SECOND 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, 1904

ISSUED BY THE CITY OF PHILADELPHIA
1905

PHILADELPHIA
DUNLAP PRINTING COMPANY, 1332-38 CHERRY STREET
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PHILADELPHIA

Mayor
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Secretary
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Contract and License Clerk
JOSEPH F. JONES

Stenographer
MARGARET FORDERER

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Ass't Stenographer and Typewriter
WILLIAM B. MILLS

Messenger
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Secretary Civil Service Board
ROLLA DANCE

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SECOND
ANNUAL MESSAGE

OFFICE OF THE MAYOR, CITY HALL

Philadelphia, April 3, 1905.

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, I transmit to your Honorable Bodies my second annual message, with a statement of the finances and the general conditions of the City.

FINANCES.

The finances of the City are in splendid shape. They are even in better condition than I had anticipated under the reduced rate of taxation, for when the tax rate was reduced from $1.85 to $1.50 I was fearful that for the first year or two we might have difficulty in making ends meet, even by practicing the strictest economy, and yet we have paid our obligations and come out of the year 1904 with a surplus of $634,876.74.

As you will see by Controller John M. Walton's excellent report, the receipts last year from all sources amounted to $45,992,209.61, and expenditures to $35,270,684.49, leaving a balance of excess of receipts over expenditures of $10,721,525.12. All of this, however, with the exception of the $600,000 surplus, has been appropriated for work being done under contract, and which did not merge at the end of the year.

We were very fortunate in disposing of our $16,000,000 loan to Messrs. J. & W. Seligman & Company of New York, at $101.036. This was considered a very good premium for a 3½ per cent. loan. This money was received on May 18, 1904, and was at once appropriated to the purposes for which it was borrowed, and the greater portion of it was very quickly put under contract. We paid off during the year through the Sinking Fund Commissioners, all the maturing obligations, amounting to $2,501,125 taken with the city securities now held by the Sinking Fund, amounting to $4,377,600, reduces the net funded debt of the city to $65,474,220.22. This will be still further reduced as soon as the Sinking Fund Commissioners can invest the $2,593,252.85 now held by them in cash.

It is a matter that all Philadelphians can well be proud of, that when we advertised for bids for the sixteen million dollar loan that we had bids for upwards of sixty-nine milions, so that it was more than four times oversubscribed.

The assessment of all real estate in the City of Philadelphia in 1904 amounted to $1,184,201,335. Of this, $78,769,019 belongs to the City of Philadelphia; $27,320,450 are for places of worship, $57,938,050 are for charitable institutions and government buildings, making a total of $164,027,519; all of these are exempted from the payment of taxes.

I think we have all been striving for an equalization of taxes by a uniform assessment of real estate and to get away from the very unequal assessments that have been known to exist. The suggestion of a compliance with the law requiring property to be assessed at its full value was made with this object in view as was also the recommendation of the publication of all assessments. This publication was made last year, but was not made until May of 1904, and I still think that publication of the assessments will help in a very material way to bring about equalization, but I think it should be done as quickly after the first of the year as it is possible to do it. Last year the lists were published by one of the morning newspapers and distributed to every house in the City of Philadelphia. It may be that this is not the wisest plan for publication and distribution. I had recommended in my message to your Honorable Bodies on September 17, 1903, that

> "It seems to me that in order to make this equalization permanent and effective that you should adopt some method for the publication of the assessments of all the properties in the City, so that each property owner (or non-property owner for that matter) may know the assessment placed upon every property in the City of Philadelphia. This is done in New York through a municipal journal known as the "City Record," and in some other cities there is a publication of the assessments of properties. I would suggest that you provide for the publication of the assessments in pamphlets by wards, and that the pamphlets be sold for a nominal sum per copy to cover the expense of publication. The advantages of such a publication are manifest. Every property owner is entitled to know whether he is receiving the same treatment in regard to the assessment of his property for the purposes of taxation as his neighbor."

It was thought better, last year, however, not to put any expense on the property owner, but that the City should bear the entire expense, hence it was published and distributed at the sole expense of the City and without any expense to the property owner. Whichever method is adopted it seems to me essential that we should continue the publication of these lists, and it may be necessary to experiment for one or two years in different methods before we finally reach the proper one, but the publication and distribution of the lists cannot fail to keep the property owners informed of their neighbor's assessment and result in information being brought to the Board of Revision that will eventually work out approximate equalization. I call your attention to this because thus far this year no appropriation has been made for the publication of the lists for 1905. I wish this could be done at once, and also that appropriations could be made before the end of the year for the publication of the lists for the ensuing year.

