brick aggregate over $400,000, so that the value of

DEPARTMENT OF PUBLIC WORKS—BUREAU OF SURVEYS.

TESTING LABORATORY.

Average Results of Portland Cement Tests Made during 1903.

BRAND.	NUMBER OF SAMPLES.		NUMBER OF BRIQUETTES.		FINENESS IN PER CENT.			Specific Gravity.	SETTING.			PER CENT. OF WATER.		TENSILE STRENGTH—POUNDS PER SQUARE INCH.					MANUFACTURER.
									TIME IN MINUTES.		TEMPERATURE OF AIR.			NEAT.			1 TO 3.		
	Collect.	Reject.	Moulded.	Broken.	No. 50.	No. 100	No. 200.		Initial.	Hard		Neat.	Sand.	24 Hours.	7 Days.	28 Days.	7 Days.	28 Days.	
Alpha	70	0	600	476	0.0	7.4	24.6	3.149	9.7	34.6	71.4—73.5	19.2	9.3	320	697	739	223	308	Alpha Port. Cement Co.
*Atlas	12	2	152	124	0.0	8.4	23.7	3.100	2.7	31.8	68.8—70.3	17.2	8.9	409	661	728	158	232	Atlas Port. Cement Co.
Columbia	1	1	14	14	0.0	6.6	21.0	3.049	1.4	28.3	71.0—73.0	25.0	10.4	273	414	442	152	232	American Cement Co.
Dexter	2	0	28	28	0.0	7.8	23.6	3.119	14.4	26.7	72.5—75.5	19.0	9.0	335	769	817	286	302	Dexter Port. Cement Co.
Dragon	32	0	272	188	0.1	6.4	23.5	3.093	6.1	33.6	66.0—67.3	20.5	9.5	331	582	672	203	394	Lawrence Cement Co.
*Giant	443	6	3,298	2,712	0.0	8.0	24.1	3.141	8.9	34.5	72.3—74.2	19.5	9.3	412	741	804	242	311	American Cement Co.
*Helderberg	1	0	14	14	0.0	2.4	19.6	3.092	15.6	37.6	67.0—70.0	21.0	9.6	194	573	642	179	271	Helderberg Cement Co.
*†Hemmour	29	11	254	224	0.0	6.0	22.5	3.106	4.9	19.9	71.5—72.1	22.0	9.8	299	489	587	183	251	Port. Cem. Fabrik Hemmour.
Krause's	11	0	146	118	0.0	5.6	21.5	3.078	4.7	26.3	80.6—83.9	19.7	9.4	435	699	755	255	312	Martin's Creek Por. Cem. Co.
*Lehigh	792	46	5,632	4,626	0.0	8.0	24.0	3.164	7.2	34.0	70.0—71.8	19.0	9.3	370	680	787	202	302	Lehigh Port. Cement Co.
Nazareth	3	0	42	34	0.0	5.7	24.1	3.108	4.0	34.7	70.0—72.0	20.0	9.4	284	672	728	217	278	Nazareth Cement Co.
Northampton	9	0	126	102	0.0	6.1	25.0	3.094	6.2	32.7	67.1—68.7	19.7	9.4	311	722	758	179	275	Northampton Port. Cement Co.
Phœnix	7	0	98	82	0.0	3.9	20.9	3.097	5.2	27.3	76.0—78.1	21.9	9.8	420	656	690	272	335	Phœnix Cement Co.
†Saturn	7	2	98	86	0.0	4.6	20.0	3.075	1.1	6.9	73.0—73.2	23.6	10.1	241	423	530	175	248	W. T. Bradley Co., Agents.
*Saylor's	71	4	586	492	0.0	6.2	24.3	3.139	9.2	38.4	71.9—73.5	20.1	9.4	180	607	735	180	263	Coplay Cement Co.
*Star	708	19	5,128	4,304	0.0	6.8	23.9	3.129	7.9	31.9	70.7—72.3	19.5	9.3	422	753	783	233	311	Bonneville Cement Co.
Vulcanite	7	0	98	86	0.0	9.3	26.0	3.106	10.5	35.1	69.3—71.7	19.0	9.3	292	755	812	223	297	Vulcanite Port. Cement Co.
*Whitehall	85	3	674	548	0.0	7.0	25.8	3.140	6.4	32.2	71.0—72.7	19.3	9.3	457	749	797	236	311	Whitehall Port. Cement Co.

G. S. WEBSTER,
Chief Engineer.

* Average of accepted cement.
† German.

W. PURVES TAYLOR,
Engineer of Tests.

DEPARTMENT OF PUBLIC WORKS—BUREAU OF SURVEYS.

TESTING LABORATORY.

Average Results of Natural Cement Tests—Made during 1903.

BRAND.	NUMBER OF SAMPLES.		NUMBER OF BRIQUETTES.		FINENESS IN PER CENT.			Specific Gravity.	SETTING.			PER CENT. OF WATER.		TENSILE STRENGTH—POUNDS PER SQUARE INCH.					MANUFACTURER.
									TIME IN MINUTES.		TEMPERATURE OF AIR.			NEAT.			1 TO 2.		
	Collect.	Reject.	Moulded.	Broken.	No. 50.	No. 100.	No. 200.		Initial.	Hard.		Neat.	Sand.	24 Hours.	7 Days.	28 Days.	7 Days.	28 Days.	
*Cumberland & Potomac	74	2	604	492	0.6	7.2	17.9	2.814	20	70	74.6—75.2	33.0	11.3	150	239	295	186	305	Cumberland & Potomac Cement Co.
*Improved Anchor	96	17	736	648	0.4	6.9	18.7	2.926	76	311	71.2—72.6	25.3	11.4	133	229	338	140	238	Coplay Cement Co.
*Improved Bonneville	338	7	2,652	2,230	0.0	4.3	14.2	2.952	14	61	72.2—72.8	25.5	11.5	172	241	321	159	262	Bonneville CementCo.
Improved Shield	1	0	14	14	0.0	3.2	13.0	2.897	14	44	70 0—70.0	27.0	11.8	117	184	279	119	227	Lawrence Cement Co.
*Improved Union	111	2	826	720	0.0	4.2	13.5	2.981	11	38	71.4—71.6	25.2	11.4	217	251	325	167	271	American Cement Co.
Improved Warner	1	1	14	14	1.0	5.8	13.0	2.781	20	260	82.0—83.0	34.0	13.6	36	100	186	74	152	C. Warner Co., Agents.

* Average of accepted cements.

G. S. WEBSTER,
Chief Engineer.
W. PURVES TAYLOR,
Engineer of Tests.

the material which has been tested by the laboratory amounts to over $1,000,000.

The cost of operation of the laboratory including depreciation of plant amounts to less than 1 per cent. of the value of the raw material. A conservative estimate of the cost of this testing if done by private laboratories would place it at least at 2½ per cent., so that the efficiency of the laboratory can plainly be seen.

The actual value to the City by reason of securing high grade material in its public works is represented by many times the cost of maintenance of the laboratory.

In addition to its computed value, it is of great importance to the City in its influence, since the knowledge that all materials must pass rigid tests, entails upon the manufacturers the utmost care to maintain standards, and induces new devices to improve the quality, and simplify the manufacture of structural materials.

The equipment of the laboratory has been increased by a 30,000 pound capacity transverse testing machine for cast iron, bricks and concrete; a new rattler for making impact tests of paving brick, and two large storage tanks for the storing of briquettes and pats of cement.

During the year 2,911 shipments of cement have been inspected and tested, 2,290 of which were Portland and 621 natural or improved cements. This work has been done for the different bureaus. Each of these shipments has been tested for specific gravity, time of setting, fineness, soundness, and tensile strength with sand, while every fifth sample has been tested for tensile strength neat. Chemical analyses have also been frequently made.

From the table showing the number of cement tests made, it is seen that 759 more samples were tested this year than were tested in 1902, or an increase in capacity of over 35 per cent.

The testing of concrete cubes has been conducted this

year on a more extensive scale than ever, 547 of these tests having been made. The testing of these cubes made from the materials taken from the mixing boxes, was undertaken with a view of determining as near as possible the behavior of these materials in the various structures, in which they have been incorporated.

The increase in the number of such tests serves to give results from which a fair average can be obtained, useful in aiding the judgment in the design of future structures, and in giving to the profession more exact knowledge in regard to concrete.

The tests of paving brick amounted to 55—a gain of 12 over last year.

During this year a great number of tests have been made of cast iron, in connection with the pipe system being installed for the distribution of filtered water, over 4,000 of such tests having been made for tensile and transverse strength.

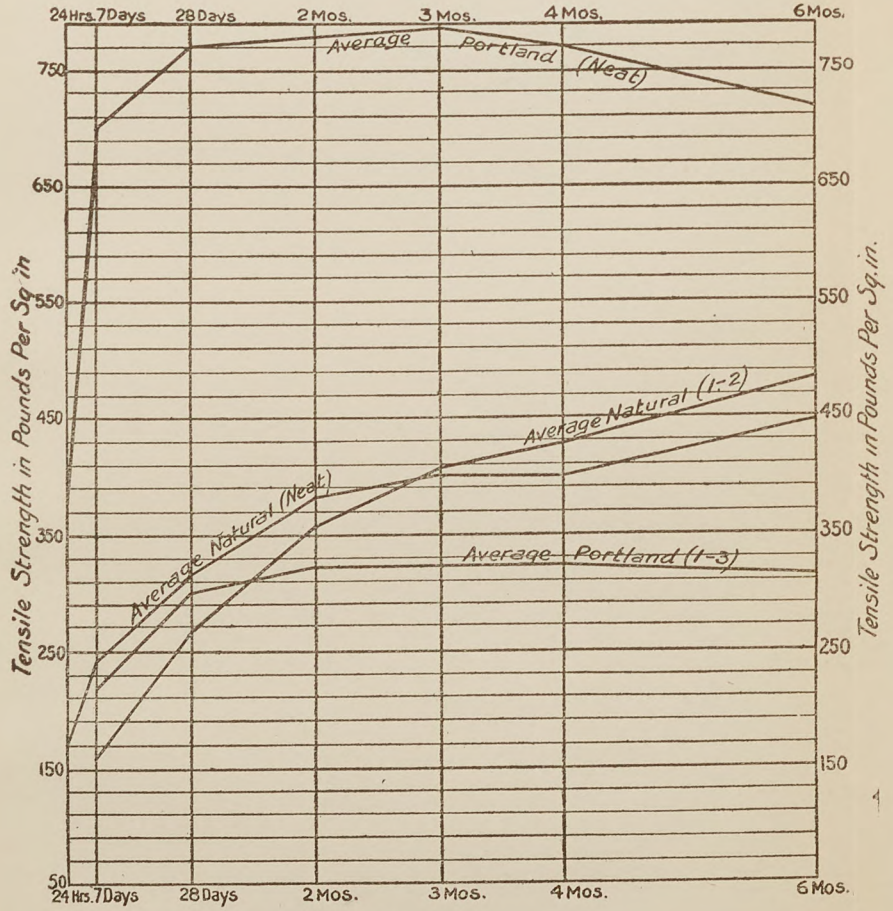
The appended tables show in detail the results of different tests which constitute the major part of the work of the laboratory.

In addition, however, to this routine work, tests of many other materials have been made, among which may be mentioned steel, asphalt, wood, stone, building brick, puddle, sand, wire rope, etc.

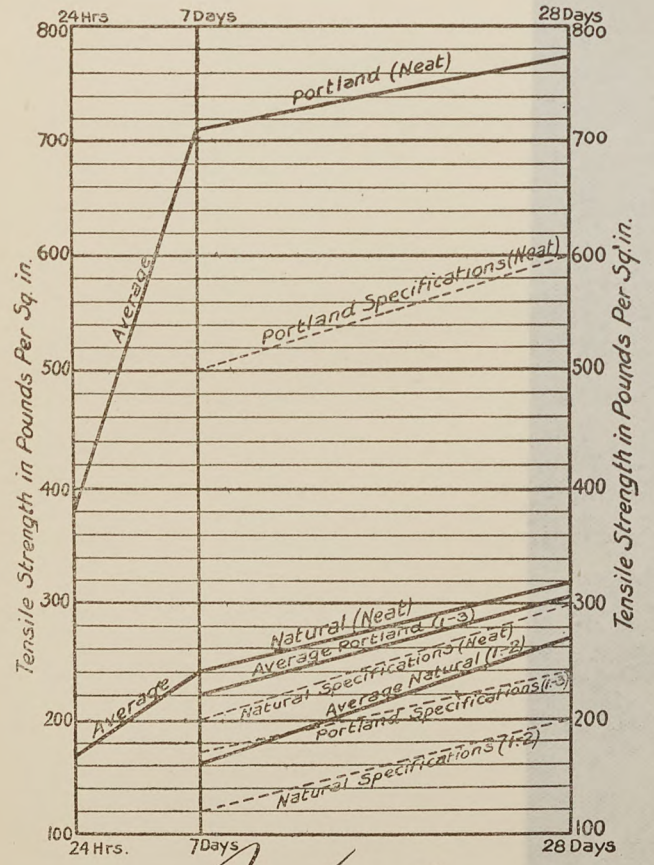
In the laboratory, investigations are continually being made for the obtaining of more reliable data concerning the properties of these materials, and also for the improvement of the methods of testing employed. It enjoys at present a wide reputation for the character of its work, and is of recognized value, not only to the City, but to the Engineering profession at large.

DEPARTMENT OF PUBLIC WORKS—BUREAU OF SURVEYS
TESTING LABORATORY

Diagrams showing Average Results of Cement Tests Neat and with Sand--Made 1903



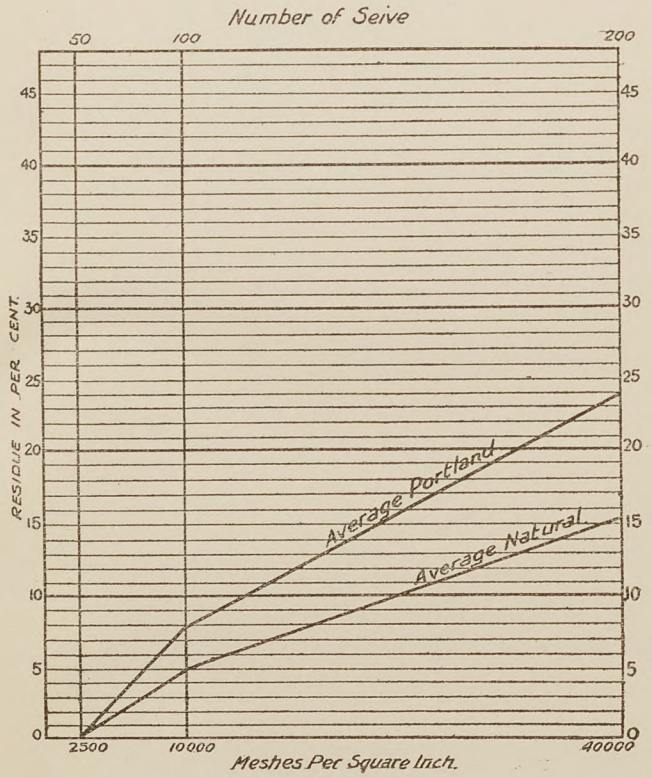
E. B. Webster
CHIEF ENGINEER.



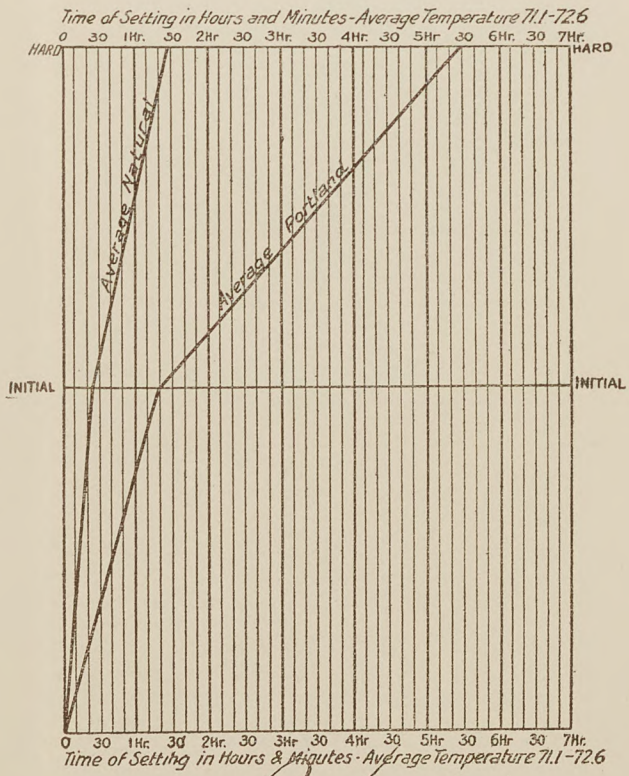
W. Purves Taylor
ENGINEER OF TESTS.

DEPARTMENT OF PUBLIC WORKS—BUREAU OF SURVEYS
TESTING LABORATORY

Average Results of Tests for Fineness and Time of Setting--Made during 1903.



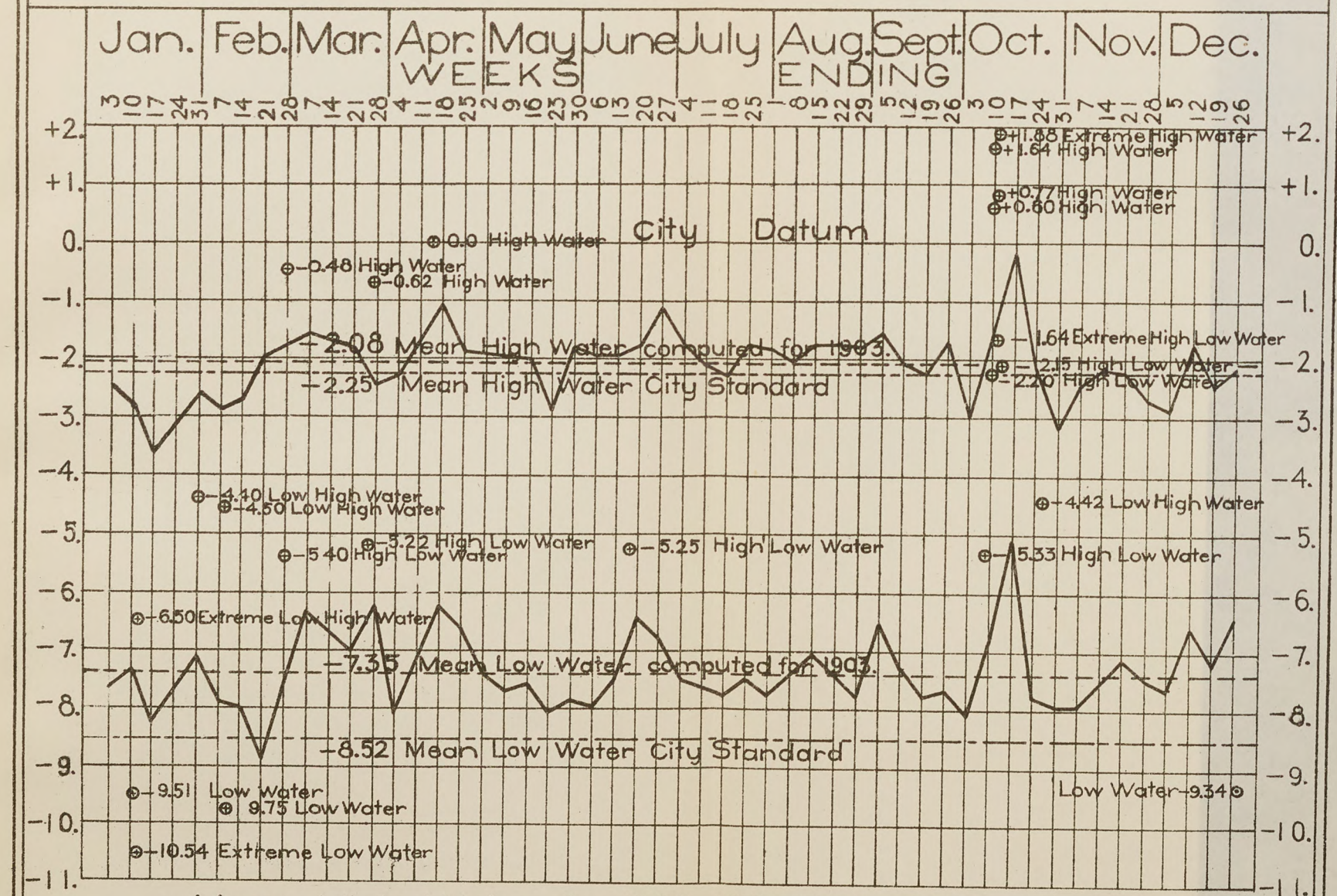
L. H. Webster
CHIEF ENGINEER.



Wm. Taylor
ENGINEER OF TESTS.

DIAGRAM OF TIDES FOR 1903 AT ARCH ST PIER.

Upper lines indicate weekly Mean High Water.
Lower " " " " Low "



Mean High Water for 1900, 1901, 1902 & 1903, −2.28
" Low " " " " " " " , −7.51

Bridges.

The funds available at the beginning of the year were as follows:

Item 19—Balance from 1902	$41,355 95
Item 19—New Bridges	150,000 00
Item 22—Poquessing Creek Bridge	20,000 00
Item 24—Stokley Street Bridge	35,000 00
Item 28—Balance (loan June 17th, 1898)	96,946 04
	$343,301 99

By ordinance of June 10, 1903, $5,000.00 was appropriated to Item 34 for one-half the cost of a footwalk tunnel under the tracks of the Philadelphia and Reading Railway at Tioga station, the other half to be paid by the Philadelphia and Reading Railway Company.

By ordinance of April 4, 1903, $10,000.00 was transferred from Item 24 to Item 19, and allotted to the Seventeenth and Indiana streets bridge.

By ordinance of December 14, 1903, the sum of $88,500.00 was transferred from Item 19.

There was expended during the year under bridge contracts and charged against the following:

Item 19	$60,152 09
Item 22	677 25
Item 24	13,672 96
Item 28	69,652 59
Item 34	1,738 20
Total	$145,893 09

Bridges under contract in the previous year, all of which were completed in 1903, with the single exception of the Passyunk avenue bridge over the Schuylkill river, were as follows:

Frankford avenue and Old Front street, over Frankford Creek.
Lehigh avenue, under Connecting Railway.
Dauphin street, under Connecting Railway.
Fifty-second street, over West Chester and Philadelphia R. R.
Passyunk avenue, over the Schuylkill River.

The new contracts made during the year are as follows:

Stokley street, over Richmond Branch of the Philadelphia and Reading Railway.

Seventeenth and Indiana streets, over the Philadelphia, Germantown and Norristown Railroad.

Tioga Tunnel (one-half cost payable by the Philadelphia and Reading Railway Company).

Frankford avenue and Poquessing Creek (one-half cost payable by Bucks County).

None of these have yet been completed.

Plans were advertised for Allegheny avenue bridge under the Connecting Railway and proposals were received July 30th, but the contract has not been awarded.

The following bridges for public use have been built by interested companies in accordance with ordinances and agreements:

Clarissa street bridge over the Richmond branch of the Philadelphia and Reading Railway, authorized by ordinance of April 7, 1893. The agreement was dated August 17, 1894.

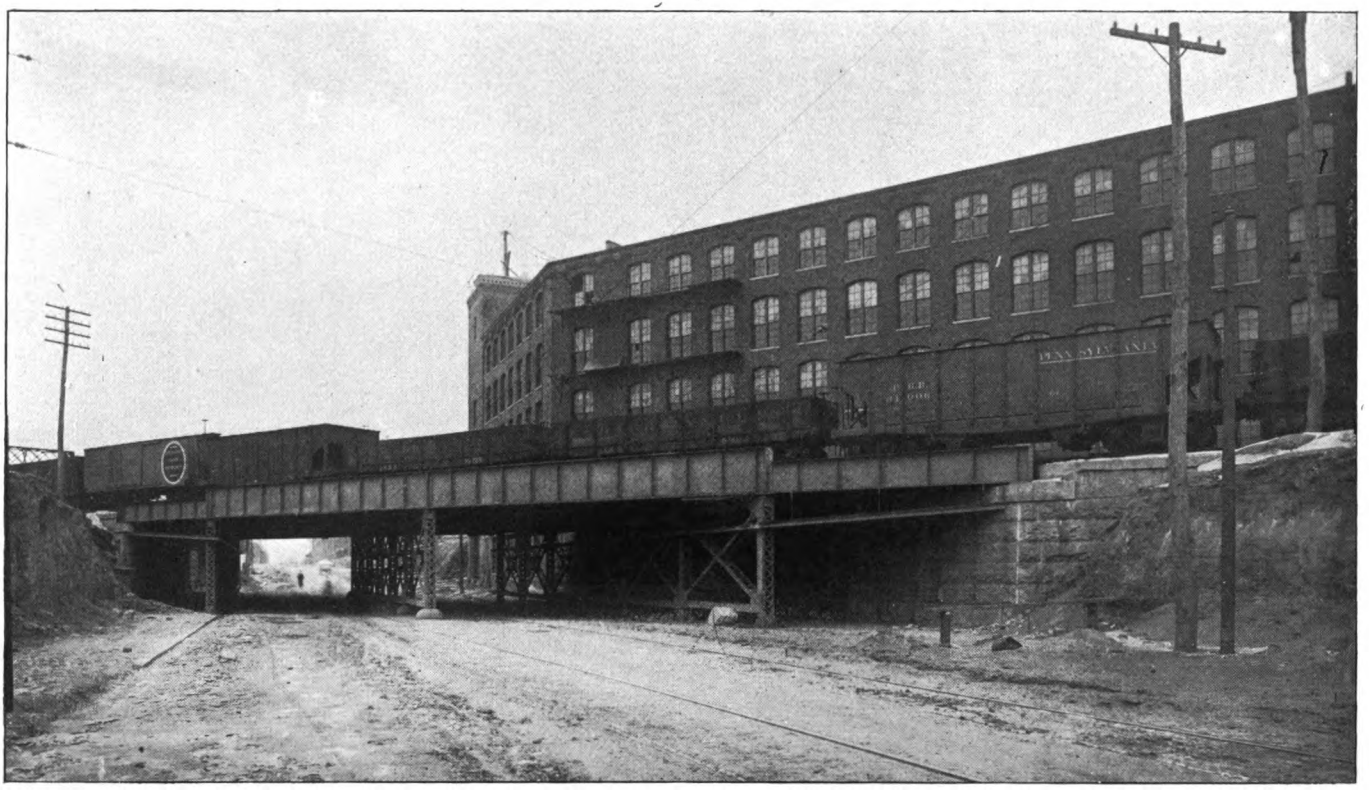
Extension of Spring Garden street bridge at west end, west of the Schuylkill river over six new tracks, by the Pennsylvania Railroad Company, authorized by ordinance of December 24, 1902.

Foot bridge over Pennsylvania avenue and Subway at Twenty-seventh and Aspen streets, by Burnham, Williams & Company, authorized by ordinance of May 20, 1903.

By ordinance of March 9, 1903, the appropriation of $150,000.00 for new bridges was apportioned and bridges authorized as follows:

Seventeenth and Indiana streets, over the Philadelphia, Germantown and Norristown Railroad.

Allegheny avenue, under Connecting Railway, with the proviso that the Pennsylvania Railroad Company contribute at least $20,000 toward the construction of the bridge.



LEHIGH AVENUE, UNDER CONNECTING RAILWAY, DECEMBER 18, 1903.

Frankford Avenue and Old Front Street Bridges and Changing the Course of Frankford Creek.

Frankford avenue and Old Front street bridges, fully described in the last report, are of steel plate girders and carry these streets over Frankford creek, the contract including also the work of changing the channel of the creek, and riprapping the banks to prevent erosion by the current. The work comprised also the straightening of the lines of Frankford avenue and Old Front street.

The completion of this work improved the congested condition at this point and added much to the appearance of Frankford avenue. The Contractor for the work was Henderson & Co., Ltd. Date of contract, May 13, 1901. Limit of contract, $110,532.00.

The total cost was $103,741.27, of which $20,566.87 was for sewers and paid for from the branch sewer item. Also the sum of $4,682.00 was paid by the Union Traction Company for temporary bridge. Final estimate was paid April 3, 1903. Inspector, Daniel Walsh. Inspector of Steel Work, J. A. Colby.

Lehigh Avenue under the Connecting Railway.

Lehigh avenue bridge carries the tracks of the Connecting Railway (the New York division of the Pennsylvania Railroad) over the line of Lehigh avenue, which has been excavated to pass under the railroad. The structure is of steel plate girders in four spans on two granite abutments and three lines of steel columns. The contract included the construction of sewers in Lehigh avenue and Eighteenth street. The total cost, exclusive of the shoring of tracks, which was done as a contribution by the Pennsylvania Railroad Company was $76,708.84, of which $4,924.34 was for sewers and taken from the branch sewer item. Contractors, Henderson & Co., Ltd. Date of contract,

May 18, 1901. The final estimate was paid November 18, 1903. Inspectors, Benjamin H. Foulkrod and John Barlow.

Dauphin Street under the Connecting Railway.

Dauphin street bridge carries the five main tracks and three side tracks of the Connecting Railway over Dauphin street, the design being similar to that of the Lehigh avenue bridge. The total cost, exclusive of the shoring of tracks, which was done as a contribution by the Pennsylvania Railroad Company, was $63,555.60. Contractors, Henderson & Co., Ltd. Date of contract, September 7, 1901. Final estimate was paid September 14, 1903. Inspector, Benjamin H. Foulkrod.

Fifty-second Street Bridge over the West Chester and Philadelphia Railroad.

Fifty-second street bridge over the West Chester and Philadelphia Railroad is of steel plate girder construction. Because of the limited appropriation the bridge is only one-half the width of Fifty-second street and has a temporary floor of wood. The structure is designed for ultimate extension to the full width of the street and for a permanent floor of asphalt. Contractors, Henderson & Co., Ltd. Date of contract, December 6, 1901. Final estimate was paid May 18, 1903. Total cost, $29,154.14. Inspector, George Warner.

Passyunk Avenue Bridge over the Schuylkill River.

This bridge which was authorized by ordinance of December 12, 1900, is intended to connect sections on both sides of the Schuylkill river, which must at the present time depend upon circuitous route for communication. Upon the east bank of the Schuylkill river there is a high

DAUPHIN STREET, UNDER CONNECTING RAILWAY, DECEMBER 18, 1903.

bluff, and upon the west bank low flats for a distance of a mile back from the river. The line of Passyunk avenue crosses the river about at the apex of a horse-shoe shaped curve, around which the largest vessels entering the port are constantly going and coming. Various studies were made of the most desirable bridge to be adopted, but the one most favored, and which has been finally submitted to the Secretary of War, and received his approval, provides for a channel span of Bascule, or lift bridge type, the leaves of the bridge when raised giving a clear water way of 244 feet.

The approaches to the river span will be partly viaduct of steel and partly filled embankment. Driveways are intended to be 36 feet clear between curbs, with a 10 feet wide footway on each side.

Plans of the western approach, abutments and four piers of the viaduct approach were advertised September 20, 1902, and the contract was awarded to David Peoples. Date of contract, November 19, 1902. Limit of contract, $55,000.00.

The foundations of this work have been put in and about forty per cent. of the contract completed. There has been paid on account the sum of $17,460.74.

The peculiar type of bridge adopted for this locality renders it impracticable to place the piers in the river under separate contracts, or independent from the steel working parts of the bridge, as the entire design of the masonry is dependent upon the design submitted for the steel work.

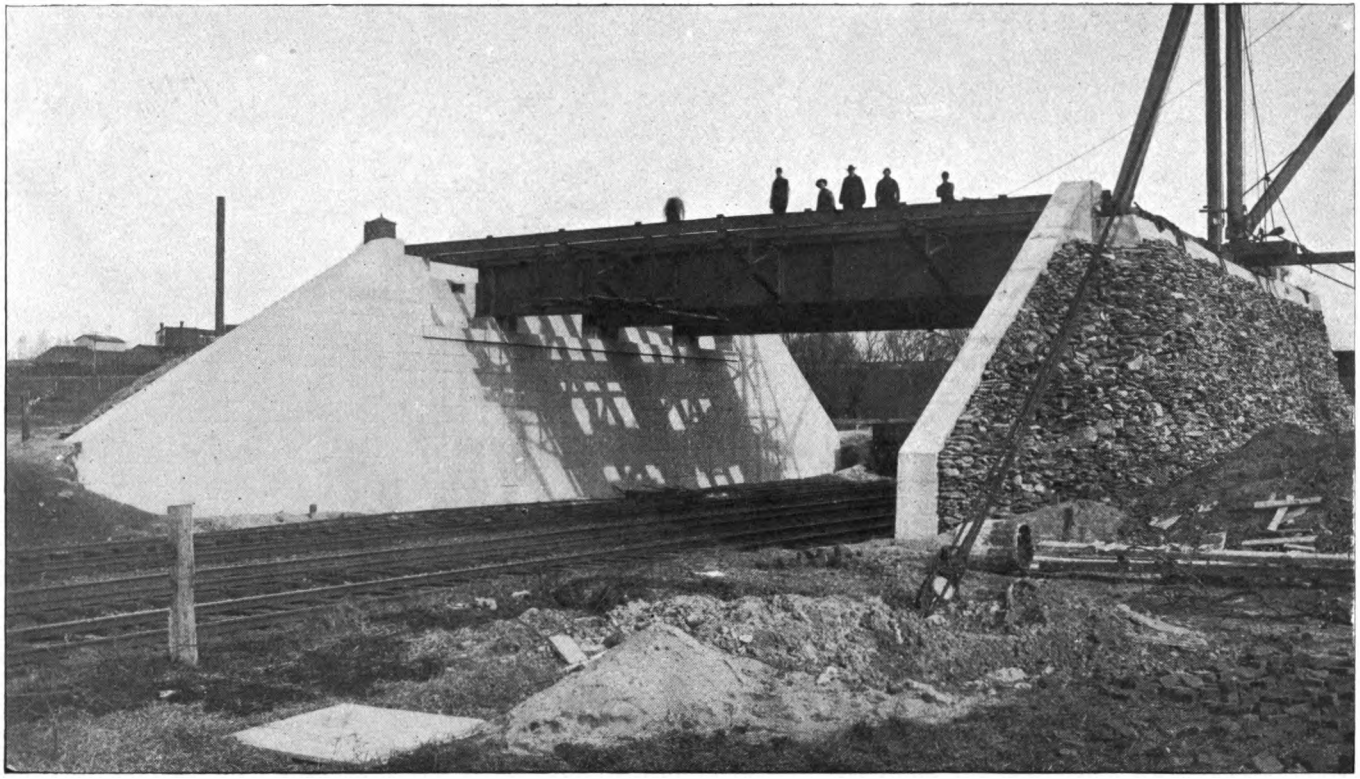
It is therefore necessary to make a liberal appropriation sufficient to complete both masonry and steel work under one contract.

Stokley Street Bridge over the Richmond Branch of the Philadelphia and Reading Railway.

This bridge is on the line of Stokley street, in the Thirty-eighth Ward, over the Richmond branch of the Philadelphia and Reading Railway. It has a clear span between abutments of 56 feet. It is steel deck plate girder construction, 60 feet wide over railings and will be paved with asphalt on the driveway and have granolithic sidewalks. The masonry is entirely cement concrete, reinforced at the top with embedded steel rods. Sections of 6 feet sewer have been built through the foundations of the abutments in provision for the future construction of a sewer in Stokley street. Contractors, McGaw and Gray. Bids were received March 23, 1903. Date of contract, April 14, 1903. Limit of contract, $25,000.00. Work seventy-eight per cent. done. Amount paid on account, $13,672.96. Inspector, Thomas W. Harvey. Inspector of Steel Work, Osborn Engineering Company.

Bridge at Seventeenth and Indiana Streets over the Tracks of the Philadelphia and Reading Railway.

This bridge is at the intersection of Seventeenth and Indiana streets, and carries the conjoined lines of these two streets over the tracks of the Philadelphia, Germantown and Norristown Railroad and the New York Division of the Philadelphia and Reading Railway. It is a steel through bridge with three trusses, skewed at north end, 127 feet clear span between abutments on center line, with two driveways each 21 feet 9 inches between curbs, and two sidewalks each 10 feet wide, the total width between railings being 74 feet. The abutments are of cement concrete reinforced with steel rods. Two lines of street railway tracks will be laid on the bridge. The driveways will be paved with asphalt, and the sidewalks with granolithic.



STOKLEY STREET, OVER RICHMOND BRANCH P. & R. RAILWAY, DECEMBER 12, 1903.

SEVENTEENTH AND INDIANA STREETS, OVER P., G. & N. R. R., DECEMBER 18, 1903.

Contractors, McGaw and Gray. Bids received March 23, 1903. Date of contract, April 14, 1903. Limit of contract, $78,000.00. The work is 80 per cent. completed. Amount paid on account, $47,065.20. Inspector, Thomas W. Harvey. Inspector of Steel Work, Osborn Engineering Company.

Bridge on the Line of Frankford Avenue over Poquessing Creek.

The appropriation of $20,000.00 for one-half the cost of constructing a new bridge in place of the old stone arch bridge on the line of Frankford avenue over Poquessing creek, between Philadelphia and Bucks County, provided that one-half the cost should be paid by Bucks County. The revised plans made by this Bureau, upon which new proposals were obtained, were approved by the Commissioners of Bucks County, August 17, 1903, proposals were received September 18, 1903, and the contract for construction awarded. The joint contract was signed by the Commissioners and approved by the court of Bucks County.

On account of the lateness in the season the only work accomplished before suspension for the winter was the building of the temporary bridge, the removal of the old bridge, and the laying of a portion of one foundation. The structure will be a composite arch of concrete and embedded steel, 71 feet clear span between abutments, 60 feet wide over parapets, with macadamized driveways 40 feet between curbs and two 8 feet 6 inches granolithic sidewalks. The parapets will be of paneled concrete with steel ribs. As all the steel work will be embedded in the concrete and nowhere exposed to the air, painting will never be required and the cost of maintenance will be confined to the driveway. Contractor, John McMenamy. Date of contract, September 24, 1903. Limit of contract, $15,000.00. Amount paid on account, $593.92. Inspector, Daniel Walsh. Inspector of Steel Work, J. A. Colby.

Footwalk Tunnel at Tioga Station—Philadelphia and Reading Railway.

The appropriation of $5,000.00 for one-half the cost of a footwalk tunnel under the tracks of the Philadelphia and Reading Railway at Tioga Station, provided that the other half of the cost be paid by the Philadelphia and Reading Railway Company. Proposals were received September 18, 1903, and the work awarded.

The tunnel is floored, walled and roofed with cement concrete, the roof, which carries the railroad tracks, being reinforced with embedded steel rails. The concrete is overlaid with asphalt mastic to exclude water. The approach stairways will also be constructed of concrete, and covered with a tile roofed canopy or shed. This tunnel will afford a convenient and safe passage for pedestrians along Tioga street, from one side to the other of the railroad, avoiding both the danger and delay of the grade crossing. Contractors, Millard & McGraw. Date of contract, October 23, 1903. Limit of contract, $10,000. Amount paid on account, $1,558.20. Inspector, J. M. Hipple.

Thirty-third Street over Pennsylvania Avenue and the Connecting Railway.

In two operations the abutments and retaining walls have been built for the projected bridges carrying Thirty-third street over Pennsylvania avenue, on which are the Philadelphia and Reading Railway tracks, and over the Connecting Railway, and are ready for steel superstructures. The first work was done in 1895, and the second contract, the abutment on the north side of Pennsylvania avenue and the retaining walls, was finished in 1902. The City has already expended on this improvement $224,000.00—more than two-thirds of its estimated total cost—and it will not be available for use until the superstructures of the two

bridges are completed. The Bureau of Highways has contracted for the necessary grading to be done without cost to the City. The opening of Thirty-third street will give a convenient and beautiful drive from a populous district to Lemon Hill and the East Park, and a more direct communication with easy grades between North and West Philadelphia.

An additional appropriation, sufficient to complete this work, is urged on the ground of expediency as well as that of necessity.

Allegheny Avenue under Connecting Railway.

Allegheny avenue is open continuously from the Delaware river to Ridge avenue, except at the crossing of the Connecting Railway near Ninth street, where travel must pass around by way of Glenwood avenue and Germantown avenue. A bridge at this point under the railroad will greatly facilitate street traffic and benefit the sections of the City separated by the railroad.

The bridge proposed will consist of 16 lines deck plate girders to carry eight tracks with a span of 50 feet 8½ inches.

Owing to the existing underground structures it is necessary to place a line of columns in the center of the avenue, resting on concrete piers.

The main abutments are designed to be built of rock faced ashlar and have a clear distance of 101 feet 5 inches between under copings. The girders will be so placed as to give a clear head room of 16 feet over the avenue.

Walnut Lane over Wissahickon Creek.

The only means of communication at present between Germantown and Roxborough, two important manufacturing and residential districts, are by long round about ways with steep grades. A high level bridge across the

Wissahickon valley will afford direct communication and enhance the value of much property in two populous sections of the City. Besides being an important thoroughfare such a bridge, if built on the plan designed by this Bureau and illustrated herewith, will be a monumental structure—an imposing ornament to one of the most beautiful portions of our park. The plan contemplates a main arch of stone, 225 feet in the clear—longer than any heretofore built in this country—spanning the Wissahickon drive and the creek, with approach arches of 45 feet clear span each, carrying the 60 feet wide street at an elevation of 120 feet above the creek. The design is peculiarly adapted to the contour of the ravine, and the rocky bluffs afford the most economical and satisfactory foundations.

While, from the location of the bridge, the cost is considerable, the large amount of traffic between the two sections of the City will justify the outlay, to save time and decrease the cost of transportation.

Graver's Lane over Chestnut Hill Branch of the Philadelphia and Reading Railway.

Graver's lane is an important highway of Chestnut Hill, Twenty-second Ward, a beautiful and growing residence section of the City. It crosses the Chestnut Hill branch of the Philadelphia and Reading Railway on a dilapidated wooden trestle without sidewalks. The Railway Company has agreed to bear an equitable share of the cost of a new bridge. The plans prepared by this Bureau contemplate an arch of concrete and steel that will be economical in first cost, inexpensive to maintain, and ornamental in appearance.