Your Honorable Bodies passed an ordinance during last year, following my suggestion in a message of December 17, 1903, directing the cancellation of all insurance policies upon City properties and the payment of the premiums to the Sinking Fund Commissioners, who should hold and invest it as an insurance fund and accumulate it until it reached $250,000, so as to meet any loss that should be occasioned by fire. This was done during the last year. All the policies were cancelled, the return premiums paid to the Sinking Fund Commissioners and the unused premiums remaining in the hands of the various departments were transferred to them, and it is proposed to appropriate from year to year to the Sinking Fund Commissioners and add to this fund an amount equivalent to the premiums used for insurance during the year 1903. The amount stood at the beginning of this year about $157,000 received by the Sinking Fund Commissioners. There has been one slight loss during the year that will have to be paid out of this amount; one of the small buildings in

Fairmount Park was injured but the loss will be less than $2,000. I believe that we shall be successful in accumulating a sum sufficient to protect the City from danger by fire, and perhaps it will be wise to increase the amount to be accumulated from $250,000 to $500,000. There will be no special hurry about this as it may be three or four years before the amount reaches $250,000.

For fifty years the City had been the holder of forty-five thousand shares of the Philadelphia and Erie Railroad Company stock, to which they had subscribed in 1854, as well as subscribing for other railroad stock for the purpose of promoting and encouraging the advancement of the City's business interests. This stock had been held as collateral security for certain loans, the last of which were paid during 1904, and during the fifty years that the city had held this stock, but a very small amount in dividends had been received by the city. Your Honorable Bodies passed a resolution on October 27, 1904, directing its sale. This stock was advertised and was sold to Drexel and Company, of Philadelphia, who were the highest bidders, for $58.63 per share, yielding the sum of $2,638,350. This amount was then placed to the credit of the Sinking Fund Commissioners for the purpose of paying off maturing loans and it is now being used for that purpose.

During the year the Supreme Court of Pennsylvania decided that the commission of one per cent. charged by the city treasurer for collecting the personal property tax should be paid into the city treasury, thus settling for all time the very much mooted question as to whether this commission should be paid into the city treasury or kept by the treasurer personally.

The mandamuses on the city treasury were again a source of great perplexity to the financial officers of the City, for while the controller had retained only $1,500,000 for mandamus purposes, the total amount taken out of the city treasury in this way during 1904 amounted to $2,524,018.-42, thus exceeding by over a million dollars the amount reserved. I call your special attention to the fact that from the total amount paid out on mandamuses, $1,487,165.55 was paid for the opening and widening of streets, and I cannot express myself too strongly on the subject, as I have had occasion to do before, that in the majority of instances where streets are opened it is for the benefit of the property holder and increases the value of his property to such an extent that he can very well afford to dedicate to the City the bed of the street, and still make a handsome profit on the development of the remaining ground.

I call your special attention to the Controller's report, in which he says:

> "The tax levy for 1904 was computed at $16,872,-055.67. This was based on an estimated assessed valuation of $1,162,074,023 at a rate of $1.50 per hundred, and was the lowest tax rate adopted in thirty-six years. Of the amount collected there remained on December 31st, allowing for discounts of $58,-012.32 and penalties of $57,351.93, about three and one-eighths per cent. of the tax levy uncollected, a smaller sum outstanding than has hitherto been shown."

Nearly all the departments and bureaus show an increase of receipts over those of 1903.

In the matter of the appropriation to the Sinking Fund Commissioners for moneys to retire the loans of the City, the large increase in the assessed values of property will make it necessary for a revision of such appropriations. The appropriations are now made upon the basis of the assessments, for instance: the appropriation to retire the $12,000,000 loan of 1900 is at the rate of 69 mills. This was made under the old assessments, and if it should be continued at 69 mills under the new assessments, it would net the Sinking Fund Commissioners over $17,000,000 at the end of thirty years to pay $12,000,000 with. This could be reduced to 54 mills. The Sinking Fund Commissioners are having a calculation made on all the loans, and we shall be ready to submit a schedule to you in the course of a few days that will determine what amounts will be sufficient to retire the various loans in the given period.

DEPARTMENT OF PUBLIC SAFETY.

The running of this great Department under the very efficient management of its Director, Mr. David J. Smyth, with its important bureaus, viz.:

Bureau of Police,
Bureau of Fire,
Electrical Bureau,
Bureau of City Property,
Bureau of Building Inspection,
Bureau of Boiler Inspection,
Bureau of Correction,

has been most satisfactory. I call your attention to his report of the work of the Bureau of Police making 73,061 arrests during the year, and the unremitted efforts to suppress vice. It may not be out of place to say here that no form of vice or crime has been or will be countenanced by the administration or the police and the work of suppression will go steadily on with the additional purposes of prosecuting male frequenters of houses and the property owners themselves who, for a larger rental revenue, appear to be willing to rent their properties for any purpose. I am very well satisfied with the work of the Police Bureau and I think your Honorable Bodies by a comparison of

Philadelphia, in regard to the existence of vice, with any other City of the world of its size, will be assured that the police officers here have done their full duty.

I take this opportunity of saying to you, and through you to your constituents that we may well be proud of our Bureau of Police from its Chief to the lowest patrolman for the excellent way that they have safeguarded our City during 1904 in every way; that we have the utmost confidence in them that they have heretofore and always will enforce the laws of the Commonwealth and the ordinances of your Honorable Bodies; that they have set their faces steadfastly against vice and crime of every description, and that their work has been done in a way that ought to commend itself to every one of our citizens, viz., in a quiet, unostentatious manner; that so effectively has this work been done that I believe there is less crime in Philadelphia at the present time in proportion to the population than has ever been before.

I call your attention to the Director's report of the condition of the Chinese quarter and what has been done there. The Chinese seem to have been laboring under the impression that they are not bound by the same laws as our own citizens, that they can run their gambling places and practice other kinds of vice which the law forbids, and we have made it known to them that they must obey our laws; that they have no greater rights than our own citizens, but that they have the same rights and that we will protect them in the enjoyment of those rights with all the power at our command, but that we insist upon it that they must live within the law.

Bureau of Fire.

I call your attention to the Director's report of the Bureau of Fire. Philadelphians may well be proud of this branch of the municipal government. It is still under the head of James C. Baxter, and its increased efficiency is shown by the fact that although there were 3,605 alarms of fire during 1904—254 alarms more than there were in 1903—the loss by fire was $686,330 less in 1904 than in 1903. The Bureau has been greatly aided in its work by the high pressure fire service, and the Board of Fire Underwriters have recently made me the following proposition:

"HON. JOHN WEAVER,
Mayor of the City of Philadelphia,
City Hall, Philadelphia.

"DEAR SIR:—At a meeting of the Executive Committee, held yesterday, the recommendation of Chief of the Bureau of Water, Mr. Frank L. Hand, that an appropriation of $100,000 be made for extension of high pressure pipe line, was considered. The committee are unanimous in their opinion that the placing of high pressure pipes and hydrants in the streets between the river and Broad street, not as yet containing them, will be an improvement in the conflagration hazard of that district. I am directed by the Executive Committee to advise you that in event of the adoption of the recommendation of Chief Hand, at the completion of the proposed extension of high pressure pipe line, a reduction of ten cents per $100 in the conflagration (blue slip) charge will be made.

Yours respectfully,

CHARLES A. HEXAMER,
Secretary."

I referred this communication to the Department of Public Works and Director Costello replied to me, giving me a copy of a communication from Chief Hand, of the Water Department, as follows:

"Attached hereto please find copy of letter received from Charles A. Hexamer, in reply to my inquiry, under date of 10th inst., as to amount of insurance in the district covered by "blue slip" mentioned in his letter and for which $100,000 is requested to extend the high pressure fire pipe line, in the following named streets:

Front street, from Race to Walnut street.
Third street, from Race to Walnut street.
Fourth street, from Race to Walnut street.
Sixth street, from Race to Walnut street.
Seventh street, from Race to Walnut street.
Ninth street, from Race to Walnut street.
Tenth street, from Race to Walnut street.
Twelfth street, from Race to Walnut street.
Thirteenth street, from Race to Walnut street.

The necessary valves and fire hydrants will also be required at the proper locations, in addition to the pipe line in the streets above named."

I think that just as soon as we can we should arrange to extend this high pressure service into the district suggested by the Underwriters.

We congratulate ourselves also upon the fact that we have not only been able to take care of our own fires, but have been enabled to very materially assist our neighboring cities as evidenced by the eight fire companies and 250 police officers we sent to Baltimore in February, 1904, to help them in the very disastrous fire that destroyed so large a part of their City.

Electrical Bureau.

I also call special attention to the Director's report of the Electrical Bureau, and the suggestions of its very able Chief.

This is a most important Bureau and one that makes possible the great efficiency of the Police and Fire Bureaus, and his suggestion that the Police and Fire Signal System should be extended should be favorably considered.

The most important suggestion, however, to my mind, is the question of overhead wires. It is a most startling statement that during 1904 over 17,000 miles of wire were added to the already immense quantity hanging above our heads from poles erected all over the City of Philadelphia, when we have been making the most strenuous efforts to put electric light, telephone and telegraph wires under ground.

I agree with the Chief of the Bureau that an ordinance should be passed compelling the gradual taking down of the overhead wires and putting them underground. It should be done in such a way, however, as not to injure the various companies owning the wires or interfering with their proper and efficient service to the public, but it is certainly a menace to the safety of the citizen if we are to add every year over sixty-nine thousand poles and seventeen thousand miles of overhead wire to that which we have already festooned over City streets. I am also heartily in accord with the Chief's suggestion that the department should be authorized to inspect all electrical installations, and the department should also have authority to prevent the illegal running of wires through the streets or over housetops, and to remove the same where it now exists. The work of the Theatrical Commission a little over a year ago revealed the fact that quite a number of the theatres were defectively wired for electric lighting purposes, and if such defective wiring should be done in places of amusement like the theatres, there is no doubt that the same kind of defective work may be done in other buildings, and even in private houses, and where this defective wiring exists it is a well known fact that it is a menace, and that fire may result therefrom at any time.