The present bridge is in such a condition that it may be necessary to divert travel from this important highway.

For the small outlay required, it is expedient to construct this bridge as early as practicable.

Wyoming Avenue over Frankford Creek.

In 1895 the City constructed a viaduct on the line of Wyoming avenue over Fishers lane and Frankford creek, but the avenue is still interrupted by a loop of the same creek between "L" and Unity streets, at the intersection of the Thirty-fifth, Twenty-third and Thirty-third Wards.

Wyoming avenue is laid out as a wide thoroughfare between Germantown and Frankford, but at present the means of communication between these two sections are insufficient, a long detour for all street traffic being required. In order to utilize fully the viaduct already built the avenue should be opened through, which will require a viaduct over the loop at the point referred to, including two spans over the creek and a trestle over the intervening lowland. This would assist materially in the development of a large and promising territory.

Hunting Park Avenue over the Richmond Branch of the Philadelphia and Reading Railway.

The present crossing of Hunting Park avenue over the Richmond branch of the Philadelphia and Reading Railway is on an old wooden bridge, without sidewalks, and inadequate for the passage of street cars. The crossing should be widened to accommodate pedestrians and to permit the extension of the Nicetown line of cars eastward of Germantown avenue to Broad street and Hunting Park. The Philadelphia Rapid Transit Company has agreed to pay one-third of the cost of a new bridge that will accommodate their two tracks, and the Philadelphia and Reading Railway Company, in consideration of additional track room under it, will also pay one-third of the cost, leaving only one-third to be borne by the City. Plans have been prepared by this Bureau for a suitable bridge at this point, and await action by Councils before they can be carried out.

Erie Avenue over the Richmond Branch of the Philadelphia and Reading Railway.

Erie avenue—one of the widest highways of the City—is at present interrupted west of Eleventh street by the Richmond branch of the Philadelphia and Reading Railway, and the nearest passage across the railroad is by the dangerous Venango street grade crossing. A bridge on the line of Erie avenue would doubtless stimulate the development of the large district east of the railroad by giving it an opening to Broad street and the Tioga section of the City. The plans for the bridge have already been prepared and the avenue has been graded on each side of the railroad.

Clarissa Street Bridge over the Richmond Branch of the Philadelphia and Reading Railway.

In pursuance of agreement of August 17, 1894, under ordinance of April 7, 1893, the Philadelphia and Reading Railway Company constructed for City use, under the inspection of the Bureau of Surveys, a steel plate girder half through bridge on the line of Clarissa street, in the Thirty-eighth Ward, over their Richmond branch. It has concrete abutments, two street railway tracks, two 10 feet granolithic sidewalks, and asphalt driveway 49 feet 6 inches between curbs. The cost was borne entirely by the Railway Company. This bridge forms the only avenue of travel to Germantown between Germantown avenue and Wissahickon avenue.

Spring Garden Street over the Pennsylvania Railroad.

The Pennsylvania Railroad Company, under authority of ordinance of Councils, December 24, 1902, added six tracks to its main line and constructed an extension to the Spring Garden street bridge over the new tracks. The extension is 100 feet long and wider than the old bridge,

Summarized Statement of Bridges Built During Year 1903.

Location of Work.	Date of Ordinance.	Appropriation.	Bids Received.	Awarded to.	Date of Contract.	Limit of Contract.	Limit of Payment by Interested Companies.	Percentage of Work Completed Dec. 31, 1903.	Amount Paid by the City Dec. 31, 1903.	Date of Final Estimates.
Frankford avenue and Old Front street over Frankford Creek, changing the course of Frankford Creek and sewers in Frankford avenue and Old Front street	December 12, 1900. June 21, 1900..... March 12, 1901....	$100,000 00 Branch sewers	March 21, 1901.....	Henderson & Co., L'td..	May 13, 1901.....	$110,582 00	$4,682, Union Trac. Co...	100.	$78,492 40 20,566 87	April 3, 1903. April 3, 1903.
Lehigh avenue, under Connecting Railway	December 12, 1900.	74,000 00	March 21, 1901.....	Henderson & Co, L'td .	May 18, 1901.....	80,300 00	Shoring tracks.....	100.	77,540 50	November 17, 1903.
Dauphin street, under Connecting Railway	December 12, 1900.	40,000 00	July 2, 1901.....	Henderson & Co., L'td..	September 7, 1901..	64,000 00	Shoring tracks	100.	63,555 60	September 14, 1903.
Passyunk avenue, over the Schuylkill River (one Abutment and four Piers)	December 12, 1900.	75,000 00	September 20, 1902.	David Peoples.....	November 19, 1902.	55,000 00	.....	40.	17,460 74	
Fifty-second street, over the West Chester and Philadelphia Railroad.	July 27, 1901..	25,000 00	Novembe 20, 1901.	Henderson & Co., L'td..	December 6, 1901...	31,000 00	.....	100.	29,234 14	March 16, 1903.
Seventeenth and Indiana streets, over the Philadelphia, Germantown and Norristown Railroad	March 9, 1903.....	70,000 00	March 23, 1903.....	McGaw & Gray.....	April 14, 1903.....	78,000 00	.....	80.	47,065 20	
Stokley street, over Philadelphia and Reading Railway	December 29, 1902.	35,000 00	March 23, 1903.	McGaw & Gray.....	April 14, 1903.....	25,000 00	.....	78.	13,672 96	
Tioga Tunnel, under Philadelphia and Reading Railway	June 10, 1903.....	by the City, 5,000 00	September 18, 1903.	Millard & McGraw.....	October 23, 1903....	5,000 00	$5,000 00, P. & R. Rwy....	45.0	1,558 20	
Frankford avenue, over Poquessing Creek	December 29, 1902.	by the City, 20,000 00	September 18, 1903.	John McMenamy.....	September 24, 1903.	15,000 00	One half cost by County of Bucks.	11.6	593 92	
Approach to Frankford avenue, over Poquessing Creek	December 29, 1902.		September 18, 1903.	Joseph Purna.....	December 21, 1903.	2,500 00				

giving the full width between curb lines of Spring Garden street. The structure is of steel plate girders, driveway paved with asphalt, sidewalks granolithic, railings ornamental, closed panels of cast iron. The maintenance of the structure will devolve perpetually upon the Railroad Company. The work was done under the supervision of this Bureau, and was finally accepted by the City July 29, 1903, with the exception of the wooden smoke shield.

Twenty-seventh and Aspen Streets Footbridge over the Philadelphia and Reading Railway and Baltimore and Ohio Subway.

By ordinance of May 20, 1903, Burnham, Williams & Company, Baldwin Locomotive Works, were authorized to remove the present wooden foot bridge over the Pennsylvania avenue subway at Aspen street and construct a steel foot bridge crossing the Subway, and their Pennsylvania avenue tracks overhead, with an approach from Twenty-seventh street. This bridge is now in process of erection and will abolish the grade crossing of the railroad sidings, and will be an ornamental passage to Fairmount Park. The entire cost is paid by Burnham, Williams and Company, and the work is being done under the supervision of this Bureau. Inspector, John Hare.

Bridges Urgently Needed.

For some years past there has been a decrease in the annual appropriations for bridges, consequently this branch of public work has not been keeping pace with the extensive real estate development of the City.

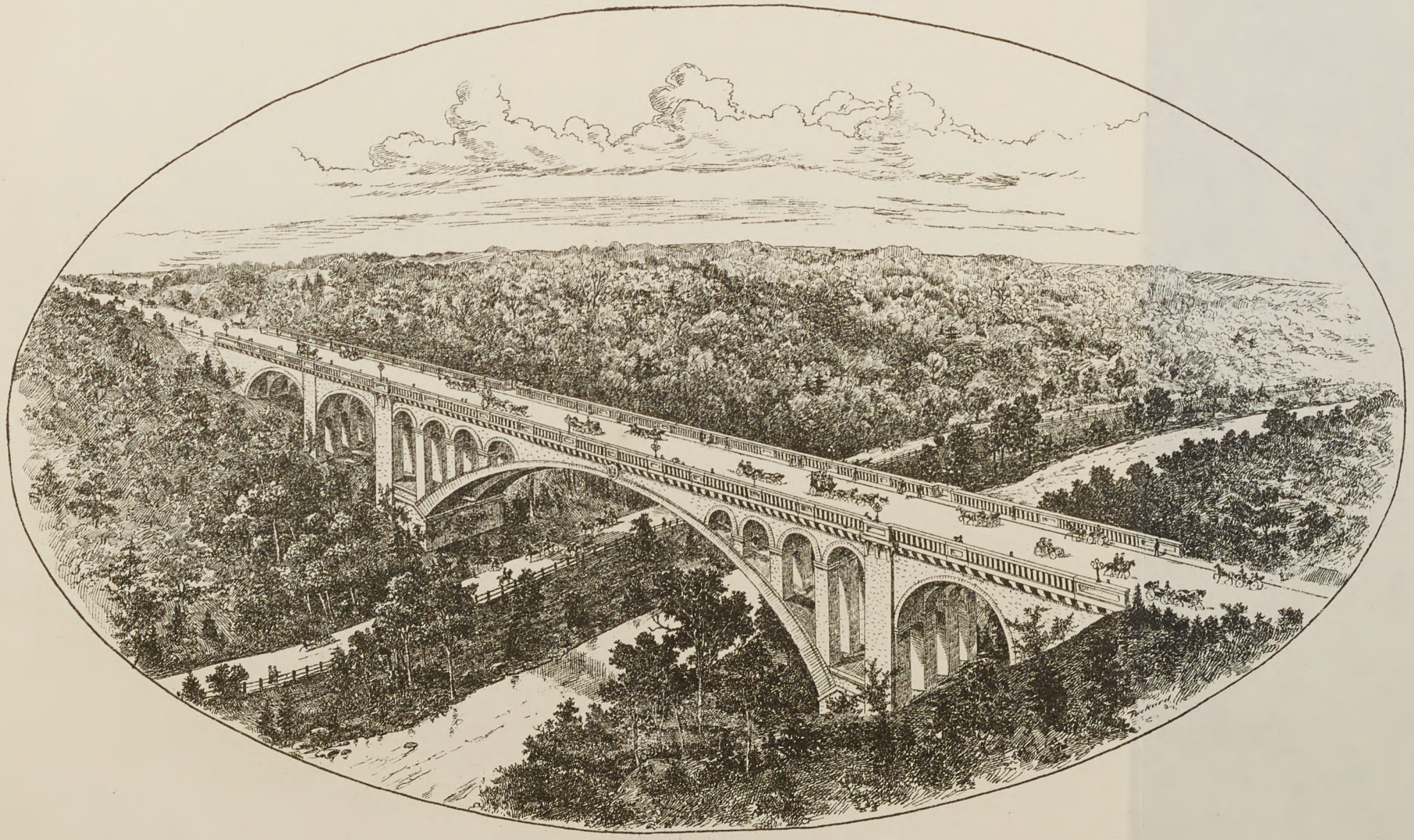
These developments are dependent upon and demand more convenient means of communication across or under railroads or over streams.

A list of urgently needed bridges follows:

Thirty-third street, over Philadelphia and Reading Railway, and Connecting Railway (to complete the superstructure).
Hunting Park avenue, over the Richmond Branch of the Philadelphia and Reading Railway.
Large street, under the Frankford Branch of the Philadelphia and Reading Railway.
Erie avenue, over the Richmond Branch of the Philadelphia and Reading Railway.
Walnut lane, over Wissahickon Creek.
Graver's lane, over the Chestnut Hill Branch of the Philadelphia and Reading Railway.
Fifty-second street, over West Chester and Philadelphia Railroad (to complete).
Sedgley avenue, over Richmond Branch of the Philadelphia and Reading Railway.
Glenwood avenue, over Richmond Branch of the Philadelphia and Reading Railway.
Wyoming avenue, over Frankford Creek.
Armat street, under Chestnut Hill Branch of the Philadelphia and Reading Railway.
Montgomery avenue, over Connecting Railway.
Fifty-eighth street, over West Chester and Philadelphia Railroad.
Front street, over Connecting Railway.
Sixty-fifth street, over Baltimore and Philadelphia Railroad.
D street, over Connecting Railway.
Sixtieth street, over Philadelphia, Wilmington and Baltimore Railroad.
Twelfth street, under Connecting Railway.
Upper deck, Falls Bridge.
School lane, over Philadelphia, Germantown and Norristown Railroad.
Approach to Falls Bridge.
Willow Grove avenue, under Germantown and Chestnut Hill Railroad.
Belfield avenue, under Philadelphia and Reading Railway.
Allegheny avenue, under Connecting Railway.
Passyunk avenue, over Schuylkill River (to complete).

Development of Low Ground in Southern Section of the City.

One of the most difficult problems with which the Bureau has been engaged for some years is that of the proper de-



velopment of low lying territory in the Southern section of the City.

This ground prior to the erection of the river embankments many years ago, was covered with water at every high tide.

By the erection of the banks there were reclaimed about 5,000 acres in the Fortieth Ward, and about 4,000 acres in the Twenty-sixth, Thirty-sixth and Thirty-ninth Wards.

At the present time the land is utilized principally for trucking, the surface water being drained into ditches which empty into the rivers through sluices on the east side, and by pumpage on the west side of the Schuylkill.

The rapid increase of building in the Fortieth Ward, and the gradual encroachment for building purposes in the Twenty-sixth and Thirty-ninth Wards, upon this low territory emphasizes the necessity for a speedy solution of plan of development.

The portion between the Delaware and Schuylkill rivers, which in a few years will undoubtedly be built up solidly presents few difficulties, other than that of obtaining material for filling to grades that will provide adequate drainage by gravity to the rivers.

The method of treatment in the Fortieth Ward is more complex, owing to the depth of filling required to provide drainage.

Similar conditions have arisen in other cities, notably Chicago and Boston. In both of these cities large areas of low land have been reclaimed from the encroachment of the tides, filled in, streets improved, drainage systems built, and abutting property occupied by large apartment houses, manufactories and residences.

In the case of Boston, the work was simplified by State legislation, empowering it to be done by a commission with power to condemn and acquire property, and to sell it after the improvement.

From reports it appears that the work was done at a profit, without considering the advantage to the City in increased tax returns and large accessions of valuable real estate near the center of the City. A somewhat similar work was successfully completed in Chicago.

The question in this City can be treated only from the standpoint of the requirements of the City 50 years hence, when the three and one-half millions of estimated population, in order to be properly housed, will require the use of the territory in question.

Profiting by the experience in other cities it appears advisable to fill in all the low land to a height sufficient to give adequate gravity drainage to the rivers.

This policy is strengthened by the knowledge of the recent experiences at Galveston, Texas, where to prevent a repetition of the disastrous inundation in 1900 the Government has constructed a concrete retaining wall or breakwater 16 feet in height above low water and 4 miles in length.

Behind this wall lies a city of 40,000 inhabitants, the buildings, streets and all other structures of which are to be raised from 9 to 12 feet above the present elevation.

In this connection, it would be good business policy, if necessary legislation could be enacted, for a commission to acquire land in the Fortieth Ward; and secure the material to be dredged in the Delaware river in the work of completing the 30 feet and the 35 feet channel projects, in which work it is estimated that 68 millions of cubic yards of material will be dredged from the Delaware river. If this could all be secured, or it would be practicable to tow it and place over the banks in the Fortieth Ward, it would be sufficient to raise the 5,000 acres a height of 8 feet, or if but one-half could be secured 2,500 acres could be so raised, all at a saving to the City and owners.

Improvement of Delaware Avenue.

The work of completing the improvement of Delaware avenue, between Vine street and South street, has been delayed, as far as the permanent paving of the avenue is concerned, owing to the necessity of completing negotiations with the various railroad interests having rights upon the avenue, with a view to determining upon a location for the tracks in the avenue, and the adoption of a rail section to meet all the requirements.

The rail section was adopted May 13, 1903, and after conferences with the various interests the location of the tracks was decided upon July 31, 1903.

By agreement between the various railroad interests under date of June 3, 1902, it was arranged that the Pennsylvania Railroad Company should do the actual work of laying the tracks, and the expense would be apportioned.

By agreement of May 20, 1902, between the City of Philadelphia, Trustee, under the will of Stephen Girard, the Pennsylvania Railroad Company, the Philadelphia and Reading Railway Company, and the Philadelphia Belt Line Railway Company, an arrangement was entered into by which the number of tracks was limited to three, rules were fixed for the laying of sidings and handling the traffic, and the obligation of the Railroad Companies for paving and repaving portions of the street surface determined, also the length of time during which the Railroad Companies would be held responsible for maintenance.

The preliminary arrangements having been made, it is expected that the Railroad Companies will be prepared to lay the tracks during the coming spring, at which time the department will be prepared to proceed with the paving of the avenue on a permanent concrete foundation.

In the matter of the continuation of the work of widening Delaware avenue, between Vine street and Green street,

after negotiations with the owners of property to fix the amount of damages had been brought to a satisfactory conclusion, the result of these negotiations was messaged to Councils by the Mayor on April 14, 1902. No action has yet been taken to provide an appropriation, and the accomplishment of the work is therefore delayed.

Deepening the Delaware River.

While the Department of Public Works has no connection with the work of deepening the channel of the Delaware river at the present time, in view of the large expenditures made by the City to carry on this work at a time when there was a lack of government appropriation, it seems fitting that some record be made of the progress being made since the work of the City was completed.

For the improvement of the channels of the Delaware and Schuylkill rivers, the City has at various times appropriated the sum of $1,555,000, of which $770,000 has been expended in the Delaware river; $300,000 of this was expended in removing the shoals at Schooner Ledge and Illinois rock, increasing the depth of water over these ledges from a minimum of 18 feet to 26 feet, and for a width of channel of 600 feet. The average depth obtained approximates 28 feet.

Since the City completed its work the government made borings, advertised and awarded contracts and, it is reported, is now engaged in rock removal for the 30-feet channel project, at this point.

During the past year there has been considerable agitation on the part of the various maritime and trade bodies, with a view to modifying the present project for improving the Delaware river channel so as to obtain a minimum depth of 35 feet. Committees from these bodies joined by the City authorities have been granted hearings by Congressional Committees with a view to securing the neces-

sary legislation to inaugurate this improvement, in order that this City may be able to present advantages equal to that of other seaboard cities to the commercial interests of the world.

For some years past no work has been done by the Government towards the improvement of the Schuylkill river channel.

In the absence of appropriations for this purpose, the City has furnished funds to aid in the work of improvement, to meet the requirements of commerce.

Improvement of the Channel of the Schuylkill River.

Under former contracts, during the years 1895 to 1899, the channel of the Schuylkill river had been dredged to a depth of twenty-two (22) feet below the plane of mean low water, from Penrose Ferry bridge to Fifty-eighth street, and to a depth of twenty (20) feet from this point, northward to about Harrison's wharf.

The requirements of navigation demanded that the depth of the channel be further increased to twenty-six (26) feet up to the northern limits of the oil refinery wharves to accommodate the increasing draught of the steamers arriving at this port.

The dredging of the twenty-six (26) feet channel was begun in 1901, under Contract No. 9, and resulted in the formation of a channel two hundred and fifty (250) feet wide and twenty-six (26) feet below mean low water, from deep water at the mouth of the river to about five hundred (500) feet above the Penrose Ferry bridge. The sum of $400,000 was set aside from the loan of June 11, 1902, by authority of ordinance of Councils of June 27, 1902, for the improvement of the channels of the Delaware and Schuylkill rivers.

The formation of a thirty (30) feet channel in the Delaware river having been undertaken and put under contract

by the United States authorities, rendered it unnecessary for the City to make any provision for this river and the entire sum was therefore devoted to the improvement of the Schuylkill river, northward from Penrose Ferry bridge. Plans and specifications for the continuance of the work were drawn up and bids were received March 23, 1903. The contract was awarded to the American Dredging Company, the lowest bidder.

The work under Contract No. 10, contemplates the following improvements to the channel of the Schuylkill river: The dredging out of the new East Channel through Gray's Ferry bridge, to a depth of twenty (20) feet below mean low water, and after removing some old wharves, to construct a piling fender rack in front of the East Rest pier of the Pennsylvania Railroad Company's new bridge, also the widening and deepening of the river approaches to these bridges, whereby the channel through both sides of the draw-spans will be made available for traffic, greatly benefiting navigation at this place. The contract requires the removal of all materials, from the channel of the river, from a point about 500 feet north from the Penrose Ferry bridge, the terminus of Contract No. 9, northward to a point about 1,000 feet above the Philadelphia Refinery Company wharf, to a depth of twenty-six (26) feet below mean low water, and from this point northward toward Harrison's wharf, it is proposed to secure 20 feet depth.

The twenty-six (26) feet channel is to be generally 250 feet in width, except around Yankee Point and at the oil wharves, where 300 feet is proposed.

The twenty (20) feet channel is to be generally 150 feet in width except where the conditions favor or demand 200 feet in width.

As in Contract No. 9, all material, except rock, and wreckage dredged from the channel of the river, is to be deposited by the hydraulic method, beyond high water mark

within the limits of League Island Park, both east and west of Broad street. This requirement will tend to raise more nearly to the proposed height, not only the entire easterly portion of the park, but also about 56 acres of the low lying portion on the west.

As necessary adjuncts to the work a canal from the Delaware river, about 4,400 feet long, of ample width and depth to accommodate the tows of scows and a receiving basin at the upper end of this canal, about 200 by 700 feet in size were excavated in the upper back channel at League Island. To properly impound the material within the park limits to prevent the flooding of adjacent properties, about 7,020 linear feet of embankment was constructed, together with a system of drainage ditches and sluices for discharging the surplus water of pumpage in such manner as to reduce to a minimum the possibility of any of the material finding its way back into the river and thus create shoaling of the channel.

Notice to begin work was given June 15, 1903, time to complete eighteen (18) months.

Work was begun promptly on dredging out the old wharves and on preliminary preparation so that by August 17, the work of channel dredging was begun about 500 feet north from Penrose Ferry bridge.

Two dredges have been constantly at work on channel dredging and for a short time three were employed. One and sometimes two pump dredges have been at work at the receiving basin, pumping material over the banks. One of these dredges discharges material through a 20-inch, the other through a 30-inch pipe. About 261,000 cubic yards of mud, sand, clay and gravel and several large boulders, amounting to 33.62 cubic yards, have been removed from the channel of the river; the ends of the old wharves that projected within the east channel line at Gray's Ferry, have been dredged out; the fender rack in front of the Pennsyl-

vania Railroad Company's bridge pier has been completed and the channel through the east side of the draw-spans at these bridges, has been dredged to a depth of twenty (20) feet at mean low water.

A length of 45/100 miles of the 26 feet channel has been completed under the present contract and about 7/10 of a mile of additional length of channel stripped of the soft overlying material. There has been paid on account of work done, $95,406.56.

Inspectors, Thos. Valentine, Henry A. Wendell, Geo. J. Simpson, Cornelius Stephens.

Registry Division.

The work done in the Registry Division is as follows:

Number of certificates of registered owners issued....	4,223
Number of searches issued to Law Department.....	547
Number of liens issued to Law Department.....	1,181
Cash paid Tax Receiver for searches.....	$1,054 00
Cash paid Tax Receiver from miscellaneous sources....	216 60
Number of original lots plotted.....	10,171
Number of transfers entered	35,369
Number of erroneous descriptions of property and titles to real estate corrected	2,361
Number of plans made for Law Department, Bureau of Highways, etc.	501
Number of examinations of Registry Books by the public	54,833
Number of descriptions filed for registry.....	45,540
Number of certificates of legal opening of streets.....	2,078
Number of affidavits of opening of streets examined and entered as legally open to public use.....	73
Number of deeds of dedication received.....	83
Number of deeds, releases and agreements recorded...	143
Amount paid for recording deeds	$396 20
Number of Road Jury plans ordered by Law Department	212

The work of filing loose descriptions of registered owners of property in stub books was as follows:

Number of new stub books completed.....	1,403
Number of descriptions filed	68,823
Number of current descriptions filed.....	30,141
Number of descriptions filed to January 1, 1904.....	589,727

The following shows the number of registry plan books that were rewritten, new plan pages made in part, and all rebound during the year 1903:

Books, North, 1, 15, 16, 21, 26, 32, 40, 42, 44, 50, 55, 60, 73, 74, 77, 86, 92, 98, 102, 115, 116, 120, 121; total.....	23
Books, South, 1, 15; total	2
Number renewed during the year	25

The continuation of the work of filing records in a systematic manner, has made it necessary to increase the facilities for filing.

Nearly all of the wall space of the rooms allotted to the registry division has been utilized for the filing of these records. Additional cases must be provided, and these will form an upper tier, utilizing the only available space.

The work of renewing old books from year to year, is barely sufficient to keep pace with their deterioration from frequent handling.

In these renewals, every effort is made to secure the best of materials, and best method of binding, to insure a longer term of service than the old books.

Concluding Remarks.

The engineering work, both in the offices of the various districts and in the main office is varied from year to year, dependent upon the classes of public works or improvements by corporations or private enterprises which are dominant. In certain district offices considerable time has been given the problems which have arisen to meet the new conditions imposed by extensive railroad improvements, in others, the preparation of plans in detail for boulevard and parkway

improvements. In the main offices, the time was occupied in planning for new public works, placing under contract and constructing these and superintending a large amount of work of various kinds which was begun during previous years. New projects for civic improvement have been studied and reported upon, the most modern methods of time saving devices for keeping the rapidly increasing number of records have been installed.

The assistants are men of scientific attainments, with special training of many years in the several lines in which they are engaged.

There were no changes in the principal office holders during the year.

The work of the employes in all parts of the bureau has been attended to with faithfulness, in some cases requiring a high grade of ingenuity and skill to properly carry out public improvements.

I desire to acknowledge the interest which you have taken in the affairs of the Bureau, and the support which you have given its policy with a view to securing the best results for the City.

The usual tables showing the detailed work and report of the bureau are appended.

Respectfully submitted,

G. S. WEBSTER,

Chief Engineer.

Bureau of Surveys. Appropriations for 1903. Balance Sheet.

Item.		Appropriations, Balances and Transfers.	Available Appropriations.	Expended.	Balance Merging.	Balance Not Merging.
1	For salaries general office, Registry Bureau and engineer corps	$62,760 00				
	Transferred to, May 26, 1903 $900 00					
	Transferred to, June 10, 1903 250 00					
	Transferred to, June 15, 1903 100 00	1,250 00				
		$64,010 00				
	Transferred from, December 2, 1903 $461 00					
	Transferred from, December 14, 1903 84 00	545 00				
			$63,465 00	$63,358 26	$106 74	
2	For stationery, record books, draughting material and instruments	$3,000 00				
	Transferred to, October 22, 1903	600 00				
			3,600 00	3,600 00		
3	For cleaning offices, carriage hire, advertising and incidentals	$2,000 00				
	Transferred to, October 22, 1903	500 00				
			2,500 00	2,500 00		
	For recording deeds of dedication	.....	500 00	396 20	103 80	
4	For salaries and expenses of district surveyors: For salaries of fourteen district surveyors	$42,000 00				
	For wages of employes, expenses, rent, furniture tools, and instruments, carriage hire, horse-keep and incidental expenses	138,000 00				
	Transfer to, October 22, 1902	5,000 00				
			185,000 00	184,996 10	3 90	
5	For corner stones and replacing landmarks	.....	500 00	472 00	28 00	
6	For examination of bridges and sewers	.....	$500 00	$497 67	$2 33	
7	For renewing plans and descriptions and rebinding plan books in Registry Bureau	.....	3,700 00	3,700 00		

Bureau of Surveys. Appropriation for 1903. Balance Sheet—Continued.

Item.		Appropriations, Balances and Transfers.	Available Appropriations.	Expended.	Balance Merging.	Balance Not Merging.
8	For carriage hire and keep of horses for Chief and assistant engineers		$1,200 00	$1,200 00		
9	For expenses Board of Harbor Commissioners, including salary of secretary, attending the preparation of plans of Port of Philadelphia		300 00	300 00		
10	For salaries of three inspectors of drain connections, at $1,200 each		3,600 00	3,600 00		
11	For salary of Supervisor of Intercepting Sewer		900 00	900 00		
12	For printing and engraving maps of the City		200 00	196 07	$3 93	
13	For the repair, reconstruction and improvement of old sewers, and for the construction of manholes, ventilators and inlets for the same	$25,000 00				
	Balance Item 13, 1902	31,003 85				
	Transfer to, December 28, 1903	1,400 00				
			57,403 85	57,317 28	86 57	
14	For removing objectionable footway gutters		2,000 00	1,154 68	845 32	
15	For the reconstruction of inlets		5,000 00	4,727 42	272 58	
16	For the construction of branch sewers and inlets and the payment of bills of assessment against city property	60,000 00				

Bureau of Surveys. Appropriation for 1903. Balance Sheet—Continued.

Item.		Appropriations, Balances and Transfers.	Available Appropriations.	Expended.	Balance Merging.	Balance Not Merging.
	Item 16—Continued.					
	Balance Item 16, 1902	$9,915 32				
	Transfer to April 4, 1903 $42,000 00					
	Transfer to May 26, 1903 1,000 00					
	Transfer to June 10, 1903 10,400 00					
	Transfer to June 15, 1903 628 00					
	Transfer to October 22, 1903 950 00					
	Transfer to December 2, 1903 8,000 00					
	Transfer to December 14, 1903 38,313 00					
		101,291 00				
		$171,206 32				
	Transfers from, December 28, 1903	1,400 00				
			$169,806 32	$104,294 99	.....	$65,511 33
17	For maintenance of pumping station at Mingo Creek	$4,000 00				
	Additional appropriation, April 4, 1903	3,000 00				
	Transfer to, December 14, 1903	500 00				
			7,500 00	7,484 78	$15 22	
18	For the construction of main sewers	$100,000 00				
	Balance, Item 18, 1902	81,033 65				
	Transfer to, May 21, 1903	27,000 00				
	Transfer to, December 14, 1903	46,000 00				
			254,033 65	188,247 92	.....	65,785 73
19	For the construction of new bridges	150,000 00				
	Balance Item 19, 1902	41,355 95				
	Transfer to April 4, 1903	10,000 00				
			201,355 95			
	Transfer from May 26, 1903 $1,900 00					
	Transfer from December 14, 1903 88,500 00					
		90,400 00				
			110,955 95	60,152 09	.....	50,803 86

Bureau of Surveys. Appropriation for 1903. Balance Sheet—Continued.

Item.		Appropriations, Balances and Transfers.	Available Appropriations.	Expended.	Balance Merging.	Balance Not Merging.
20	For McKean street relief sewer.....	$25,000 00				
	Balance Item 20, 1902.....	12,600 00				
			$37,600 00	$37,600 00		
21	For Cohocksink relief sewer.....	100,000 00				
	Balance Item 21, 1902.....	50,400 00				
			150,400 00	105,600 00	.....	$44,800 00
22	For the reconstruction of bridge over Poquessing Creek.....	20,000 00				
	Transfer from December 2, 1903..... $8,000 00					
	Transfer from December 14, 1903..... 500 00					
		8,500 00				
			11,500 00	677 25	.....	10,822 75
23	For the construction of Market street sewer.....	.....	100,000 00	.....	.....	100,000 00
24	For the construction of bridge on the line of Stokley street.....	35,000 00				
	Transfer from April 4, 1903.....	10,000 00				
			25,000 00	13,672 96	.....	11,327 04
25	For abolishing grade crossings on Pennsylvania avenue and Noble street. Balance Item 25, 1902. Loan March 15, 1894.....	1,514 86				
	Credit by Controller February 19, 1903.....	42,000 00				
			43,514 86	42,775 09	.....	739 77
26	For widening Delaware ave., extending wharves, altering sewers, etc., and for costs and damages. Balance Item 26, 1902. Loan Jan. 13, 1896.....	.....	43,553 53	.....	.....	43,553 53
27	For deepening channels Delaware and Schuylkill rivers. Balance Item 27, 1902.....	.....	1,065 72	1,065 72		

Bureau of Surveys. Appropriations for 1903. Balance Sheet—Continued.

Item.		Appropriations, Balances aad Transfers.	Available Appropriations.	Expended.	Balance Merging.	Balance Not Merging.
28	For construction of new bridges. Balance Item 28, 1902. Loan June 17, 1898.....	.....	$96,946 04	$69,652 59	.....	$27,293 45
29	For dredging Delaware and Schuylkill rivers. Balance Item 29, 1902. Loan June 11, 1902.....	.....	400,000 00	117,983 92	.....	282,016 08
30	For the construction of branch sewers and inlets. Balance Item 16½, 1902. Loan June 11, 1902.....	.....	112,963 61	110,038 37	.....	2.925 24
31	For the construction of main sewers. Balance Item 18½, 1902. Loan June 11, 1902.....	.....	755,800 00	635.205 30	.....	120,594 70
32	For the construction of main sewers. Balance Item 23, 1902 Loan June 17, 1898..... Transferred from May 15, 1903..	$40,869 83 40,869 83				
32½	For extension of Shunk street sewer. Transferred to May 15, 1903. (Loan June 17, 1898).	.....	40,869 83	8,100 02	.....	32,769 81
33	For abolishing grade crossings on the line of the Philadelphia and Trenton Railroad: Balance, Item 24, 1902, loan June 17, 1898.....	.....	699,889 22	.....	.....	699,889 22
34	For the construction of tunnel at Tioga Station: Appropriated, June 10, 1903..... For dedication of Delaware avenue by Pennsylvania Railroad: Appropriated, June 15, 1903.....	....	5,000 00 2,000 00	1,738 20 2,000 00	....	3,261 80
35	For testing apparatus for testing laboratory: Transferred to, December 14, 1903.....	.....	500 00	500 00	.....	
			$3,399,267 58	$1,835,704 88	$1,468 39	$1,562,094 31

Recapitulation.

Appropriation for 1903	$885,160 00	
Balance available from 1902	2,378,911 58	
Additional appropriations during 1903	286,910 83	
	$3,550,982 41	
Transfers from	151,714 83	
	$3,399,267 58	
Amount expended		$1,835,704 88
Amount merged		1,468 39
Balance carried forward to 1904		1,562,094 31
		$3,399,267 58

Receipts of the Bureau of Surveys (except District Surveyors) for the Year 1903.

	Sewer Permits.	Sewer Assessment Bills.	Balances of Accounts.	Removing Objectionable Footway Gutters.	Searches.	Miscellaneous	Total.
January	$106 50	$1,300 14	$6 84	$430 60	$67 75	$19 10	$1,930 93
February	221 00	1,535 60	62	537 95	63 75	20 00	2,378 92
March	1,090 50	2,119 19	7 34	242 00	93 25	29 60	3,581 88
April	1,112 00	577 78	6 87	86 20	99 75	36 35	1,918 95
May	1,153 25	427 43	28 64	.....	102 75	23 10	1,735 17
June	1,337 00	1,742 91	20 78	.....	108 25	13 35	3,222 29
July	987 00	823 42	4 00	.....	102 00	5 00	1,921 42
August	927 50	1,296 96	36 18	.....	69 75	3 85	2,334 24
September	978 50	2,027 89	2 32	.....	83 00	11 50	3,103 21
October	1,101 00	1,919 67	.....	.....	94 50	31 85	3,147 02
November	862 00	724 56	31	.....	78 25	16 55	1,681 67
December	445 50	350 00	.....	157 39	91 00	6 35	1,050 24
Total	$10,321 75	$14,845 55	$113 90	$1,454 14	$1,054 00	$216 60	$28,005 94

General Statement of Work Done by District Surveyors During the Year 1903.

District.	Surveyor and Regulator.	Lots Surveyed, Number of.	Curb Regulations, Linear Feet.	Grade Regulations, Linear Feet.	New Paving, Square Yards.	Repaving, Square Yards.	Macadam, Square Yards.	Footway Paving and Repaving Square Yards.	Street Lines and Grades Projected, Acres.	Street Lines and Grades Revised, Acres.	Topographical Surveys, Acres.	Farm Land Surveyed, Acres.	Estimates of Projected Work Prepared.	Grading Measured, Cubic Yards.
1	John M. Nobre.....	354	35,450	85,781	33,809	3,124	3,282	1,100	6	1,696	.....	69	79	321,841
2	Charles W. Close..	230	11,281	5,275	363	26,589	3,521	.....	4	.....	.....	15	45	87,241
3	W C. Cranmer....	603	10,686	44,386	.....	16,403	.....	.....	.....	117	.....	.....	9	
4	Frits Bloch.....	210	3,682	16,740	2,962	44,533	.....	2,932	.....	151	.....	.....	6	
5	Walter Brinton....	1,088	28,877	155,000	67,138	2,828	.....	.....	225	2,260	.....	266	75	345,494
6	Joseph Mercer.....	383	32,528	87,628	27,990	54,933	.....	.....	45	75	.....	45	237	256,914
7	W. K. Carlile.....	172	3,575	22,411	2,126	4,871	.....	2,587	.....	.....	.....	.....	5	10,515
8	C. A. Sundstrom...	235	15,701	7,213	10,417	98	.....	.....	.....	300	.....	69	30	22,176
9	Joseph C. Wagner.	663	28,983	171,296	17,296	530	17,927	26	.....	964	.....	.....	28	90,715
10	J. H. Webster, Jr..	314	8,886	176,398	33,059	20,323	67,156	.....	.....	650	100	152	37	87,509
11	Joseph Johnson...	2,104	48,521	192,519	61,765	1,835	20,423	1,853	.....	253	.....	.....	129	80,428
12	J. H. Gillingham..	1,010	30,524	127,533	24,020	11,359	.....	.....	.....	.....	.....	308	109	140,766
13	H. M. Fu ler.....	546	21,097	84,783	31,238	1,987	.....	.....	.....	550	.....	75	50	107,210
14	C. B Webster.....	45	5,852	117,789	.....	.....	92,689	.....	231	622	1,423	608	12	31,715
	Total.....	7,957	285,643	1,294,752	312.183	189,413	204,998	8,498	511	7,638	1,523	1,607	851	1,582,524

General Statement of Work done by District Surveyors during the Year 1903—Continued.

District.	Surveyor and Regulator.	Railroad Track Laid—Linear Feet.	Crossing Stone Measured—Linear Feet.	Gutter Measured—Stone, Vitrified Brick and Iron—Linear Feet.	Water Pipe Measured—Linear Feet.	Sewer Measured—Linear Feet.	Railway Plans Prepared.	Jury Plans Prepared.	Plans Prepared for Highway and Survey Committees of Councils.	Plans of Streets to be Placed Upon City Plan.	Plans of Streets to be Paved or Repaved.	Plans Showing Laterals from Sewer to Curb.	Miscellaneous Plans Prepared.
1	John M. Nobre.....	750	231	841	8,660	6,269	9	5	2	9	14	9	163
2	Charles W. Close.....	4,503	.....	.....	1,758	5,943	5	11	4	2	.....	5	81
3	W. C. Cranmer.....	.....	206	1,096	461	7,621	9	13	7	.....	9	2	
4	Frits Bloch.....	15,237	84	1,611	1,210	3,628	22	2	4	1	.....	.....	49
5	Walter Brinton.....	.....	.....	.....	19,434	16,557	3	34	4	5	23	3	
6	Joseph Mercer.....	.....	8,011	.....	19,522	11,885	10	40	.....	20	58	40	28
7	W. K. Carlile.....	6,232	.....	.....	90	1,805	13	2	5	3	3	.....	33
8	C. A. Sundstrom.....	.....	76	.....	6,949	13,534	1	23	.....	2			
9	Joseph C. Wagner.....	28,420	.....	.....	10,757	10,953	1	13	25	4	9	8	132
10	John H. Webster, Jr.....	.....	.....	.....	2,917	8,146	11	21	10	4	34	3	193
11	Joseph Johnson.....	7,776	.....	.....	22,316	34,715	2	11	1	9	28	21	83
12	J. H. Gillingham.....	.....	.....	.....	9,121	21,258	8	26	13	15	12	1	200
13	H. M. Fuller.....	.....	464	.....	9,453	20,896	3	20	3	3	17	2	
14	C. B. Webster.....	.....	.....	8,208	.....	711	1	9	5	1	.....	.....	216
	Total.....	62,918	9,072	11,756	112,648	163,921	98	230	83	78	207	94	1,178

Main Sewers.

MAIN SEWERS COMPLETED.	LENGTH.		COST OF CONSTRUCTION.			
	Feet.	Miles.	Assessment Bills.	PAID BY CITY.		Total Cost.
				Warrants.	Inspection.	
Mains completed prior to 1855	95,040	18.00				
Mains completed prior to 1855 to 1868	27,456	5.20	.....	.....	.....	$234,588 33
Mains completed prior to 1868	3,226	0.61	$3,758 21	$6,528 99	.....	10,287 20
Mains completed prior to 1869	18,384	3.48	33,943 02	148,408 36	.....	182,351 38
Mains completed prior to 1870	5,422	1.03	11,381 67	214,321 35	.....	225,703 02
Mains completed prior to 1871	7,327	1.38	15,242 86	294,114 66	.....	309,357 32
Mains completed prior to 1872	1,570	0.30	2,008 08	213,087 75	.....	215,095 83
Mains completed prior to 1873	7,655	1.46	.....	.....	.....	98,946 75
Mains completed prior to 1874	8,935	1.69	.....	.....	.....	146,884 94
Mains completed prior to 1875	5,365	1.02	6,061 99	134,606 94	.....	140,668 93
Mains completed prior to 1876	9,714	1.84	4,486 67	486,879 27	.....	491,365 94
Mains completed prior to 1877	17,491	3.31	39,744 33	291,588 35	$3,886 33	335,219 01
Mains completed prior to 1878	20,342	3.85	37,787 92	188,321 95	5,123 31	231,233 18
Mains completed prior to 1879	5,250	0.99	10,152 02	50,736 84	.....	60,888 86
Mains completed prior to 1880	2,368	0.45	4,178 75	52,579 50	151 62	56,909 87
Mains complet d prior to 1881	1,961	0.37	2,939 60	40,389 94	927 51	44,257 05

Main Sewers—Conttnued.