Bureau of City Property.

I call your attention to the report of the Chief of the Bureau of City Property attached to the report of the Director of Public Safety, and especially to that part of it that sets forth the permanent improvements that have been completed and started: The Clarence H. Clark Park, the Black Oak Park, the Westmoreland Park, the Bartram Park, the erection of the pavilion at Otis street wharf, which is a recreation pier; the improvement of Mifflin Square, etc., etc. I might say in this connection that during the year your Honorable Bodies passed an ordinance placing upon the City plan a large stretch of land on the banks of Cobb's creek, which bounds the western end of the county, and which it is proposed to develop in the course of time, and perhaps extend, if the money can be found, to the southwestern boundary of the county.

There has also been a proposition made to place upon the City plan sufficient ground on either bank of the Pennypack creek, running from the Delaware river immediately above the House of Correction, following the course of the Pennypack creek about six miles to the Montgomery county line. Some method, however, will have to be devised for financing this and the Cobb's creek proposition before anything is done looking towards the condemnation of the property. It is a very wise thing for us to provide for these parks in advance as the property in these localities can be obtained at a cheaper rate now than they will in the future, for as improvements are extended in the direction of the property sought to be obtained, this particular property will necessarily increase in value, and the City will have to pay that increased rate.

I am very much in favor of having a complete park system that shall be a credit to the City, and shall give all of our citizens the opportunity that they should have for getting away from the crowded streets of the City into the open country for recreation, rest and enjoyment. At the same time, we must keep carefully in mind the financial ability of the City to take these parks and consider their relative importance to the many other things that are constantly being demanded.

Bureau of Building Inspection.

You will find an interesting report from the Chief of this Bureau. There appears to have been 14,152 building operations carried on during the year of an estimated value of over twenty-eight millions of dollars. Of these building operations, 6,698 were dwelling houses, costing upwards of $15,000,000, and this appears to have been the greatest number of dwellings ever erected in the City's history with the exception of the year 1897.

Boiler Inspection.

The work of this department has been very much increased during the past year on account of the passage of the Smoke Ordinance, which was to take effect on October 1, 1904. The coal strike in Pennsylvania during the year 1902 was a most disastrous one to the City of Philadelphia in many ways, for it had the effect of introducing in nearly all of our manufacturing establishments the use of soft coal, and this has been followed by our City being deluged day after day with immense volumes of black smoke, so that it has made it exceedingly uncomfortable for our citizens, so much so that your Honorable Bodies were constrained to pass an ordinance regulating the emission of smoke, and the Bureau of Boiler Inspection is now engaged in endeavoring to have the manufacturers and other coal consumers so adjust the running of their plants as to comply with this ordinance. If this is not done, the Bureau will be compelled to commence prosecutions for the enforcement of the law. I hope that we shall thus bring about an entire abolition of this smoke nuisance.

DEPARTMENT OF PUBLIC WORKS.

This great Department including, as it does, the
Bureau of Surveys,
Bureau of Water,
Bureau of Filtration,
Bureau of Highways,
Bureau of Street Cleaning,
Bureau of City Ice Boats,
Bureau of Gas,
Bureau of Lighting (gas and gasoline lamps only),
Board of Highway Supervisors,
Board of Surveyors,
has been splendidly managed by the very able Director of Public Works, Mr Peter E. Costello. You will notice from his report, attached hereto, that the expenditures of the various bureaus of his Department amounted to $10,845,712.53.

I call your special attention to his reference to the City Ice Boats, and his approval again of the recommendation of the Superintendent for a new and powerful ice boat. You may remember that I said to your Honorable Bodies in my last Annual Message on April 4, 1904:

> "In this connection, I call your attention to the Director's report referring to the report of the Superintendent of the Ice Boats, who urges the building of a new 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."

The time has come for a new ice boat, for our hopes as to the severity of winter weather expressed a year ago have not been realized. On the contrary, the winter just passed has been more severe than last winter, and I take the liberty of incorporating here a message that I sent to your Honorable Bodies on February 15, 1905:

"*February 15, 1905.*

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

"GENTLEMEN:—The Director of Public Works reports to me that the City Ice Boat No. 3 was sunk at the Delaware Breakwater on February 5th last at 6 A. M. by striking the sunken barge 'Santiago,' there being no lights nor buoys on the wreck to mark its location.