Main Sewers Completed.	Length.		Cost of Construction.			
	Feet.	Miles.	Assessment Bills.	Paid by City.		Total Cost.
				Warrants.	Inspection.	
Mains completed 1882	2,614	0.50	$5,804 30	$17,842 20	.....	$23,646 50
Mains completed 1883	4,286	0.92	5,332 51	128,614 98	$1,346 65	135,294 14
Mains completed 1884	21,859	4.05	12,439 14	205,323 88	.....	217,762 52
Mains completed 1885	12,552	2.38	7,784 65	127,502 03	.....	135,286 68
Mains completed 1886	18,518	3.51	12,516 25	193,277 59	.....	205,793 84
Mains completed 1887	13,750	2.60	3,462 65	282,290 45	.....	285,753 10
Mains completed 1888	14,705	2.79	10,394 80	205,526 12	.....	215,920 42
Mains completed 1889	25,640	4.86	12,875 97	324,565 58	10,764 94	348,206 49
Mains completed 1890	29,569	5.59	8,328 93	650,325 29	11,923 26	670,577 48
Mains completed 1891	36,102	6.84	5,592 13	594,875 42	10,356 28	610,823 83
Mains completed 1892	45,125	8.55	12,635 95	537,374 40	12,790 28	562,800 63
Mains completed 1893	76,715	14.53	18,268 26	1,151,665 87	18,416 65	1,188,345 78
Mains completed 1894	102,269	19.37	1,345 72	1,434,497 79	26,609 92	1,462,453 43
Mains completed 1895	48,768	9.23	18,528 72	328,701 53	14,808 28	362,038 53
Mains completed 1896	18,661	3.53	17,849 84	137,282 72	5,313 32	160,395 88

Main Sewers—Continued.

MAIN SEWERS COMPLETED.	LENGTH.		COST OF CONSTRUCTION.			
	Feet.	Miles.	Assessment Bills.	PAID BY CITY.		Total Cost.
				Warrants.	Inspection.	
Mains completed 1897	413	.07	.....	$2,329 82	$200 00	$2,529 82
Mains completed 1898	6,130	1.16	.....	49,176 70	.....	49,176 70
Mains completed 1899	14,458	2.74	$5,263 63	119,592 34	3,696 66	128,552 63
Mains completed 1900	26,626	5.04	13,625 02	468,822 09	14,919 95	497.367 06
Mains completed 1901	21,929	4.15	1,291 72	547,185 99	17,545 82	566,023 53
Mains completed 1902	25,302	4.79	1,752 25	633,360 50	17,606 58	652,719 33
Mains completed 1903	43,431	8.23	.....	1,006,479 38	22,386 50	1,028,865 88
Total	846,974	160.41	$346,772 06	$11,218,126 07	$198,768 86	$12,244,037 01

Length and Cost of Main Sewers Built during the Year 1903

Location.	Size.	Length in Feet.		Cost per Foot.	Payment.		Total Cost.	Contractor.	Inspectors.
		Prior to 1903.	In 1903.		In Assessment Bills.	In City Warrants.			
Cohocksink relief sewer on Germantown avenue, from Thompson st. to Montgomery street	8 ft. 6 in	633.00	2,103.18	$36 00		$80,262 48	$98,502 48	George A. Vare.	Thomas MacElwee.
Cohocksink relief sewer on Shackamaxon street, between the Delaware river and Thompson street.	9 ft. 6 in. with 2 ft. 3 in. x 1 ft. 6 in. appurtenant sewer	1,826.06		41 00		19,865 68	97,326 16	David Peoples.	E. H. Sickels.
	10 ft. x 7 ft. 9 in. concrete sewer	127.00		43 00					
	10 ft. x 7 ft. 9 in. in timber sewer	23.00		By items					
Cohocksink relief sewer on Germantown avenue, from Montgomery avenue to Berks street, and on Berks street, from Germantown avenue to Ninth street	8 ft. 6 in		1,450.00	47 50		55,200 00	Not finished	Geo. A. Vare.	W. E. Haley. Thomas MacElwee.
Cohocksink sewer, reconstruction on Dauphin street, east of Broad street	13 feet enlarged from 12 feet		41.00	By items		2,818 29	2,818 29	Robt. Higgins.	H. M. Smith. C. A. Crossin.

Length and Cost of Main Sewers Built during the Year 1903—Continued.

Location.	Size.	Length in Feet.		Cost per Foot.	Payment.		Total Cost.	Contractors.	Inspectors.
		Prior to 1903.	In 1903.		In Assessment Bills.	In City Warrants.			
Cohocksink relief sewer on Thompson street, between Shackamaxon street and Germantown avenue...	9 ft. 6 in. with 2 ft. 3 in. x 1 ft. 6 in.	180.95	.....	$48 00	.....	$65,084 49	114,684 49	George A. Vare.	W. E. Haley. T. MacElwee
	9 ft. with 2 ft. 3 in x 1 ft. 6 in.....	128.00	502.53	48 00	.....				
	9 feet.....	.....	131.00	48 00	.....				
	8 ft. 6 in.....	979.00	6.35	8 00	.....				
	Two separating chambers.....	.....	258.00	Lump sum. 18600 00	.....				
	Two junction chambers.....	.....	.....	.....	.....				
	12 inch t. c pipe.	129.00	.....	2 40	.....				
Cohocksink sewer, reconstruction, on Montgomery st., from a point east of Ninth st. to Ninth st.; on Ninth street, from Montgomery st. to Norris street.....	9 feet diameter, enlarged to 9 ft. 6 in.....	432.00	166.33	By Items.....		51,184 40	$70,194 74	Robert Higgins.	John Vicary.
	9 feet diameter, enlarged to 10 ft.....	.....	494.46						
	8 ft. 6 in.....	.....	4.00						
	8 feet.....	.....	5.00						
	Separat'g chamber.....	.....	35.00						
	Separat'g chamber.....	.....	26.00						
Cohocksink sewer, reconstruction, on Montgomery st., east of Eighth street.....	9 feet diameter, enlarged to 10 feet diameter .	.....	41 00	By Items.....		2,683 23	2,683 23	Robert Higgins.	H. M. Smith. C. A. Crossin.

Length and Cost of Main Sewers Built during the Year 1903—Continued.

Location.	Size.	Length in Feet.		Cost per Foot.	Payment.		Total Cost.	Contractor.	Inspector.
		Prior to 1903.	In 1903.		In Assessment Bills.	In City Warrants.			
Miscellaneous work in connection with the repair, improvement and reconstruction of old sewers applied to the Cohocksink, Mill creek and other old sewers	Miscel aneous w ork pa id for b y item s					631.36	631 36	Robert Higgins.	H. M. Smith. John Barlow John Vicary.
Cresheim creek, interce ting sewer on Germantown avenue, f r o m Cresheim creek to Moreland ave., on Moreland avenue from Germantown avenue to a proposed drainage street	Special concrete section 7 ft. 6 in. by 5 ft	.....	402.28	$48 50	.....	55,238 40	Not finished.	David McMahon	F. D. Morris.
	6 ft. with 12 in. terra c o t t a pipe	.....	493.19	39 50					
	6 ft	.....	290.29	41 00					
	5 ft. 3 in	.....	130.00	27 50					
Disston street, from Mason street to Keystone street	5 ft	247 00	.....	13 14	.....	7,582 34	12,382 34	J. McMenamy ..	John Hare.
	4 ft	300.00	351.30	7 53					
	3 ft. 6 in	.....	261.17	6 98					
Dobson's run sewer in Thirty-third street, from Scott's run to Allegheny avenue, and on Allegheny avenue from Thirty-third street to Twenty-ninth street	4 ft. with 15 in. terra c o t t a pipe	.....	418.00	14 78	.....	27,072 00	Not finished.	The Haddington Quarry & Construction Co...	D. Walsh. J. W. Harmer
	4 ft. 9 in. with 15 in. terra cotta pipe	.....	1,041.72	15 25					
	4 ft. 6 in. with 15 in. t e r r a cotta pipe	.....	855.00	18 50					

Length and Cost of Main Sewers Built during the Year 1903—Continued.

Location.	Size.	Length in Feet.		Cost per Foot.	Payment.		Total Cost.	Contractors.	Inspectors.
		Prior to 1903.	In 1903.		In Assessment Bills.	In City Warrants.			
Frankford intercepting sewer system on Wakeling st, from Frankford creek northwestwardly.....	16 ft. hor. x 10 ft. 6 in. vert.....	.....	$525.00	$59 00	.....	$33,936 00	Not finished.	Rich'd P. Bennis	G. W. Myers.
	11 ft. 6 in. hor. x 10 ft. 6 in. vert..	.....	160.00	48 00					
Georges run sewer extension in Bryn Mawr ave., from terminus north of Wynnewood avenue to Woodbine avenue, thence to Fifty-first street, thence to City line ave.	6 ft. 6 in.....	567 00	633.00	20 60	.....	34,292 25	$43,532 25	Daniel Dooley...	J. W. Gillett.
	5 ft. 6 in.....	.....	600.00	12 00					
	5 feet.....	.....	175.00	11 50					
	5 feet.....	.....	964.43	8 75					
Intercepting sewer (main stem) extension, from present terminus at Nixon's mills, northeast of Fountain street, thence on private property to Shawmont avenue, and on Shawmont avenue to Eva st....	2 ft. 9 in.....	.....	2,020.00	5 75	.....	57,760 00	Not finished.	J. H. Wallace & Co.....	J. M. Hipple. J. W. Harmer E. H. Sickels. P. McGough.
	2 ft. 6 in.....	.....	3,451.00	8 25					
	15 in. t. c. pipe....	.....	3,139.00	4 25					
	12 in t. c. pipe....	.....	255.00	3 75					
	Inv'd siphon at canal crossing.	.....	.....	Lump sum. 4,000 00					
Jackson street, from the Schuylkill river eastwardly.....	7 ft. 6 in.....	.....	289.78	29 88	.....	14,988 94	14,988 94	D. J. McNichol..	J. E. Peters. John Barlow

Length and Cost of Main Sewers Built During the Year 1903—Continued.

Location.	Size.	Length in Feet.		Cost per Foot.	Payment.		Total Cost.	Contractors.	Inspectors.
		Prior to 1903.	In 1903.		In Assessment bills.	In City Warrants.			
Indian run sewer in Sixty-sixth street from City avenue to Sherwood avenue and Sixty-eighth street, thence to Malvern avenue and on Malvern avenue to creek at Sixty-ninth street	6 ft.	.....	482.75	$13 66	.....	$30,848 00	Not finished.	The Haddington Quarry and Construc. Co.	F. D. Morris. J. D. Henderson.
	5 ft. 3 in.	.....	919.72	12 48					
	4 ft. 9 in.	.....	300.00	9 43					
	4 ft. 9 in.	.....	893.60	10 92					
	2 ft. 6 in.	.....	763.77	8 95					
	Special concrete section	.....	61.00	Lump sum. 1,078 00					
Luzerne street from terminus east of Second street, northeastwardly through City property to the Wingohocking creek	7 ft.	.....	1,475.00	18 00	.....	21,280 00	Not finished.	J. McMenamy.	J. J. MacVeigh
McKean street relief sewer from Third street to Ninth street	7 ft. 6 in.	1,778.00	1,170.74	24 90	.....	39,229 96	76,629 96	J. H. Loucheim.	P. D. Brown.
	Connec'g Chamber	.....	15.20	Lump sum. 520 00					
McKean street from Ninth street to Twelfth street	7 ft.	.....	921.46	34 00	.....	29,120 00	Not finished.	Geo. A. Vare.	P. D. Brown.
Orthodox street from terminus near Delaware avenue towards Richmond street	6 ft.	829.00	.....	19 00	.....	9,251 11	39,971 11	David Peoples.	J. N. Brown.
	5 ft.	550.00	.....	14 00					
	4 ft. 6 in.	12.00	.....	12 00					
Orthodox street from Balfour street to Richmond street	4 ft. 6 in.	.....	588.65	10 59	.....	13,865 64	13,865 64	J. McMenamy.	John Hare.
	4 ft.	.....	646.12	7 39					

Length and Cost of Main Sewers Built during the Year 1903—Continued.

Location.	Size.	Length in Feet.		Cost per Foot.	Payment.		Total cost.	Contractors.	Inspectors.
		Prior to 1903.	In 1903.		In Assessment Bills.	In City Warrants.			
Pratt stree' from Frankford avenue northwestwardly	11 feet	.....	847.00	28 74	.....	$19,200 00	Not finished.	J. McMenamy	B. H. Smithson.
Princeton street, from the Delaware river to Hegerman street	6 feet	.....	179.00	21 00	.....	44,421 24	44,421 24	Rich. P. Bennis	Geo. Warner. T. W. Harvey. B. H. Foulkrod.
	6 feet	.....	880.25	18 00					
	5 feet	.....	827.00	16 00					
	4 feet	.....	934.00	7 00					
Princeton street, from Hegerman street to the northwesterly side of Torresdale avenue	3 ft. 6 in	.....	.....	9 90	Work is in progress		.....	Rich. P. Bennis	B. H. Foulkrod.
	3 ft. 6 in	.....	.....	6 20					
Rosehill street, from Allegheny avenue to the Connecting Railway	6 ft. 6 in	1071.20	.....	14 45	.....	8,367 12	34,407 12	J. H. Wallace & Co	T. D. Hooper.
	6 feet	606.39	.....	18 64					
	5 feet	572.00	99.84	9 84					
Shunk street sewer system, extension on Shunk street from west of Shelby street to Front street, on Front street to Porter street, and on Porter street westwardly	7 ft. 6 in	.....	1871.38	38 00	.....	98,100 02	Not finished.	Geo. A. Vare	Jos. Hunter.
	6 ft. 6 in	.....	1077.00	34 00					
	Separat'g chamber	.....	34.00	Lump sum. 3,200 00					
	Junction chamber	.....	34.00	Lump sum. 3,200 00					
Thomas Run sewer, extension on Fifty-seventh street from Florence avenue to Beaumont ave., thence south on Beaumont ave. to near Fifty-ninth street, thence across private property to Cobb's creek	11 feet	370.80	985.88	28 40	.....	34,553 57	42,843 57	Rob'rt Higgins	J. D. Henderson. C. E. Preston.
	10 feet	.....	102.80	20 00					
	6 feet	.....	35.84	14 00					
	Junction chamber	.....	32.90	Lump sum. 1,400 00					

Length and Cost of Main Sewers Built During the Year 1903—Continued.

Location.	Size.	Length in Feet.		Cost per Foot.	Payment.		Total Cost.	Contractors.	Inspectors.
		Prior to 1903.	In 1903.		In Assessment Bills.	In City Warrants.			
Thomas Run sewer (west branch) in Pine street, from Conestoga street to Allison street, on Allison street to Locust street, and on Locust street to Fifty-ninth street....	6 ft. 6 in.....	911.62	.....	$14 75	.....	$9,277 31	$22,157 31	Daniel Dooley...	C. E. Preston.
	6 ft. 0 in.....	179.56	411.01	14 75					
Winghocking Creek sewer extension (east branch) on Ogontz avenue, from Eighteenth street and Bellfield avenue to Olney avenue..	10 ft. 6 in.....	.....	1655.00	26 88	.....	53,760 00	Not finished.	David McMahon	John McCormick.
	10 ft. 0 in.....	.....	975.00	24 83					
	Junction Chamber.	.....	47.63	Lump sum. 2,400 00					
Wingohocking Creek sewer extension (east branch) on Anderson street, from terminus north of Chelten avenue to Price street, on Price street to Crittenden street, and on Crittenden street to Haines street.....	8 ft. 6 in.....	900.00	542.92	29 40	.....	21 658 18	42,818 18	David McMahon	E. S. DeHaven.
Winghocking Creek sewer extension on Courtland street, from west of Seventh street to Seventh and Annsbury streets, thence on Annsbury street toward the N. P. branch of the Philadelphia and Reading Railway.....	17 ft. 3 in..... Special section.	.....	398.30	56 49	.....	22,499 97	22,499 97	David McMahon	J. M. Hipple

Length and Cost of Main Sewers Built during the Year 1903—Continued.

Location.	Size.	Length in Feet.		Cost per Foot.	Payment.		Total Cost.	Contractors.	Inspectors.
		Prior to 1903.	In 1903.		In Assessment Bills.	In City Warrants.			
York street sewer extension, from Tulip street to Emerald street	7 feet	1,353.03	562.64	28 50	.....	28,837 40	59,557 40	J. H. Louchheim	T.W. Harvey. Geo. Warner. W. W. Brinkworth.
	Special section chamber	.....	140.00	32 00					
York street, from American street to Fifth street, on Fifth street, from York street to Cumberland street	4 feet 9 inches	.....	849.00	20 00	.....	13,600 00	Not finished.	George A. Vare.	W. W. Brinkworth.

Branch Sewers.

Branch Sewers Completed.	Length.		Cost of Construction, Not Including Inlets Specially Ordered.			
			Assessment Bills.	Paid by City.		Total Cost.
	Feet.	Miles.		Warrants.	Inspection.	
Branch sewers built prior to 1855	103,060	19.50				
Branch sewers built 1855 to 1867	92,852	17.57				$189,259 43
Branch sewers built 1867	33,946	6.43	$62,927 84	$9,384 00		72,311 84
Branch sewers built 1868	32,667	6.19	62,569 21	13,112 87		75,682 08
Branch sewers built 1869	49,598	9.39	116,447 61	19,869 96		136,317 57
Branch sewers built 1870	57,099	10.81	137,600 04	27,013 34		164,613 38
Branch sewers built 1871	49,829	9.44	109,505 59	9,049 97		118,555 56
Branch sewers built 1872	45,763	8.67	102,566 11	12,310 37		114,876 48
Branch sewers built 1873	69,800	13.22	152,830 14	27,866 12		180,696 26
Branch sewers built 1874	59,936	11.35	136,144 74	16,788 55		152,933 29
Branch sewers built 1875	77,977	14.77	179,432 85	6,680 41		186,113 26
Branch sewers built 1876	43,560	8.25	98,133 03	11,203 96		109,336 99
Branch sewers built 1877	28,932	5.48	59,390 64	5,422 40		64,813 04
Branch sewers built 1878	32,104	6.08	70,949 88			67,376 90
Branch sewers built 1879	17,644	3.34	35,875 96	1,004 02		36,879 98

Branch Sewers—Continued.

Branch Sewers Completed.	Length.		Cost of Construction, Not Including Inlets Specially Ordered.			
			Assessment Bills.	Paid by City.		Total Cost.
	Feet.	Miles.		Warrants.	Inspection.	
Branch sewers built 1880	17,641	3.34	$38,826 99	.....	.....	$32,169 90
Branch sewe s built 1881	33,824	6.46	75,231 29	.....	.....	70,091 62
Branch sewers built 1882	25,556	4.84	58,528 86	$8,325 26	.....	66,854 12
Branch sewers built 1883	40,385	7.65	91,588 02	38,900 31	.....	130,488 33
Branch sewers built 1884	62,276	11.79	109,049 87	40,278 76	.....	149,328 63
Branch sewers built 1885	79,154	14.99	149,358 27	25,760 67	$9,396 45	184,515 39
Branch sewers built 1886	113,300	21.46	181,036 87	68,943 60	15,236 23	265,216 75
Branch sewers built 1887	101,999	19.32	173,530 34	65,639 48	16,454 19	255,674 01
Branch sewers built 1888	159,890	30.28	329,561 93	148,767 40	20,224 62	498,553 95
Branch sewers built 1889	162,037	30.69	309,272 09	99,104 95	24,037 87	432,414 91
Branch sewers built 1890	143,538	27.19	239,587 65	97,290 77	22,269 28	358,097 70
Branch sewers built 1891	156,681	29.67	254,066 04	98,077 47	24,285 99	376,429 50
Branch sewers built 1892	132,000	25.00	251,723 24	102,026 26	19,678 05	373,427 55
Branch sewers built 1893	232,863	44.10	465,°48 44	333,565 26	33,889 63	833,303 33
Branch sewers built 1894	332,220	62.92	651,286 40	435,280 09	54,926 00	1,141,492 49

Branch Sewers—Continued.

Branch Sewers Completed.	Length.		Cost of Construction, not Including Inlets Specially Ordered.			
			Assessment Bills.	Paid by City.		Total Cost.
	Feet.	Miles.		Warrants.	Inspection.	
Branch sewers built 1895	224,625	42.55	$383,819 68	$192,369 13	$53,639 12	$629,827 93
Branch sewers built 1896	116,633	22.09	347,515 35	125,997 59	51,675 57	525,188 51
Branch sewers built 1897	133,080	25.20	212,933 31	136,847 08	36,882 52	386,662 91
Branch sewers built 1898	114,102	21.61	208,610 31	187,953 24	33,116 06	429,679 61
Branch sewers built 1899	176,013	33.33	277,930 89	266,281 35	46,082 92	590,295 16
Branch sewers built 1900	186,238	35.27	288,110 98	251,476 06	44,596 04	584,183 08
Branch sewers built 1901	121,373	22.99	207,169 05	149,091 62	37,226 27	393,486 94
Branch sewers built 1902	110,630	20.95	201,441 27	131,279 26	37,009 59	369,730 12
Branch sewers built 1903	82,589	15.64	144,218 33	167,760 33	26,556 38	338,535 04
Total	3,853,459	729.82	$6 969,624 11	$3,330,721 91	$612,177 83	$11,086,413 54

N. B.—The amount paid in City Warrants includes inspection, unless otherwise stated.

Summarized Statement of Branch Sewers Built during the year 1903.

Branch Sewers.		Brick and Stone Inlets.		Manholes.	Well-holes.	Curved Granite Curb.	Lateral House Connections.	Repaving.	Payments.		Inspection.	Total cost of branch sewers.	Excess bills and balances.
Feet.	Miles.	Size.	Number built.	Number built.	Vertical feet.	Number feet.	Number feet.	Number square yards.	In assessment bills.	In City warrants.	Total for branch sewers, inlets, etc.		
82,588.89	15.641	No. 1.	2	Manholes 532	23	3,255.71	52,600.5	67.85	$144,218 33	$167,760 33	$27,776 35	$339,755 01	$27,899 49
		No. 2.	98	Junction Manholes 22									
		No. 3.	176										
		No. 4.	25	Buckets 8									

Inlets rebuilt	19	
Straight curb	511	feet
Additional excavation	1,212.3	cubic yards
Brick masonry	4.34	cubic yards
Rubble masonry	1,251.71	cubic yards
Concrete	6.5	cubic yards

Statement of Inlets Built with and without Grate Tops, Inlets Rebuilt, Removed and Rebuilt at Other Places, Curved Granite Curb, Sewer Spurs, Masonry, etc., in Connection with Old Sewers, during the Year 1903.

INLETS.			MANHOLES.		CURVED GRANITE CURB.		LATERAL CONNECTIONS.		6, 8, 12, 15 & 18-INCH T. C. PIPE.		SEWER SPURS.			BRICK MASONRY, ETC.
Form.	No. Built and Rebuilt.	Cost.	No. Built.	Cost.	No. Feet.	Cost.	No. Feet.	Cost.	No. Feet.	Cost.	Size.	No. Feet.	Cost.	Cost.
New Inlets.														
Solid cast iron cover No. 1..	2	$166 00	1	$30 00	1,663.89	$3,505 36	6,287	$3,792 10	346	$428 70	15-inch T. C. pipe..	44.00	$96 80	$483 63
Solid cast iron cover No. 2..	21	1,680 75	....	.....	.....	.....	.....	.....	.....	.....	2 ft. 3 in. x 1 ft. 6 in.	344.50	574 45	
Solid cast iron cover No. 3..	36	2,491 50	....	....	.....	.....	.....	.....	.....	.....	2 ft. circular.....	35.00	80 50	
Solid cast iron cover No. 4..	13	575 00	....	.....	.....	.....	.....	.....	.....	.....	3 ft. circular.....	16.00	88 00	
Iron grate cover No 2.....	2	146 75	Ju	nction.	Straight Cu	Granite rb.								
Iron grate cover No. 3.....	24	1,597 50	1	46 00	139.21	214 24								
Iron grate cover No. 4..... ..	19	870 00												
Old Inlets.														
Inlets rebuilt.....	68	2,550 00												
Inlets only grated.....	5	95 00												
Total.....	190	$10,122 50	2	$76 00	1,803.10	$3,719 60	6,287	$3,792 10	346	$428 70	.....	439.50	$839 75	$483 63

Total cost for the above work, $19,462 28.
Cost of inspection included in "Branch Sewer Account."

Length and Cost of Branch Sewers Built During the Year 1903.

Location.	Size.	Length in feet.	Inlets. Size.	Inlets. No. built.	Inlets. Cost each.	Manholes. No. built.	Manholes. Cost each.	Wellholes, C. Curb, H. Connections, etc. No. built.	Wellholes, C. Curb, H. Connections, etc. Per foot.	Wellholes, C. Curb, H. Connections, etc. Total cost.	Cost per foot.	Payment. In assessment bills.	Payment. In City warrants.	Payment. Total cost.	Excess bills and balances.	Inspectors.	Contractors.	Date of fins. estimate.
Allegheny ave. from Second st. to Lawrence st.	3 ft. x 2 ft.	641.	2	4	$75 00	....	.....	64.42 c. c.	$2 00	$128 84	$2 03							
	3 ft. x 2 ft. vit. sh. b. b.	278.	3	1 reb uilt	70 00	8	$30 00	6. st. c.	1 10	6 60	2 03	$1,442 99	$2,027 33	$3,470 32	.....	Th s. Meeley..	How'rd E. Ruch.	Feb. 24
	2 ft. 6 in. x 1 ft. 8 in.	317.	....	1	35 00	....	.....	325. h. c.	50	162 50	1 03							
	12 in. v. p.	50.	....	....	.....	....	.....	.....	.....	.....	1 00							
Blavis st. from Sixteenth st. to Seventeenth st.	3 ft. x 2 ft. vit. sh. b. b.	53.	....	....	.....	....	.....	44.2 c. c.	2 00	88 40	1 51	1,056 50	376 69	1,433 19	.....	B.Z.Lippincott.	Patrick Durkin.	Apr. 20
	2 ft. 6 in. x 1 ft. 8 in.	396.	3	4	70 00	4	30 00	24. st. c.	1 10	26 40	1 41							
	12 in. v. p.	30.	....	....	.....	....	.....	500. h. c.	50	250 00	1 00							
Boyer st from Mt. Pleasant av. to Durham st. and on Durham st. from Boyer st. to Chew st.	4 ft. circ. stone b. b.	325.	2	4	75 00	....	.....	.....	.....	.....	6 48	2,235 87	4,594 19	6,829 56	.....	J. McCormick.	J. T. McMahon..	Apr. 20
	4 ft. circ. vit. sh. b. b.	597.	3	1	70 00	8	25 00	47. c. c.	2.00	94 00	6 48							
	3 ft. x 2 ft. vit. sh. b. b.	34.	....	....	.....	....	.....	.....	.....	.....	5 00							
	12 in. v. p.	21.	....	....	.....	....	.....	.....	.....	.....	1 00							
Belmont avenue, from Conshohocken ave. to City ave., and on City av. from Belmont ave. to Overbrook ave.	2 ft. 6 in. x 1 ft. 8 in.	915.	....	....	.....	....	.....	.....	.....	.....	4 50							
	2 ft. 3 in. x 1 ft. 6 in. vit. sh. b. b.	643.6	2	2	75 00	8	25 00	48.71 c. c.	2 00	97 42	4 50							
	2 ft. 3 in. x 1 ft. 6 in.	488.4	3	8	70 00	8	6 00 Buckets	96. st. c.	1 10	105 60	4 00	.....	10804 57	10,304 57	2,025 31	W. L. Holbrook	Jas. A. Mullen.	May 11
	12 in. v. p.	1.0.	....	....	.....	....	.....	.....	.....	.....	1 00							
	15 in. t. c.	5.	....	....	.....	....	.....	.....	.....	.....	1 25							

Length and Cost of Branch Sewers Built during the Year 1903—Continued.

Location.	Size.	Length in feet.	Inlets. Size.	Inlets. No. built.	Inlets. Cost each.	Manholes. No. built.	Manholes. Cost each.	Wellholes. C. Curb, H. Connections, etc. No. built.	Per foot.	Total cost.	Cost per foot.	Payment. In assessment bills.	Payment. In City warrants.	Payment. Total Cost.	Excess bills and balances.	Inspectors.	Contractors.	Date of final estimate.
Budd st., from Aspen st. to 225 ft. northward	2 ft. 3 in. x 1 ft. 6 in.	225.	....	....	.....	2	$35 00	h. c. 150.	$0 50	$75 00	$1 65	.....	$500 00	$500 00	$569 60	W. B. Thomas.	Jos. McGlathery.	June 1
Boston st., from Edgemont st. to Salmon st., and on Salmon st. from Boston st. to Cumberland st.	3 ft. x 2 ft.....	323.	2	1	$80 00	4	35 00	h. c. 226.	0 50	113 00	2 21	$894 93	204 80	1,099 73	.....	H. C. Parker.	E. Pascuzzi.	July 21
	.....	.....	3	1	75 00													
Cedar street, from Somerset street to William st..	3 ft. x 2 ft.....	693.	3	5	70 00	5	30 00	c. c. 41.67	2 00	83 34	1 98							
				reb	uilt			h. c. 1,088.	.50	544 00	.....	1,535 00	1,048 98	2,583 98	.....	F. C. Spitzer...	J. Jafolla & Son.	Jan. 27
				1	35 00	.....	.....	rubble mas'y. 11.	4 50	49 50								
Carlisle st., from Wyoming ave. to Windrim av.	2 ft. 3 in. x 1 ft. 6 in..	1,453.	....	....	.....	.....	.....	c. c. 43.82	2 00	87 64	2 87							
								strag't curb.										
	12 in. v. p.....	24.	3	3	70 00	12	30 00	12.	1 10	13 20	1 00	3,792 67	1,753 78	5,546 45	.....	W. F. Elliott and H. C. Parker...	Walter D. Stone.	Mar. 24
								h. c. 1,363.	.50	681 50								

Length and Cost of Branch Sewers Built during the Year 1903— Continued.

Location.	Size.	Length in feet.	Inlets. Size.	Inlets. No. built.	Inlets. Cost each.	Manholes. No. built.	Manholes. Cost each.	Wellholes, C. Curb, H. Connections, etc. No built.	Per foot.	Total cost.	Cost per foot.	Payment. In assessment bills.	Payment. In City warrants.	Payment. Total cost.	Excess bills and balances.	Inspectors.	Contractors.	Date of final estimate.
Chew st., from Durham st. to Mt. Airy ave., and on Mt. Airy ave. from Chew st. to Germantown ave.	3 ft. 6 in. circ. vit. sh. b. b.	566.									$5 74							
	3 ft. circ. vit. sh. b.b.	358.	2	5	$75 00	7	$30 00	c. c. 114.	$2 00	$228 00	5 24	$2,285 51	$4,324 00	$6,609 51	.....	J. McCormick.	J. T. McMahon..	Apr.29
	3 ft. 3 in. x 2 ft. 2 in. vit. sh. b. b.	39.	3	2	70 00	....	.....	.....	.....	.....	3 00							
	3 ft. x 2 ft. vit. sh. b. b.	57.	....	....	.....	....	.....	.....	.....	.....	3 00							
	15 in. v. p.	87.	....	....	.....	....	.....	.....	.....	.....	1 25							
	12 in. t. c.	45.	....	....	.....	....	.....	.....	.....	.....	3 00							
Carlton st., from Fifteenth st. to 197 ft. eastward.	2 ft. 3 in. x 1 ft. 6 in.	216.2	....	....	.....	3	35 00	h. c. 32.	50	16 00	1 75	499 35	.....	499 35	80 58 23 25	H. C. Parker...	Robt. Lombardi.	May26
Clymer st., from Twenty-first st. to 350 feet westward.	2 ft. 3 in. x 1 ft. 6 in.	351.75	....	....	.....	3	35 00	h. c. 174.	50	87 00	1 39	680 93	.....	680 93	1 32 254 40	Thos. Meeley..	B. Monaghan.....	May26
Cameron st., from Francis st. to Wylie street....	2 ft. 3 in. x 1 ft. 6 in.	355.	rebuilt.	1	35 00	3	35 00	c. c. 13.5	2 00	27 00	2 03	811 00	148 15	959 15	.....	George Webb..	Chas. D. Land....	June5
	12 in. v. p.	23.	....	....	.....	....	.....	h. c. 97.	50	48 50	1 00							

Length and Cost of Branch Sewers Built during the Year 1903—Continued.

Location.	Size.	Length in feet.	Inlets.			Manholes.		Wellholes, C. Curb, H. Connections, etc.			Cost per foot.	Payment.			Excess bills and balances.	Inspectors.	Contractors.	Date of final estimate.
			Size.	No. built.	Cost each.	No. built.	Cost each.	No. built.	Per foot.	Total cost.		In assessment bills.	In City warrants.	Total cost.				
Coral street, from Westmoreland st. to Ontario street	3 ft. x 2 ft.	774.	3	2	$75 00	5	$35 00	c. c. 38.5	$2 00	$77 00	$1 55	$1,799 70	.....	$1,799 70	$4 01	E. C. Hill	Patrick Durkin..	June 9
								h. c. 396.	50	198 00	.....	.....	.....	.....	218 30			
Carlisle st., from Reed st. to 150 feet south of Dickinson st	3 ft. x 2 ft.	180.	....	....	.....	....	.....	.....	.....	.....	1 40	.....	.....	.....	49			
	2 ft. 6 in. x 1 ft. 8 in.	482.	....	....	.....	4	35 00	h. c. 377.	50	188 50	1 40	1,193 30	.....	1,193 30	229 24	B. Z. Lippincott	Robt. P. Ryan...	Jun. 15
	12 in. v. p.	8.	....	....	.....	....	.....	.....	.....	.....	1 00							
Catharine st., fr'm Fiftieth st. to Fifty-first st.	2 ft. 3 in. x 1 ft. 6 in.	500.	3	1	70 00	4	30 00	h. c. 784.	50	392 00	1 56	1,330 84	$67 16	1,398 00	.....	H. J. Bader....	Joseph McGlathery.....	
	12 in. v. p.	36.	....	....	.....	....	.....	.....	.....	.....	1 00							July 6
Catharine st., fr'm Twenty-first st. to Twenty-second st.	2 ft. 3 in. x 1 ft. 6 in.	426.	....	....	.....	....	.....	.....	.....	.....	2 70	.....	.....	.....	.....	W. J. Kiley....	Robt. Lombardi.	Aug. 24
	12 ft. v. p.	19.	....	....	.....	3	35 00	.....	.....	.....	1 00	594 00	680 20	1,274 20				
Cumberland st., from Twenty-second st. to Twenty-sl'th st.	3 ft x 2 ft.	897.06	....	....	.....	....	.....	c. c. 112.41	2 00	224 82	1 59							
	2 ft. 6 in. x 1 ft. 8 in.	564.25	2	2	80 00	13	35 00	st. c. 24.	1 10	26 40	1 49	3,613 16	1,787 37	5,400 53	.....	B. Z. Lippincott	J. Jafolla & Son.	Sept. 9
	2 ft. 3 in. x 1 ft. 6 in.	375.	3	6	75 00	1	45 00	h. c 2442.	50	1,221 00	1 39							
	12 in. v. p.	30.	....	....	.....	....	.....	.....	.....	.....	1 00							

Length and Cost of Branch Sewers Built during the Year 1903—Continued.

Location.	Size.	Length in feet.	Inlets. Size.	Inlets. No. built.	Inlets. Cost each.	Manholes. No. built.	Manholes. Cost each.	Wellholes. C. Curb. H. Connections etc. No. built.	Per foot.	Total cost.	Cost per foot.	Payment. In assessment bills.	Payment. In City warrants.	Payment. Total cost.	Excess bills and balances.	Inspectors.	Contractors.	Date of Final estimate.
DeKalb st., from Warren st., to Cuthbert st.	2 ft. 3 in. x 1 ft. 6 in	346.	3	1	$75 00	3	$35 00	c. c. 25.	$2 00	$50 00	$1 91							
			reb	uilt	.....	....	.....	h. c. 172.	50	86 00								
								repav ing. 12.5		3 13								
	12 in. v. p.	10.	....	2	35 00	....	.....	excav ation 12.5	50	6 25	1 00	$808 73	$290 45	$1,099 18	.....	J. P. Flood.....	John Morrison..	Sept. 30
								brick mas'y 3.3	9 00	29 70								
								rubble mas'y 0.72	4 50	3 24								
Edgemont street from Allegh'ny ave. to Westmoreland st.	3 ft. x 2 ft.	717.	2	1	75 00	....	.....	c. c. 16.42	2 00	32 84	1 14	.....	.....	.....	7 34	F. C. Spitzer...	J. Jafolla & Son	Mar. 17
	15 in. v. p.	20.	3	1	70 00	7	30 00	h. c. 1,113.	50	556 50	1 25	1,786 72	.....	1,786 72	100 12			
Eighteenth stre't from Westmoreland st. to Ontario st.	2 ft. 3 in. x 1 ft. 6 in.	523.67	....	....	.....	4	80 00	h. c. 696.	50	348 00	3 94	1,369 00	1,185 26	2,554 26	.....	George Webb..	J. T. McMahon.	Apr. 24
	12 in. v. p.	23.	....	....	.....	....	.....	.....	.....	.....	1 00							

Length and Cost of Branch Sewers Built during the Year 1903—Continued.

Location.	Size.	Length in feet.	Inlets. Size.	Inlets. No. built.	Inlets. Cost each.	Manholes. No. built.	Manholes. Cost each.	Wellholes, C. Curb, H. Connections, etc. No. built.	Wellholes, C. Curb, H. Connections, etc. Per foot.	Wellholes, C. Curb, H. Connections, etc. Total cost.	Cost per foot.	Payment. In assessment bills.	Payment. In City warrants.	Payment. Total cost.	Excess bills and balances.	Inspectors.	Contractors.	Date of final estimate.
Elmwood avenue from Fifty-eighth st. to Sixty-fifth st.	3 ft. 3 in. x 2 ft. 2 in.	451.	....	....	.....	.....	.....	.....	.....	.....	$1 70							
	2 ft. 6 in. x 1 ft. 8 in.	1,671.	2	4	$75 00	24	$30 00	c. c. 151.67	$2 00	$303 34	1 55	.....	$7,363 19	$7,363 19	$8,687 65	J. McParland.	Daniel S. Bader.	Oct. 6.
	2 ft. 3 in. x 1 ft. 6 in.	1,093.	3	5	70 00	.....	.....	.....	.....	.....	1 45							
	15 in. t. c.	465.	....	....	.....	.....	.....	.....	.....	.....	1 45							
	12 in. v. p.	74.	....	....	.....	.....	.....	.....	.....	.....	1 00							
Ella st. from Ontario st. to Tioga st.	2 ft. 3 in. x 1 ft. 6 in.	502.	3	2	75 00	4	35 00	st. c. 12.	1 10	13 20	2 25	1,398 32	319 38	1,717 70	.....	C. A. Crossin...	Patrick Durkin.	Nov. 17
								h. c. 570.	50	285 00							
Fifteenth st, from Courtland st. to Bellfield ave.	2 ft. 3 in. x 1 ft. 6 in.	543.	....	....	.....	.....	.....	c. c. 16.	2 00	32 00	3 65							
	12 in. v. p.	36.	3	1	70 00	4	30 00	rubble mas'ry 487.	4 50	2,191.50	1 00	1,317 92	3,153 53	4,471 45	.....	R. W. Fleming.	Jno. F. McNichol	Apr. 7
								excavation. 80.	50	40 00								
Frazier st., from Wyalusing ave. to Master st.	2 ft. 3 in. x 1 ft. 6 in.	1,564.	3	1	70 00	10	30 00	c. c. 13.	2 00	26 00	1 27	3,222 28	.....	3,222 28	6 87	Eugene Emery	David France...	Apr. 14
								h. c. 1,680.	50	840 00	.....	.....	.....	.....	584 76			

Length and Cost of Branch Sewers Built during the Year 1903—Continued.

Location.	Size.	Length in feet.	Inlets.			Manholes.		Wellholes, C. Curb, H. Connections, etc.			Cost per foot.	Payment.			Excess bills and balances.	Inspectors.	Contractors.	Date of final estimate.
			Size.	No. built.	Cost each.	No. built.	Cost each.	No. built.	Per foot.	Total cost.		In assessment bills.	In City warrants.	Total cost.				
Flora st., from Pennock st. to Twenty-sev'nth st., and on Etting st., from Flora street to Stiles street....	2 ft. 3 in. x 1 ft. 6 in.	465.	....	....	.....	....	.....	c. c. 10.	$2 00	$20 00	$1 90							
	12 inch v. p.....	9.	3	2	$70 00	4	$30 00	h. c. 134.	50	67 00	1 00	$1,146 02	$103 48	$1,249 50	.....	George Webb..	J. H. Louchheim	May 25
Funston st., from Fifty-first st. to Fifty-second st.	2 ft. 3 in. x 1 ft. 6 in. vit. sh. b. b.....	647.	2	2	80 00	3	35 00	c. c. 24.08	2 00	48 16	3 40	1,727 77	1,005 19	2,732 96	.....	W. L. Holbrook	Jas. H. Deehan..	July 7
	12 inch v. p.....	33.	....	....	.....	....	.....	h. c. 374.	50	187 00	1 00							
Fifty-first st., fr'm Ogden st. to Westminster avenue, and on Hoopes st. from Fifty-first st. to Fifty-second st..	2 ft. 3 in. x 1 ft. 6 in.	976.	2	1	80 00	....	.....	c. c. 38.03	2 00	76 06	2 98							
	12 ft. v. p	46.	3	2	75 00	5	35 00	h. c. 931.	50	465 50	1 00							
								rubble mas'y. 655.06	4 50	2,947 77	.....	2,375 49	4,639 32	7,014 81	.....	J. P. Flood.....	John Morrison.	Sept. 1
								excava tion. 382.	50	166 00								
Fulton st., from Sixth st. to westward.....	12 in. t. c.....	100.	....	....	.....	1	30 00	.....	.....	.....	1 85	173 50	66 50	240 00	.....	R. W. Fleming.	Joseph Perna...	Sept. 22
	.....	.....	....	....	.....	1	25 00											

Length and Cost of Branch Sewers Built During the Year 1903—Continued.