"I am glad to inform you that her crew of thirty-one men were saved, being rescued from the floes of floating ice upon which they had taken refuge by the tugs 'Gettysburg,' 'Teaser,' 'Boxer,' 'Sommer N. Smith' and 'North America.' We immediately made arrangements with D. W. Burbage & Company to save what portable property could be saved on a fifty per cent. basis, and after a careful examination of the wreck and a careful consideration of the conditions, the Superintendent of Ice Boats, Director of Public Works and I determined that it would be unwise to attempt to raise the wreck, as she was a very old boat, having been built in 1872, and we therefore abandoned her to the United States Government. The condition of the river was such that it was necessary for us to get a boat to take the place of this ice boat, as it was found impossible for the two remaining boats to keep the harbor open. We therefore made an arrangement with the Philadelphia and Reading Railway Company and procured the service of their ocean tug 'International,' for which we have agreed to pay one hundred (100) dollars per day during her service.

The sinking of this boat has brought before us very forcibly the absolute necessity for having such a fleet of ice breakers as will render it absolutely impossible to have the Delaware river even partially closed to navigation at any time during the severest winter. The three antiquated ice boats that we had before the sinking of No. 3 have really been doing very remarkable work for boats as old as they were, but it is essential that we should have two boats, and they should be ready for the opening of the next winter season, and we have therefore requested the firm of Melville & Macalpine, of which firm Admiral Melville, late of the United States Navy, is the senior member, to prepare plans for a new boat.

"For the past two years I have been impressed with the thought that it was not a wise economy to have boats exclusively for ice breaking that were in service some times less than two months during the year, and the rest of the time were tied up absolutely useless. In addition to which, I am convinced that while the river is in its present condition from ice, the river front is absolutely without any protection by police and fire boats, as it would be impossible for them to go from one place to another, as they could not break the ice and would have great difficulty in getting through it. One of the old police and fire boats, 'The Samuel G. King' was partially wrecked last winter, and an examination of her condition has convinced us that it would not pay to rebuild her.

"After careful consideration I have come to the conclusion that from an economic and efficient stand-point, it would be very much better to build another ice boat that had the greatest possible ability as an ice breaker, and also combines the fire fighting features. This will be very little additional expense, and will give us a boat that can be utilized for fire purposes during the nine or ten months in the year that the ice boat is ordinarily tied up. In addition to this, we shall have an ice breaker that can be used as a fire boat during the winter when it is impossible for our present fire boats to get near a burning building on the water front.

"I find in an article in 'The Mechanical Engineer,' under the head of Ice Breakers, the following:

" 'The new development of the ice-breaking steamer has just been tried with satisfactory results in St. Petersburg. The great expense of an ice breaker is much increased by its comparative uselessness during the months in which it is not performing its special functions. In order to obviate this, the new ice breaker has been adapted for use as a fire-preventing steamer.'

"There is no doubt in my mind that the City will be very much better off if we can eventually combine our ice boats with the police and fire boats so as to have one fleet of boats that will be useful for all purposes, and be constantly in commission. At present, as stated above, we have a fleet of ice boats that are useful only two or three months in the year, and a fleet of police and fire boats that are useful only during the time that the ice boats are not in commission. The condition of Ice Boat No. 1 is such that it may be put out of commission at any time; it is so old that it is impossible for it to last much longer, and in order to put our harbor in first class condition for next year, we should have two modern boats with a combination of fire features as suggested above, and I would therefore respectfully request your Honorable Bodies to appropriate say sufficient money to build and equip one immediately, and to authorize the Department to contract for the two, and arrange for the second one to be paid for out of next year's appropriation.

Yours very truly,

JOHN WEAVER,

Mayor."

I am more than ever convinced that for the sake of economy and the most effective work we must have the combination boats as described in the above message.

Bureau of Highways.

The work of this Bureau goes steadily forward, forty miles of streets being opened and graded last year. There were over ten and three-quarter miles of new streets paved with sheet asphalt, granite blocks and brick. The cost of asphalt paving has been reduced by competition since the the use of the word "Lake" has been abandoned in ordinances for paving with asphalt, in this way we have succeeded in having greater competition, and have reduced the cost of paving about $1 a yard within the last two years. In other words, two years ago we were paying from $2.50 to $2.60 a yard, and our bids at the present time are from $1.50 to $1.75 a yard, and I urge upon your Honorable bodies the elimination of the words "vitrified fire clay" from ordinances for brick paving. The department has a testing apparatus to determine the quality and durability of paving brick, and if a particular brand is not designated but is left for the Department to determine on the merits of the respective bricks, we shall have the best quality, and shall have more competition than we have heretofore had, which will surely bring down the cost of paving with brick.

I again ask your Honorable Bodies to consider the advisability of immediately passing an ordinance permitting builders to do the grading or paving of streets, or both, when the Department is without the necessary appropriation to do it, as it frequently happens that a builder who is building an entire block of houses on both sides of the street is desirous of putting his houses immediately on the market, and he cannot do so because the Department has exhausted its appropriation for the year, and there seems to be a manifest injustice in compelling the builder to wait until the department receives the necessary appropriation when the builder is both able and willing to do his own grading and paving, and it can be provided in an ordinance that your Honorable Bodies shall pass that it shall only be done by permission of the Department of Public Works, and subject to its supervision and control, both as to the character of the work, and the material used.