Location.	Size.	Length in feet.	Inlets. Size.	Inlets. No. built.	Inlets. Cost each.	Manholes. No. built.	Manholes. Cost each.	Wellholes. C. Curb., H. Connections, etc. No. built.	Wellholes. C. Curb., H. Connections, etc. Per foot.	Wellholes. C. Curb., H. Connections, etc. Total cost.	Cost per foot.	Payment. In assessment bills.	Payment. In City warrants.	Payment. Total cost.	Excess bills and balances.	Inspectors.	Contractors.	Date of final estimate.
Fulton st., from Seventh st. to 180 ft. eastward.	12 in. t. c.	153.	reb	ullt 2	$35 00	2	$30 00	c. c. 26.46 h. c. 80.	$2 00 50	$52 92 40 00	$1 75	$404 75	$85 92	$490 67	.....	R. W. Fleming.	Joseph Perna...	Sept. 22
Firth st., from Twenty-fifth st. to Twenty-sixth st.	2 ft. 3 in. x 1 ft. 6 in. 12 in. v. p.	402 15 3.	3 4	1 1	70 00 45 00	4	30 00	st. c. 12. h. c. 273.	1 10 50	13 20 136 50	1 75 1 00	1,039 13	52 33	1,091 46	.....	B. Z. Lippincott	Jas. H. Deehan..	Dec. 28
Fifty-fourth st., from Spruce st. to Pine st.	3 ft. 3 in. x 2 ft. 2 in. 2 ft. 3 in. x 1 ft. 6 in. 12 in. v. p. 15 in. t. c.	402.5 12. 20. 12.	2 ..... 3	3 ..... 1	80 00 ..... 75 00	3	35 00	c. c. 30.34 h. c. 93. ..... rubble mas'y. 44.3	2 00 ..... 50 4 50	60 68 ..... 196 50 199.35	2 84 2 84 1 00 1 25	791 50	1,297 21	2,088 71	.....	W. B. Thomas.	Robt. P. Ryan ..	Dec.
Gratz st., from Westmoreland st. to Ontario st.	2 ft. 3 in. x 1 ft. 6 in.	545.	3	4	70 00	5	30 00	c. c. 25.67 st. c. 24. h. c. 5.51	2 00 1 10 50	51 34 26 40 275 50	2 95	1,200 00	1,190 99	2,390 99	.....	George Webb..	Jas. T. McMahon.	Apr. 1

Length and Cost of Branch Sewers Built during the Year 1903—Continued.

Location.	Size.	Length in feet.	Inlets.			Manholes.		Wellholes. C. Curb, H. Connections, etc.			Cost per foot.	Payment.			Estimated bills and balances.	Inspectors.	Contractors.	Date of final estimate.
			Size.	No. built.	Cost each.	No. built.	Cost each.	No. built.	Per foot.	Total cost.		In assessment bills.	In City warrants.	Total cost.				
Glenwood ave., from Allegheny ave. to Ninth st.	3 ft. x 2 ft.	296.		2	1 $80 00		1 $35 00	well-hole. 17.	$7 00	$119 00	$2 69	$304 00	$792 24	$1,096 24	.....	H. C. Parker...	E. Pascuzzi.....	June 29
								c. c. 19.	2 00	38 00							
								excavation. 38.	50	19 00								
								rubble mas'ry 2.	4 50	9 00								
Greenwich street, from Twenty-third street to Twenty-fourth street	2 ft. 6 in. x 1 ft. 8 in.	364.	....	....	.....	2	35 00	h. c. 225.	50	112 50	1 66	805 74	.....	805 74	$19 26	D. S. Rorer.....	Jos. McGlathery.	Aug. 25
	12 in. v. p.	19.	....	....	.....	....	.....	.....	.....	.....	1 00	.....	.....	.....	231 00			
Gross street, from Girard ave. to Haverford st...	2 ft. 3 in. x 1 ft. 6 in.	480.	....	....	.....	2	35 00	h. c. 580.	50	265 00	1 50	1,077 00	.....	1,077 00	18	Eugene Emery	A. Zecca.....	Sept. 1.
	12 in. v. p.	22.	....	....	.....	....	.....	.....	.....	.....	1 00	.....	.....	.....	160 92			
Germantown av., from Mt. Airy to Allen's lane...	3 ft. circ. vit. sh. b. b.	28.	....	....	.....	....	.....	.....	.....	.....	9 44							
	3 ft x 2 ft. vit. sh. b. b.	460.	2	1	80 00	7	35 00	c. c. 44.25	2 00	88 50	9 44	1,171 80	8,078 64	9,240 94	.....	T. R. Wiggins..	David McMahon	Nov. 2.
	2 ft. 6 in. x 1 ft. 8 in. vit. sh. b. b.	8.	3	3	75 00	....	.....	st. c. 6.	1 10	6 60	9 44							
	2 ft. 3 in. x 1 ft. 6 in. vit. sh. b. b.	415.	....	....	.....	....	.....	.....	.....	.....	9 44							
	12 in. v. p.	5	....	....	.....	....	.....	.....	.....	.....	1 00							

Length and Cost of Branch Sewers Built during the Year 1903—Continued.

Location.	Size.	Length in feet.	Inlets. Size.	Inlets. No. built.	Inlets. Cost each.	Manholes. No. built.	Manholes. Cost each.	Wellholes. C. Curb, H. Connections, etc. No. built.	Per foot.	Total cost.	Cost per foot.	Payment. In assessment bills	In City warrants.	Total cost.	Excess bills and balances.	Inspectors.	Contractors.	Date of final estimate.
Haverford street, Fiftieth st. to Fifty-first st.	15 in. t. c.	490.				2	$80 00				$1 57	$786 53	$130 77	$867 30		D. J. Davis	Conan & Co.	Jan. 27.
	12 in. v. p.	38.									1 00							
Hall street, from Fifth st. to 162 feet westward.	12 in. t. c.	155.	4	1	$45 00	1	30 00	c. c. 12.46	$2 00	$24 92	1 79	356 80	95 57	452 37		R. C. Gamble.	Robt. Lombardi.	Mar. 31
				1 reb	uilt													
				1	35 00	1	40 00											
"H" street, from Russell street to Tioga street.	3 ft. 3 in. x 2 ft. 2 in.	390.	2	2	75 00	3	30 00	c. c. 46.	2 00	92 00	1 64	795 00	592 70	1,387 70		R. C. Gamble.	E. Pascuzzi.	May 11
	2 ft. 3 in. x 1 ft. 6 in.	75.	3	1	70 00			st. c. 6.	1 10	6 60	1 64							
								h. c. 433.	.50	216 50								
Hawthorne st., from Harrison street to Wakeling street.	2 ft. 3 in. x 1 ft. 6 in.	493.5				4	35 00	h. c. 710.	50	355 00	3 25					C. R. Rigler.	Jos. G. Conklin.	May 19
	12 in. v. p.	8.									1 00	1,903 00	803 88	2,106 88				
Huntingdon st., from Patton st. to Thirty-third street.	8 ft x 2 ft.	192.5	3	2	75 00	2	35 00				2 90					R. W. Fleming.	Robt. Lombardi.	Dec. 8.
	2 ft. 6 in. x 1 ft. 8 in.	457.	4	1	45 00	3	45 00	h. c. 556.	50	278 00	1 94	1,397 66	826 62	2,224 28				
	2 ft. 8 in. x 1 ft. 6 in.	18.5									1 89							
	15 in. t. c.	32.									1 89							
	12 in. v. p.	6.									1 00							

Length and Cost of Branch Sewers Built during the Year 1903—Continued.

Location.	Size.	Length in feet.	Inlets.			Manholes.		Wellholes, C. Curb, H. Connections, etc.			Cost per foot.	Payment.			Excess bills and balances.	Inspectors.	Contractors.	Date of final estimate.
			Size.	No. built.	Cost each.	No. built.	Cost each.	No. built.	Per foot.	Total cost.		In assessment bills.	In City warrants.	Total cost.				
Haverford street, from Sixty-third street to Merion road, and on Master st., from Sixty-second street to Haverford st...	4 ft. x 2 ft. 8 in.....	575.	....	....	.....	....	.....	.....	.....	.....	$4 10							
	3 ft. 3 in. x 2 ft. 2 in. vit. sh. b. b.....	544.5	2	6	$75 00	10	$25 00	.....	.....	.....	2 51							
	3 ft. x 2 ft.....	239.	3	6	70 00	2	30 00	c. c. 94.15	$2 00	$188 30	4 70	$4,120 24	$8,645 93	$12,766 17	.....	John Doyle....	John Morrison..	Dec. 15
	3 ft. x 2 ft. vit. sh. b. b.....	777.5	....	....	.....	....	.....	.....	.....	.....	3 46							
	2 ft. 6 in. x 1 ft. 8 in. vit. sh. b. b.....	846.	....	....	.....	....	.....	.....	.....	.....	3 60							
	2 ft. 3 in. x 1 ft. 6 in. vit. sh. b. b.....	6.	....	....	.....	....	.....	.....	.....	.....	3 37							
	2 ft. 3 in. x 1 ft. 6 in.	100.	....	....	.....	....	.....	.....	.....	.....	4 16							
	12 in v. p.....	4.	....	..	.....	....	.....	.....	.....	.....	1 00							
Jasper st., from Clearfield st. to 325 ft. southwest	2 ft. 6 in. x 1 ft. 8 in.	287.	....	....	.....	3	30 00	h. c. 333.	50	166 50	1 45	643 65	.....	643 65	$0 62 76 50	F. C. Spitzer...	J. Jafolla & Son.	Feb. 3
Jackson st., from Eighteenth st. to Passyunk av.	2 ft. 6 in. x 1 ft. 8 in.	248.	4	3	45 00	2	35 00	h. c. 194.	50	97 00	1 25	423 84	228 16	652 00	.....	W. B. Thomas.	J. Jafolla & Son.	Ju'e 16
	12 in. v. p.....	40.	....	....	.....	....	.....	.....	.....	.....	1 00							

Length and Cost of Branch Sewers Built during the Year 1903—Continued.

Location.	Size.	Length in feet.	Inlets.			Manholes.		Wellholes, C. Curb, H. Connections, etc.			Cost per foot.	Payment.			Excess bills and balances.	Inspectors.	Contractors.	Date of final estimate.
			Size.	No. built.	Cost each.	No. built.	Cost each.	No. built.	Per foot.	Total cost.		In assessment bills.	In City warrants.	Total cost.				
Krall street, from Queen lane to Crawford st., and on Crawford st., from Krall street to Ridge avenue..	3 ft. 3 in. circ. s. b. b., with 15 in. t. c.	345.75	....	....	.....	....	.....	well-hole. 17.	$5 00	$85 00	$4 80							
	2 in. circ. s. b. b., with 12 in. t. c....	522.5	1	2	$85 00	7	$30 00	c. c. 15.75	2 00	31 50	4 00							
	2 ft. circ. s. b. b	83.33	2	2	75 00	6	45 00	st. c. 6.	1 10	6 60	3 70	$1,616 64	$4,158 03	$5,774 67	.....	B. F. Slack.....	Richard Bennis.	Apr. 27
	15 in. t. c.....	85.5	....	....	.....	....	.....	h c. 568.	50	284 00	2 70							
	12 in. t. c.....	70.5	....	....	.....	....	.....	rep'g. 40.	25	10 00	3 10							
								rubble mas'y. 4.5	4 50	20 25								
								excavation 60.	50	30 00								
Kip st., from Ontario street to Tioga street....	2 ft. 6 in. x 1 ft. 8 in. vit. sh. b. b.....	208.	3	2	70 00	4	30 00	c. c. 31.42	2 00	62 84	1 80	1,395 97	152 57	1,548 54	.....	W. J. Kiley....	David Peoples...	May 4
	2 ft. 6 in. x 1 ft. 8 in.	205.	....	....	.....	....	.....	st. c. 18.	1 10	19 80	1 90							
								h. c. 560.	50	280 00								
Kimball st., from Nineteenth st. to Twentieth st.	2 ft. 6 in. x 1 ft. 8 in.	418.	....	reb 2	uilt 35 00	3	35 00	c. c. 22.6	2 00	45 20	1 57	1,040 02	.....	1,040 02	$14 96	Geo. Moore....	Robert P. Ryan.	J'ne 16
	12 v. p	32.	....	....	.....	....	.....	h. c. 189.	50	94 50	1 00							
								repaving. 12.35	3 00	37 05								

Length and Cost of Branch Sewers Built during the Year 1903—Continued.

Location.	Size.	Length in feet.	Inlets.			Manholes.		Wellholes, C. Curb, H. Connections, etc.			Cost per foot.	Payment.			Excess bills and balances.	Inspectors.	Contractors.	Date of final estimate.
			Size.	No. built.	Cost each.	No. built.	Cost each.	No. built.	Per foot.	Total cost.		In assessment bills.	In City warrants.	Total cost.				
Letterly st. from Gaul street to Cedar st., and on Gaul st. from Cumberland st. to Adams st....	3 ft. x 2 ft.....	832.	3	5	$75 00	6	$35 00	c. c. 75.	$2 99	$150 00	$1 54	$1,715 22	$732 06	$2,447 28	.....	D. S. Rorer.....	J. Jaffolla & Son.	June 8.
				reb	uilt			h. c.										
				1	35 00	....	.....	792.	.50	396 00								
Livingstone st., from Columbia ave. to Earl st...	3 ft. x 2 ft.....	295.	2	1	80 00	3	35 00	c. c. 21 17	2 00	42 34	5 94	707 89	1,366 75	2,074 64	.....	W. W. Brinkworth.....	Harmer & Quinn	June 29
								h. c. 190.	.50	95 00								
Lansdowne ave, from Fifty-ninth street to Sixty-second st.	3 ft. 9 in. circ.....	485.	2	3	75 00	7	25 00	c. c. 49.	2 00	98 00	7 00	3,404 00	4,003 53	7,407 53	.....	P. F. McGough	Joseph Perna....	July 6.
	2 ft. 6 in. x 1 ft. 8 in.	661.	3	2	70 00	3	30 00	st. t. 12.	1 10	13 20	2 00							
	2 ft. 3 in. x 1 ft. 6 in.	927.	....	....	.....	....	.....	h. c. 360.	.50	180 00	1 79							
	12 in. v. p.....	110.	....	....	.....	....	.....	.....	.....	.....	1 00							
Livingstone st., from Huntingdon street to Albert street...	3 ft. x 2 ft.....	235.	2	1	80 00	2	35 00	c. c. 42.25	2 00	84 50	1 30	426 32	367 68	794 00	.....	H. C. Parker..	E. Pascuzzi.....	July 21
								h. c. 208.	.50	104 00								
			3	2	75 00	....	.....											

Length and Cost of Branch Sewers Built during the Year 1903—Continued.

Location.	Size.	Length in feet.	Inlets.			Manholes.		Wellholes, C. Curb, H. Connections, etc.			Cost per foot.	Payment.			Excess bills and balances.	Inspectors.	Contractors.	Date of final estimate.
			Size.	No. built.	Cost each.	No. built.	Cost each.	No. built.	Per foot.	Total cost.		In assessment bills.	In City warrants.	Total cost.				
Lippincott street, fr'm Twentieth st. to Twenty-third street.....	3 ft. x 2 ft.....	441.	....	....	.....	.....	.....	.....	.....	.....	$1 53							
	2 ft. 6 in x 1 ft. 8 in.	474.	....	....	.....	11	$30 00	well-hole. 6.	$5 00	$30 00	1 53	$3140 76	$577 81	$3,718 57	.....	George Moore.	Robert P. Ryan.	Aug. 3
	2 ft. 3 in. x 1 ft. 6 in.	549.75	....	....	.....	.....	.....	h. c. 2,123.	50	1,061 50	1 53							
	12 inch v. p.....	56.	....	....	.....	.....	.....	.....	.....	.....	1 00							
Media st, from Fifty-ninth st. to Sixty first st.	3 ft. 3 in. x 2 ft. 2 in.	470.	2	3	875 00	....	.....	c. c. 114.	2 00	228 00	1 83							
	3 ft. x 2 ft.....	382.	3	6	70 00	4	30 00	h. c. 752.	50	376 00	1 81	1,804 79	1,367 95	3,172 74	.....	D. J. Davis.....	Conan & Co.....	Mar. 17
	2 ft. 3 in. x 1 ft. 6 in.	126.	....	....	.....	....	.....	.....	.....	.....	1 47							
	12 inch v. p.....	67.	....	....	.....	....	.....	.....	.....	.....	1 00							
Manning st., from Twenty-third st. to Twenty-fifth street.....	2 ft. 3 in. x 1 ft. 6 in.	529.	2	1	75 00	3	30 00	c. c. 23.33	2 00	46 66	1 96	1,270 73	84 77	1,355 50	.....	Thos. Meeley..	Robert P. Ryan.	Apr. 28
	12 inch v. p	62.	4	1	45 00	....	.....	.....	.....	.....	1 00							
Montgomery av., from Memphis st. to 130 ft. N. W.	3 ft. x 2 ft., vit. sh. b. b.....	131.	....	....	.....	1	35 00	h. c. 211.	50	105 50	2 23	390 00	42 63	432 63	.....	George Moore.	W. B. M. Conklin	May 6

Length and Cost of Branch Sewers built during the Year 1903—Continued.

Location.	Size.	Length in feet.	Inlets.			Manholes.		Wellholes, C. Curb, H. Connections, etc.			Cost per foot.	Payment.			Excess bills and balances.	Inspectors.	Contractors.	Date of final estimate.
			Size.	No. built.	Cost each.	No. built.	Cost each.	No. built.	Per foot.	Total cost.		In assessment bills.	In City warrants.	Total cost.				
Mt. Pleasant ave. from Germantown ave. to Sprague st.	4 ft. 3 in. circ. vit. sh. b. b.	701.	....	....	.....	....	.....	.....	.....	.....	$8 83							
	3 ft. x 2 ft. vit sh. b. b.	726.		2	$75 00	13	$25 00	st. c. 18. rubble mas'y	$1 10	$19 80	3 38	$4,717 79	$7,408 10	$12,125 89	.....	John Bishop, J. McCormick..	J. T. McMahon..	May 13
	2 ft. 3 in. x 1 ft. 6 in. vit. sh. b. b.	400.	3	8	70 00	....	.....	3.3	4 50	14 85	3 38							
	2 ft. 3 in. x 1 ft. 6 in.	281.	....	....	.....	....	.....	.....	.....	.....	3 38							
	15 in. t. c.	59.	....	....	.....	....	.....	.....	.....	.....	1 25							
	12 in. v. p.	37.	....	....	.....	....	.....	.....	.....	.....	1 00							
Manayunk ave. from Krams av. to Dupont st.	15 in. t. c. with 8 in. t. c.	293.64	....	....	.....	3	25 00	.....	.....	.....	4 33	928 53	1,617 97	2,546 50	.....	J. W. Harmer.	J. H. Wallace & Co.	May 19
	15 in. t. c.	53.25	3	4	70 00	1	40 00	h. c. 840.	50	420 00	4 33							
	8 in. t. c.	53.	....	....	.....	....	.....	.....	.....	.....	4 33							
Montrose st. fr'm Fourth street to Passyunk ave.	3 ft. x 2 ft.	273.	4	8 reb	45 00 uilt	9	30 00	c. c. 97.05	2 00	194 10	1 85	2,676 61	382 04	3,058 65	.....	H. W. Newton. John Bishop...	Bertholet & Bosher	May 25
	2 ft. 3 in. x 1 ft. 6 in.	870.	....	2	35 00	....	.....	.....	.....	.....	1 85							
	12 in. v. p.	50.	....	....	.....	....	.....	.....	.....	.....	1 00							

Length and Cost of Branch Sewers Built during the Year 1903—Continued.

Location.	Size.	Length in feet.	Inlets.			Manholes.		Wellholes, C. Curb, H. Connections, etc.			Cost per foot.	Payment.			Excess bills and balances.	Inspectors.	Contractors.	Date of final estimate.
			Size.	No. built.	Cost each.	No. built.	Cost each.	No. built.	Per foot.	Total cost.		In assessment bills.	In City warrants.	Total cost.				
Mildred st., from Spring street to Summer st.....	12 in. t. c.....	200.	4	1	$45 00	1	$35 00	concrete. 5.5	$5 50	$30 25	$1 87	$493 25	.....	$493 25	$4 75	H. C. Parker...	Robt. Lombardi.	May 26
	12 in. v. p.....	9.	.....	.....	.....	.....	.....	.....	.....	.....	1 00	.....	.....	.....	33 00			
Melvale st., from Ontario street to Tioga street.	3 feet x 2 feet.....	771.	3	6	75 00	5	35 00	c. c. 87.	2 00	174 00	1 14	1,750 56	$249 38	1,999 94	.....	D. S. Rorer.....	J. Jafolla & Son..	May 29
								h. c. 644.	50	322 00							
Mifflin st., from Twenty-third st to Point Breeze avenue.....	2 ft. 6 in. x 1 ft. 8 in.	233.	4	2	45 00	2	35 00	h. c. 247.	50	123 50	1 45	550 27	71 08	621 35	.....	W. B. Thomas.	Joseph Perna....	Aug. 26
Nineteenth st., from Wingohocking street to Courtland st.	2 ft. 3 in. x 1 ft. 6 in.	552.	rebuilt.	2	35 00	4	30 00	c. c. 32.	2 00	64 00	1 90	1,200 00	505 80	1,705 80	.....	J. W. Harmer..	Richard Bennis.	Mar. 27
								h. c. 806.	50	403 00							
Norfolk st., from Front street to Swanson st.....	2 ft. 3 in. x 1 ft. 6 in.	535.	3	1	70 00	3	30 00	c. c. 38.33 rubble mas'y.	2 00	76 66	2 23	1,323 40	273 80	1,597 20	.....	B. Z. Lippincott	Robt. P. Ryan...	June 2
	12 in. v. p.....	22.	4	3	45 00	....	.....	2.33	4 50	10 49	1 00							

Length and Cost of Branch Sewers Built during the Year 1903—Continued.

Location.	Size.	Length in feet.	Inlets.			Manholes.		Wellholes, C. Curb, H. Connections, etc.			Cost per foot.	Payment.			Excess bills and balances.	Inspectors.	Contractors.	Date of final estimate.
			Size.	No. built.	Cost each.	No. built.	Cost each.	No. built.	Per foot.	Total cost.		In assessment bills.	In City warrants.	Total cost.				
Narragansett st., from Crittenden st. to Stenton ave.....	2 ft. 3 in. x 1 ft. 6 in.	666.	3	4	$75 00	5	$35 00	c. c. 66.42	$2 00	$132 84	$8 65	$1,870 18	$5,107 36	$6,977 54	.....	George Webb..	Chas. D. Lamd..	Sept. 1.
								st. c. 18.	1 10	19 80							
								h. c. 1,178.	50	589 00								
Ontario st., from "A" st. to "G" street.....	4 ft. circ. vit. sh. b. b.....	1,140.	2	11	75 00	20	30 00	c. c. 249.15	2 00	498 30	4 51	7,828 46	4,645 61	12,474 07	.....	Wm. J. Kiley. P. F. McGough.	Robt. P. Ryan...	Apr. 28
	3 ft. 6 in. x 2 ft. 4 in.	50.	3	7	70 00	3	45 00	st. c. 24.	1 10	26 40	1 90							
	3 ft. 3 in. x 2 ft. 2 in. vit. sh. b. b.....	40.	....	....	.....	.....	.....	h. c. 3,821.	50	1,910 50	1 90							
	3 ft. x 2 ft. vit. sh. b. b.....	852.	....	....	.....	.....	.....	.....	.....	.....	1 04							
	2 ft. 6 in. x 1 ft. 8 in.	1,381.	....	....	.....	.....	.....	.....	.....	.....	98							
	2 ft. 6 in. x 1 ft. 8 in. vit. sh. b. b.....	33.	....	....	.....	.....	.....	.....	.....	.....	98							
	2 ft. 3 in. x 1 ft. 6 in.	179.	....	....	.....	.....	.....	.....	.....	.....	98							
	15 in. t. c.....	169.	....	....	.....	.....	.....	.....	.....	.....	1 25							
	12 in. v. p.....	18.	....	....	.....	.....	.....	.....	.....	.....	1 00							
Ontario st., from Park av. to Germantown ave..	2 ft. 3 in. x 1 ft. 6 in.	496.71	3	3	70 00	4	30 00	c. c. 28.33	2 00	46 66	1 37	739 10	694 55	1,433 65	.....	W. L. Holbrook.....	E. Pascuzzi.....	Jan. 27
			4	2	45 00	....	.....	h. c. 573.	50	286 50								

Length and Cost of Branch Sewers Built during the Year 1903—Continued.

Location.	Size.	Length in feet.	Inlets.			Manholes.		Wellholes, C. Curb, H. Connections, etc.			Cost per foot.	Payment.			Excess bills and balances.	Inspectors.	Contractors.	Date of final estimate.
			Size.	No. built.	Cost each.	No. built.	Cost each.	No. built.	Per foot.	Total cost.		In assessment bills.	In City warrants.	Total cost.				
Pennsdale street, from Terrace st, to Manay'k av.	15 in. t. c. with 8 in. t. c.	520.4	3	4	$70 00	5	$25 00	h. c. 1462.5	$ 50	$781 25	$4 40	$1,325 68	$2,118 33	$3,444 01	.....	J. W. Harmer.	Richard Bennis.	Feb. 10
	6 in. v. p.	36.	....	.....	.....	....	.....	.....	.....	.....	50							
Peach st., from Arch st. to Race street.	2 ft. 3 in. x 1 ft. 6 in.	508.	3 reb	1 built	75 00	3	35 00	c. c. 30.29	2 00	60 58	1 85	1,200 00	191 33	1,391 33	.....	George M. Raphael.	Jas. A. Mullen.	June 2
	12 in. v. p.	13.	....	1	35 00	....	.....	h. c. 330. rubble mas'y.	50	165 00	1 00							
								1.6	4 50	7 20								
Pine st., from Fifty-second st. to Fifty-third st.	3 ft. x 2 ft.	522.	3	2	75 00	4	35 00	c. c. 26.	2 00	52 00	1 81	945 00	670 32	1,615 32	.....	W. W. Brinkworth.	Jos. McGlathery	June 5
								h. c. 657.	50	328 50							
Paschall av., fr'm Sixty-fifth st. to Sixty-eighth st.	3 ft. 3 in. circ.	455.	2	1	75 00	11	80 00	c. c. 120.12	2 00	240 24	2 95	1,245 00	5,377 89	6,622 89	2,054 00	H. J. Bader.	Jos. McGlathery	June 5
	3 ft. 6 in. x 2 ft. 4 in.	500.	3	8	70 00	....	.....	.....	.....	.....	2 95							
	3 ft. x 2 ft.	565.	....	....	.....	....	.....	.....	.....	.....	2 95							
	3 ft. 3 in. x 2 ft. 2 in.	29.	....	....	.....	....	.....	.....	.....	.....	2 95							
	2 ft. 6 in. x 1 ft. 8 in.	29.	....	....	.....	....	.....	.....	.....	.....	2 95							
	2 ft. 3 in. x 1 ft. 6 in.	249.	....	....	.....	....	.....	.....	.....	.....	2 95							
	12 in. v. p.	28.	....	....	.....	....	.....	.....	.....	.....	1 00							

Length and Cost of Branch Sewers Built during the Year 1903—Continued.

Location.	Size.	Length in feet.	Inlets.			Manholes.		Wellholes, C. Curb, H. Connections, etc.			Cost per foot.	Payment.			Excess bills and balances.	Inspectors.	Contractors.	Date of final estimate.
			Size.	No. built.	Cost each.	No. built.	Cost each.	No. built.	Per foot.	Total cost.		In assessment bills.	In City warrants.	Total cost.				
Parrish st., from Fifty-first st. to Fifty-second st.	2 ft. 3 in. x 1 ft. 6 in. stone b. b.	92.	2	2	$80 00	3	$35 00	c. c. 24.07	$2 00	$48 14	$3 05							
	2 ft. 3 in. x 1 ft. 6 in. vit. sh. b. b.	541.	....	....	.....	....	.....	h. c. 1164.	50	582 00	2 70	$1,713 53	$963 11	$2,676 64	.....	W. L. Holbrook	Conan & Co	Jun 15
	12 in. v. p.	10.	....	....	.....	....	.....	rubble mas'y. 5 6	4 50	25 20	1 00							
	15 in. t. c.	4.	....	....	.....	....	.....	.....	.....	.....	1 25							
Pastorius street, from Wayne st. to Greene st.	12 in. t. c.	1,144.5	3	2	70 00	2	25 00	c. c. 20.	2 00	40 00	3 64	3,123 49	1,567 49	4,690 98	.....	T. R. Wiggins..	David McMahon	July 13
						7	30 00	h. c. 170.	.50	85 00								
Pemberton street from Fifteenth st. to Rosewood st.	2 ft. 3 in. x 1 ft. 6 in.	349.	....	....	.....	3	35 00	h. c. 180.	.50	90 00	1 60	762 40	.....	762 40	$2 19	R. W. Fleming.	Joseph Perna....	Aug. 26
	12 in. v. p.	9.	....	....	.....	....	.....	.....	.....	.....	1 00	.....	.....	.....	88 00			
Pike street, from Thirteenth st. to Park ave.	2 ft. 6 in. x 1 ft. 8 in.	226.	2	1	80 00	2	35 00	c. c. 15.17	2 00	30.34	2 12							
	12 in. v. p.	36.	3	1	75 00	....	.....	st. c. 6.	1 10	6 60	1 00	552 55	349 01	901 56	.....	C. A. Crossin...	Patrick Durkin.	Dec. 1
								h. c. 249.	.50	124 50							

Length and Cost of Branch Sewers Built during the Year 1903—Continued.

Location.	Size.	Length in feet.	Inlets. Size.	Inlets. No. built.	Inlets. Cost each.	Manholes. No. built.	Manholes. Cost each.	Wellholes, C. Curb, H. Connections, etc. No built.	Per foot.	Total cost.	Cost per foot.	Payment. In assessment bills.	Payment. In City warrants.	Payment. Total cost.	Excess bills and balances.	Inspectors.	Contractors.	Date of final estimate.
Race street, from Fifty-third st. to Fifty-fourth st., and on Fifty-fourth st from Race st. to 311 feet northward.	2 ft. 3 in. x 1 ft 6 in.	857.	....	....	.....	....	.....	c. c. 39.	$2 00	$78 00	$1 68							
	12 in. v p	147.5	3	3	$75 00	3	$35 00	h. c. 1,048.	50	524 00	1 00	$1,934 52	$631 09	$2,565 61	.....	J. P. Flood.....	John Morrison..	June 8
								rubble mas'y. 10.3	4 50	46 35							
Rhawn st. from State road to Penna. R. R.....	3 ft. 6 in. x 2 ft. 4 in.	366.	....	....	.....	....	.....	c. c. 15.5	2 00	31 00	2 90	.....	.....	.....	.....	R. W. Fleming.	R. P. Bennis.....	July 13
	3 ft. x 2 ft.	345.25	3	2	70 00	4	25 00	st. c. 18.	1 10	19 80	2 70	.....	2,295 38	2,295 38	$1,907 43			
	12 in. v. p.....	11.	....	....	.....	....	.....	.....	.....	.....	1 00							
Reese st. from Luzerne st to Lycoming st., on Lycoming st., from Reese st. to Sixth st. and on Sixth st. fr'm Lycoming st. to 50 feet south of Hunt'g P'rk av.	5 ft. 6 in. circ. vit. sh. b. b.....	1,319.	2	10	75 00	....	.....	c. c. 209.81	2 00	419 62	8 23							
	3 ft. 6 in. x 2 ft. 4 in.	49.	3	2	70 00	8	25 00	st. c. 36.	1 10	39 60	1 75	3,124 56	10723 58	13,848 14	.....	J. J. McVeigh..	Howard E. Ruch	July 14
	3 ft. x 2 ft.	89.	....	....	.....	....	.....	h. c. 1,616.	50	808 00	1 65							
								excavation 580.	50	290 00	1 55							
	2 ft. 6 in. x 1 ft. 8 in.	29.	....	....	.....	....	.....	.....	.....	.....	1 00							
	12 in. v. p.....	33.	....	....	.....	....	.....	.....	.....	.....	1 25							
	15 in. t. c.....	28.	....	....	.....	....	.....	.....	.....	.....								

Length and Cost of Branch Sewers Built during the Year 1903—Continued.

Location.	Size.	Length in feet.	Inlets.			Manholes.		Wellholes, C. Curb, H. Connections, etc.			Cost per foot.	Payment.			Excess bills and balances.	Inspectors.	Contractors.	Date of final estimate.
			Size.	No. built.	Cost each.	No. built.	Cost each.	No. built.	Per foot.	Total cost.		In assessment bills.	In City warrants.	Total cost.				
Rittenhouse st., fr'm Crittenden st. to Stenton ave.	2 ft. 3 in. x 1 ft. 6 in.	671.		3	4 $75 00	5	$35 00	c. c. 34.54 st. c. 36. h. c. 1,090.	$2 00 1 10 50	$69 08 39 60 545 00	$10 00	$1,885 02	$5,953 66	$7 838 68	.....	E. C. Hill.....	Richard Bennis.	July 21
Redfield st., from Arch st. to Race street	2 ft. 3 in. x 1 ft. 6 in.	500.	.....	.....	.....	3	35 00	h. c. 312.	50	156 00	1 87	1,196 00	.....	1,196 00	$4 00	W.L.Holbrook	John Morrison..	July 28
Ridge ave., from Scott's lane to Allegheny ave., and on Allegh'y av., from Ridge av. to Thirty-third street	2 ft. 3 in. circ. st. b. b., with 18 in. t. c.	409.5	.....	.....	.....	.....	.....	c. c. 24.	2 00	48 00	5 50							
	2 ft. circ. st. b. b., with 18 in. t. c....	864.3	2	1	80 00	13	30 00	h. c. 975.	50	487 50	4 98							
	2 ft. circ., with 10 in. t. c.....	77.	.....	reb uilt. 1	35 00	2	40 00	excavation. 26.	50	13 00	4 00	.....	8,439 96	8,439 96	1,426 65	W.L. Holbrook	Jas. H. Deehan..	Nov. 4.
	18 in. t. c.....	141.	.....	.....	.....	.....	.....	rubble mas'y 3. concrete. 1	4 50 5 50	13 50 5 50	3 00							
Sepviva st., from Eyre street to Palmer street..	2 ft. 6 in. x 1 ft. 8 in.	300.	.....	.....	.....	3	30 00	h. c. 144.	50	72 00	1 50	612 00	.....	612 00	9 08 45 88	D. S. Rorer.....	J. Jafolla & Son.	May 5.

Length and Cost of Branch Sewers Built during the Year 1903—Continued.

Location.	Size.	Length in feet.	Inlets.			Manholes.		Wellholes, C. Curb, H. Connections, etc.			Cost per foot.	Payment.			Excess bills and balances.	Inspectors.	Contractors.	Date of final estimate.
			Size.	No. built.	Cost each.	No. built.	Cost each.	No. built.	Per foot.	Total cost.		In assessment bills.	In City warrants.	Total cost.				
Salmon st., from Buckius st. to Ash street	2 ft. 3 in. x 1 ft. 6 in.	511.5				4	$30 00				$1 80	$1,054 70		$1,054 70	$14 11			
	12 in. v. p.	14.									1 00				322 23	H. C. Parker...	Rob't Lombardi	May 19
Sixty-first street, from Lancaster ave. to Oxford st., and on Columbia avenue, from Sixtieth street to Sixty-third street	3 ft. 3 in. x 2 ft. 2 in. vit. sh. b. b.	612.	2	5	$75 00			c. c. 87.	$2 00	$174 00	5 97							
	3 ft. x 2 ft.	375.	3	3	70 00	15	25 00	st. c. 12.	1 10	13 20	5 72							
	2 ft. 3 in. x 1 ft. 6 in.	1,694.									5 33		15984 36	15,984 36	6,311 12	J. P. Flood.....	John Morrison..	May 19
	12 in. v. p.	2.									1 00							
	15 in. t. c.	6.									1 25							
Sixteenth street, from Hunting Park avenue to Ruffner st.	2 ft. 3 in. x 1 ft. 6 in.	200.	3	2	75 00			c. c. 18.	2 00	36 00	2 25	440 15	$265 15	705 30		E. C. Hill.....	Patrick Durkin.	June 2.
	12 in. v. p.	9.						st. c. 18.	1 10	19 80	1 00							
								h. c. 81.	50	40 50								
Sansom st., from Front st. to 165 feet westward	12 in. t. c.	166.	4	1	45 00	2	25 00	c. c. 13.	2 00	26 00	2 00	319 48	168 52	488 00		H. W. Newton.	Joseph Perna....	June 30
			Rebuilt.	1	35 00													

Length and Cost of Branch Sewers Built during the Year 1903—Continued.

Location.	Size.	Length in feet.	Inlets.			Manholes.		Wellholes, C. Curb, H. Connections, etc.			Cost per foot.	Payment.			Excess bills and balances.	Inspectors.	Contractors	Date of final estimate.
			Size.	No. built.	Cost each.	No. built.	Cost each.	No. built.	Per foot.	Total cost.		In assessment bills.	In City warrants.	Total cost.				
Saybrook street, f'm Sixty-ninth street to Seventieth street.....	2 ft. 3 in. x 1 ft. 6 in.	452.		3	1 $75 00	4	$35 00	h. c. 498.	$0 50	$249 00	$1 75	$1283 00	.....	$1,283 00	$3 50	H. J. Bader.....	Jos. McGlathery.	Aug. 25
	12 in. v. p..... ...	28.	...	....	.....	....	.....	.....	.....	.....	1 00	.....	.....	.....	22 50	.....		
Sixty-fourth st., fr'm Callowhill st. to Girard av., and on Girard ave., fr'm Sixty-third street to Sixty-fifth st..	3 ft. x 2 ft. stone b. b.	513.		2	2 75 00	7	30 00	c. c. 63.	2 00	126 00	3 10							
	3 ft. x 2 ft. vit. sh. b. b.	570.		3	3 70 00	....	.....	h. c. 1,751.	50	875 50	2 90	3,632 69	$2849 20	6,481 89	.....	Eugene Emery	Conan & Co.....	Sep. 12
	2 ft. 6 in. x 1 ft. 8 in.	286.	....	....	.....	....	.....	.....	.....	.....	3 02							
	2 ft. 3 in. x 1 ft. 6 in.	251.	....	....	.....	....	.....	.....	.....	.....	2 87							
	12 inch v. p.....	83.	....	....	.....	....	.....	.....	.....	.....	1 00							
Tulip street, from Unruh street to Rawle street...	3 ft. x 2 ft.....	328.5		3	2 70 00	4	25 00	c. c. 30.9	2 00	61 80	1 70	.....	1,216 50	1,216 50	1,235 04	Geo. W. Myers.	R. P. Bennis.....	Apr. 7
	2 ft. 6 in. x 1 ft. 8 in.	233.1	....	....	.....	....	.....	st. c. 6.	1 10	6 60	1 50							
Thirty-fourth st., from Harold st. to 150 ft. northward.....	15 inch t. c.....	114.	....	....	.....	1	30 00	.....	.....	.....	1 97	288 25	11 33	299 58	.....	D. S. Rorer.....	David France...	Apr. 15
						1	45 00											
Tilton st., from Neff st. to Allegheny avenue..	3 ft. x 2 ft.....	700.		3	4 70 00	11	30 00	c. c. 45.42	2 00	90 84	1 35	3,024 84	.....	3,024 84	12	C. R. Rigler....	J. Jafolla & Son.	Apr. 27
	2 ft. 3 in. x 1 ft. 6 in.	766.	....	....	.....	....	.....	h. c. 819.	50	409 50	1 25	.....	.....	.....	555 58			
								excavation. 24.	50	12 00								

Length and Cost of Branch Sewers Built during the Year 1903—Continued.

Location.	Size.	Length in feet.	Inlets. Size.	Inlets. No. built.	Inlets. Cost each.	Manholes. No. built.	Manholes. Cost each.	Wellholes, C. Curb, H. Connections, etc. No. built.	Wellholes, C. Curb, H. Connections, etc. Per foot.	Wellholes, C. Curb, H. Connections, etc. Total cost.	Cost per foot.	Payment. In assessment bills.	Payment. In City warrants.	Payment. Total cost.	Excess bills and balances.	Inspectors.	Contractors.	Date of final estimate.
Tioga st., from "A" st. to Rosehill street.....	3 ft. 3 in. x 2 ft. 2 in. stone b. b.....	241.		2	$75 00	5	$30 00	c. c. 80.5	$2 00	$161 00	$2 37	$1869 22	$2485 55	$4,354 77	.....	P. F. McGough	E. Pascuzzi.....	Apr. 27
	3 ft. 3 in. x 2 ft. 2 in. vit. sh. b. b.....	615.5		3	70 00	1	45 00	st. c. 6.	1 10	6 60	2 37							
	3 ft. x 2 ft.....	27.	....	....	.....	....	.....	h. c. 1549. rubble mas'y	50	774 50	2 37							
	2 ft. 6 in. x 1 ft. 8 in	140.	....	....	.....	....	.....	16.5	4 50	74 25	2 37							
	2 ft. 6 in. x 1 ft. 8 in. vit. sh. b. b.....	56.	....	....	.....	....	.....	.....	.....	.....	2 37							
Twenty-first st., from Somerset street to 260 feet northward	2 ft. 3 in. x 1 ft. 6 in.	273.08	....	....	.....	2	35 00	h. c. 313. repaving.	50	156 50	1 70	699 74	.....	699 74	.....	H. C. Parker..	Robt. Lombardi.	June 15
								3.	3 00	9 00							
Twentieth street, from Somerset st. to Indiana st.	3 ft. 3 in. x 2 ft. 2 in.	549.5	2	3	80 00	6	35 00	c. c. 39.75	2 00	79 50	1 47	2,445 00	744 65	3,189 65	.....	R. C. Gamble..	E. Pascuzzi	June 16
	2 ft. 6 in. x 1 ft. 8 in.	582.5	....	....	.....	1	45 00	st. c. 6.	1 10	6 60	1 47							
	12 in. v. p.....	22.	....	....	.....	....	.....	h. c. 1836. rubble mas'y.	50	918 00	1 00							
								1.	50	4 50							

Length and Cost of Branch Sewers Built during the Year 1903—Continued.