I also call your attention to the report of the Superintendent of Bridges. Some very good work has been done by the Bureau during the past year. A number of concrete bridges have been built, which appear to be far superior to anything that has heretofore been built by the City, as it has the combined advantages of durability at a minimum cost.

I would also remind you that there is $500,000 still remaining of the $1,000,000 for new bridges, included in the $16,000,000 loan, which has not yet been appropriated. It is very important that we should provide for a new bridge over the Pennsylvania Railroad at Spring Garden street as the present one is entirely useless, and only remains in its present position from the fact that we have been compelled to build very strong wooden supports to take the place of the iron ones, to keep the deck of the bridge in place. This should be entirely removed and a new bridge built. No time should be lost in having this work done.

Your Honorable Bodies have also passed an ordinance opening Twenty-fifth street north of Diamond street. This will involve the building of a bridge over the Pennsylvania Railroad, and money should be appropriated out of the $500,000 for this bridge.

There are several other bridges badly needed that I have already called to the attention of your Honorable Bodies, which will more than exhaust the balance of the $500,000 referred to. I wish we could have the appropriation made at once, so that the bridges can be advertised for, and the work under way, and perhaps completed during the coming summer.

Bureau of Street Cleaning.

In regard to the removal and disposal of garbage and dead animals, the City paid during 1904 $536,700.

The original bids were so much higher for 1904 than the City had paid during the year 1903 that we rejected all the bids and readvertised, and the new bids were $63,000 less than the original bids, and the contract was awarded for $536,700, and still I am not satisfied that the City is getting the work done for the lowest amount possible. There is little or no competition, as it is next to impossible for anyone to bid and erect a plant for the reduction of garbage between the time that the contracts are awarded and the opening of the next year.

I have requested the Director of Public Works to advertise for bids for 1906 immediately, so that we can give eight or nine months time to the successful bidder.

I sent to your Honorable Bodies some eighteen months ago a proposition from a Philadelphia lawyer, Mr. John D. Pessano, asking for a thirty year contract for the garbage, and agreeing to pay the City $1.00 a load for it; have it properly disposed of, and at the end of the thirty years turn over the reduction plant to the City free of cost. Of course, I do not know whether this could have been carried out, or who it was that was back of Mr. Pessano, as he declined to give me the names, but said that he would give them to a committee of your Honorable Bodies that should be appointed to investigate the proposition. Mr. Pessano is now deceased, so that I suppose there is no chance of having a like proposition made, but I would call your attention to the fact that the Philadelphia Almshouse is selling its garbage now through the Department of Supplies for 20½ cents per barrel, and the purchaser carts it away without cost to the City. This, of course, is only a small quantity, but it does seem as though the City ought to be able to have its garbage collected and disposed of for a less amount than they are paying at the present time, and I am in hopes that the advertising for next year's contract at the present time will have a very good effect, although I think the City suffers under the great disadvantage of not being able to give a contract for a longer period than a year, because a would-be competitor would scarcely feel justified in spending a large amount of money to put up a reduction plant if he felt that there was no chance of his getting the contract except for one year. I think if legislation could be passed that would enable the City to advertise for bids for this and other municipal work in the alternative for one year or for five years, that we should get a very material reduction in street cleaning contracts, garbage contracts and other things for the longer period.

The problem of keeping the streets clear of snow during the winter months has been a most difficult one, and I cannot permit this opportunity to pass without commending the very able chief of the Bureau for the excellent work that he has done in this regard, and the enthusiastic manner in which it has been done during the past year, and to compliment the Director of Public Works for his staunch support of the Bureau. It is well known that after every snow the Transit Company came along with their plows and sweepers, and swept the snow into piles alongside the tracks—at the same time the property owners shoveled the snow off their pavements and made the piles larger. We have felt right along that the Transit Company should help the City in disposing of this snow; at the same time we did not feel that we could compel them to take care of the snow shoveled off the sidewalks. We endeavored, during the winter of 1903-4, to arrange with the officials of the Rapid Transit Company to do a share of this work, but the negotiations were terminated for reasons that it is not necessary to discuss here, and suits were brought against the Transit Company for the purpose of determining the City's rights and the Transit Company's duties in this matter. The cases dragged along, however, that when the winter's snows came in November we were apparently no nearer a solution of the question than we were last winter. We therefore took up the question again with the Transit Company and succeeded in making a temporary arrangement with them to pay us $15,000 a year towards the expense of clearing the streets of snow in the business sections of the City, and they have made the first payment for the year ending July 1, 1905. This arrangement is entirely without prejudice to the rights of the City or the Transit Company in any suit, but we thought it best to make this temporary arrangement and hope it will meet with your approval.

Bureau of Surveys.