Location.	Size.	Length in feet.	Inlets. Size.	Inlets. No. built.	Inlets. Cost each.	Manholes. No. built.	Manholes. Cost each.	Wellholes. C. Curb, H. Connections, etc. No. built.	Per foot.	Total cost.	Cost per foot.	Payment. In assessment bills.	Payment. In City warrants.	Payment. Total cost.	Excess bills and balances.	Inspectors.	Contractors.	Date of final estimate.
Toronto st. f'm 200 ft. W. Twenty-first st. to Twenty-second st....	3 ft. x 2 ft.....	260.	3	1	$75 00	1	$35 90	c. c. 12.88	$2 00	$25 76	$2 87	$522 83	$537 63	$1,060 46	.....	R. C. Gamble..	Walter D. Stone.	July 7.
						1	45 00	h. c. 267.	.50	133 50								
Tulip street, from Allegheny ave. to Ann street...	3 ft. x 2 ft.....	1,708.	....	....	.....	13	35 00	h. c. 742.	.50	371 00	1 60	3,558 80	.....	3,558 80	$ 3 42 592 45	Chas. R. Rigler.	Jos. G. Conklin..	Aug. 19
Twenty-fifth st., from York st. to Firth st.....	2 ft. 6 in. x 1 ft. 8 in.	190.	2	1	75 00	8	30 00	c. c. 23.08	2 00	46 16	1 48	1,668 22	141 09	1,809 31	.....	W. J. Kiley....	Rob't Lombardi.	Sept. 15
	2 ft. 3 in. x 1 ft. 6 in.	491.	4	1	45 00	....	.....	h. c. 718.	.50	359 00	1 45							
	12 in. v. p.....	51.	....	....	.....	....	.....	.....	.....	.....	1 00							
Twenty-fifth st., from Firth st. to Huntingdon street.....	2 ft. 3 in. x 1 ft. 6 in.	310.	3	1	75 00	2	35 00	h. c. 216.	.50	108 00	1 84	714 29	166 08	880 37	.....	J. McParland..	Rob't Lombardi.	Dec. 29.
	12 in. v. p.....	30.	....	....	.....	....	.....	excavation 3.8	.50	1 90	1 00							
								brick mas'y. 1.035	9 00	9 32								
								rubble mas'y. 3.5	4 50	15 75								

Length and Cost of Branch Sewers Built during the Year 1903—Continued.

Location.	Size.	Length in feet.	Inlets. Size.	Inlets. No. built.	Inlets. Cost each.	Manholes. No. built.	Manholes. Cost each.	Wellholes, C. Curb, H. Connections, etc. No. built.	Wellholes, C. Curb, H. Connections, etc. Per foot.	Wellholes, C. Curb, H. Connections, etc. Total cost.	Cost per foot.	Payment. In assessment bills.	Payment. In City warrants.	Payment. Total cost.	Excess bills and balances.	Inspectors.	Contractors.	Date of final estimate.
Twenty-third st., from Sedgley avenue to Firth Street	2 ft. 3 in. x 1 ft. 6 in.	496.25	....	....	.....	5	$30 00	h. c. 658.	$0 50	$329 00	$1 67	$1,307 74	.....	$1,307 74	$0 31 37 50	B. Z. Lippincott	Jas. H. Deehan...	Nov. 25
Westmorela'd st., from Tenth st. to Goodman st., and on Goodman st., from Sedgley ave. to Roy st.	3 ft. x 2 ft. vit. sh. b. b.	138.	2	1	$75 00	4	30 00	c. c. 20.	2 00	40 00	1 50	938 52	$327 28	1,265 80	.....	H. J. Bader.....	R. P. Ryan.....	Feb. 9.
	15 in. t. c.....	376.	3	2	70 00	1	45 00	st. c. 18.	1 10	19 80	1 25							
								h. c. 242.	50	121 00								
								excavation. 56.	50	28 00								
Willard st., from "F" st. to "G" st., and on Madison st., from "F" st. to "G" street	2 ft. 6 in. x 1 ft. 8 in.	1,070.	2	3	75 00	8	30 00	c. c. 89.12	2 00	178 24	1 34	2,370 00	311 54	2,681 54	.....	P. F. McGough.	H. E. Yoast.....	Feb. 21.
			3	4	70 00	....	.....	st. c. 25.	1 10	27 50								
								h. c. 594.	50	297 00								
Westmorela'd st., from Thirteenth st. to Germantown avenue...	2 ft. 3 in. x 1 ft. 6 in.	410.5	reb	uil	t			st. c. 6.	1 10	6 60	1 76	.....	.....	.....	.....	J. McParland..	Robt. P. Ryan...	Mar. 18
	12 in. v. p.....	2.	....	....	.....	....	.....	h. c. 587.	50	293 50	1 00	1,068 49	81 09	1,149 58				

Length and Cost of Branch Sewers Built during the Year 1903—Continued.

Location.	Size.	Length in feet.	Inlets.			Manholes.		Wellholes, C. Curb, H. Connections, etc.			Cost per foot.	Payment.			Excess bills and balances.	Inspectors.	Contractors.	Date of final estimate.
			Size.	No. built.	Cost each.	No. built.	Cost each.	No. built.	Per foot.	Total cost.		In assessment bills.	In City warrants.	Total cost.				
Wishart st., from "D" st. to Rorer street	3 ft. x 2 ft.	225.	....	....	.....	3	$35 00	h. c. 150.	$0 50	$75 00	$1 79	$450 00	$132 75	$582 75	.....	D. S. Rorer.....	J. Jafolla & Son..	June 16
Wolf street, from Nineteenth st. to 120 feet eastward	3 ft. 6 in. x 2 ft. 4 in.	147.	3	4	$75 00	1	35 00	c. c. 26.	2 00	52 00	1 30	290 99	482 51	773 50	.....	W. B. Thomas.	Joseph Perna....	July 14
	3 ft. x 2 ft.	64.	....	....	.....	....	.....	h. c. 218.	50	109 00	1 35							

Department of Public Works, Bureau of Surveys. Testing Laboratory. Number of Samples of Cement Tested from 1896 to 1903, inclusive.

Month.	1896.	1897.	1898.	1899.	1900.	1901.	1902.	1903.
January	2	14	6	1	26	32	62	176
February	1	14	13	1	21	18	26	100
March	0	11	27	15	65	52	60	213
April	18	42	27	20	90	110	166	278
May	23	45	92	69	65	148	170	283
June	4	83	68	81	75	135	202	330
July	16	69	52	40	105	138	212	330
August	21	43	47	16	140	125	214	226
September	24	70	69	102	132	134	252	266
October	23	67	45	50	141	184	276	163
November	24	39	62	62	107	144	224	372
December	40	34	14	59	59	104	288	174
Total	192	531	522	516	1,026	1,324	2,152	2,911

G. S. WEBSTER,
Chief Engineer.

W. PURVES TAYLOR,
Engineer of Tests.

Tests of Concrete Cubes from the Stokley Street Bridge.

Composition—1 part cement, 3 parts sand, 6 parts stone.

Cube No.	Age.	Brand cement.	Size stone.	Cross section. Sq. in.	Height. Inches.	First sign of failure. Lbs. per sq. in.	Ultimate strength. Lbs. per sq. in.	Place used.	Remarks.
7	29 days.	Whitehall.	1¼ in.	35.70	5.95	745	1,073	Main wall, east end	Broken on side, edges rough, failure regular, mortar crumbly.
10	29 days.	Whitehall.	1¼ in.	35.58	5.95	809	1,228	10 course, centre wall	Faces and edges very rough, failure irregular, mortar crumbly.
11	31 days.	Whitehall.	1¼ in.	35.76	6.01	568	1,243	Bridge seat	Broken on side, failure regular, mortar crumbly.
5	59 days.	Whitehall.	1¼ in.	36.42	5.98	961	1,840	Main wall, centre	Broken on side, failure slightly irregular, mortar good.
4	60 days.	Whitehall.	1¼ in.	35.46	5.97	1,099	1,643	Main wall, centre	Broken on side, failure regular, mortar crumbly.
6	60 days.	Whitehall.	1¼ in.	35.82	5.93	1,217	1,578	Main wall, centre	Broken on side, failure regular, mortar crumbly.
2	89 days.	Whitehall.	1¼ in.	35.05	5.96	1,483	1,548	Main wall	Broken on side, failure irregular, mortar soft.
1	90 days.	Whitehall.	1¼ in.	35.70	5.98	1,154	1,314	Main wall	Broken on side, failure irregular, mortar crumbly.
3	90 days.	Whitehall.	1¼ in.	35.28	5.95	1,561	1,668	Main wall, centre	Broken on side, failure irregular, mortar good.

G. S. WEBSTER,
Chief Engineer.

W. PURVES TAYLOR,
Engineer of Tests.

Tests of Conerete Cubes from the Torresdale Conduit Model Section and Shaft 1.

Composition—1 part cement, 3 parts sand 5 parts stone.

Cube No.	Age.	Brand cement.	Size stone.	Cross section. Sq. in.	Height. Inches.	First sign of failure. Lbs. per sq. in.	Ultimate strength. Lbs. per sq. in.	Place used.	Remarks.
...	239 days..	Not given	Not given	36.00	5.98	444	514	Model section	Mortar porous and crumbly.
1	239 days..	Star.....	¾-inch ...	36.18	6.10	901	1,739	Outside steel shell	Top rough, corners broken.
2	240 days..	Star.....	¾-inch....	36.00	5.93	989	1,513	Outside steel shell	Corners broken.
3	240 days..	Star.....	.....	35.82	5.89	464	603	Between brick lining and steel shell.....	Made of sand mortar without stone.

G. S. WEBSTER,
Chief Engineer.

W. PURVES TAYLOR,
Engineer of Tests.

Tests of Concrete Cubes from the Torresdale Conduit Shaft 2.

Composition—1 part cement, 3 parts sand, 5 parts stone.

Cube No.	Age.	Brand cement.	Size stone.	Cross section. Sq. in.	Height. Inches.	First sign of failure. Lbs. per sq. in.	Ultimate strength. Lbs. per sq. in.	Place used.	Remarks.
6	59 days..	Star....	1½-in.	36.00	6.05	1,758	3,982	Cradle.	
7	60 days..	Star....	1½-in.	35.94	5.99	1,088	1,279	Cradle	Mortar soft.
12	60 days..	Star....	1½-in.	36.24	6.02	2,723	3,506	Arch.	
13	60 days..	Star....	1½-in.	35.70	6.00	2,305	2,438	Cradle	Broken on side—Failure irregular.
14	60 days..	Star....	1½-in.	36.36	6.04	2,849	3,557	Arch	Broken on side.
5	61 days..	Star....	1½-in.	36.12	6.02	2,871	3,286	Cradle	Broken on side—Failure irregular.
3	89 days..	Star....	1½-in.	36.00	6.01	2,211	2,392	Cradle.	
4	90 days..	Star....	1½-in.	36.00	6.00	2,975	3,622	Cradle	Broken on side.
8	90 days..	Star....	1½-in.	36.06	6.02	2,457	2,815	Arch	Broken on side—Failure slightly irregular.
9	90 days..	Star....	1½-in.	35.76	5.99	1,678	1,865	Arch.	
10	90 days..	Star....	1½-in.	36.42	6.02	975	1,195	Arch	Broken on side—Failure irregular, mortar soft.
11	90 days..	Star....	1½-in.	36.12	6.03	1,836	2,446	Arch	Mortar good—Failure irregular.
1	120 days..	Star....	1½-in.	36.12	5.99	2,192	2,646	Cradle.	
2	121 days..	Star....	1½-in.	36.18	6.00	1,608	2,199	Cradle.	

NOTE.—Stone ½ in. to 1½ in. hornblende gneiss.

G. S. WEBSTER,
Chief Engineer.

W. PURVES TAYLOR,
Engineer of Tests.

Tests of Concrete Cubes from the Upper Roxborough Filter Beds.

Composition—1 part cement, 3 parts sand, 5 parts stone.

Cube No.	Age.	Brand cement.	Size stone.	Cross section. Sq. in.	Height. Inches.	First sign of failure. Lbs. per sq. in.	Ultimate strength. Lbs. per sq. in.	Place used.	Remarks.
130	119 days..	Star..	¾-in...	35.70	5.98	781	2,441	Ground arches, Filter No. 4.....	Failure somewhat irregular, cube skewed.
131	120 days..	Star..	¾-in...	35.70	6.02	1,916	2,646	Ground arches, Filter No. 3.....	Cube skewed.
126	178 days..	Star..	¾-in...	35.76	5.98	1,521	2,609	Ground arches, Filter No. 4.....	Cube skewed, mortar somewhat porous.
125	179 days..	Star..	¾-in...	35.82	6.04	2,834	3,312	Walls of regulating houses.....	Cube skewed.
129	181 days..	Star..	¾-in...	35.76	6.04	2,070	2,740	Roof of sand incline, Filter No. 4.....	Failure somewhat irregular, cube skewed.
10	1 year....	Star..	1½-in...	35.70	6.00	1,468	1,673	Floor of filtered water basin.....	Cube skewed.
11	1 year....	Star..	1½-in...	35.70	6.00	790	1,161	Floor of filtered water basin.....	Cube skewed, mortar porous.
18	1 year....	Star..	¾ in...	35.64	6.00	1,607	1,733	Walls and piers, filtered water basin.	
19	1 year....	Star..	¾-in...	35.64	6.03	1,431	1,833	Piers, west walls and south walls, F. W. B...	Failure irregular.
51	1 year....	Star..	1½-in...	35.58	5.88	864	1,870	Piers, Filter No. 7. Floors, Filters No. 6 and 7.	Broken on side, edges chipped, mortar soft.
52	1 year....	Star..	1½-in...	35.16	5.96	956	1,530	Floor, Filter No. 6.....	Broken on side, mortar crumbly.
78	1 year....	Star..	1½-in...	35.40	6.04	1,658	2,797	North end collector, Filter No. 8.	
79	1 year....	Star..	1½-in...	35.11	5.98	1,422	2,230	North floor, Filter No. 2.	
96	1 year....	Star..	1½-in...	36.84	5.91	1,954	3,474	Piers, Filter No. 1.....	Faces slightly porous.
97	1 year....	Star..	1½-in...	35.52	6.00	1,587	3,263	Roof sand incline, Filter No 7.	
98	1 year....	Star..	Graded.	35.70	6.03	807	2,204	North wall, Filter No. 3.....	Broken on side.

G. S. WEBSTER,
Chief Engineer.

W. PURVES TAYLOR,
Engineer of Tests.

Tests of Concrete Cubes from the Oak Lane Reservoir

Composition—1 part Cement, 3 parts Sand, 5 parts Stone.

Cube No.	Age.	Brand cement.	Size stone.	Cross section. Sq. in.	Height. Inches.	First sign of failure Lbs. per sq. in.	Ultimate strength Lbs. per sq. in.	Place Used.	Remarks.
4	60 days.	Alpha..	¾ to 1½ in.	36.00	6.02	556	3,126	Walls of north inlet chamber.....	Faces and edges rough.
6	60 days.	Alpha..	¾ to 1½ in.	36.30	6.00	2,582	2,728	Walls of north inlet chamber.....	Broken on side, failure irregular, mortar good.
7	60 days.	Alpha..	¾ to 1½ in.	36.72	6.02	2,483	2,797	Walls of north inlet chamber.....	Broken on side, failure irregular, mortar good.
13	60 days.	Alpha..	¾ to 1½ in.	36.30	6.01	849	1,478	Bottom of north basin.....	Broken on side, faces and edges rough, mortar crumbly.
14	60 days.	Alpha..	¾ to 1½ in	36.18	6.00	1,246	1,401	Bottom of north basin.....	Broken on side, failure irregular, mortar soft.
15	60 days.	Alpha..	¾ to 1½ in.	36.06	6.00	1,306	1,382	Bottom of north basin.....	Failure irregular, mortar crumbly.
16	60 days.	Alpha..	¾ to 1½ in.	36.78	6.04	995	1,271	Bottom of north basin.....	Broken on side, failure irregular, mortar good.
17	60 days.	Alpha..	¾ to 1½ in.	35.64	6.00	1,150	1,202	Bottom of north basin.....	Broken on side, failure regular, mortar soft.
18	60 days.	Alpha..	¾ to 1½ in.	35.82	6.00	1,183	1,245	Bottom of north basin.....	Broken on side, failure irregular, mortar soft.
9	61 days.	Alpha..	¾ to 1½ in.	36.24	6.02	2,400	2,580	Walls, north inlet chamber.....	Broken on side, faces rough.
11	89 days.	Alpha..	¾ to 1½ in.	35.82	5.96	2,007	2,121	Walls, north inlet chamber.....	Broken on side, failure irregular, mortar good.
12	89 days.	Alpha..	¾ to 1½ in.	36.00	6.00	1,628	1,870	Walls, north inlet chamber.....	Broken on side, failure irregular, mortar soft.
2	90 days.	Alpha..	¾ to 1½ in.	36.36	6.04	1,250	2,655	Foundation, north inlet chamber.	Failure irregular, mortar good.
3	90 days.	Alpha..	¾ to 1½ in.	36.00	6.00	2,041	2,097	Foundation, north inlet chamber.	Broken on side.

Tests of Concrete Cubes from the Oak Lane Reservoir.—Continued.

Cube No.	Age.	Brand cement.	Size stone.	Cross section Sq. in.	Height. Inches.	First sign of failure Lbs. per sq. in.	Ultimate strength Lbs. per sq. in.	Place used.	Remarks.
5	90 days.	Alpha..	¾ to 1½ in.	36.66	6.04	1,407	1,529	Wall, north inlet chamber.....	Broken on side, failure irregular, mortar good.
8	90 days.	Alpha..	¾ to 1½ in.	36.12	6.00	1,943	2,188	Wall, north inlet chamber.....	Broken on side, failure irregular, mortar soft.
10	90 days	Alpha .	¾ to 1½ in.	36.66	6.03	1,265	1,690	Wall, north inlet chamber.....	Failure irregular, mortar soft.
1	120 days	Alpha..	¾ to 1½ in.	36.12	5.97	2,209	2,383	Foundation, north inlet chamber.	Broken on side, faces and edges very rough, mortar soft.

G. S. WEBSTER,
Chief Engineer.

W. PURVES TAYLOR,
Engineer of Tests.

Tests of Concrete Cubes from the Torresdale Conduit Shaft 3.

Composition—1 part cement, 3 parts sand, 5 parts stone.

Cube No.	Age.	Brand cement.	Size stone.	Cross section. Sq. in.	Height. Inches.	First sign of failure. Lbs. per sq. in.	Ultimate strength. Lbs. per sq. in.	Place used.	Remarks.
18	60 days.	Star....	Graded..	36.36	6.02	2,915	3,112	Shaft 3, arch.....	Broken on side.
19	60 days.	Star....	Graded..	36.00	6.02	2,203	2,597	Shaft 3, arch.....	Broken on side.
20	60 days.	Star....	Graded..	36.18	6.02	1,617	1,632	Shaft 3, arch.....	Broken on side, failure regular, mortar soft.
4	88 days.	Lehigh.	1½-in.....	35.82	5.99	2,987	3,463	Shaft 3, arch.....	Failure slightly irregular, mortar good.
8	88 days.	Star....	1½-in.....	35.94	6.00	1,664	1,842	Shaft 3, arch.....	Failure irregular, mortar good.
6	89 days.	Star....	1½-in.....	35.88	6.00	989	1,239	Shaft 3.	Failure irregular, mortar good.
7	89 days.	Star....	1½-in.....	35.76	6.00	841	951	Shaft 3.....	Failure irregular, mortar crumbly.
5	90 days.	Star....	1½-in.....	35.88	6.00	1,734	3,512	Shaft 3.....	Failure slightly irregular, mortar good, broken on side.
9	90 days.	Lehigh.	1½-in.....	35.94	6.00	1,552	1,995	Shaft 3, cradle.....	Failure regular, mortar soft, broken on side.
10	90 days.	Star....	1½-in.....	36.06	5.90	1,025	3,286	Shaft 3, cradle.....	Failure irregular, mortar good.
13	90 days.	Star....	1½-in.....	36.24	6.00	4,553	5,119	Shaft 3, arch.....	Broken on side, mortar good, failure slightly irregular.
14	90 days.	Star....	1½-in.....	35.94	6.01	1,388	1,436	Shaft 3, arch.....	Failure irregular, mortar soft.
15	90 days.	Star....	1½-in.....	36.24	6.01	2,155	2,567	Shaft 3, arch.	
16	90 days.	Star....	1½-in.....	35.88	6.00	1,605	2,085	Shaft 3, arch.....	Broken on side.

Tests of Concrete Cubes from the Torresdale Conduit Shaft 3—Continued.

Composition—1 part cement, 3 parts sand, 5 parts stone.

Cube No.	Age.	Brand cement.	Size stone.	Cross section. Sq. in.	Height. Inches.	First sign of failure. Lbs. per sq. in.	Ultimate strength. Lbs. per sq. in.	Place used.	Remarks.
17	90 days.	Star....	1½-in.....	36.24	6.00	2,582	2,892	Shaft 3, arch.....	Broken on side.
2	119 days.	Lehigh.	1½-in.....	36.00	5.98	1,817	2,627	Shaft 3.....	Broken on side.
3	119 days.	Lehigh.	1½-in.....	35.70	6.00	1,420	1,683	Shaft 3. cradle.....	Broken on side, failure slightly irregular, mortar good.
1	120 days.	Lehigh.	1½-in.....	35.76	5.98	1,580	2,099	Shaft 3.....	Failure irregular, mortar good.
11	120 days.	Star....	1½-in.....	35.94	5.99	1,614	2,314	Shaft 3, arch.....	Failure irregular, mortar soft and crumbly.
12	120 days.	Star....	1½-in.....	36.00	6.01	1,675	1,909	Shaft 3, arch.....	Broken on side.

G. S. WEBSTER,
Chief Engineer.

W. PURVES TAYLOR,
Engineer of Tests.

Tests of Concrete Cubes from the Torresdate Conduit, Shaft 4.

Composition—1 part cement, 3 parts sand, 5 parts stone.

Cube No.	Age.	Brand cement.	Size stone.	Cross section. Sq. in.	Height. Inches.	First sign of failure. Lbs. per sq. in.	Ultimate strength. Lbs. per sq. in.	Place used.	Remarks.
7	59 days.	Lehigh.	1½-in.....	35.82	5.98	793	1,315	Arch No. 4.	
25	59 days.	Star....	1½-in.....	36 12	6.00	1,597	3,524	Arch.	
8	60 days.	Lehigh.	1½-in.....	35.88	5.97	1,379	1,421	Cradle, south, No. 4.....	Broken on side, mortar crumbly.
19	60 days.	Star....	1½-in.....	36.00	6.00	3,564	3,628	Arch.....	Failure irregular.
26	60 days.	Star....	1½-in.....	35.82	6.03	1,147	1,932	Arch.....	Failure irregular.
20	61 days.	Star....	1½-in.....	36.54	6.00	2,151	3,013	Arch.....	Broken on side.
6	88 days.	Lehigh.	1½-in.....	35.88	5.95	1,168	1,452	Arch.	
14	88 days.	Lehigh.	1½-in.....	36.00	6.03	1,614	1,784	Cradle.....	Broken on side, faces porous, failure irregular.
5	90 days.	Lehigh.	1½-in.....	35.88	5.97	390	603	Cradle No. 4.....	Faces rough, mortar soft, corner broken.
18	90 days.	Star....	1½-in.....	36.00	5.99	1,767	2,512	Arch.....	
23	90 days.	Star....	1½-in.....	36.18	6.02	1,658	2,014	Arch.....	Failure irregular.
24	90 days.	Star....	1½-in.....	36.12	6.00	2,129	3,441	Arch.....	Failure irregular.
13	91 days.	Lehigh.	1½-in.....	36.36	6.00	2,132	2,743	Cradle.	
12	92 days.	Star....	1½-in.....	36.00	6.03	2,791	3,128	Cradle.....	Broken on side, faces slightly porous.

Tests of Concrete Cubes from the Torresdale Conduit, Shaft No. 4—Continued.

Composition—1 part cement, 3 parts sand, 5 parts stone.

Cube No.	Age.	Brand cement.	Size stone.	Cross section. Sq. in.	Height. Inches.	First Sign of failure. Lbs. per sq. in.	Ultimate strength. Lbs. per sq. in.	Place used.	Remarks.
17	92 days	Star....	1½-inch..	35.94	6.00	1,790	2,159	Arch.....	Failure irregular.
3	119 days	Lehigh.	1½-inch..	35.82	6.00	757	823	Cradle.....	Mortar crumbly, face and edges rough.
10	119 days	Lehigh.	1½-inch..	35.88	6.00	1,067	1,162	Cradle.....	Mortar soft.
11	119 days	Star....	1½-inch..	35.94	6.00	1,038	1,078	Cradle.....	Broken on side, mortar crumbly.
2	120 days	Lehigh.	1½-inch..	35.58	5.92	599	633	Cradle.....	Broken on side, mortar very crumbly.
9	120 days	Lehigh.	1½-inch..	36.00	5.98	2,867	3,468	Arch.....	Broken on side, failure slightly irregular.
15	120 days	Lehigh.	1½-inch..	36.00	6.01	1,636	1,656	Cradle.....	Broken on side, failure slightly irregular.
16	120 days	Star....	1½-inch..	36.42	6.03	887	1,098	Cradle.....	Broken on side, mortar soft.
21	120 days	Star....	1½-inch..	36.30	6.00	1,991	2,089	Cradle.....	Broken on side, failure irregular.
22	120 days	Star....	1½-inch..	35.70	6.00	2,322	2,849	Cradle.	
1	181 days	Lehigh.	1½-inch..	35.88	6.00	822	918	Cradle.....	Broken on side, mortar soft.

NOTE—Stone ½ in. to 1½ in. hornblende gneiss.

G. S. WEBSTER,
Chief Engineer.

W. PURVES TAYLOR,
Engineer of Tests.

Tests of Concrete Cubes from the Torresdale Conduit Shaft 7 and 8.

Composition—1 part cement, 3 parts sand, 5 parts stone.

Cube No.	Age.	Brand cement.	Size stone.	Cross section. Sq. in.	Height. Inches.	First sign of failure. Lbs. per sq. in.	Ultimate strength. Lbs. per sq. in.	Place used.	Remarks.
37	58 days...	Star.....	¾-in.....	36.06	6.00	1,714	4,951	Shaft 8, arch.	
38	59 days...	Star.....	¾-in....	36.00	6.00	1,803	3,281	Shaft 8, arch.	
42	59 days...	Star.....	1½-in.....	35.88	6.00	822	1,052	Shaft 7, cradle.....	Mortar soft, failure irregular, broken on side.
7	60 days...	Star.....	Graded...	36.00	5 95	1,197	1,289	Shaft 8, south heading.....	Mortar soft, faces porous, broken on side.
9	60 days...	Star.....	Graded...	35.70	5.95	1,008	1,166	Shaft 8, south.....	Mortar somewhat soft, broken on side.
36	87 days...	Star.....	¾-in.....	35.22	6.08	2,427	2,691	Shaft 8, arch.....	Broken on side.
28	88 days...	Lehigh...	¾-in.....	35.10	6.02	2,276	2,627	Shaft 8, arch.	
16	89 days...	Lehigh...	1½-in.....	36.80	5.95	1,435	2,818	Shaft 8, north.....	Broken on side.
40	89 days...	Star.....	1½-in.....	35.88	6.02	908	1,126	Shaft 8, cradle.	
5	90 days...	Star.....	¾-in.....	35.64	5.98	1,622	2,2 6	Shaft 8, south heading.....	Broken on side, faces and edges rough.
6	90 days...	Star.....	¾-in.....	35.82	6.00	2,057	2,868	Shaft 8, north heading.....	Broken on side, corner broken.
14	90 days...	Star.....	1½-in.....	35.88	6.05	1,274	1,736	Shaft 8, south.	
15	90 days...	Star.....	1½-in.....	8 .06	6.00	1,658	2,674	Shaft 8, north.....	Broken on side.
17	90 days...	Lehigh...	1½-in.....	35.40	6.00	2,624	3,422	Shaft 8, north.....	Broken on side.

Tests of Concrete Cubes from the Torresdale Conduit Shaft 7 and 8—Continued.

Composition—1 part cement, 3 parts sand, 5 parts stone.

Cube No.	Age.	Brand cement.	Size stone.	Cross section. Sq. in.	Height. Inches.	First sign of failure. Lbs. per sq. in.	Ultimate strength. Lbs. per sq. in.	Place used.	Remarks.
26	90 days...	Star.....	¾-in.....	36.00	6.00	2,922	3,820	Shaft 8, arch.....	Broken on side, failure irregular.
27	90 days...	Star.....	¾-in.....	36.36	5.93	3,215	4,964	Shaft 8, arch.....	Broken on side.
29	90 days...	Star.....	¾-in.....	35.11	6.00	1,398	1,512	Shaft 8, arch.....	Broken on side, failure slightly irregular.
35	90 days...	Star.....	¾-in.....	36.36	6.00	3,330	3,429	Shaft 8, arch.....	Failure slightly irregular.
39	90 days...	Star.....	1½-in.....	36.18	6.08	976	3,281	Shaft 7, cradle.	
25	118 days..	Star.....	¾-in.....	36.48	6.02	2,979	3,334	Shaft 8, arch.....	Broken on side.
12	119 days..	Lehigh...	1½-in.....	35.88	6.08	870	1,408	Shaft 8, south.....	Mortar soft.
22	119 days..	Star.....	¾-in.....	36.00	6.01	2,222	3,419	Shaft 8, arch.....	Broken on side, failure irregular.
24	119 days..	Star.....	¾-in.....	35.94	6.00	1,024	1,113	Shaft 8, arch.....	Mortar crumbly.
3	120 days..	Star.....	¾-in.....	36.00	6.00	725	1,153	Shaft 8, south heading.....	Mortar crumbly, corners chipped.
4	120 days..	Star.....	¾-in.....	36.00	6.05	1,017	1,307	Shaft 8, south.....	Mortar crumbly, cors. chipped, broken on side.
13	120 days..	Star.....	1½-in.....	35.88	6.00	945	1,553	Shaft 8, south.....	Mortar crumbly.
23	120 days..	Star.....	¾-in.....	34.68	6.00	1,338	1,398	Shaft 8, arch.....	Broken on side.
32	120 days..	Star.....	¾-in.....	35.76	6.02	1,952	2,008	Shaft 8, arch.....	Broken on side, failure slightly irregular.

Tests of Concrete Cubes from the Torresdale Conduit Shaft 7 and 8—Continued.

Composition—1 part cement, 3 parts sand, 5 parts stone.

Cube No.	Age.	Brand cement.	Size stone.	Cross section. Sq. in.	Height. Inches.	First sign of failure. Lbs. per sq. in.	Ultimate strength. Lbs. per sq. in.	Place used.	Remarks.
33	120 days..	Star.....	¾-in.....	35.52	6.02	1,444	1,459	Shaft 8, arch.....	Broken on side.
34	120 days..	Star.....	¾-in.....	35.58	6.00	1,351	1,416	Shaft 8, arch.....	Broken on side, failure irregular.
2	179 days..	Star.....	¾-in.....	36.18	6.00	1,542	1,864	Shaft 8, south	Mortar soft.
1	180 days..	Star.....	¾-in.....	36.00	5.95	2,147	2,175	Shaft 8, south	Broken on side, corners chipped.
10	180 days..	Star.....	1½-in.....	35.94	5.99	1,691	2,802	Shaft 8, south	Broken on side.
11	180 days..	Lehigh...	1½-in.....	35.94	6.00	1,712	3,794	Shaft 8, south	Broken on side, failure irregular.
18	180 days..	Lehigh...	1½-in.....	35.70	6.00	2,076	2,541	Shaft 8, arch.....	Broken on side, failure irregular.
19	180 days..	Star.....	1½-in.....	35.88	6.00	4,740	5,053	Shaft 8, cradle.....	Broken on side.
20	180 days..	Star.....	¾-in.....	35.52	5.99	2,402	2,760	Shaft 8, cradle.	
21	180 days..	Star.....	¾-in.....	35.94	5.99	2,368	2,856	Shaft 8, cradle.	
1	239 days..	Not given		36.00	6.01	761	1,156	Inner lining of shaft 7.....	Top very rough, corners chipped.
2	240 days..	Not given		36.00	5.99	1,305	1,627	Inner lining of shaft 7.....	Bottom much broken.
4	240 days..	Not given		36.00	6.10	472	880	Inner lining of shaft 7.....	Top very rough, corners chipped,

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W. PURVES TAYLOR,
Engineer of Tests.

Tests of Concrete Cubes from the Lardner's Point Pumping Station.

Composition—1 part cement, 3 parts sand, 5 parts stone.

Cube No.	Age.	Brand cement.	Size stone.	Cross section. Sq. in.	Height. Inches.	First sign of failure. Lbs. per sq. in.	Ultimate strength. Lbs. per sq. in.	Place used.	Remarks.
24	58 days.	Hemmour.	1½-inch....	35.76	5.99	509	774	Engine house walls.....	Mortar crumbly.
21	59 days.	Hemmour.	¾-inch.....	36.00	6.00	753	992	Engine house, footing of walls....	Mortar crumbly.
22	59 days.	Hemmour.	Limestone screenings.	35.88	6.00	725	829	Engine house walls.....	Mortar crumbly.
34	59 days.	Saylor's....	1½-inch....	35.64	6.00	807	1,193	N. and S. walls, engine house.....	Mortar very crumbly.
7	60 days.	Alpha.....	¾-inch.....	36.30	6.00	780	1,524	Engine foundation, No. 7.....	Mortar porous.
10	60 days.	Hemmour.	¾-inch.....	35.70	6.02	894	1,008	Engine foundation, No. 8.....	Mortar crumbly.
16	60 days.	Hemmour.	¾-inch.....	35.88	6.03	1,129	1,565	Arch over pump well.....	Mortar soft.
23	60 days.	Hemmour.	1½-inch....	35.94	6.00	556	1,113	Engine house walls.....	Mortar crumbly.
33	60 days.	Saylor's....	1½-inch....	35.87	6.04	681	1,337	Wall, engine house.....	Mortar crumbly.
15	61 days.	Alpha.....	small ballast.	35.88	5.98	864	1,865	Invert. Del. river conduit.	
45	88 days.	Krause's...	¾-inch.....	36.30	5.98	1,440	1,789	Walls, intake chamb. Del. riv. con.	
20	89 days.	Hemmour.	¾-inch.....	35.40	6.04	896	1,218	Engine house, footing of walls..	Failure slightly irregular. Mortar very crumbly.
25	89 days.	Hemmour.	1½-inch....	36.12	5.98	396	581	Engine house walls.....	Failure irregular. Mortar crumbly.
1	90 days.	Alpha.....	¾-inch.....	36.00	6.02	1,325	1,783	South stack foundation.	

Tests of Concrete Cubes from the Lardner's Point Pumping Station—Continued.

Composition—1 part cement, 3 parts sand, 5 parts stone.

Cube No.	Age.	Brand cement.	Size stone.	Cross section. Sq. in.	Height. Inches.	First sign of failure. Lbs. per sq. in.	Ultimate strength. Lbs. per sq. in.	Place used.	Remarks.
3	90 days.	Hemmour.	¾-inch....	35.70	5.98	801	1,159	North stack, foundation.....	Corner broken.
6	90 days.	Alpha.....	¾-inch....	36.00	6.05	1,853	1,995	Engine foundation No. 7.....	Mortar soft, broken on side.
9	90 days.	Hemmour.	¾-inch....	36.00	5.97	504	607	Engine foundation No. 5.....	Mortar soft and corners broken.
19	90 days.	Saylor's....	¾-inch....	35.82	6.00	653	1,711	Arch, Delaware river conduit.....	
32	90 days.	Saylor's....	¾-inch....	36.00	6.00	1,261	2,713	West wall, engine house.....	Failure slightly irregular, faces full of crevices.
38	10 days.	Saylor's....	1½-inch....	35.88	6.00	922	1,064	Boiler foundation	Mortar crumbly.
44	90 days	Krause's...	¾-inch....	35.88	6.08	1,014	1,203	Boiler foundation.....	Mortar crumbly, failure irregular.
46	90 days.	Krause's...	¾-inch....	36.60	6.00	1,780	2,192	Boiler foundation.....	
26	91 days.	Hemmour.	1½-inch....	35.94	5.98	492	753	Engine house walls.....	Mortar crumbly.
31	91 days.	Saylor's....	¾-inch....	36.00	6.00	708	1,483	South wall, engine house.....	Failure slightly irregular.
37	91 days.	Saylor's....	¾-inch....	35.88	6.00	1,290	2,154	Floor of intake chamber, Delaware river conduit.	
18	117 days.	Hemmour.	¾-inch....	35.64	5.98	822	953	Pump well, south end.....	Failure slightly irregular, mortar crumbly.
8	119 days.	Hemmour.	¾-inch....	35.70	6.00	1,109	1,619	Engine foundation No. 10.....	Mortar soft.
13	119 days.	Hemmour.	¾-inch....	36.12	6.02	966	1,357	Engine foundation No. 6.....	Mortar very soft.

Tests of Concrete Cubes from the Lardner's Point Pumping Station.—Continued.

Composition—1 part cement, 3 parts sand, 5 parts stone.

Cube No.	Age.	Brand cement.	Size stone.	Cross section, Sq. in.	Height. Inches.	First sign of failure Lbs. per sq. in.	Ultimate strength Lbs. per sq. in.	Place used.	Remarks.
5	120 days	Hemmour.	¾-in.....	36.00	6.00	903	1,046	West wall, boiler house.....	Mortar crumbly, broken on side
14	120 days	Hemmour.	small ballast	36.00	6.00	842	1,784	Engine foundation No. 9.....	Failure irregular.
17	120 days	Hemmour.	¾-in.....	35.88	6.01	940	1,214	North wall, engine house.....	
27	120 days	Hemmour.	1½-in.....	36.00	6.00	166	252	Engine house walls...	Cube in bad cond. corners very much broken, broken on side.
28	120 days	Hemmour.	1½-in.....	35.88	5.99	418	587	Engine house wall east	Mortar very soft.
30	120 days	Saylor's....	¾-in.....	36.60	5.98	1,369	1,444	Engine house wall north.....	Broken on side.
35	120 days	Saylor's....	1½-in.....	36.78	6.01	1,221	1,478	Engine house wall east.....	Broken on side, failure irregular.
36	120 days	Saylor's....	¾-in.....	36.30	6.00	1,036	1,137	Engine house wall east.....	Mortar crumbly.
39	120 days	Krause's ..	¾-in.....	36.36	6 00	980	1,273	Boiler foundation.....	Broken on side.
40	120 days	Krause's ..	¾-in.....	36.06	6.00	896	1,276	Boiler foundation	Broken on side, failure irregular, mortar crumbly.
41	120 days	Krause's ..	¾-in.....	36 12	5.98	1,716	1,829	Boiler foundation	Broken on side, mortar crumbly.
42	120 days	Krause's ..	¾-in.....	36.12	6.01	1,077	1,210	Floor of smoke tunnel	Broken on side, failure irregular, mortar crumbly,
43	120 days	Krause's ..	¾-in.....	36.12	6.02	1,503	2,103	Delaware river conduit.....	Mortar crumbly, corner broken.
29	121 days	Saylor's....	¾-in.....	36.42	5.95	939	1,459	East wall, engine house.....	Mortar crumbly.

Tests of Concrete Cubes from the Lardner's Point Pumping Station.—Continued.

Composition—1 part cement, 3 parts sand, 5 parts stone.

Cube No.	Age.	Brand cement	Size stone.	Cross section. Sq. in.	Height. Inches.	First sign of failure Lbs. per sq. in.	Ultimate strength Lbs. per sq. in.	Place used.	Remarks.
2	179 days	Alpha	¾-in.....	35.70	6.01	1,650	1,826	South stack, foundation.....	Mortar crumbly.
4	180 days	Hemmour.	¾-in.....	36.00	6.00	1,589	1,693	North stack, foundation.....	Mortar crumbly, corner broken.
11	180 days	Hemmour.	¾-in.....	36.00	6.02	903	1,120	Engine oundation No. 9.....	Mortar crumbly.
12	180 days	Hemmour.	¾-in.....	35.76	5.97	858	910	Engine foundation.....	Mortar crumbly, failure irregular, corners much broken.

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Tests of Concrete Cubes from the Torresdale Conduit Shaft 5 and 6.

Composition—1 part cement, 3 parts sand, 5 parts stone.

Cube No.	Age.	Brand cement.	Size stone.	Cross section. Sq. in.	Height. Inches.	First sign of failure. Lbs. per sq. in.	Ultimate strength. Lbs. per sq. in.	Place used.	Remarks.
31	59 days...	Lehigh...	1½ in.....	35.94	6.00	798	1,068	Over arch.....	Mortar crumbly, corners chipped.
59	59 days...	Lehigh...	1½ in.....	36.00	6.01	1,314	1,489	Arch.	
60	59 days...	Lehigh...	1½ in.....	36.00	5.99	1,406	1,907	Arch.....	Broken on side.
62	59 days...	Star.....	1½ in.....	36.00	6.00	2,594	2,872	Arch.....	Failure slightly irregular.
7	60 days...	Star.....	Graded..	35.70	6.00	2,204	2,855	North heading.....	Broken on side, faces rough.
8	60 days...	Star.....	Graded..	35.91	6.00	1,436	2,576	South heading.....	Broken on side, corners chipped.
25	60 days...	Lehigh...	1½ in.....	35.94	5.95	1,074	1,382	Over arch	Mortar crumbly.
26	60 days...	Lehigh...	1½ in.....	35.82	6.00	1,522	3,202	Arch.....	Broken on side, top badly curved.
27	60 days...	Lehigh...	1½ in.....	35.76	5.99	989	1,359	Cradle, shaft 5.....	Faces porous.
58	60 days...	Lehigh...	1½ in.....	36.00	6.00	1,322	1,685	Arch, shaft 5.....	Failure irregular.
61	60 days...	Star.....	1½ in.....	35.94	6.00	1,274	1,875	Arch, shaft 5.	
32	61 days...	Lehigh...	1½ in.....	36.00	6.00	1,536	1,742	Over arch, shaft 5.....	Faces porous.
20	89 days...	Lehigh...	1½ in.....	36.00	6.00	2,278	2,541	Cradle, shaft 5.	
24	89 days...	Lehigh...	1½ in.....	35.82	6.00	921	983	Over arch, shaft 5.....	Mortar crumbly.