This Bureau is continuing its very good work under the management of the very efficient Chief Engineer, Mr. George S. Webster. The immense amount of work that is accomplished by this Bureau is marvellous, and it is work of the most important kind; the determination of all City grades and changes from time to time; the giving of property lines; the grading of streets; the building of sewers, and other underground structures; the drawing of plans, and the keeping of the permanent records of the same, are all part of the work of this Bureau.

In regard to the Northeast boulevard, the $1,000,000 that was borrowed in the $16,000,000 loan bill for the purpose of extending the Northeast Boulevard was divided by your Honorable Bodies so as to give $500,000 towards the cost of the land actually taken for the Boulevard, and the other $500,000 was devoted to a part of the work in improving the same between Broad street and Second street. A bill in equity has been filed, however, against the City officials to prevent them using any part of the $500,000 thus set aside by your Honorable Bodies for the purpose of paying for the land actually taken for the boulevard. This action is pending in court, and we hope to have a decision of the case in a very short time. The Parkway from the City Hall to Fairmount Park is an improvement that has been contemplated for some time, and your Honorable Bodies revised the plan of that part of the boulevard northwest of Logan Square, and reduced the width thereof from 300 feet to 250 feet, and placed the same on the City plan at the reduced width. You then passed an ordinance authorizing me to endeavor to see if I could come to terms with the property owners, and thus save the time, trouble and expense of going before a road jury, and having their property taken away from them long before there would be any final decision as to the amount of their damages. I have been working at this for several weeks; it is a much more difficult problem than I had anticipated. Of the $2,000,000 available out of the loan bill for the building of this boulevard, your Honorable Bodies passed an ordinance appropriating $1,700,000 for the acquisition of the property on the line of the boulevard and $300,000 for the actual building of the boulevard between Logan Square and the Park. In the appropriation for the property, you provided about one-third more than the assessed values of the properties. There were on the line of the boulevard 467 properties, and I have received offers to sell from the owners of 254 of the properties, leaving 213 still to be heard from. The aggregate amount of the prices asked by these 254 owners is $1,627,421.44, and the 213 still to be heard from include some of the largest properties on the line of the boulevard. You will see from the above, however, that the aggregate of the asking price by the property owners is probably more than double the estimated value. The assessed value of the property to be taken in the development of this part of the boulevard is about $1,357,900. To this has been added $342,100, making the total appropriation by your Honorable Bodies $1,700,000. It was thought in making the estimate of the value of the properties that in adding over twenty-five per cent. to the assessed value we certainly could not be below the actual value, but if the asking price is an indication of the actual value then we were very wide of the mark, as I believe the value of the 213 properties still to be heard from is very much greater than the 254 properties already heard from. In some instances the amounts that have been asked by the property owner has been very near the assessed value of the property, but in other cases—a great many of them—the asking price has been from double to four times the assessed value, and an incident came to my attention a few days ago that may account for some of the prices that have been asked. It appears that a corporation represents a number of the property owners, and have sent out letters asking for permission to represent others, and in the letter they have used the following language:

"It was our idea that you would name a price for the property which the trustees would be willing to accept, and anything above this amount which we could obtain, we would accept as our remuneration for our services.

"We would expect you to place a reasonable price upon the property in order that we may have something to work upon. It is hardly likely a person desiring to purchase a property would say what they would be willing to give, until they knew what you held it at.

"If this proposition would meet with your approval, we would be pleased to take the matter up at once with the Mayor."

Of course, this doesn't give us the information as to how much in addition to the market value that the owner is willing to take has been added for the corporation whose duty it appears to be to squeeze as much out of the City as possible. If these methods are adopted in dealing with the City, it is difficult to determine just what to do, because there is no doubt that such methods would be continued before a road jury, and it may become a question for your Honorable Bodies to determine whether or not you will go on with the building of the proposed parkway, or abandon the project altogether. If its total cost is to be two or three times as much as the estimated cost, and the excess over the estimated cost is not provided for by loan, it must of necessity come out of mandamuses, and the matters now pending in the City Solicitor's office will more than exhaust the $2,500,000 that has been reserved, and it would mean the additional burden on the City Treasury of several millions in mandamuses that has not been provided for. I shall, however, continue the work given to me by your Honorable Bodies in your previous ordinance, and see if we can get closer together in the matter of the prices to be paid to the property owners that have already manifested a willingness to make an amicable settlement with the City, and I shall have occasion to report to you further I hope within a very short time.

During the year, we awarded a contract for the building of the South Broad Street Boulevard from Moyamensing avenue to League Island Park. The work is being rapidly pushed by the contractor without any more inconvenience to the public using the street than is absolutely necessary. This boulevard is being built at a width of 160 feet, and proceedings are pending before a road jury to assess damages for the widening of the street to 160 feet.

I call your special attention to the report of the Chief of this Bureau in regard to the great work that has been done, and is being continued in the building of main and branch sewers.