Tests of Concrete Cubes from the Torresdale Conduit Shaft 5 and 6—Continued.

Composition—1 part cement, 3 parts sand, 5 parts stone.

Cube No.	Age.	Brand cement.	Size stone.	Cross section. Sq. in.	Height. Inches.	First sign of failure. Lbs. per sq. in.	Ultimate strength. Lbs. per sq. in.	Place used.	Remarks.
47	89 days...	Lehigh...	1¼ in.....	36.00	6.00	1,244	1,532	Arch, shaft 5.....	Failure slightly irregular.
48	89 days...	Lehigh...	1¼ in.....	35.94	5.93	1,2.5	1,626	Arch, shaft 5.....	Broken on side, failure irregular, mortar soft.
50	89 days...	Lehigh...	1½-in.....	36.00	6.00	980	1,481	Shaft No. 6, arch.....	Failure slightly irregular.
5	90 days...	Star.....	Graded...	36.00	6.00	1,761	2,678	South heading, shaft 5.....	Broken on top, mortar slightly porous.
6	90 days...	Star.....	Graded...	36.00	6.00	1,444	2,441	South heading, shaft 5.....	Faces somewhat porous, corners chipped.
19	90 days...	Lehigh...	1½-in.....	35.88	6 00	1,469	2,737	Cradle, shaft 5.	
21	90 days...	Lehigh ..	1½-in.....	35.88	6.00	973	1,837	Cradle, shaft 5.....	Mortar crumbly, corners chipped.
22	90 days...	Lehigh...	1½-in.....	35.88	6.00	1,742	2,466	Cradle, shaft 5.	
23	90 days...	Lehigh...	1½-in.....	35.76	5.97	2,257	2,986	Cradle, shaft 6.	
29	90 days...	Lehigh...	1½-in.....	35.94	6.00	1,205	1,465	Over arch, shaft 5.....	Mortar crumbly.
49	90 days...	Lehigh...	1½-in.....	35.88	6.00	688	898	Arch, shaft 6.....	Mortar soft.
55	90 days...	Lehigh...	1½-in.....	36.00	6.00	2,091	2,3.3	Arch, shaft 6.....	Failure irregular.
57	90 days...	Lehigh...	1½-in.....	36.12	6.02	1,580	1,880	Arch, shaft 5.....	Broken on side.
63	90 days...	Star.....	1½-in.....	36.24	6.00	1,567	1,897	Arch, shaft 5.....	Broken on side, failure irregular.

Tests of Concrete Cubes from the Torresdale Conduit Shaft 5 and 6—Continued.

Composition—1 part cement, 3 parts sand, 5 parts stone.

Cube No.	Age.	Brand cement.	Size stone.	Cross section. q. in.	Height. Inches.	First sign of failure. Lbs. per sq. in.	Ultimate strength. Lbs. per sq. in.	Place used.	Remarks.
64	90 days...	Star.....	1½-in.....	36.00	6.02	1,464	1,986	Arch, shaft 5.....	Broken on side.
30	91 days...	Lehigh...	1½-in.....	35.88	6.00	1,221	1,645	Over arch, shaft 5.....	Mortar soft.
42	91 days...	Lehigh...	1½-in.....	36.06	6.00	1,209	2,371	Over arch, shaft 5.....	Failure irregular.
56	91 days...	Lehigh...	1½-in.....	36.00	6.00	1,464	1,839	Over arch, shaft 5.	
28	92 days...	Lehigh...	1½-in.....	36.00	6.00	1,411	2,136	Over arch, shaft 5.....	Mortar crumbly.
41	92 days...	Lehigh...	1½-in.....	36.00	6.01	1,372	2,642	Arch, shaft 5.....	Failure slightly irregular.
15	118 days..	Lehigh...	1½-in.....	36.00	6.00	1,264	1,772	Cradle, shaft 5.....	Mortar crumbly.
17	119 days..	Lehigh...	1½-in.....	35.88	5.95	756	868	Cradle, shaft 5.....	Mortar crumbly.
38	119 days..	Lehigh...	1½-in.....	36.00	6.00	1,747	2,428	Arch, shaft 5.....	Failure irregular.
39	119 days..	Lehigh...	1½-in.....	35.88	5.98	1,639	1,905	Arch, shaft 5.	
3	120 days..	Star.....	1½-in.....	35.40	6.00	923	3,713	Shaft 5, south.....	Corners chipped.
4	120 days..	Star.....	Graded...	3 .00	6.02	1,744	3,221	Shaft 5 and 6, south.....	Broken on side, corners very much broken.
14	120 days..	Lehigh...	1½-in.....	35.94	5.90	746	1,630	Cradle, shaft 5.	
18	120 days..	Lehigh...	1½-in.....	35.82	6 05	1,508	1,841	Cradle, shaft 5.....	Mortar crumbly.

Tests of Concrete Cubes from the Torresdale Conduit Shaft 5 and 6—Continued.

Composition—1 part cement, 3 parts sand, 5 parts stone.

Cube No	Age.	Brand cement.	Size stone.	Cross section Sq. in.	Height. Inches.	First sign of failure. Lbs. per sq. in.	Ultimate strength. Lbs. per sq. in.	Place used.	Remarks.
37	120 days..	Lehigh...	1½-in.....	36.00	6.00	1,944	2,354	Arch, shaft 5.	
40	120 days..	Lehigh...	1½-in.....	35.88	6.00	1,889	2,259	Arch, shaft 5.	
43	120 days..	Lehigh...	1½-in.....	36.00	6.00	1,441	1,644	Arch, shaft 5.....	Broken on side, mortar soft.
44	120 days..	Lehigh...	1½-in.....	36.00	6.00	1,358	1,496	Arch, shaft 6.....	Broken on side.
46	120 days..	Lehigh...	1½-in.....	36.00	6.00	1,083	1,524	Arch, shaft 5.	
52	120 days..	Lehigh...	1½-in.....	36.30	6.00	1,182	1,500	Arch, shaft 6.....	Broken on side, failure irregular.
53	120 days...	Lehigh...	1½-in.....	36.30	6.00	2,479	2,597	Arch, shaft 6.....	Broken on side.
54	120 days...	Lehigh...	1½-in.....	36.36	6.01	2,024	2,184	Arch, shaft 6.....	Broken on side, failure irregular.
16	121 days...	Lehig ...	1½-in.....	36.00	6.00	1,741	2,261	Cradle, shaft 5.	
45	121 days...	Lehigh...	1½-in.....	36.00	6.00	930	1,338	Arch, shaft 5.....	Mortar soft.
1	179 days...	Star.....	1½-in.....	36.00	6.00	1,244	2,570	Shaft 6, north.	
9	179 days...	Star.....	1½-in.....	35.88	6.00	1,622	3,026	Shaft 5, cradle.	
13	179 days...	Star.....	1½-in.....	36.00	6.00	939	2,635	Shaft 5, cradle.....	Failure slightly irregular.
34	180 days...	Lehigh...	1½-in	36.12	6.05	1,816	2,320	Shaft 5, arch.....	Corners chipped.

Tests of Concrete Cubes from the Torresdale Conduit Shaft 5 and 6—Continued.

Composition—1 part cement, 3 parts sand, 5 parts stone.

Cube No.	Age.	Brand cement.	Size stone.	Cross section. Sq. in.	Height. Inches.	First sign of failure. Lbs. per sq. in.	Ultimate strength. Lbs. per sq. in.	Place used.	Remarks.
35	180 days...	Lehigh...	1½-in.....	36.30	6.02	1,440	1,500	Shaft 5, arch.....	Broken on side, failure irregular.
36	180 days...	Lehigh...	1½-in.....	36.06	6.04	893	1,232	Shaft 5, arch.....	Mortar soft, failure irregular.
2	181 days...	Star.....	1½-in.....	35.88	6.00	1,343	2,533	Shaft 5, south.	
10	181 days...	Star.....	1½-in.....	35.88	6.03	928	2,077	Shaft 5, cradle.....	Failure irregular.
12	181 days..	Star.....	1½-in.....	36.00	6.00	2,222	3,278	Cradle, shaft 5.....	Broken on side, faces porous.
33	181 days...	Lehigh...	1½-in.....	36.00	6.00	1,844	2,251	Arch, shaft 5.	
11	182 days...	Star.....	1½-in.....	35.82	6.01	1,075	2,713	Shaft 5, cradle.....	Failure slightly irregular.

NOTE—Stone, ½-inch—1½-inch hornblende gneiss.

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Tests of Concrete Cubes from the Belmont Filter Beds.

Composition—1 part cement, 3 parts sand, 5 parts stone.

Cube No.	Age.	Brand cement.	Size stone.	Cross section. Sq. in.	Height. Inches.	First sign of failure. Lbs. per sq. in.	Ultimate strength. Lbs. per sq. in.	Place used.	Remarks.
139	29 days...	Lehigh...	1½ to ¼-in.	36.00	6.00	431	725	Pavement and reservoir slope....	Failure irregular, mortar crumbly, corner broken.
95	30 days...	Lehigh...	1½ to ¼-in.	36.24	6.00	684	1,739	Vaulting and floor.....	Edges chipped.
96	30 day ...	Lehigh...	1½ to ¼-in.	35.70	6.00	930	1,244	Vaulting, floor and piers.....	Mortar very bad, corners much broken.
97	30 days...	Lehigh...	1½ to ¼-in.	36.00	6.00	1,156	1,922	Walls and floors.....	Mortar crumbly, corners chipped.
98	30 days...	Lehigh...	1½ to ¼-in.	36.00	6.00	608	1,613	Vaulting and walls.....	Mortar soft, corners chipped.
99	30 days...	Lehigh...	1½ to ¼-in.	36.00	6.00	1,275	1,750	Vaulting and walls.....	Mortar soft, corners chipped.
100	30 days...	Lehigh...	1½ to ¼-in.	36.00	6.00	889	1,445	Vaulting and walls.....	Mortar soft.
137	30 days...	Lehigh...	1½ to ¼-in.	36.00	6.00	622	803	Pavement and reservoir slope....	Mortar crumbly, failure slightly irregular.
138	30 days...	Lehigh...	1½ to ¼-in.	36.00	6.00	619	957	Pavement and reservoir slope....	Mortar crumbly, bottom very rough.
141	30 days...	Star.....	1½ to ¼-in.	36.00	6.01	1,828	1,814	Pavement and reservoir slope.	
140	32 days...	Lehigh...	1½ to ¼-in.	36.06	6.00	607	978	Pavement and reservoir slope....	Mortar crumbly.
90	59 days...	Star.....	1½ to ¼-in.	35.70	5.98	417	1,017	Floor and vaulting.....	Mortar soft, corner broken.
94	59 days...	Lehigh...	1½ to ¼-in.	36.72	6.00	863	1,157	Floor and vaulting.....	Mortar soft, corners very much broken.
118	59 days...	Star.....	1½ to ¼-in.	35.82	6.12	659	1,546	Pavement and reservoir slope....	Mortar soft.

Tests of Concrete Cubes from the Belmont Filter Beds.—Continued.

Composition—1 part cement, 3 parts sand, 5 parts stone.

Cube No.	Age.	Brand cement.	Size stone.	Cross section. Sq. in.	Height. Inches.	First sign of failure. Lbs. per sq. in.	Ultimate strength. Lbs. per sq. in.	Place used.	Remarks.
120	59 days...	Star.....	1½ to ¼-in.	35.88	6.06	904	1,872	Vaulting and reservoir slope.....	Mortar porous, failure slightly irregular.
89	60 days...	Lehigh...	1½ to ¼ in.	36.00	6.00	530	1,023	Floor and vaulting.....	Mortar soft.
92	60 days...	Lehigh...	1½ to ¼ in.	35.70	6.00	706	1,191	Floor and vaulting.....	Mortar crumbly, broken on side, corner broken
93	60 days...	Star.....	1½ to ¼ in.	36.24	6.00	1,165	1,398	Floor and vaulting.....	Mortar soft.
116	60 days...	Star.....	1½ to ¼ in.	36.00	6.11	1,242	2,094	Vaulting, main collector.....	Mortar soft.
132	60 days...	Lehigh...	1½ to ¼ in.	36.12	6.00	728	1,267	Pavement.....	Mortar somewhat crumbly.
133	60 days...	Star.....	1½ to ¼ in.	36.60	6.00	955	1,394	Pavement and reservoi slope....	Mortar soft.
134	60 days...	Star.....	1½ to ¼ in.	36.30	6.02	1,044	1,142	Pavement and reservoir slope....	Mortar soft, broken on side.
135	60 days...	Star.....	1½ to ¼ in.	36.24	6.00	1,348	1,510	Reservoir slope.....	Mortar crumbly, broken on side, failure irregular.
136	60 days...	Star.....	1½ to ¼ in.	36.24	6.00	751	954	Reservoir slope.....	Mortar soft, broken on side, corner broken.
91	61 days...	Lehigh...	1½ to ¼ in.	36.78	6.04	838	1,097	Floor and walls.....	Mortar crumbly, broken on side, corner chipped.
117	61 days...	Star.....	1½ to ¼ in.	36.60	6.00	2,847	2,922	Piers and reservoir slopes.	
119	61 days...	Lehigh...	1½ to ¼ in.	36.12	6.10	775	2,209	Pavement, reservoir slopes.....	Mortar porous.

Tests of Concrete Cubes from the Belmont Filter Beds.—Continued.

Composition--1 part cement, 3 parts sand, 5 parts stone.

Cube No.	Age.	Brand cement.	Size stone.	Cross section. Sq. in.	Height. Inches.	First sign of failure Lbs. per sq. in.	Ultimate strength Lbs. per sq. in.	Place used.	Remarks.
114	88 days...	Star.....	1½ to ¼ in.	35.88	6.08	1,162	2,407	Vaulting.....	Mortar soft.
86	89 days...	Lehigh...	1½ to ¼ in.	35.88	6.08	908	2,002	Floor and wall.....	Mortar soft.
113	89 days...	Star.....	1½ to ¼ in.	36.06	6.10	1,062	1,861	Vaulting, main collector.	
128	89 days...	Star.....	1½ to ¼-in.	36.12	6.00	761	976	Floor, pavement.....	Mortar crumbly, broken on side.
83	90 days...	Lehigh...	1½ to ¼-in.	36.06	6.00	685	1,189	Floor and vaulting.....	Mortar crumbly, corner broken.
84	90 days...	Lehigh...	1½ to ¼-in.	36.00	6.06	775	995	Floor and wall.....	Mortar soft.
85	90 days...	Lehigh...	1½ to ¼-in.	36.00	6.05	900	1,691	Floor and wall.	
87	90 days...	Star.....	1½ to ¼-in	36.12	6.10	1,489	2,680	Floor, piers, vaulting.	
88	90 days...	Star.....	1½ to ¼-in.	35.94	6.04	1,617	2,287	Floor and vaulting.	
126	90 days...	Star.....	1½ to ¼-in.	36.30	6.00	1,314	1,683	Floor and pavement.....	Mortar soft, broken on side.
129	90 days...	Star.....	1½ to ¼-in.	36.90	6.04	1,257	1,488	Reservoir slope.....	Broken on side.
130	90 days...	Star.....	1½ to ¼-in.	36.18	6.09	1,642	2,405	Reservoir slope and pavement....	Failure irregular.
131	90 days...	Lehigh...	1½ to ¼-in.	36.12	6.06	844	1,384	Pavement.....	Mortar soft.
111	91 days...	Lehigh...	1½ to ¼-in.	36.06	6.10	1,453	1,737	Wall and floor.....	Mortar crumbly, broken on side.

Tests of Concrete Cubes from the Belmont Filter Beds—Continued.

Composition—1 part cement, 3 parts sand, 5 parts stone.

Cube No.	Age.	Brand cement.	Size stone.	Cross section. Sq. in.	Height. Inches.	First sign of failure. Lbs. per sq. in.	Ultimate strength. Lbs. per sq. in.	Place used.	Remarks.
112	91 days..	Lehigh...	1½ to ¼-in.	36.72	6.00	1,428	2,021	Vaulting, main collector.....	Broken on side.
115	91 days..	Lehigh...	1½ to ¼-in.	36.12	6.09	3,079	3,516	Vaulting, main collector.....	Broken on side.
79	119 days..	Lehigh...	1½ to ¼-in.	36.00	6.03	819	2,210	Vaulting.	
82	119 days..	Star.....	1½ to ¼-in.	35.64	6.03	837	1,155	Floor and vaulting.....	Mortar soft.
106	119 days..	Lehigh...	1½ to ¼ in.	36.60	6.00	1,358	1,761	Floor and vaulting.....	Mortar soft, failure irregular, broken on side.
107	119 days..	Lehigh...	1½ to ¼ in.	36.72	6.00	1,637	1,889	Floor and vaulting.....	Mortar crumbly, failure irregular, broken on side.
109	119 days..	Lehigh...	1½ to ¼ in.	36.24	6.00	979	2,117	Piers and vaulting.....	Mortar soft, broken on side.
77	120 days..	Lehigh...	1½ to ¼ in.	36.00	6.00	1,161	1,924	Vaulting.....	Mortar soft.
78	120 days..	Star.....	1½ to ¼ in.	36.00	6.05	819	2,331	Vaulting.....	Mortar porous.
80	120 days..	Lehigh...	1½ to ¼ in.	35.94	6.00	1,633	2,034	Vaulting.	
81	120 days..	Lehigh...	1½ to ¼ in.	36.00	6.00	869	1,756	Floor.....	Mortar crumbly.
108	120 days..	Lehigh...	1½ to ¼ in.	36.00	6.06	667	2,277	Vaulting and wall.....	Mortar soft.
110	120 days..	Lehigh...	1½ to ¼ in.	36.60	6.00	1,332	2,130	Reservoir slope.....	Failure slightly irregular.
121	120 days..	Star.....	1½ to ¼ in.	36.84	6.06	2,109	2,264	Floor and vaulting.....	Broken on side.

Tests of Concrete Cubes from the Belmont Filter Beds—Continued.

Composition—1 part cement, 3 parts sand, 5 parts stone.

Cube No.	Age.	Brand cement.	Size stone.	Cross section. Sq. in.	Height. Inches.	First sign of failure. Lbs. per sq. in.	Ultimate strength. Lbs. per sq. in.	Place used.	Remarks.
122	120 days..	Star.....	1½ to ¼ in.	36.96	6.00	1,382	1,539	Floor and vaulting.....	Mortar soft, broken on side.
123	120 days..	Star.....	1½ to ¼ in.	36.72	6.05	1,860	1,995	Floor and vaulting.....	Failure irregular, broken on side.
124	120 days..	Star.....	1½ to ¼ in.	36.96	6.08	1,883	1,971	Floor and vaulting.....	Broken on side.
125	120 days..	Star.....	1½ to ¼ in.	36.66	6 04	1,800	1,913	Floor and pavement.....	Mortar soft, broken on side.
72	179 days..	Lehigh...	1½ to ¼ in.	36.00	6.08	1,472	1,915	Floor and vaulting.	
78	179 days..	Lehigh...	1½ to ¼ in.	35.88	6.09	1,240	1,734	Wall.	
76	179 days..	Lehigh...	1½ to ¼ in.	36.12	6.01	686	2,192	Vaulting.....	Failure slightly irregular.
104	179 days..	Lehigh ..	1½ to ¼ in.	36.60	6.00	1,516	1,667	Vaulting and floor.....	Mortar soft, broken on side.
3	180 days	Lehigh. Star....	1½ to ¼ in.	36.00	5.99	1,381	1,746	Division walls, Filters 2 and 3. Floor, Filters 4 and 5.	
4	180 days	Lehigh. Star....	1½ to ¼ in.	36.00	5.96	992	1,061	Division wall, Filters 2 and 3... Floor, Filters 4 and 5.....	Corner broken.
49	180 days..	Lehigh...	1½ to ¼ in.	36.00	6.08	1,131	1,796	Vaulting.....	Failure somewhat irregular.
50	180 days..	Star.....	1½ to ¼ in.	36.00	6.05	1,358	2,059	Vaultings, walls and piers.....	Mortar somewhat porous.
68	180 days..	Lehigh...	1½ to ¼ in.	36.00	6.00	2,181	8,498	Wall.	

Tests of Concrete Cubes from the Belmont Filter Beds—Continued.

Composition—1 part cement, 3 parts sand, 5 parts stone.

Cube No.	Age.	Brand cement.	Size stone.	Cross section. Sq. in.	Height. Inches.	First sign of failure. Lbs. per sq. in.	Ultimate strength. Lbs. per sq. in.	Place used.	Remarks.
64	180 days..	Lehigh...	1½ to ¼ in.	36.00	6.00	2,306	3,177	Vaulting and piers.	
71	180 days..	Lehigh...	1½ to ¼ in.	35.76	6.00	1,574	1,643	Wall.....	Failure somewhat irregular, mortar soft.
75	180 days..	Lehigh...	1½ to ¼ in.	36.42	6.04	1,705	2,150	Vaulting.....	Failure somewhat irregular.
101	180 days..	Lehigh...	1½ to ¼ in.	36.00	6.05	1,656	1,882	Vaulting.....	Failure somewhat irregular, mortar soft, broken on side.
102	180 days..	Lehigh...	1½ to ¼ in.	37.39	6.00	733	1,208	Vaulting and reservoir slope.....	Mortar soft, broken on side.
103	180 days..	Lehigh...	1½ to ¼ in.	36.72	6.00	850	977	Vaulting and floor.....	Broken on side, corner broken.
105	180 days..	Star.....	1½ to ¼ in.	36.06	6.02	915	1,398	Vaulting and piers.....	Mortar soft.
74	181 days..	Lehigh...	1½ to ¼-in.	35.94	6.00	960	1,603	Vaulting.....	Mortar crumbly.
33	1 year....	Star.....	1½ to ¼ in.	35.88	6.03	1,187	1,865	Floor and vaulting.	
34	1 year....	Star.....	1½ to ¼-in.	35.64	6.00	741	1,664	Floor and vaulting.....	Mortar soft.
35	1 year....	Star.....	1½ to ¼-in.	36.00	6.02	1,219	1,923	Floor and walls.....	Mortar crumbly.
36	1 year....	Star.....	1½ to ¼-in.	36.00	5.99	1,358	1,772	Floor and walls.....	Mortar crumbly, failure irregular.
51	1 year....	Star.....	1½ to ¼-in.	36 00	6.00	708	1,146	Vaulting.	
52	1 year....	Lehigh...	1½ to ¼-in.	36.54	6.00	1,732	2,616	Vaulting.....	Failure irregular.
53	1 year....	Star.....	1½ to ¼-in.	36.42	6.00	1,538	2,277	Vaulting and wall.....	Mortar soft.
54	1 year....	Lehigh...	1½ to ¼-in.	36.00	6.00	689	1,901	Piers.....	Failure irregular.

G. S. WEBSTER,
Chief Engineer.

W. PURVES TAYLOR,
Engineer in Charge.

Tests of Concrete Cubes from the Torresdale Conduit Shafts 9, 10, 11.

Composition—1 part cement, 3 parts sand, 5 parts stone.

Cube No.	Age.	Brand cement.	Size stone.	Cross section. Sq. in.	Height. Inches.	First sign of failure. Lbs. per sq. in.	Ultimate strength. Lbs. per sq. in.	Place used.	Remarks.
28	31 days...	Lehigh...	¾-in.....	36.00	6 03	528	580	Shaft 10, south.....	Mortar soft.
27	33 days...	Star.....	¾-in.....	36.00	6.03	1,019	1,065	Shaft 10, north.	
82	58 days...	Star.....	¾-in.....	35.94	6.05	2,388	3,000	Shaft 11, lining of arch.....	Broken on side.
54	59 days...	Star.....	¾-in.....	36.00	6.00	2,450	3,104	Shaft 10, arch.	
83	59 days...	Star.....	¾-in.....	36.24	5.96	2,042	2,509	Shaft 11.....	Failure irregular.
84	59 days...	Saturn...	¾-in.....	36.18	5.99	718	868	Shaft 10, cradle.....	Broken on side, mortar crumbly.
97	59 days...	Star.....	¾-in.....	36.66	6.02	1,855	2,565	Shaft 9, packing.....	Broken on side, failure irregular.
19	60 days...	Star.....	¾-in.....	36.30	6.08	2,066	3,363	Shaft 10, north.	
20	60 days...	Star.....	¾-in.....	36.24	5.89	1,046	2,326	Shaft 10, south.....	Top very uneven.
57	60 days...	Star.....	¾-in.....	36.36	6.00	1,617	2,572	Shaft 10, cradle.....	Faces porous.
81	60 days...	Star.....	¾-in.....	36.18	5.97	1,451	2,791	Shaft 11, arch of lining.....	Broken on side.
94	69 days...	Star.....	¾-in.....	36.78	5.98	2,208	2,976	Shaft 9, packing.....	Broken on side, failure irregular.
95	60 days...	Star.....	¾-in.....	35.94	6.05	2,543	3,314	Shaft 9, packing.....	Failure slightly irregular.
96	60 days...	Star.....	¾-in.....	36.66	5.97	1,926	2,796	Shaft 9, packing.....	Broken on side.

Tests of Concrete Cubes from the Torresdale Conduit Shafts 9, 10, 11.—Continued.

Composition—1 part cement, 3 parts sand, 5 parts stone.

Cube No.	Age.	Brand cement.	Size stone.	Cross section. Sq. in	Height Inches.	First sign of failure Lbs. per sq. in.	Ultimate strength Lbs. per sq. in.	Place used.	Remarks.
53	61 days...	Lehigh...	¾-in.....	35.70	6.03	1,454	1,520	Shaft 10, arch.	Corners broken, failure irregular.
56	61 days...	Star.....	¾-in.....	36.00	6.00	1,194	1,278	Shaft 10, arch.	
73	89 days...	Saturn...	¾-in.....	35.88	6.00	1,084	1,453	Shaft 9, arch...	Faces slightly porous.
76	89 days...	Star.....	¾-in.....	35.76	6.03	1,524	4,112	Shaft 11, bend	Broken on side.
89	89 days...	Giant.....	¾-in.....	36.12	6.06	2,384	3,494	Shaft 9, cradling.....	Broken on side, failure irregular.
92	89 days...	Giant,....	¾-in.....	36.18	6.02	2,255	3,145	Shaft 9, cradling.....	Broken on side.
9	90 days...	Star.....	¾-in.....	36.12	6.00	545	1,164	Shaft 9, south heading.....	Cube very defective, failure somewhat irreg.
10	90 days...	Star.....	¾-in.....	36.30	5.98	835	1,294	Shaft 9, south heading.....	Failure somewhat irregular.
11	90 days...	Star.....	¾-in.....	36.06	6.02	1,226	2,230	Shaft 9, south heading.....	Faces of cube rough, failure somewhat irreg.
12	90 days...	Star.....	¾-in.....	36.00	5.97	1,306	2,471	Shaft 10, north heading.....	Front face porous.
15	90 days...	Star.....	¾-in.....	35.46	6.00	1,940	2,214	Shaft 9, south heading.....	Broken on side.
16	90 days...	Star.....	¾-in.....	36.00	6.00	883	1,898	Shaft 9, south heading.....	Faces somewhat porous.
21	90 days...	Star.....	¾-in.....	36.00	6.04	1,461	2,830	Shaft 10, north	Corners chipped.
22	90 days...	Star.....	¾-in.....	36.66	5.97	734	2,246	Shaft 9, south heading.....	Mortar crumbly, corners chipped.

Tests of Concrete Cubes from the Torresdale Conduit Shafts 9, 10, 11.—Continued.

Composition—1 part cement, 3 parts sand, 5 parts stone.

Cube No.	Age.	Brand cement.	Size stone.	Cross section. Sq. in.	Height. Inches.	First sign of failure. Lbs. per sq. in.	Ultimate strength. Lbs. per sq. in.	Place used.	Remarks.
29	90 days...	Star.....	¾-in.....	36.54	6.00	717	831	Shaft 10, north	Mortar crumbly, broken on side.
30	90 days...	Lehigh...	¾-in.....	36.00	5.98	922	1,246	Shaft 11, north	Mortar soft, faces porous.
49	90 days...	Star.....	¾-in.....	35.88	6.00	2,299	2,514	Shaft 10, south, packing.....	Broken on side.
52	90 days...	Lehigh...	¾-in.....	35.82	5.98	1,203	1,340	Shaft 10, cradle.....	Broken on side, mortar crumbly.
67	90 days...	Saturn...	¾-in.....	35.34	5.96	452	492	Shaft 10, arch.....	Mortar very crumbly and soft.
79	90 days...	Star.....	¾-in.....	36.36	5.99	2,082	2,265	Shaft 11 ,lining of arch.....	Broken on side, failure irregular.
85	90 days...	Saturn...	¾-in.....	36.60	6.05	2,150	2,483	Shaft 10, arch.....	Broken on side, failure irregular.
86	90 days...	Saturn...	¾-in.....	36.00	6.04	2,105	2,471	Shaft 10, arch.....	Failure slightly irregular.
87	90 days...	Giant	¾-in.....	36.11	6.05	2,382	3,047	Shaft 9, cradle.....	Failure slightly irregular, broken on side.
88	90 days...	Giant	¾-in.....	36.18	6.05	2,401	2,620	Shaft 9, cradling	Failure slightly irregular, broken on side.
90	90 days...	Giant	¾-in.....	36.60	6.00	1,683	1,843	Shaft 9, cradling.....	Failure slightly irregular, broken on side.
91	90 days...	Giant	¾-in.....	36.78	5.98	1,615	2,219	Shaft 9, cradling.....	Failure slightly irregular, broken on side.
93	90 days...	Star.....	¾-in.....	36 66	5.99	3,407	4,067	Shaft 9, cradling.....	Broken on side, mortar good.
50	91 days...	Star.....	¾-in.....	35.88	6.00	680	2,782	Shaft 11, packing.	

Tests of Concrete Cubes from the Torresdale Conduit Shafts 9, 10, 11—Continued.

Composition—1 part cement, 3 parts sand, 5 parts stone.

Cube No.	Age.	Brand cement.	Size stone.	Cross section. Sq. in.	Height. Inches.	First sign of failure. Lbs. per sq. in.	Ult'mate strength. Lbs. per sq. in.	Place used.	Remarks.
51	91 days...	Star.....	¾-in.....	35.94	6.00	1,497	1,678	Shaft 10, packing.....	Mortar crumbly.
68	91 days...	Saturn...	¾-in.....	36 00	5.99	719	1,093	Shaft 10, arch.....	Mortar crumbly.
75	91 days...	Star.....	¾-in.....	36.00	6.00	1,197	1,375	Shaft 11, bend	Failure irregular.
77	91 days...	Star.....	Screen'gs	36.12	6.00	2,605	3,253	Shaft 11, bend.....	Failure irregular.
80	91 days...	Star.....	¾-in.....	36.60	5.95	2,822	3,119	Shaft 11, lining of arch.	
66	92 days...	Saturn...	¾-in.....	35.82	5.99	514	748	Shaft 10, arch.....	Failure slightly irregular, mortar crumbly.
72	92 days...	Saturn...	¾-in.....	36.00	5.98	1,178	1,611	Shaft 9, arch	Failure irregular, mortar soft.
40	119 days...	Lehigh...	¾-in.....	36.21	6.00	1,830	2,036	Shaft 10, sou th.....	Mortar soft.
46	119 days...	Lehigh...	¾-in.....	35.88	5.98	1,547	1,868	Shaft 10, packing.	
62	119 days...	Saturn...	¾-in.....	36.24	6.00	1,868	2,134	Shaft 10, arch.	
63	119 days...	Star.....	¾-in.....	35.94	6.00	1,575	2,403	Shaft 11, arch.....	Broken on side.
71	119 days...	Saturn...	¾-in.....	36.36	6.00	1,196	1,467	Shaft 10, arch.....	Failure slightly irregular.
78	119 days...	Star.....	¾-in.....	36.54	6.01	3,095	3,618	Shaft 10, bottom.....	Broken on side.
3	120 days...	Star	¾-in.....	36.00	5.95	628	1,420	Shaft 9, south heading.....	Cube very defective, mortar soft.

Tests of Concrete Cubes from the Torresdale Conduit Shafts 9, 10, 11—Continued.

Composition—1 part cement, 3 parts sand, 5 parts stone.

Cube No.	Age.	Brand cement.	Size stone.	Cross section. Sq. in.	Height. Inches.	First sign of failure Lbs. per sq. in.	Ultimate strength Lbs. per sq. in.	Place used.	Remarks.
4	120 d ys...	Star.....	¾-in.....	36.24	5.96	795	1,828	Shaft 9, south heading.....	Broken on side.
13	120 days...	Sta	¾-in.....	36.00	6.00	611	2,399	Shaft 10, south heading.....	Corners chipped, mortar brittle.
14	120 days...	Star.....	¾-in.....	35.94	6.00	593	1,925	Shaft 10, north heading.....	Corners broken.
23	120 days...	Star.....	¾-in.....	35.94	5.92	1,185	2,465	Shaft 9, south.	
24	120 days..	Star.....	¾-in.....	36.48	6.00	1,297	1,865	Shaft 10, south	Faces slightly porous, mortar soft.
36	120 days..	Lehigh...	¾-in.....	36.00	6.04	1,864	2,175	Shaft 10, north.	
38	120 days..	Lehigh ..	¾-in.....	36.18	5.98	1,617	2,093	Shaft 10, south	Broken on side, mortar soft.
39	120 days..	Lehigh...	¾-in.....	36.48	6.00	630	820	Shaft 10, north	Broken on side, mortar crumbly.
47	120 days..	Lehigh...	¾-in.....	36.00	6.00	1,669	1,936	Shaft 10, packing.	
48	120 days..	Star.....	¾-in.....	36.00	6.00	2,405	2,727	Shaft 10, packing.....	Broken on side.
74	120 days..	Star.....	¾-in.....	35.88	6.05	2,491	2,627	Shaft 9, arch.....	Broken on side.
45	121 days..	Lehigh...	¾-in.....	35.94	6.00	957	2,008	Shaft 10, packing.	
64	121 days..	Saturn...	¾-in.....	36.48	5.97	2,415	2,941	Shaft 11, arch.	
65	121 days..	Lehigh...	¾-in.....	36.60	6.06	1,041	1,527	Shaft 10, arch.	

Tests of Concrete Cubes from the Torresdale Conduit Shafts 9, 10, 11—Continued.

Composition—1 part cement, 3 parts sand, 5 parts stone.

Cube No.	Age.	Brand cement.	Size stone.	Cross section. Sq. in.	Height. Inches.	First sign of failure. Lbs. per sq. in.	Ultimate strength. Lbs. per sq. in.	Place used.	Remarks.
70	121 days..	Saturn...	¾-in.....	36.00	6.00	1,442	1,866	Shaft 10, arch.....	Failure slightly irregular.
37	122 days..	Lehigh ..	¾-in.....	36.12	5.98	1,271	1,551	Shaft 10, south.....	Broken on side.
44	178 days..	Lehigh ..	¾-in.....	36 24	6.00	2,210	2,253	Shaft 10, packing.....	Broken on side.
5	179 days..	Star.....	¾-in.....	35.87	6.05	530	1,001	Shaft 9, south heading.....	Mortar crumbly.
6	179 days..	Star.....	¾-in.....	36.18	6.00	498	802	Shaft 11, between brick lining and steel shell.....	Mortar crumbly.
25	179 days..	Star.....	¾-in.....	35.94	5 98	915	1,678	Shaft 9, north.....	Mortar somewhat porous.
26	179 days..	Star.....	¾-in.....	36.00	5.99	1,664	2,758	Shaft 10, south.	
31	179 days..	Lehigh...	¾-in.....	35.70	6.00	919	1,656	Shaft 10, south.....	Broken on side, failure irregular.
32	179 days..	Lehigh...	¾-in.....	36.00	5.97	800	841	Shaft 10, south.....	Broken on side, failure irregular, mortar crumbly.
34	179 days..	Star.....	¾-in.....	35.94	6.00	1,797	2,241	Shaft 10, north.....	Broken on side, failure irregular.
35	179 days..	Star.....	¾-in.....	35.88	6.00	1,321	1,541	Shaft 10, south.....	Failure slightly irregular.
41	179 days..	Lehigh...	¾-in.....	36.00	6.05	1,011	1,212	Shaft 10, south.....	Mortar crumbly.
42	179 days..	Lehigh...	¾-in.....	36.00	6.00	1,580	1,992	Shaft 10, packing	

Tests of Concrete Cubes from the Torresdale Conduit Shafts 9, 10, 11—Continued.

Composition—1 part cement, 2 parts sand, 5 parts stone.

Cube No.	Age.	Brand cement.	Size stone.	Cross section. Sq. in.	Height. Inches.	First sign of failure. Lbs. per sq. in.	Ultimate strength. Lbs. per sq. in.	Place used.	Remarks.
1	180 days..	Star.....	¾-in.....	35.46	5.98	2,335	2,623	Shaft 9, south heading.....	Broken on side, corners broken.
2	180 days..	Star.....	¾-in.....	36.00	6.02	1,223	1,646	Shaft 9, south heading.....	Mortar soft, corner broken.
7	180 days..	Star.....	¾-in.....	36.00	5.93	639	906	Shaft 11, between brick lining and steel shell.	
8	180 days..	Star.....	¾-in.....	36.00	5.96	1,022	1,343	Shaft 11, between brick lining and steel shell.	
43	180 days..	Lehigh...	¾-in.....	35.52	6.05	1,534	2,220	Shaft 10, packing.	
58	180 days..	Star.....	¾-in.....	36.00	6.02	1,775	2,044	Shaft 11, arch.....	Failure irregular, corners chipped.
59	180 days..	Star.....	¾-in.....	36.36	6.05	2,167	2,202	Shaft 11, arch.....	Failure irregular.
60	180 days...	Star.....	¾-in.....	36.66	5.99	1,260	1,505	Shaft 10, arch.....	Broken on side, mortar soft.
61	180 days...	Star.....	¾-in.....	36.42	5.98	843	931	Shaft 11, arch.....	Broken on side, mortar soft.
17	181 days...	Star.....	¾-in.....	35.10	6.00	2,670	3,735	Shaft 9, south heading	Broken on side.
18	181 days...	Star.....	¾-in.....	35.76	6.00	841	963	Shaft 9, south heading	Mortar crumbly.
33	181 days...	Lehigh...	¾-in.....	36.12	6.00	1,143	1,392	Shaft 10, north.....	Mortar soft, failure irregular.
8	184 days...	Star.....	¾-in.....	36.00	5.90	1,031	1,342	Shaft 9, south heading.....	Cube in bad condition, mortar crumbly.

Tests of Concrete Cubes from the Torresdale Conduit Shafts 9, 10, 11—Continued.

Composition—1 part cement, 3 parts sand, 5 parts stone.

Cube No.	Age.	Brand cement.	Size stone.	Cross section. Sq. in.	Height. Inches.	First sign of failure. Lbs. per sq. in.	Ultimate strength. Lbs. per sq. in.	Place used.	Remarks.
1	240 days...	Star.....	¾-in.....	36.00	6.01	1,056	1,238	Shaft 11, between brick lining and steel shell.....	Mortar somewhat porous.
3	240 days...	Star.....	¾-in.....	36.00	6.00	1,122	1,449	Shaft 11, between brick lining and steel shell.....	Corner broken.
4	240 days...	Star.....	¾-in.....	36.00	6.01	1,086	1,353	Shaft 11, between brick lining and steel shell.....	Corner broken, mortar porous.
5	240 days...	Star.....	¾-in.....	36.00	6.01	1,044	1,496	Shaft 11, between brick lining and steel shell.	
2	241 days...	Star.....	¾-in.....	36.00	6.02	975	1,289	Shaft 11, between brick lining and steel shell.....	Corners broken.

G. S. WEBSTER,
Chief Engineer.

W. PURVES TAYLOR,
Engineer of Tests.

Tests of Concrete Cubes from the Torresdale Filter Beds.

Composition—1 part cement, 3 parts sand, 5 parts stone.

Cube No.	Age.	Brand cement.	Size stone.	Cross section. Sq. in.	Height. Inches.	First sign of failure. Lbs. per sq. in.	Ultimate strength. Lbs. per sq. in.	Place used.	Remarks.
109	29 days...	Star.....	1½-in.....	35.94	6.03	1,464	2,445	Vaulting, filters 4 and 5.	
148	29 days...	Star.....	¾-in.....	36.00	6.00	3,953	4,028	Piers, battery No. 3.	
193	30 days...	Star.....	¾-in.....	36.00	6.00	1,375	1,655	9-ft. conduit.....	Mortar soft.
194	30 days...	Star.....	1½-in.....	36.24	6.02	1,730	1,914	Vaulting, battery No. 3.	
195	30 days...	Lehigh...	¾-in.....	36.36	6.05	1,788	3,135	Piers, battery No. 6.	
196	30 days...	Star.....	1½-in.....	36.42	6.03	2,875	3,174	Floor, filtered water basin.....	Broken on side, mortar soft.
107	31 days...	Giant....	¾-in.....	35.88	6.00	1,196	1,432	No. 9, conduit.....	Broken on side, mortar crumbly.
108	31 days...	Giant....	1½-in.....	36.00	6.05	1,380	3,037	Dividing wall, filters 32-33.	
147	31 days...	Star.....	1½-in.....	36.00	6.00	1,475	2,761	Walls, battery No. 3.	
192	31 days...	Star.....	¾-in.....	36.12	6.05	2,037	2,695	Piers, filtered water basin.	
146	32 days...	Lehigh...	1½-in.....	35.76	6.00	1,314	2,144	Vaulting, battery No. 4.....	Corner broken, mortar soft.
106	58 days ..	Lehigh...	1½-in.....	36.00	6.01	1,447	2,968	East wall, filters 12 and 33.	
105	59 days...	Lehigh...	1½-in.....	36.54	6.02	1,916	2,623	Regulating chamber, filts. 2 and 3.	
180	59 days...	Lehigh...	1½-in.....	35.82	6.02	980	2,668	Floor, battery No. 3.	

Tests of Concrete Cubes from the Torresdale Filter Beds.—Continued.

Composition—1 part cement, 2 parts sand, 5 parts stone.

Cube No.	Age.	Brand cement.	Size stone.	Cross section. Sq. in.	Height. Inches.	First sign of failure Lbs. per sq. in.	Ultimate strength Lbs. per sq. in.	Place used.	Remarks.
132	59 days...	Star.....	¾-in.....	35.94	5.99	1,308	1,806	Floor, battery No. 3.....	Broken on side, mortar crumbly.
176	59 days...	Lehigh...	¾-in.....	36.12	6.02	1,641	3,979	Vaulting, battery No. 3.....	Failure irregular.
102	60 days...	Lehigh...	1½-in.....	35.70	6.00	2,157	2,823	Floor, filter No. 15.	
103	60 days...	Lehigh...	1½-in.....	36.00	6.00	2,703	2,994	Floor, filter Nos. 18 and 19.....	Broken on side.
104	60 days...	Lehigh ..	¾ in.....	35.70	6.01	1,361	1,813	9 ft. conduit.	
129	60 days...	Giant....	1½-in.....	36.06	6.00	1,114	2,335	Walls, battery No. 4.....	Broken on side, mortar somewhat porous.
131	60 days...	Star.....	1½-in.....	36.00	6.07	2,383	2,975	Vaulting, battery No. 4.	Failure somewhat irregular.
191	60 days...	Giant.....	1½-in.....	36.24	6.00	3,140	3,739	Floor, battery No. 6.....	Failure irregular, broken on side.
178	60 days...	Lehigh...	1½-in.....	36.00	6.00	1,206	1,951	9 ft. conduit.....	Failure irregular, broken on side.
179	60 days...	Giant.....	¾-in.....	36.12	6.04	1,093	2,448	Main collector, battery No. 4.	
180	60 days...	Lehigh...	1½-in.....	36.24	6.02	2,729	3,540	Vaulting, battery No. 3.	
186	60 days...	Giant	1½-in.....	36.60	6.03	3,033	3,324	Vaulting, battery No. 3.....	Failure irregular, broken on side.
187	60 days...	Lehigh...	1½-in.....	36.42	6.02	2,032	2,314	Floor, battery No. 6.....	Failure irregular, broken on side, mortar soft.
188	60 days...	Giant	¾-in.....	36.54	6.03	1,839	3,355	Piers, filtered water basin.....	Broken on side.

Tests of Concrete Cubes from the Torresdale Filter Beds.—Continued.

Composition—1 part cement, 3 parts sand, 5 parts stone.

Cube No.	Age.	Brand cement.	Size stone.	Cross section. Sq. in.	Height. Inches.	First sign of failure Lbs. per sq. in.	Ultimate strength Lbs. per sq. in.	Place used.	Remarks.
189	60 days...	Lehigh...	¾-in.....	36.18	5.97	1,319	2,042	9 ft. conduit.....	Failure irregular.
190	60 days...	Star.....	1½-in.....	36.12	5.95	1,888	2,405	Floor, battery No. 6.....	Failure irregular, broken on side.
128	61 days...	Giant.....	1½-in.....	36.06	5.98	1,667	2,565	Floor, battery No. 4	Mortar porous.
134	61 days...	Star.....	1½-in.....	35.70	6.02	1,124	2,518	Reg. chambers, filter, 36, 37.	
177	61 days...	Giant	1½-in.....	36.30	6.00	906	1,679	Piers, filtered water basin.	
101	89 days...	Star.....	¾-in.....	35.88	5.98	1,419	2,024	9 feet conduit.	
136	89 days...	Saylor's.	1½-in.....	35.82	6.03	1,218	2,583	9 feet conduit.	
185	89 days...	Lehigh...	1½-in.....	36.06	6.03	2,451	2,951	Floor, filtered water basin.	
100	90 days...	Lehigh ..	1½-in....	35.64	6.00	1,142	2,220	Floor, filters No. 18, 19.	
135	90 days...	Star.....	1½-in.....	36.00	6.00	1,092	2,729	Vaulting, filter No. 4.....	Failure slightly irregular.
138	90 days...	Lehigh...	¾-in.....	36.00	6.00	1,886	3,328	Piers, battery No. 4.....	Failure slightly irregular, faces porous.
139	90 days...	Giant.....	¾-in.....	35.94	5.97	1,188	1,956	Piers, battery No. 4.	
140	90 days...	Star.....	1½-in.....	35.52	6.00	639	712	9 feet conduit.....	Failure slightly irregular, mortar crumbly.
171	90 days...	Lehigh...	¾-in.....	36.24	6.00	1,575	1,637	9 feet conduit.	Broken on side.

Tests of Concrete Cubes from the Torresdale Filter Beds—Continued.

Composition—1 part cement, 3 parts sand, 5 parts stone.

Cube No.	Age.	Brand cement.	Size stone.	Cross section. Sq. in.	Height. Inches.	First sign of failure. Lbs. per sq. in.	Ultimate strength. Lbs. per sq. in.	Place used.	Remarks.
172	90 days...	Lehigh...	1½-in.....	36.30	6.02	2,391	2,693	Walls, battery No. 3.	
173	90 days...	Giant.....	¾-in.....	36.24	6.00	1,523	2,218	Vaulting, battery No. 3.....	Failure slightly irregular, corner broken.
174	90 days...	Lehigh...	¾-in.....	36.60	6.00	1,404	1,578	9 feet conduit.....	Broken on side, mortar soft.
175	90 days...	Giant....	1½-in.....	36.36	6.03	1,790	2,037	Reg. houses, filters Nos. 52-53.....	Broken on side, mortar soft, failure irregular.
182	90 days...	Giant.....	1½-in.....	36.30	5.98	1,934	2,317	Floor, battery No. 6.	
184	90 days...	Lehigh...	1½-in.....	35.94	6.02	829	1,542	Floor, battery No. 6.	
99	91 days...	Giant....	1½-in.....	35.46	6.00	1,539	3,285	Floor, filter No. 16.	
137	91 days...	Giant....	¾-in.....	36.00	6.00	1,961	3,038	Piers, battery No. 3.....	Failure irregular.
181	91 days...	Lehigh...	1½-in.....	36.00	6.01	2,006	2,451	Floor, filtered water basin.	
183	91 days...	Giant....	¾-in.....	36.36	6.05	1,768	1,963	9-ft. conduit.....	Broken on side, mortar good.
98	92 days...	Giant....	1½-in.....	36.00	6.00	664	3,189	Wall, filters Nos. 18-27.	
97	118 days...	Giant....	1½-in.....	35.76	6.00	1,605	2,708	Floor, filters Nos. 26-27.....	Failure irregular.
95	119 days...	Giant....	1½-in.....	35.82	6.01	2,445	3,159	Floor, filter No. 15.....	Failure irregular.
96	119 days...	Star.....	1½-in.....	36.06	6.00	2,401	3,095	Floor, filter No. 17.	

Tests of Concrete Cubes from the Torresdale Filter Beds —Continued.

Composition—1 part cement, 3 parts sand, 5 parts stone.

Cube No.	Age.	Brand cement.	Size stone.	Cross section. Sq. in.	Height. Inches.	First sign of failure Lbs. per sq. in.	Ultimate strength Lbs. per sq. in.	Place used.	Remarks.
144	119 days...	Giant....	1½-in.....	36.48	6.00	2,522	2,991	Wall, battery No. 4.....	Broken on side.
164	119 days...	Lehigh...	¾-in.....	36.30	5.98	3,160	3,430	Vaulting, battery No. 4.....	Broken on side.
169	119 days...	Giant....	1½-in.....	36.18	6.01	1,327	1,732	Regulating houses, filters 16-17....	Broken on side.
84	120 days...	Star.....	¾-in.....	36.00	6.06	2,908	3,586	10-ft. conduit.	
85	120 days..	Giant....	1½-in.....	36.06	6.04	1,462	1,859	Vaulting, battery No. 1.....	Corner broken.
86	120 days..	Held'rb'g	¾-in.....	35.70	6.00	1,695	2,748	7 ft. 6 in. conduit.	
87	120 days..	Giant....	Graded...	36.00	6.00	1,672	2,735	Wall, battery No. 2.....	Failure somewhat irregular.
88	120 days..	Giant....	¾-in.....	36.00	6.00	883	1,507	7 ft. 6 in. conduit.....	Mortar soft.
89	120 days..	Giant....	¾-in.....	36.00	5.97	1,025	1,329	10 ft. conduit.....	Mortar soft, front face rough.
94	120 days..	Giant....	1½-in.....	36.00	6.00	2,181	3,467	Wall, filters No. 32, 33.	
142	120 days..	Lehigh...	¾-in.....	36.12	5.99	1,540	1,715	9 ft. conduit.....	Mortar soft, broken on side.
148	120 days..	Lehigh...	¾-in.....	36.24	6.03	1,244	1,782	10 ft. conduit.	
145	120 days..	Lehigh...	1½-in.....	36.60	6.03	1,240	1,731	Walls, battery No. 4.....	Mortar soft, broken on side.
161	120 days..	Lehigh...	¾-in.....	36.06	6.00	1,705	1,829	Piers, filtered water basin.....	Mortar soft, broken on side.

Tests of Concrete Cubes from the Torresdale Filter Beds—Continued.

Composition—1 part cement, 3 parts sand, 5 parts stone.

Cube No.	Age.	Brand cement.	Size stone.	Cross section. Sq. in.	Height. Inches.	First sign of failure. Lbs. per sq. in.	Ultimate strength. Lbs. per sq. in.	Place used.	Remarks.
162	120 days..	Giant....	¾-in.....	35.88	5.99	1,742	2,236	Floor, battery No. 5.....	Broken on side.
163	120 days..	Giant....	¾-in.....	35.94	6.02	1,886	2,127	9-ft. conduit.....	Broken on side, mortar soft.
165	120 days..	Giant....	1½-in.....	36.12	5.96	1,805	2,364	Walls, battery No. 6.....	Broken on side, mortar soft.
166	120 days..	Giant....	1½-in.....	36.18	6.00	3,781	4,484	Vaulting, battery No. 3.....	Broken on side.
167	120 days..	Giant....	1½-in.....	36.18	5.99	1,909	2,185	Walls, battery No. 6.....	Broken on side, mortar soft.
170	120 days...	Lehig	1½-in.....	36.48	6.02	2,823	3,843	Walls, battery No. 5.....	Broken on side, mortar good.
141	121 days...	Star.....	¾-in.....	36.30	6.05	1,832	2,527	Floor, battery No. 3.....	Failure irregular.
168	121 days...	Lehigh...	1½-in.....	36.12	6.03	2,367	3,095	Vaulting, battery No. 3.....	Broken on side, mortar good.
93	179 days...	Giant....	¾-in.....	36.42	6.00	1,883	1,942	Floor, filter No. 28.....	Broken on side.
56	180 days...	Saturn...	2-in.....	36.00	6.00	619	1,493	Vaulting, filter No. 1.....	Mortar somewhat crumbly.
57	180 days...	Saturn...	2-in.....	35.76	6.00	822	1,449	Vaulting, filter No. 1.....	Edges chipped.
58	180 days...	Saturn...	¾-in.....	35.76	5.96	1,085	1,425	Piers, battery No. 1.	
59	180 days...	Star.....	2-in.....	35.70	6.00	1,804	2,969	Floor, filter No. 8.	
61	180 days...	Saturn...	¾-in.....	35.94	5.99	1,132	1,484	Piers and vaulting, battery No. 1.	Faces and edges rough.

Tests of Concrete Cubes from the Torresdale Filter Beds.—Continued.

Composition—1 part cement, 3 parts sand, 5 parts stone.

Cube No.	Age.	Brand cement.	Size stone.	Cross section. Sq. in.	Height. Inches.	First sign of failure. Lbs. per sq. in.	Ultimate strength. Lbs. per sq. in.	Place used.	Remarks.
63	180 days...	Giant....	¾-in.....	36.00	5.98	1,717	2,413	Piers, filter No. 9.....	Mortar somewhat porous, front edges broken.
70	180 days...	Giant....	1½-in.....	36.00	6.02	2,925	3,804	House, filter No. 1.	
71	180 days...	Whiteh'l.	¾-in.....	35.64	5.98	1,603	2,141	Wall, filter No. 5.....	Faces porous.
78	180 days...	Star.....	¾-in.....	35.82	6.06	1,270	1,523	7-ft.-6-in. conduit.....	Broken on side, faces porous, mortar crumbly.
81	180 days...	Giant....	¾-in.....	36.48	6.00	790	1,048	10-ft. conduit.....	Mortar soft, corners chipped.
82	180 days...	Giant....	¾-in.....	35.94	6.00	2,360	3,028	7-ft.-6-in. conduit.....	Edges chipped.
83	180 days...	Star.....	Mixed....	36.42	5.98	1,873	3,071	Wall, battery No. 1.....	Corners broken.
90	180 days...	Giant....	1½-in.....	36.48	6.00	1,604	1,939	Floor, filter No. 28.....	Broken on side, corner much broken.
91	180 days...	Star.....	¾-in.....	36.00	6.00	1,236	1,887	Piers, filter Nos. 18 and 27.....	Failure somewhat irregular, mortar soft.
92	180 days...	Giant....	¾-in.....	35.82	6.04	1,513	2,172	Piers, filter Nos. 32 and 33.	
111	180 days...	Giant....	¾-in.....	36.42	6.03	3,534	3,833	Piers, battery No. 4.....	Broken on side.
112	180 days...	Star.....	¾-in.....	36.42	5.98	2,512	3,001	9-ft. conduit.....	Broken on side, corners chipped.
113	180 days...	Star.....	¾-in.....	36.12	6.04	2,982	3,853	Piers, battery No. 3.....	Corner much broken.
114	180 days...	Star.....	1½-in.....	36.36	6.01	3,171	3,887	Floor, battery No. 4.....	Broken on side.

Tests of Concrete Cubes from the Torresdale Filter Beds—Continued.

Composition—1 part cement, 3 parts sand, 5 parts stone.

Cube No.	Age.	Brand cement.	Size stone.	Cross section. Sq. in.	Height. Inches.	First sign of failure. Lbs. per sq. in.	Ultimate strength. Lbs. per sq. in.	Place used.	Remarks.
115	180 days..	Lehigh...	¾-in.....	36.42	6.02	2,833	3,336	Piers, battery No. 3.....	Broken on side, mortar good.
110	181 days..	Lehigh...	¾-in.....	36.36	5.98	1,672	1,817	9-ft. conduit.....	Broken on side, mortar soft.
60	1 year ...	Saturn...	2½-in.....	35.94	6.00	1,644	2,390	Floor, filter No. 7.....	Broken on side.
62	1 year....	Star.....	1½-in.....	35.70	6.00	2,280	2,707	West wall, filter No. 1.	
79	1 year....	Star.....	Mixed....	36.18	6.02	918	962	Wall, battery No. 1.....	Broken on side, all corners much broken, mortar soft, failure irregular.
80	1 year....	Giant	¾-in.....	36.18	6.00	1,036	1,169	10-ft. conduit.....	Broken on side, failure irregular, mortar soft.

G. S. WEBSTER,
Chief Engineer.

W. PURVES TAYLOR,
Engineer of Tests.

ANNUAL REPORT

OF THE

BUREAU OF STREET CLEANING

FOR THE

YEAR ENDING DECEMBER 31, 1903

OFFICERS

OF THE

BUREAU OF STREET CLEANING

Chief,

SAMUEL SUTCLIFFE.

Inspectors,

William Buchanan,	Henry S. Myers,
Thomas Orr,	Edward K. Cole,
Aaron F. Stull.	Dennis F. Fitzgerald,
Thomas R. Firth,	Samuel L. Moore,
John F. Slater,	William C. Felton,
Joseph MacIver,	Robert W. Scott.

Chief Clerk,

Samuel U. G. Mehaffey.

Clerk,

William H. McCoy.

Assistant Clerk,

William H. Jones.

Messenger,

Edward G. Stearne.

ANNUAL REPORT

OF THE

BUREAU OF STREET CLEANING

FOR THE YEAR 1903

Philadelphia, January 2, 1904.

PETER E. COSTELLO, ESQ.,
Director, Department Public Works.

SIR:—I have the honor to submit the following report of the work of this Bureau for the year 1903, the sixteenth annual report of the Bureau:

In making this report, I carry it through eight months of my tenure of office as Chief of the Bureau, with the four months of that of my predecessor, and make a comparative analysis of work done, in connection with the various schedules offered.

The whole amount appropriated was.....	$1,242,470 00
The whole amount expended was	1,197,937 06
Balance	$44,532 94

Of this balance there was transferred to other Bureaus $16,553.95, leaving to merge into the City Treasury a balance of $27,978.99.

There was deducted from the pay of contractors, for violations of contracts, $40,640.50 in the cleaning districts, and $1,825.00 in the garbage collection districts; making in all the sum of $42,465.50.

The number of warrants drawn and countersigned was 500.

There were received from all sources 4,169 complaints, an increase over the previous year, owing to the rigid inspection enforced during the present Administration.

There were cleaned during the year 230,239.45 miles of streets, on a basis of ten (10) squares per mile, and 1,083,759 sewer inlets. There were also 158,074 private alleys cleaned, from which streets, alleys and inlets, there were removed *218,928 cartloads of dirt. There were removed from buildings *630,593 cartloads of ashes and *27,949 cartloads of dry waste, and *301,643 cartloads of kitchen garbage; making a grand total of matter removed of *1,179,113 cartloads. There were also removed 17,513 dead animals, which were collected and disposed of with the garbage.

The net cost to the City for the above described work was $1,167,184.50.

There were also removed from the footways of highway bridges crossing the Schuylkill river 1,472 single * cartloads of snow @ 46 cents per load, and 790 double * cartloads @ 88 cents per load, and from the streets around the City Hall 1,070 single * cartloads @ 48 cents per load, and 589 double * cartloads @ 95 cents per load, contract price, making a total cost to the City of $2,445.47, $233.22 of which carried over to be paid for in 1904.

The single loads equal about one cubic yard, and the double loads equal two cubic yards.

The whole cost to the City for the supervision of the work herein mentioned was $27,640.31.

Bids for the cleaning of streets, alleys, etc., and the removal of garbage, etc., were opened December 16, 1903, under specifications for 1904, that were so materially improved by additional amount of work required as to necessitate upon the part of successful bidders, the performance

of nearly twice as much cleaning as heretofore. Under these specifications, as revised, much night work was to have been done in all the districts, in addition to the regular day cleaning. However, these bids, excepting that of the American Product Company, for the removal of garbage, etc., were held in abeyance, and new bids advertised for under the specifications current during 1903, and these bids were opened on December 30, 1903.

The contracts were awarded to the lowest bidders, amounting to $976,100.00 for the cleaning of streets, inlets and public market houses, and for the removal of ashes and household waste, and the sum of $536,700.00 for the collection and disposal of kitchen garbage and dead animals.

With the specifications of 1903, some difficulty was experienced in carrying out the work as was desired, but under the then existing circumstances, the best possible results were obtained with the means at my command. Some loop holes were open, and these could be fairly stopped only by imposing such penalties as were warranted, and by these penalties, there reverted to the City Treasury the sum of $40,640.50.

When assuming the position of Chief of the Bureau of Street Cleaning, on April 27, 1903, the average monthly removal of loads of dirt from the City's streets was 15,892; for the nine months of my tenure of office, there have been removed on an average of 19,420 loads, indicating an increase of near 20 per cent. of waste material removed from the highways.

The number of men employed at my appointment, per days per month, was 24,918, while during the remainder of the year, the monthly average was 28,048.

For the first four months of 1903, the monthly average

* A cartload of ashes and of street dirt is equal to one cubic yard; a cartload of garbage is equal to one ton.

of alleys cleaned was 11,524, while during the succeeding eight months, the average increased to 14,000. The same proportionate increase has obtained throughout the schedule under which the work for this Bureau is performed.

While the cost of cleaning streets, including the cleaning of alleys and inlets, and the removal of ashes and household waste, during the year 1902, was $3.74 per running mile per year; the cost for the same work during 1903 was $2.83 per running mile; the reduction in price per mile being largely due to the increased amount of work done. In nearly half of the City this means daily cleaning of the streets.

The removal of snow from the streets in the center of the City has always been a difficult problem, principally, from the lack of appropriation, and in consequence the removal of snow has been limited to the area of the streets surrounding the City Hall on the one side, and being removed by carts, the method was both primitive and expensive.

By experiments successfully made, and on a scale of sufficient magnitude to prove its worth, it has been abundantly demonstrated that snow can be removed from the streets immediately after the fall of such snow, at a much less cost than by the price per load now paid. When the snow is thawing or when the snow had frozen over night, necessitating double force of men, the use of picks and other tools, and even under such unfavorable conditions, the cost per square was nominal in comparison with the old method of removal.

The advantages under the new system are not alone in the reduction in price of removal, but the efficient manner in which the work is done at so small a cost. The territory over which such a system can be extended is limited only by the appropriation made for such purposes, and the re-

sults obtained cannot but justify an increased expenditure for such removal.

I desire to recommend for the future a material increase in the amount of cleaning to be done in the Third, Fourth and Fifth Districts. So much of the territory covered by these respective districts is now built up solidly that daily cleaning of nearly all the streets is practically necessary to render the general appearance at all sightly, as the tri-weekly cleaning, as called for under the present specifications, is not at all satisfactory.

On many streets in the City, where travel is very heavy, I deem it advisable to recommend that these same streets be cleaned, in addition to the regular day cleaning, at night, particularly on Saturdays, and between the hours of 6 P. M. and midnight. This work is desirable so as to avoid the unsightly appearance so often evident on Sunday mornings.

One difficult problem to be met with during the winter months, has been in keeping the street crossings free from ice and snow, as operative at the present, the specifications call for the removal only from the crossings, while a proviso of future benefit might be in the removal of snow and ice from the entire intersections of all streets, from house line to house line.

The specifications for 1904 fail to provide suitable penalties for many causes of neglect which might be readily overcome by imposing such penalties as would be warranted, and I am, in consequence, powerless to enforce them in the manner desired.

I have received many complaints in reference to sweeping streets and the collection of ashes after such cleaning, thereby making the work of cleaning almost useless. The specifications, I regret to say, under which we now are working, do not state specifically as to the time these streets should be cleaned or as to when the collection of ashes

should be made over these several localities, and as no penalties are provided to govern such case, the difficulty lies in finding a suitable remedy. The general specifications provide for work to be done in a proper manner, but where the work of cleaning required is stipulated to but three times a week, and no special days denominated, interference is practically impossible when the contract is carried out as specified.

I would also recommend that the rubbish and household waste be collected on different days from when the collections of ashes are made so as to insure their separation. I feel satisfied that if contractors were compelled to make these collections separately, one year's experience would successfully demonstrate the fact that instead of the City being compelled to pay for the removal of such household waste and rubbish, an income of many thousands of dollars would go into the City Treasury for the privilege of making such collections. Under these circumstances I beg to suggest that future specifications be so drawn as to compel the collection of ashes on days separate and distinct from when the collection of household waste and rubbish is made.

Reports from the other bureaus show that there have been added during the year 5,586 new buildings, 17.5 miles of new streets, and 500 new inlets, making to date 308,230 buildings, 962.23 miles of streets, and 20,688 inlets.

Further information will be found in detail on the accompanying schedules:

A. Appropriations and expenditures.

B. and C. Work done by contractors.

D. Statement of complaints.

E. Statement of deductions.

Transmitted herewith is a copy of the specifications for 1904.

I desire to express my appreciation of the assistance given me by all the employees of this bureau, and to thank you for the sincere approval of all my efforts to fully enforce the terms of the various contracts.

Yours respectfully,

SAMUEL SUTCLIFFE,

Chief of Bureau.

SCHEDULE "A."

Appropriations and Expenditures during the year 1903.

Items.	For	Appropriation.	Expended.	Balance merging.
1	Officers' salaries	$21,475 00	$21,474 53	$0 47
2	Horses and carriages for chief of Bureau and Inspectors	5,172 00	5,171 66	34
3	Printing, stationery and incidentals	995 00	994 12	88
4	Cleaning streets, etc	680,826 05	653,209 50	27,616 55
5	Removing garbage, etc	515,235 00	514,875 00	360 00
6	Removing snow, etc	2,213 00	2,212 25	75
	Total appropriation	$1,225,916 05		
	*Transferred from ..... Item 1 ... $95 00; Item 2 ... 28 00; Item 4 ... 13,023 95; Item 5 ... 1,465 00; Item 6 ... 2,787 00			
	Transferred from $17,398 95	$17,398 95		
	Net totals	$1,243,315 00	$1,197,937 06	$27,978 99

SCHEDULE B.—*Total Amount of Work Done During the Year 1903.*

Months.	CLEANED.						REMOVED.					FORCES EMPLOYED.					Number of Complaints.
								†NUMBER OF LOADS.				CLEANING STREETS AND REMOVING ASHES.					
	*Squares.	Alleys.	Inlets.	Crossings.	Market Houses.	Snow from Fire Plugs.	Number of Dead Animals.	Dirt.	Ashes.	Dry Waste.	Garbage.	Men.	Machines.	Carts.	Garbage Carts.	Rain or Snow, Number of Days.	
January	126,827	9,365	92,152	56,781	178	310	1,309	13,071	66,085	3,037	18,870	25,008	155	19,052	8,848	11	166
February	99,556	7,792	84,347	91,882	162	2,640	1,168	11,395	60,606	2,372	16,169	21,930	167	17,727	8,241	9	187
March	156,544	14,200	83,222	.....	168	.....	1,193	17,706	57,895	2,055	16,173	24,243	527	17,812	8,242	11	260
April	197,546	14,739	102,314	.....	210	.....	1,485	21,396	65,854	2,553	21,065	28,492	801	21,275	10,277	7	353
May	201,829	12,834	84,446	.....	168	.....	1,273	20,447	48,285	2,247	17,441	25,479	784	16,895	8,245	.....	665
June	199,996	12,018	83,725	.....	172	.....	1,277	17,379	41,664	2,091	20,300	24,923	828	16,423	8,494	12	433
July	254,180	16,091	102,229	.....	183	.....	1,518	23,440	46,700	2,476	28,508	32,118	1,020	20,084	10,600	14	482
August	202,785	13,596	82,831	.....	168	.....	1,254	17,675	35,092	1,985	28,797	26,192	833	16,119	8,544	6	345
September	267,512	17,922	104,666	.....	210	.....	2,058	23,715	44,986	2,571	51,852	33,159	1,103	20,442	11,215	3	419
October	211,712	14,170	83,230	.....	168	.....	1,766	18,884	41,293	2,101	31,768	26,442	851	16,907	8,675	4	326
November	208,064	14,025	82,626	.....	168	.....	1,568	18,136	49,581	2,068	24,267	26,673	828	17,612	8,564	4	293
December	175,897	10,422	97,971	70,979	189	3,150	1,644	15,684	72,552	2,393	26,133	29,383	517	22,019	9,923	3	240
Totals	2,302,398	158,074	1,083,759	219,642	2,144	6,100	17,513	218,928	630,593	27,949	301,643	324,042	8,414	212,367	109,868	85	4,169

* A square covers about 500 feet in length, with an average width of roadway of 26 feet.

† A cartload of ashes and of street dirt is equal to one cubic yard; a cartload of garbage is equal to one ton.

SCHEDULE C.—*Total Amount of Work Done by Districts During the Year 1903.*

Districts.	CLEANED.						REMOVED.					FORCES EMPLOYED.				Amounts of Contracts.	Garbage for entire City.	Totals.
	Squares.	Alleys.	Inlets.	Crossings.	Market houses.	Snow from fire plugs.	No. of dead animals.	*Number of Loads.				Cleaning Street and Removing Ashes.			Garbage carts.			
								Dirt.	Ashes.	Dry waste.	Garbage.	Men.	Machines.	Carts.				
First	468,992	26,519	190,211	51,216	624	804	3,098	45,265	111,185	5,540	46,141	62,382	1,138	29,145	19,128	$125,000 00		
Second	367,441	26,226	196,590	56,100	1,217	922	3,891	48,323	108,789	6,555	48,581	71,541	1,829	43,715	19,596	180,000 00		
Third	306,558	17,810	88,311	36,553	303	1,372	3,646	13,056	65,616	3,782	69,326	40,583	1,049	19,537	23,408	59,000 00		
Fourth	701,362	46,971	423,065	42,127	.....	1,031	3,729	79,172	194,338	5,604	75,156	76,794	2,666	73,377	24,455	172,000 00	$516,700 00	
Fifth	433,985	40,548	157,548	29,184	.....	840	3,649	22,065	150,665	6,468	62,489	52,485	1,597	42,720	28,281	134,450 00		
Sixth	24,060	.....	28,034	4,462	.....	1,131	.....	11,047	.....	.....	.....	20,077	135	3,873	.....	23,400 00		
Totals, 1903	2,302,398	158,074	1,083,759	219,642	2,144	6,100	17,513	218,928	630,593	27,949	301,643	324,042	8,414	212,367	109,868	$693,850 00	$516,700 00	$1,210,550 00
Totals, 1902	1,899,422	195,090	1,090,781	373,255	2,142	14,528	17,032	189,735	617,847	29,963	279,333	301,474	6,915	201,436	106,041	$720,830 00	$459,900 00	$1,210,730 00
Totals, 1901	2,046,139	173,387	1,034,329	127,481	2,123	4,295	14,753	178,495	689,883	30,472	252,238	283,336	7,712	179,655	101,595	$595,584 00	$441,863 00	$1,037,447 00
Totals, 1900	2,154,611	.....	1,128,423	261,790	2,174	17,548	10,532	192,125	568,636	15,253	224,256	272,287	7,884	172,173	93,784	$529,889 00	$398,000 00	$927,889 00

* A cart load of ashes and of street dirt is equal to one cubic yard; a cart load of garbage is equal to one ton.

SCHEDULE "D."

Statement of Complaints Received from all Sources During the Year 1903.

District.	Garbage.	Dead animals.	Ashes.	Household waste.	Streets.	Alleys.	Inlets.	Totals.	Removed by contractors.	Referred to other Bureaus.	Unfounded.
First	34	8	32	2	321	201	67	665	556	40	69
Second	112	18	146	11	582	134	260	1,263	1,062	47	154
Third	118	7	56	2	337	77	93	690	655	14	21
Fourth	71	12	59	1	353	174	111	781	668	44	69
Fifth	120	11	42	1	354	100	70	698	619	34	45
Broad street	.....	....	.....	....	70	.....	2	72	71	1	.....
Totals, 1903	455	56	335	17	2,017	686	603	4,169	3,631	180	358
Totals, 1902	431	37	264	7	937	531	496	2,703	2,261	102	340
Totals, 1901	8,428	48	255	13	769	661	494	10,668	2,755	183	7,730
Totals, 1900	417	30	290	15	739	.....	758	2,248	1,803	194	251

Source of Complaints.

	Garbage.	Dead animals.	Ashes.	Household waste.	Streets.	Alleys.	Inlets.	Totals.
Director's office	180	2	83	7	209	54	54	589
Direct to office	275	54	252	10	1,808	632	549	3,580
Totals	455	56	335	17	2,017	686	603	4,169

SCHEDULE "E."

Penalties Imposed for Violations of Contracts.

Months.	Amounts.	Districts.	Amounts.
January	$425 00	*Street Cleaning.*	
February	567 00		
March	1,662 00	First	$1,848 00
April	2,929 00	Second	5,154 00
May	15,548 00	Third	9,084 50
June	6,969 00	Fourth	18,085 00
July	2,949 00	Fifth	4,827 00
August	1,450 00	Sixth	1,642 00
September	2,631 00	Total street cleaning	$40,640 50
October	2,797 00		
November	1,969 00	*Garbage.*	
December	2,569 50		
		First	$35 00
		Second	530 00
		Third	345 00
		Fourth	300 00
		Fifth	615 00
		Total, Garbage	$1,825 00
Totals for year	$42,465 50	Total, Street Cleaning and Garbage	$42,465 50

ANNUAL REPORT

OF THE

BUREAU OF LIGHTING

FOR THE

YEAR ENDING DECEMBER 31, 1903

OFFICERS

OF THE

BUREAU OF LIGHTING

Chief,

JOHN J. KIRK.

Chief Clerk,

JOHN J. HOERR.

Clerk,

RICHARD TRENWITH.

Inspectors,

JOHN H. HOPKIN,

PETER H. SMITH,

AUGUSTIN S. ROBERTS,

FRANK JACOBI,

DAVID F. LARE.

ANNUAL REPORT

OF THE

BUREAU OF LIGHTING

FOR THE YEAR 1903

Philadelphia, December 31, 1903.

PETER E. COSTELLO, ESQ.,
Director, Department of Public Works

DEAR SIR:—I have the honor herewith to present this the fifteenth annual report of the Bureau of Lighting for the year ending December 31, 1903.

The appropriation to this Bureau for the year 1903 was $330,216.00, transferred from this amount $64.00, and $1,229.56 merged, leaving the expenditures $328,922.44.

For salaries (Item 1) there was appropriated $8,900, of this amount $36.29 merged, leaving expenditures $8,863.71.

For keep of horses and wagons (Item 2) there was appropriated $2,400.00, expended $2,400.00.

For incidentals (Item 3) there was appropriated $500, of this amount $1.58 merged, leaving the expenditures $498.42.

For gasoline lighting (Item 4) there was appropriated $309,891.00, transferred from this amount $64.00, making the appropriation $309,827.00, of this amount $1,163.14 merged, leaving the expenditures $308,663.86.

For new gasoline lamps (Item 5) there was appropri-

ated $7,000.00, of this amount $13.51 merged, leaving the expenditures $6,986.49.

For lighting the Northern Liberties District (Item 6) there was appropriated $1,525.00, of this amount $15.04 merged, leaving the expenditures $1,509.96.

The number of public lights of all kinds on December 31, 1903, was as follows:

Gas lamps	21,447
Gasoline lamps	13,034
Electric lights	9,977
	44,458

The number of public lights of all kinds on January 1, 1903, was as follows:

Gas lamps	21,104	
Gasoline lamps	12,534	
Electric lights	9,426	
		43,064
Increase during the year 1903 of		1,394

Divided as follows: Gas lamps, 343; gasoline lamps, 500; electric arc lights, 551.

Of the number of electric arc lights 50 along Delaware avenue and Front street, from Vine to South streets, are maintained by the Board of Directors of the City Trusts free of cost to the City, and 95 free electric arc lights are maintained by the different electric lighting companies for privileges granted. Two hundred and thirty-one (231) gas lamps are maintained by the Bureau of Charities and Correction at Tacony and Holmesburg, of which 123 are lighted and 108 are dead or discontinued lamps.

The number of lamps lighted and under the immediate supervision of this Bureau on January 1, 1903, number added and discontinued during the year and total number on December 31, 1903, was as follows:

Gas lamps maintained by the United Gas Improvement Co., January 1, 1903	20,677	
Added during the year	344	
		21,021
Gasoline lamps maintained by the Penna. Globe Gas Light Co., January 1, 1903	12,534	
Added during the year	500	
		13,034
Gas lamps maintained by the Northern Liberties Gas Co., January 1, 1903	75	
Discontinued during the year	1	
		74
Total number of lighted lamps on December 31, 1903		34,129
Total number of lighted lamps on January 1, 1903		33,286
Increase of lighted lamps during the year		843

On December 1, 1897, date of lease by the City of Philadelphia to the United Gas Improvement Company of the City Gas Works, the care and maintenance of the gas lamps of the City, with the exception of those in the Northern Liberties District (bounded by Vine street on the south, Canal street on the north, Sixth street on the west, and Delaware avenue on the east), and those maintained by the Bureau of Charities and Correction at Tacony and Holmesburg were transferred to said company.

The work performed by this Bureau since the transfer to the United Gas Improvement Company has been a general supervision of the work to be performed by said company, the location of all new lamps, discontinuances, removals and relocations of lamps are furnished by this Bureau through the Director's office to said company.

The work done by them has been entirely satisfactory, the lamps are lighted and extinguished regularly and kept in good repair, and all complaints received prompt attention.

The total number of gas lamps under the care of the United Gas Improvement Company on January 1, 1903,

was 20,798. There were added during the year 1,054 lamps, 302 of which were new lamps and 752 were relocated from lamps discontinued on account of their proximity to electric arc lights and other causes, making a total of 21,852 lamps. There were 710 lamps discontinued and removed during the year, deducting these from the above total (21,852), leaves a balance on December 31, 1903, of 21,142 lamps, of which 121 are dead or discontinued lamps, and 21,021 are lighted lamps.

The following summary will explain the above statement:

Number of lamps under care of the U. G. I. Co. on January 1, 1903		20,798
Number of new lamps erected	302	
Number of discontinued lamps relocated	752	
		1,054
		21,852
Number of lamps discontinued and removed	710	
Number of dead lamps still remaining	121	
		831
Number of lighted lamps on December 31, 1903		21,021

The number of locations for new gas lamps returned by the Director, Department of Public Works to the United Gas Improvement Company from December 1, 1897, to December 31, 1902, was 1,635. During the year there were returned 309 new gas lamp locations, making a total of 1,944 locations returned since the date of the lease. The above named company returned the locations of 144 lamps which they stated could not be erected on account of no mains, etc., leaving 1,800 lamps to erect, of these they have returned 1,760 erections, leaving a balance of 40 lamps still to be erected on December 31, 1903. These lamps will be erected as soon as the streets are in condition so to do.

The following summary will explain the above statement:

Number of new lamps returned to the U. G. I. Co from Dec. 1, 1897, to Dec. 31, 1903	1,944
Returned by the U. G. I. Co., as could not be erected on account of no mains, etc	144
Total to erect	1,800
Returned erected	1,760
Balance remaining to erect Dec. 31, 1903	40

As stated in my former reports, the 300 additional gas lamps which the United Gas Improvement Company under the terms of their lease with the City are required to erect each year is in sufficient to meet the demand for gas lamps. This will occur yearly owing to the number of building operations and the opening of new streets to be paved.

This insufficiency has been provided for by the erection of new electric arc lights and the discontinuance of gas lamps in proximity to the same, said company removing the discontinued lamps and erecting them at other places needed, designated by the Bureau.

During the year there were 597 gas lamps recommended by the Chief of the Bureau to be discontinued on account of their proximity to electric arc lights and other causes. These, together with 21 lamps recommended in previous years, to be discontinued and relocated, but which could not be erected at places designated on account of no mains, etc., makes a total of 618 lamps returned to the United Gas Improvement Company for removal and relocation during the year.

The following statement shows the number of lamps returnd by the Director, Department of Public Works, to the United Gas Improvement Co., to be discontinued and relocated from December 1, 1897, to December 31, 1903; number removed and erected and balance to remove and erect, viz.:

Number of lamps to discontinue and relocate from Dec. 1, 1897, to Dec. 31, 1902	3,023
Number of locations returned as could not be erected	21
	3,002
Number of lamps returned to U. G. I. Co., to remove and relocate in 1903	618
Number to erect since Dec. 1, 1897	3,620
Number returned erected from Dec. 1, 1897, to Dec. 31 1903	3,572
Balance remaining to remove and erect Dec. 31, 1903	48

The Northern Liberties Gas Company under contract with the City of Philadelphia at $20.20 per lamp per year, lighted and maintained on January 1, 1903, 75 gas lamps. There was one (1) gas lamp discontinued on account of its proximity to electric arc light, leaving a total of 74 gas lamps lighted and maintained by said company on December 31, 1903.

Under specifications prepared by the Bureau, bids for lighting the naphtha lamps of the City during the year 1903, were advertised for on November 8, 1902, and were opened by the Director, Department of Public Works, on November 25, 1902.

The bid of the Pennsylvania Globe Gas Light Company was as follows:

For naphtha lamps of twenty (20) candle power guaranteed, twenty-one (21) dollars per lamp per year.

Lamps of twenty (20) candle power guaranteed, twenty-one (21) dollars per lamp per year.

Lamps of sixty (60) candle power guaranteed, twenty-nine (29) dollars and fifty (50) cents per lamp per year for as many of each as may be required.

The contract was awarded said company by the Director on December 9, 1902.

On January 1, 1903, there were 7,060 plate burner

gasoline lamps, 133 of these were discontinued during the year on account of proximity to electric arc lights, gas lamps erected and other causes, leaving 6,927 lamps. One hundred and fifty-nine (159) lamps were relocated and erected at other places designated (26 of these were Welsbach lamps discontinued for various causes), and 266 new lamps located by ordinance of Councils, March 26, 1903, were erected, these added to the above total (6,927) makes the total number of plate burner lamps on December 31, 1903, 7,352.

On January 1, 1903, there were 5,474 Welsbach incandescent lamps, 349 of these were discontinued during the year on account of proximity to electric arc lights, gas lamps erected and other causes (26 of which were relocated as plate burner lamps), leaving 5,125 lamps. Three hundred and twenty-five (325) were relocated and erected at other places designated and 232 new lamps located by ordinance of Councils, March 26, 1903, were erected, these added to the above total (5,125) makes the total number of Welsbach incandescent lamps on December 31, 1903, 5,682. These added to the 7,352 plate burner lamps mentioned above makes a total of 13,034 gasoline lamps lighted and maintained by the Pennsylvania Globe Gas Light Company on December 31, 1903.

The following summary will explain the above statement:

Number of plate burner lamps Jan. 1, 1903		7,060
Number of plate burner lamps discontinued		133
		6,927
Number of plate burner lamps relocated	133	
Number of Welsbach lamps relocated as plate burner lamps	26	
Number of new plate burner lamps erected, Ordinance March 26, 1903	266	
		425
Total number of plate burner lamps, Dec. 31, 1903		7,352

Number of Welsbach lamps on Jan. 1, 1903.....	5,474	
Number of Welsbach lamps discontinued	349	
	5,125	
Number of Welsbach lamps relocated.....	325	
Number of Welsbach lamps erected, Ordinance March 26, 1903	232	
		5,682
Total number of gasoline lamps on December 31, 1903..		13,034

There were located by resolution of Councils, March 26, 1903, 503 gasoline lamps. Of this number 498 were erected, of which 266 were plate burner lamps and 232 were Welsbach incandescent lamps and 5 were not erected for the following reasons:

Too close to electric light	1
Located where lamps were up	2
Repetition in ordinance	1
Located too close to lamp up.....	1
Total	5

The work of the Pennsylvania Globe Gas Light Company has been entirely satisfactory, the lamps being kept in good order and lighted with regularity.

In closing this report I acknowledge my indebtedness to you for the valuable aid you have afforded me and the courtesy which you have given me in the administration of the Bureau. My thanks are also due to my subordinates for the faithful manner in which they have discharged the duties of their positions.

For further information, permit me to refer you to the tables appended.

Yours truly,

JOHN J. KIRK,
Chief of Bureau.

Summary of Appropriation, Bureau of Lighting.

Items.		Appropriation.	Expended.	Unexpended.	Transferred.	Merging.
1	Salaries	$8,900 00	$8,863 71	$36 29	.....	$36 29
2	Keep of horses and wagons	2,400 00	2,400 00			
3	Incidentals	500 00	498 42	1 58	.....	1 58
4	Gasoline lighting	309,891 00	308,663 86	1,227 14	64 00	1,163 14
5	New gasoline lamps	7,000 00	6,986 49	13 51	.....	13 51
6	Lighting Northern Liberties District	1,525 00	1,509 96	15 04	.....	15 04
	Totals	$330,216 00	$328,922 44	$1,293 56	$64 00	$1,229 56

DETAIL OF EXPENDITURES.

Bureau of Lighting.

Salaries	$8,863 71
Keep of horses and wagons	2,400 00
Stationery	309 10
Cleaning office	90 00
Incidentals	99 32
Penna. Globe Gas Light Co.	315,650 35
Northern Liberties Gas Co.	1,509 96
Total	$328,922 44

Statement Showing the Number of Each Kind of Lamps at the Beginning of the Year, Additions, Discontinuances, etc.

	No. of lamps, Jan. 1, 1903.	Additions.	Discontinuances.	No. of lamps, Dec. 31, 1903.
Number of lamps maintained by U. G. I. Co...	20,798	1,054	710	*21,142
Contract with the Northern Liberties Gas Co..	75	.....	1	74
Number of lamps maintained by the Bureau of Charities and Correction.....	231	.....	.....	*231
Number of gasoline lamps.....	12,534	982	482	13,084
Number of electric lights.....	9,426	551	.....	9,977
Total.....	43,064	2,587	1,193	44,458

*Not lighted because of proximity to electric lights.

Of the number of gas lamps maintained by the United Gas Improvement Company during the year 1903, there were not lighted because of proximity to electric lights..... 121
Of the number of gas lamps maintained by the Bureau of Charities and Correction during the year 1903, there were not lighted because of proximity to electric lights..... 108
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Statement Showing the Number of Gas Lamps Lighted and Maintained by the United Gas Improvement Company, December 1, 1897; Number Discontinued and Removed, Relocated and New Erections, by Wards, to December 31, 1903.

Wards.	Number of Lamps, Dec. 31, 1897.	Discontinued and Removed since Dec. 1, 1897.	Relocated since Dec. 1, 1897.	New Erections since Dec. 1, 1897.	Number of Lamps Lighted, Dec. 31, 1903.
First	573	86	20	12	519
Second	243	75	4	.....	172
Third	52	26	.....	.....	26
Fourth	68	18	.....	.....	50
Fifth	187	20	1	1	169
Sixth	108	27	.....	.....	81
Seventh	265	85	15	16	211
Eighth	298	82	6	3	225
Ninth	122	48	5	.....	79
Tenth	259	90	2	.....	171
Eleventh	1	.....	.....	.....	1
Twelfth					
Thirteenth	106	45	2	.....	63
Fourteenth	141	71	.....	3	73
Fifteenth	636	153	15	2	500
Sixteenth	33	14	.....	.....	19
Seventeenth	85	43	1	.....	43
Eighteenth	309	97	9	11	232
Nineteenth	572	208	64	8	436
Twentieth	468	178	3	2	295
Twenty-first	994	90	23	20	947
Twenty-second	2,540	156	217	141	2,742
Twenty-third	475	74	21	37	459
Twenty-fourth	1,089	119	87	36	1,093
Twenty-fifth	727	114	146	242	1,001
Twenty-sixth	618	87	99	54	684

Statement of Number of Lamps Lighted, etc.—Continued.

Wards.	Number of Lamps, Dec. 1, 1897.	Discontinued and Removed since Dec. 1, 1897.	Relocated since Dec. 1, 1897.	New Erections since Dec. 1, 1897.	Number of Lamps Lighted Dec. 31, 1903.
Twenty-seventh	822	151	216	162	1,049
Twenty-eighth	785	118	136	43	846
Twenty-ninth	845	190	32	9	696
Thirtieth	264	103	12	8	181
Thirty-first	361	141	22	15	257
Thirty-second	449	123	18	1	345
Thirty-third	1,010	134	488	246	1,610
Thirty-fourth	882	102	821	330	1,931
Thirty-fifth	7	.....	.....	.....	7
Thirty sixth	735	106	173	94	896
Thirty-seventh	329	93	38	13	287
Thirty-eighth	754	77	156	62	895
Thirty-ninth	597	113	136	24	644
Fortieth	286	58	235	82	545
Forty-first					
Forty-second	124	15	349	83	541
Total	19,219	3,530	3,572	1,760	21,021

Monthly Statement of Gas Lamps Lighted by the United Gas Improvement Co., from January 1, 1903, to December 31, 1903; Showing the Number of Removals, Relocations and New Erections.

Months.	Number of lamps.	Removed during the year.	Relocated during the year.	New erections during the year.	Total number of lamps lighted.
January	20,677	80	80	1	20,678
February	20,678	44	44	2	20,680
March	20,680	15	8	29	20,697
April	20,697	8	14	74	20,782
May	20,782	4	8	70	20,851
June	20,851	40	48	68	20,927
July	20,927	65	59	33	20,954
August	20,954	90	98	7	20,969
September	20,969	179	185	8	20,978
October	20,978	125	121	4	20,978
November	20,978	34	47	4	20,995
December	20,995	31	50	7	21,021
Total, December 31, 1903		710	752	302	21,021

Number of Posts, Number Lighted, Not Lighted, Number of Burners, Number Lighted, Not Lighted, in Public Squares.

Squares.	Number of Posts.	Lighted.	Not Lighted.	Number of Burners.	Lighted.	Not Lighted.
Jefferson	16	4	12	32	8	24
Washington	51	14	37	71	28	43
Independence	41	28	13	61	43	18
Franklin	22	11	11	44	22	22
Logan	26	26	.....	52	52	
Rittenhouse	24	24	.....	48	48	
Ontario	8	8	.....	24	24	
Passyunk	16	11	5	32	22	10
Wharton	12	12	.....	36	36	
Fairhill	8	.....	8	8	.....	8
Norris	15	.....	15	30	.....	30
Fitler	4	4	.....	12	12	
Allegheny	22	22	.....	22	22	
Fotterall	32	32	.....	32	32	
Total	297	196	101	504	349	155

Monthly Statement Showing the Number of Lamps Lighted and Number Discontinued and Removed in the Northern Liberties District.

Months.	Number of lamps.	Discontinued on account of electric lights or other causes.	Total.
January	75	.....	75
February	75	.....	75
March	75	.....	75
April	75	.....	75
May	75	.....	75
June	75	.....	75
July	75	.....	75
August	75	.....	75
September	75	1	74
October	74	.....	74
November	74	.....	74
December	74	.....	74
Total lighted December 31, 1903	.....	1	74

Statement showing the Number of Plate Burner and Welsbach Gasoline Lamps on January 1, 1903, number discontinued, relocated and new erections to December 31, 1903, by Wards.

Wards.	Number of Plate Lamps, January 1, 1903.	Plate Lamps, discontinued.	Plate Lamps, relocated.	Plate Lamps, new erections.	Total Number Plate Lamps, December 31, 1903.	Number of Welsbach Lamps, Jan. 1, 1903.	Welsbach Lamps, discontinued.	Welsbach Lamps, relocated.	Welsbach Lamps, new erections.	Total Number Welsbach Lamps, Dec. 31, 1903.	Total Number of Plate and Welsbach Lamps, December 31, 1903.
First	303	1	1	11	314	11	1	.....	1	11	325
Second	143	3	2	1	143	2	....	.....	3	5	148
Third	99	2	....	3	100	.....	....	2	.....	2	102
Fourth	116	.....	....	6	122	.....	....	.....	.....	.....	122
Fifth	51	.....	1	.....	52	5	....	1	.....	6	58
Sixth	27	.....	2	1	30	.....	....	.....	.....	.....	30
Seventh	166	1	1	2	168	3	1	1	1	4	172
Eighth	86	7	4	3	86	7	1	.....	.....	6	92
Ninth	13	1	....	1	13	6	....	.....	.....	6	19
Tenth	56	.....	....	.....	56	3	....	.....	.....	3	59
Eleventh	79	.....	1	1	81	.....	....	.....	.....	.....	81
Twelfth	94	.....	8	.....	102	.....	....	.....	.....	.....	102
Thirteenth	51	1	....	1	51	.....	....	2	.....	2	53
Fourteenth	99	1	1	1	100	2	1	.....	.....	1	101
Fifteenth	193	1	....	5	197	26	1	.....	.....	25	222
Sixteenth	106	.....	....	.....	106	.....	....	.....	.....	.....	106
Seventeenth	132	.....	....	1	133	1	....	.....	.....	1	134
Eighteenth	171	8	1	8	172	23	1	6	.....	28	200
Nineteenth	364	8	13	12	381	57	5	9	.....	61	442
Twentieth	346	3	....	3	346	12	....	2	.....	14	360
Twenty-first	17	.....	....	1	18	483	6	10	35	522	540
Twenty-second	28	14	10	2	26	516	9	26	12	545	571
Twenty-third	37	8	....	3	32	209	13	14	9	210	242
Twenty-fourth	282	1	11	5	297	99	19	9	1	90	387
Twenty-fifth	109	3	26	16	148	301	45	12	17	285	433

Statement Showing the Number of Gasoline Lamps—Continued.

Wards.	Number of Plate Lamps, January 1, 1903.	Plate Lamps, discontinued.	Plate Lamps, relocated.	Plate Lamps, new erections.	Total Number Plate Lamps, December 31, 1903.	Number of Welsbach Lamps, Jan. 1, 1903.	Welsbach Lamps, discontinued.	Welsbach Lamps, relocated.	Welsbach Lamps, new erections.	Total Number Welsbach Lamps, Dec. 31, 1903.	Total Number of Plate and Welsbach Lamps, December 31, 1903.
Twenty-sixth.....	400	1	5	6	410	14	6	1	.....	9	419
Twenty-seventh...	47	.....	....	1	48	132	13	5	1	125	173
Twenty-eighth.....	319	2	4	32	353	25	....	2	2	29	382
Twenty-ninth.....	435	4	....	7	438	42	....	4	.....	46	484
Thirtieth.....	169	1	1	4	173	9	2	.....	.....	7	180
Thirty-first.....	288	.....	11	10	309	44	3	.....	.....	41	350
Thirty-second	343	25	4	3	325	9	....	25	.....	34	359
Thirty-third.....	361	9	14	39	405	237	14	22	5	250	655
Thirty-fourth.....	83	.....	12	5	100	412	48	10	21	395	495
Thirty-fifth.....	1	.....	....	.....	1	950	5	58	68	1,071	1,072
Thirty-sixth.....	272	.....	2	17	291	109	7	.....	8	110	401
Thirty-seventh....	222	.....	6	9	237	5	1	.....	2	6	243
Thirty-eighth.....	71	.....	12	12	95	197	15	2	2	186	281
Thirty-ninth.....	586	1	4	11	600	22	7	.....	.....	15	615
Fortieth.....	271	5	2	21	289	377	10	4	8	379	668
Forty-first.....	22	22	....	.....	.....	264	5	42	.....	301	301
Forty-second.....	2	.....	....	2	4	869	110	56	36	851	855
Totals.....	7,060	133	159	266	7,352	5,474	349	325	232	5,682	13,034

Monthly Statement of Plate Burner and Welsbach Gasoline Lamps, New Erections, Relocations, Discontinuances, etc., from January 1, 1903, to December 31, 1903.

Months.	Number of plate lamps.	Plate lamps discontinued.	Plate lamps relocated.	Plate lamps, new erections.	Total number of plate lamps.	Number of Welsbach lamps.	Welsbach lamps discontinued.	Welsbach lamps relocated.	Welsbach lamps, new erections.	Total number of Welsbach lamps.	Total number of plate and Welsbach lamps.
January	7,060	1	4	.....	7,063	5,474	9	5	.....	5,470	12,533
February	7,063	.....	13	.....	7,076	5,470	77	18	.....	5,411	12,487
March	7,076	.....	30	.....	7,106	5,411	5	18	.....	5,424	12,530
April	7,106	1	10	14	7,129	5,424	8	5	9	5,430	12,559
May	7,129	10	14	1	7,134	5,430	75	69	1	5,425	12,559
June	7,134	11	18	251	7,392	5,425	51	27	221	5,622	13,014
July	7,392	24	16	.....	7,384	5,622	31	53	1	5,645	13,029
August	7,384	.....	18	.....	7,402	5,645	28	11	.....	5,628	13,030
September	7,402	3	8	.....	7,407	5,628	24	23	.....	5,627	13,034
October	7,407	2	13	.....	7,418	5,627	26	5	.....	5,606	13,024
November	7,418	81	8	.....	7,345	5,606	4	87	.....	5,689	13,034
December	7,345	.....	7	.....	7,352	5,689	11	4	.....	5,682	13,034
Total, Dec. 31, 1903.	.....	.....	133	159	266	7,352	.....	349	325	282	5,682	13,034

Statement of Gasoline Lamps Located by Resolution of Councils, March 26, 1903; Number Erected and Number not Erected, by Wards.

Wards.	Located.	Welsbach Erected.	Plate Erected.	Plate Not Erected.	Wards.	Located.	Welsbach Erected.	Plate Erected.	Plate Not Erected.
First	12	1	11		Twenty-third	12	9	3	
Second	4	3	1		Twenty-fourth	6	1	5	
Third	3	.....	3		Twenty-fifth	33	17	16	
Fourth	6	.....	6		Twenty-sixth	6	.....	6	
Fifth					Twenty-sev'th	2	1	1	
Sixth	1	.....	1		Twenty-eighth	34	2	32	
Seventh	3	1	2		Twenty-ninth	7	.....	7	
Eighth	3	.....	3		Thirtieth	4	.....	4	
Ninth	2	.....	1	1	Thirty-first	10	.....	10	
Tenth					Thirty-second	3	.....	3	
Eleventh	2	.....	1	1	Thirty-third	44	5	39	
Twelfth					Thirty-fourth	26	21	5	
Thirteenth	1	.....	1		Thirty-fifth	68	68		
Fourteenth	1	.....	1		Thirty-sixth	25	8	17	
Fifteenth	5	.....	5		Thirty-seventh	10	2	8	
Sixteenth					Thirty-eighth	15	2	13	
Seventeenth	2	.....	1	1	Thirty-ninth	12	.....	11	1
Eighteenth	8	.....	8		Fortieth	29	8	21	
Nineteenth	13	.....	12	1	Forty-first				
Twentieth	3	.....	3		Forty-second	38	36	2	
Twenty-first	36	35	1						
Twenty-second	14	12	2		Total	503	232	266	5

ANNUAL REPORT

OF THE

BUREAU OF GAS

FOR THE

YEAR ENDING DECEMBER 31, 1903

OFFICERS

OF THE

BUREAU OF GAS

Chief Inspector of Meters,
DR. N. WILEY THOMAS.

First Assistant Meter Inspector,
JOHN S. STEWART.

Second Assistant Meter Inspector,
ALEXANDER McCAULY.

Clerk and Assistant Inspector,
ALBERT C. JOHNSTON.

Photometer Inspector,
CHARLES W. KAESER.

Messenger and Assistant Inspector,
BENJAMIN INGRAM.

ANNUAL REPORT

OF THE

BUREAU OF GAS

FOR THE YEAR 1903

Philadelphia, January 12, 1904.

PETER E. COSTELLO, ESQ.,
Director, Department of Public Works.

MY DEAR SIR:—I have the honor to submit herewith the report of the Bureau of Gas for the year ending December 31, 1903.

The appropriations and expenditures were as follows:

Appropriations for 1903	$10,000
Expenditures for 1903	10,000

It is almost incredible that illuminating gas should have a history of less than one hundred years, for while it was known early in the eighteenth century that combustible gas could be made from coal, and attempts were made about the year 1802 to make use of it as a source of light, yet the Gas Light and Coke Company of London did not become incorporated until 1810.

The gas industry of to-day has achieved admirable success by the combination of business acumen with the skill of carefully trained technical experts, in which arrange-

ment, the former sell to advantage the product manufactured and distributed by the latter. The methods adopted have developed gas engineers who are competent to handle the difficulties of large plants, while the commercial feature of the undertaking successfully attempts to so enlarge the consumption at certain periods that its demand may be more uniform and thus establish certain well-known conditions necessary to economical production.

This trend and the desire to advance in the same direction is well illustrated by the following extract taken from one of the periodicals circulated among gas engineers: "Technical education is no longer regarded as an experiment, for there are too many gray-headed alumni managing the industrial affairs of this country to regard special college training in any but a serious light. The habit of systematic reasoning and extended investigation which is thus acquired enables the technical graduates to quickly grasp the details of a business, catch up with the practically trained man in a short time and then assume control of the management.

"The possibilities within the reach of technical graduates are no doubt great and the remuneration quite satisfactory in comparison with other learned professions, but the training has for its goal, the engineer or the superintendent, whereas, the greater rewards go to those managers who combine both business and technical essentials. In the gas business, as elsewhere, there is a demand for the man trained both technically and commercially. Formerly, economies were effected in the retort house, and are yet for that matter; but the profits are no longer so dependent upon operation. 'Smaller profits and large sales' are the slogan and this brings the business end of the gas company into unusual prominence. . . . As to how this business training is to be secured is a problem for educators and

those concerned. . . . . A knowledge of business is essential to self-preservation as soon as one leaves the place where things are made. It would be strange indeed if a man could not be educated in how to sell things and keep the money, as well as how to make them."

Gas for illumination or fuel was but a few years since considered a luxury; it is now a public necessity; a merely temporary curtailment of the supply is viewed as an intolerable inconvenience, so that in city life, at least, it is imperative that there shall be at all times ready for use an abundant supply of gas of good quality. In Philadelphia to-day these conditions are fulfilled unless perhaps there are local defects in the distributing system on the premises which may prevent the flow of gas from the main to the burner. The extension of the general distributing system has progressed with the growth of the City, and the demand for a sufficient supply has been met without any deterioration in the quality of the gas.

Science and art, it may be said, are blended in the systematic utilization of the means of artificial lighting; this is especially true with respect to the incandescent gas light. Wherever intense light is required we find that the incandescent mantel is employed. It is universally satisfactory, except in cases where the consumer utterly ignores the simple directions for the proper handling that will insure the highest efficiency, in fact the remarkable properties of the incandescent mantel become more attractive as we become better acquainted with them.

In view of the rather unique arrangement under which this Bureau operates, it may perhaps be conducive to a clear apprehension of our duties for attention to be directed to the clauses of the contract between the City of Philadelphia and The United Gas Improvement Company, which apply directly to our work.

It will be observed that our labors are practically two-fold; the exercise of such oversight as shall insure the supply of gas of good quality, at least 22 candle-power, and in case of dispute concerning the accuracy of a bill, the consumer shall be provided with protection against incorrect meters.

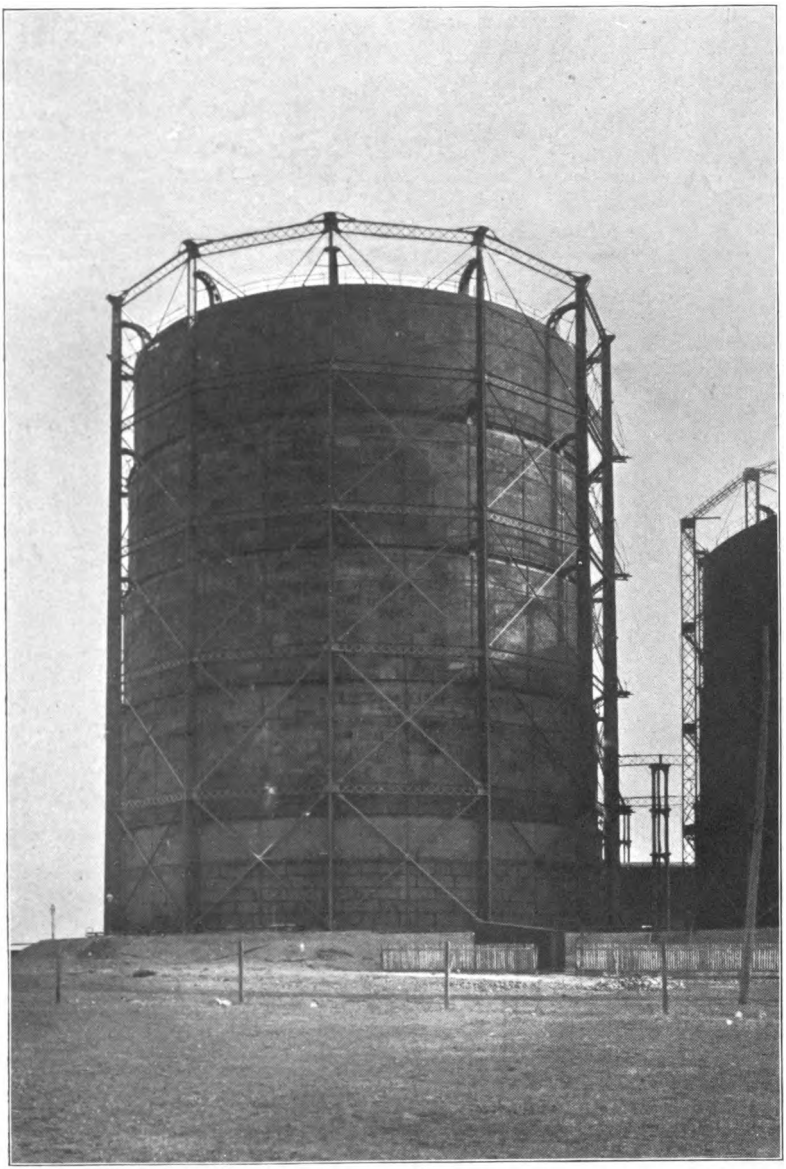
—

EXTRACTS FROM THE AGREEMENT BETWEEN THE CITY OF PHILADELPHIA AND THE UNITED GAS IMPROVEMENT COMPANY.

Testing Candle Power of Gas.

CLAUSE 9: Said The United Gas Improvement Company, or its assigns, shall furnish proper stations for testing the candle power of the gas, located at a distance of not less than one (1) mile from each point of manufacture, and shall equip the same with a bar photometer and other appliances customary and necessary for such purposes. Tests shall be made and recorded daily by The United Gas Improvement Company, or its assigns, and such records shall be, at all times, open to the inspection of the City. All such tests shall be made in the presence of a representative of the City, appointed by the Mayor, who shall have the right to also make such tests himself at such stations in the presence of the Company's representative. Such representative of the City shall be the Inspector of Meters, if City Councils shall provide by this contract or otherwise for the appointment of such an official.

The said The United Gas Improvement Company, its successors or assigns, shall, as soon after the delivery to them of said gas works hereunder as is possible with due diligence and dispatch, supply gas of good quality of not less than twenty-two (22 candle-power, daily average, tested as above, and maintain said supply during the con-



FIVE-LIFT HOLDER, STATION B, 25TH WARD GAS WORKS.

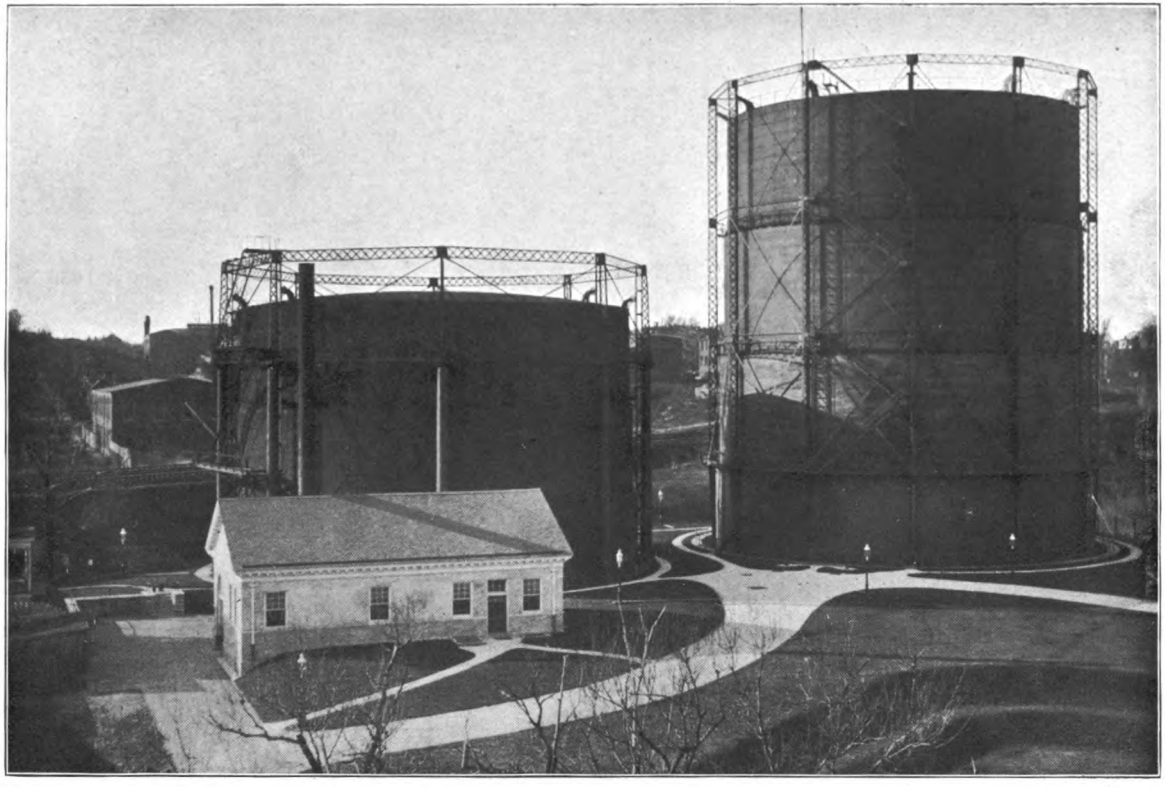
tinuance of this lease, unless prevented by accidents beyond their control.

After the expiration of two years from the date of this lease for every failure of The United Gas Improvement Company, its successors or assigns, to comply with the terms and conditions of this clause, relative to tests, quality and candle-power of gas, the said The United Gas Improvement Company, its successors and assigns, shall pay to the City of Philadelphia a penalty of five hundred (500) dollars for each day during which such failure continues. In every case of such default and demand made by the City for the payment of the fine The United Gas Improvement Company, its successors or assigns, shall be entitled to repayment of the same by the City, if it shall be shown that the default on account of which the fine was imposed was due to causes beyond the control of said The United Gas Improvement Company, its successors and assigns.

Testing Meters.

Clause 11: In order to provide for the amicable settlement of any disputes or disagreements which may arise between consumers and said The United Gas Improvement Company, or its assigns, as to the amount of gas for which bill has been rendered and payment demanded, the correctness of which is disputed by the consumer, said The United Gas Improvement Company agrees, for itself and for its successors and assigns, that it will provide a proper and convenient place or places, on the leased property at which its meters may be inspected, with the proper and customary apparatus therefor, for the use of the official, and his assistants, who may be appointed by the Mayor as Inspector of Meters. Upon complaint of any consumer doubting the accuracy of the bill and declining to pay the same, lodged with such Inspector, alleging that the amount of gas for

which the bill has been rendered and payment demanded is in excess of the amount consumed by such consumer, and upon demand thereafter made by the Inspector in writing to The United Gas Improvement Company, or its assigns, shall disconnect the meter in question and deliver it to the inspection station for examination, where the testing of the meter for the purpose of ascertaining the correctness of its measurements shall be made by such Inspector, in the presence of the representative of said The United Gas Improvement Company, or its assigns. Such tests shall to made according to the established and well-known methods used for such purposes. Any such meter shall be disconnected by said Company, or its assigns, between the hours of eight o'clock A. M. and three o'clock P. M., within 48 hours of the time when said company, or its assigns shall receive notice to disconnect such meter for such reasons; and the same shall be tested and returned to said The United Gas Improvement Company, or its assigns, within 24 hours from its receipt at the testing station, bearing a seal upon which shall be written the report of the inspector that the meter in question is correct or incorrect, and if the latter, the percentage which it runs, fast or slow, and the bill of the consumer about which the complaint has been made shall be corrected according to such finding and report of the Inspector. Such Inspector of Meters and such Assistants as the Mayor shall deem necessary shall be appointed by the Mayor, and shall be duly sworn in conformity with the law to faithfully, honestly and diligently perform the duties of their respective offices. Said The United Gas Improvement Company agrees for itself, and its successors and assigns, that it will annually and at the beginning of each year of the lease to pay to the City of Philadelphia the sum of ten thousand (10,000) dollars towards paying the salaries and expenses of the Inspector of Meters and his assistants, after the same shall



GENERAL VIEW OF GERMANTOWN HOLDER STATION.

be appointed in pursuance of this clause, and also towards defraying the expenses which the City may be put to in connection with tests of gas made in pursuance of Clause 9 of this lease. When the meter is removed for the purpose of testing, the said Company shall place a meter in place of the one removed at its own cost and expense, the object being that no consumer shall be without light. The type of meter used for the measurement of gas shall be such type as shall be in general use in other large cities in the United States. Any consumer desiring such test shall, on making his application to such Inspector, pay him the sum of one (1) dollar, taking his receipt therefor, which amount shall be returned to the consumer if the tests and reports of the Inspector shall show that the meter in question is fast, but otherwise shall be paid by the Inspector into the Treasury of the City of Philadelphia. Bills shall not be rendered more frequently than are now rendered to the various classes of consumers.

—

The Quality of the Gas.

In order to ascertain the quality of the gas and its illuminating value the usual inspection has been carried on at the testing stations.

The photometrical results, which were as follows, involve one of the most important tests connected with the gas industry:

	Candle-power.
January	23.07
February	22.94
March	22.99
April	22.99
May	22.88
June	23.21
July	23.00
August	22.89

	Candle-power
September	22.97
October	23.05
November	22.90
December	23.15
Maximum monthly average	23.21
Minimum monthly average	22.88

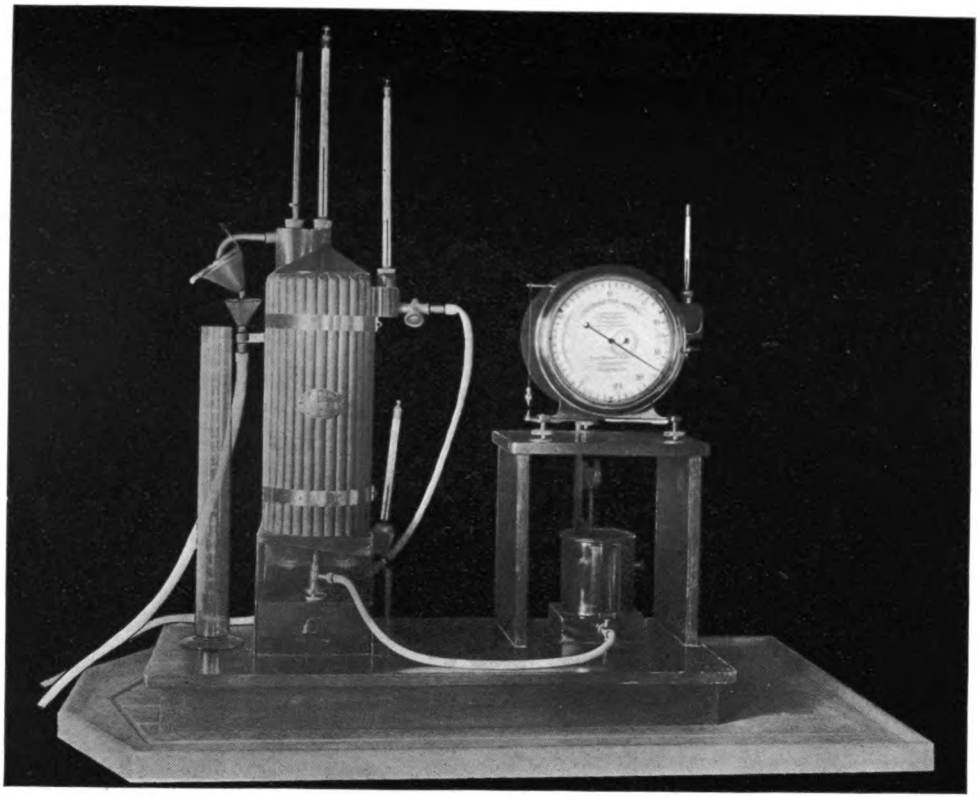
The customary examination for sulphuretted hydrogen and tarry matter proved their absence, the ammonia content averaged 1.20 grains per 100 cubic feet, and the total sulphur 6.50 grains.

The specific gravity was 0.644, while the heating value reached 700 British Thermal Units per cubic foot.

Gas is almost universally utilized for the production of heat, therefore, to be able to determine its heating value is now very desirable. The use of gaseous fuel is greatly increasing and in order that the facilities afforded at the testing stations shall be the best and fully abreast of any advance that may be noted, there has been provided an additional Calorimeter of the Simmance-Abady type. This is built on the same general plan as the Junker's which is now in use. The determination of the heating value of the gas as effected by the calorimeter is accomplished by the observation of the heat developed from a constantly burning flame, which is entirely transmitted to an evenly flowing stream of water. Stated briefly, it enables the operator to ascertain the volume of gas required to produce a definite increase in temperature of a known weight of water (an illustration shows the features of the Simmance-Abady Calorimeter).

We have also received a complete apparatus for the chemical analysis of the gas which is a very considerable addition to our laboratory equipment.

The chemical composition of the gas is fairly indicated by the following results:



SIMMANCE-ABADY CALORIMETER.

	Per Cent.
Carbon di-oxide	2.50
Illuminants	11.50
Oxygen	0.75
Hydrogen	32.60
Carbon mon-oxide	21.65
Methane	26.20
Nitrogen	4.80
	100.00

Meter Inspection.

The increased demand for the inspection of meters which we had expected to note in our last report appeared during the past year.

With application for the examination of a meter in case of a dispute between the consumer and the Gas Company touching the accuracy of the bill rendered, it is required that a deposit of one (1) dollar shall be made with this office, which is returned to the consumer when the results of the test show the meter to be fast, but if the meter is not found to be fast, the fee for inspection is paid into the City Treasury.

During the past year we have inspected 81 meters, 68 of which were fast, showing an average of 3 per cent., while the remaining 13 averaged 1.1 per cent. slow.

Total amount received		$81 00
Amount returned to consumers	$68 00	
Amount deposited in City Treasury	13 00	
		$81 00

Gas is used for so many purposes and there are so many appliances employed and in many directions a general tendency toward extravagance in consumption that it is doubtless true that some consumers find their bills increased; it is equally true that we have failed to find such inaccuracies in the meters as might reasonably explain the matter satisfactorily. The extravagant use of gas by consumers, who will not exercise common prudence, is also

probably due to some extent to the easy facility with which the gas may be obtained.

All consumers, whether extravagant or economical, are at stated intervals made positively aware of a meter on the premises, which with unusual certainty maintains a record of the volume of gas consumed, regardless of our inattention. Our ability to secure sufficient gas doubtless may, at times, lead to the use of more than we absolutely require, but on the other hand the consumer naturally insists there shall at all times be enough to meet any reasonable demand that may be made upon the supply.

It may also be stated that the general condition of enlargement and improvement continues to be manifested at the manufacturing stations located at Point Breeze and Richmond; I desire to add, too, that the requirements of the contract between the City and The United Gas Improvement Company touching the candle power of gas have been complied with and the standard fully maintained, also in all cases of meter inspection we have found the Gas Company prompt in carrying out the terms of the agreement.

In conclusion, allow me to thank you for your kind consideration and I desire also to express my gratitude for the ready assistance I have received from the officers of the Bureau of Gas.

Very respectfully yours,

N. WILEY THOMAS.

ANNUAL REPORT

OF THE

BUREAU OF CITY ICE BOATS

FOR THE

YEAR ENDING DECEMBER 31, 1903

OFFICERS

OF THE

BUREAU OF CITY ICE BOATS

Superintendent,

JAMES S. JEFFERSON.

Engineer,

C. CLENDANIELS.

ANNUAL REPORT

OF THE

BUREAU OF CITY ICE BOATS

FOR THE YEAR 1903

Philadelphia, January 2, 1904.

PETER F. COSTELLO, ESQ.,
Director, Department of Public Works.

DEAR SIR:—I have the honor to submit the following report of the operations of the City Ice Boats for the year ending December 31, 1903:

January 1, 1903, found City Ice Boats Nos. 1, 2 and 3 lying at their berths at the House of Correction wharf, steam up and a half crew aboard ready for service.

January 13. Boat No. 2 was placed in active commission, considerable ice having formed.

January 14. Boat No. 2 assisted two steamships and two tugs with tows.

January 15. Boat No. 1 was ordered in commission.

January 15. Boat No. 2 assisted tug with two schooners.

January 16. Boat No. 1 assisted tug with car float at Thompson Point, also steamship off League Island Navy Yard.

January 17. Boat No. 1 assisted one steamship and four tugs which were fast in the Horseshoe.

January 18. Working in vicinity of Cramer Hill. Boat No. 2 convoyed four tugs and four schooners from New Castle to "Ship John."

January 19. Boats Nos. 1 and 2 working on regular stations.

January 20. Boat No. 1 assisted two tugs with barges in Horseshoe. Boat No. 2 convoyed one steamship and one tug to City from New Castle.

January 21. Boat No. 1 assisted two tugs with barks in tow fast in Horseshoe.

January 23. River in such good condition that Boat No. 2 returned to berth at House of Correction wharf.

January 24. Boat No. 1 returned to berth at House of Correction wharf.

January 28. Maritime Exchange reported heavy shore ice filling channel. Boat No. 2 ordered into commission.

January 29. Working at New Castle.

January 30. Working between New Castle and City, breaking field ice.

January 31. Returned to berth at House of Correction wharf. All three boats now at their berths.

February 14. Crews paid off and discharged and boats turned over to care-takers after being ordered out of commission.

Care-takers now commenced laying up boats, cleaning boilers and bilges and laying up engines, making necessary repairs, etc.

During the summer a new donkey boiler was installed on boat No. 3 and her decks sheathed.

March 26. Boat No. 3 was placed in Cramps dry-dock and her bottom cleaned, scraped and painted with red lead paint.

August 15. Boat No. 2 was taken to Neafie & Levy Ship and Engine Building Company's yard to have new boilers placed in her and to be rebuilt. This work was to be completed by January 1, 1904, but at this date it looks as if it would take ten days more to complete her or about January 15, 1904.

Boats Nos. 1 and 3 are in excellent condition for the coming ice season; their engines, boilers, pumps and valves having been overhauled during the summer and their wheels thoroughly repaired.

December 1. Fires were started on two boilers on boats Nos. 1 and 3.

December 15. Half crew was placed on board the boats, to take them to coal piers and have the machinery tested.

December 30. Boats Nos. 1 and 3 were ordered into commission on this date. Both boats were sent down the river to work in the Horseshoe.

December 31. The conditions at this date are very unfavorable, the river being full of heavy ice and the temperature still falling. From present indications it appears as though the winter would be long and severe. Boats have been working night and day for the past 48 hours.

Recommendations.

I most urgently recommend that the City Government make arrangements for the building of a new ice boat. This boat should be more powerful than any of the present boats and able to navigate the river in any condition of ice times. To build an ice boat, with modern equipment, would cost from $250,000 to $300,000. With our present boats growing older the building of a new boat cannot be much longer delayed if it is expected that the river and bay are to be kept open to navigation during the severe winter weather.

I again urge the necessity of placing a telephone on the wharf at the House of Correction, both for convenience and as a protection in case of fire.

Boat No. 3 will require new stacks the coming summer, and boat No. 1 will require new donkey boiler and her decks sheathed.

Number of days boats were in commission: Two boats

in commission 25 days and 3 boats in commission with half crews, 35 days. Total number of days boats were in commission, 60 days.

Annexed is a statement of expenditures of the Bureau of City Ice Boats for the year 1903.

All of which is respectfully submitted.

Yours truly,

JAMES S. JEFFERSON,
Superintendent.

Annual Statement of Expenditures of Bureau of City Ice Boats for the Year 1903.

	Transfers to and from Items as Noted.						
	Item 1.	Item 2.	Item 3.	Item 4.	Item 5.	Item 6.	Item 7.
Annual appropriation	$5,000 00	$5,000 00	$12,980 00	$2,000 00	$1,200 00	$500 00	$25,000 00
Transfers to	3 591 00					150 00	
Transfers from		1,59. 00	2,000 00	150 00			
Available balances	8,591 00	3,409 00	10,980 00	1,850 00	1,200 00	650 00	25,000 00
Amounts for which warrants were drawn	4,904 91	3,407 63	10,686 68	1,819 97	1,200 00	643 07	19,000 00
Amounts carried over to 1904	3,500 00						6,000 00
Amounts merging	186 09	1 37	293 32	30 03		6 93	

Annual appropriation	$51,680 00	
Transferred to	150 00	
		$51,830 00
Amounts for which warrants were drawn	$41,662 26	
Amounts carried over to 1904	9,500 00	
Amounts transferred to other bureaus	150 00	
Amounts merging	517 74	
		$51,830 00
Amounts for which warrants were drawn	$41,662 26	
Total amount paid City Treasurer	810 00	
Total operating expenses, including repairs	$40,852 26	