During the year over two miles of main sewers and upwards of twenty-one miles of branch sewers were built at the expense of the City and upwards of five miles of sewers built at private expense, so that at the end of last year we had fully completed in the City upwards of one hundred and sixty-two miles of main sewers and upwards of seven hundred and fifty-four miles of branch sewers, all of which have been built at the expense of the City, and upwards of ninety-one miles of sewers built at private expense, making a total length of sewers now in the City of upwards of one thousand and eight miles.

Grade Crossings.

In accordance with your resolution I have been endeavoring for several months to arrange for the abolition of the grade crossings on South Broad street where the tracks of the Pennsylvania Railroad Company and the Schuylkill River East Side Railroad cross this street. We have not yet come to a conclusion in the matter; negotiations are still going on looking towards bringing the two railroads together, and having them cross Broad street on the same bridge. Of course, in providing for crossing Broad street we must also provide for the crossing of other streets both east and west of Broad street that will in the course of a short time, in the development of South Philadelphia, be built up, and I trust that I shall be able to communicate something more definite to you in a short time.

In regard to the Ninth street grade crossings I stated to your Honorable Bodies in my last annual message that the result of my negotiations with the Philadelphia & Reading Railroad Company was that the railroad company had given me their ultimatum that they would only pay one-third of the entire cost of elevating the tracks between the Reading Terminal and Huntingdon street; the City to pay two-thirds of the cost. After that I endeavored to ascertain what streets we could depress under the tracks, and what streets we could elevate over the tracks at the present grade, at an expense to the City of less than two-thirds of the estimated value of elevation, and I had an estimate made of the cost of carrying several streets under the tracks, including the cost of depressing the center of Girard avenue, carrying the street car tracks and a wagon and footway under the railroad tracks, but still retaining enough of the sidewalks and roadway on the present level so as not to seriously inconvenience the property owners along the street. While we could have succeeded in depressing several of the streets under the railroad tracks at less than one-half the estimated cost of elevation, it would still have left a number of very dangerous grade crossings, and the carrying of the streets under the railroad tracks, which would be left at the present grade, would not have been the best solution of the problem. After spending several months in efforts to determine the best way to accomplish the abolition of grade crossings, I again called on the President of the Philadelphia & Reading Railroad Company, and after some negotiations found that they were ready to recede from their position that they took a year ago and said that the railroad company would be willing to pay one-half of the total cost of the elevation. I then suggested that in the estimate of cost made by the railroad company a number of things had been included, which were exclusively for the benefit of the railroad company, and suggested that these amounts should be eliminated from the estimated cost, which will be borne in such proportionate shares by the City and the railroad company as shall finally be agreed upon. It was suggested that the Chief Engineer of the Bureau of Surveys of the City and the Chief Engineer of the Philadelphia & Reading Railroad Company should go over the plans and estimates, and should determine what were the items that were exclusively for the benefit of the railroad company, which amount so ascertained we were desirous should be left out of the estimate with which the railroad company and the City should deal. The City's original estimate of the cost of these constructions that were considered to be exclusively for the benefit of the railroad company was over $1,000,000, but after the engineers for the City and the railroad company went over the plans very carefully this estimate was reduced to between four and five hundred thousand dollars. The officials of the City and the railroad company have not yet been able to come to a conclusion on these matters, but we trust we shall be able to do so in a very few days.

Prior to this year the railroad company had not been willing to consider the abolition of the grade crossings north of Huntingdon street, but the City officials have always maintained that the whole territory should be considered between Spring Garden street and Wayne Junction, and the railroad officials have now very generously consented to permit their offer to pay one-half the cost of the abolition of the grade crossings on Ninth street to apply to the crossings between Huntingdon street and Wayne Junction. This, to my mind, is exceedingly important as the grade crossings at present existing in Tioga at Allegheny avenue, Westmoreland street, Nineteenth street, Tioga street, Venango street and Hunting Park avenue, if permitted to remain at grade will eventually become the most dangerous of any grade crossings that we have ever had in the City. This whole section is being rapidly built up; express trains go through there at from forty to fifty miles an hour, and there are one or two dangerous curves in the road, so that it is quite important that our present arrangement should provide for all of these grade crossings to be abolished. The only difficulty about it is that the engineers have not yet been able to agree upon the method to be adopted in the Tioga District for the abolition of the grade crossings. The engineers for the City and the railroad company are working on plans now, and I trust that we shall be able to agree on a plan that will abolish the grade crossings and be advantageous to the railroad company, and not destroy the territory adjoining the railroad. The City and railroad officials have practically agreed upon the method of constructing between Spring Garden street and Huntingdon street except that the railroad company desire to build a solid structure north of Girard avenue while the City officials have favored the building of a steel frame structure up to a point north of Oxford street, so as to leave the bed of Ninth street open as a street from Oxford street to Girard avenue, and connect with Ninth street south of Girard avenue. These, however, are minor details, which I have no doubt the officials of the railroad company and the City will be able to agree upon if your Honorable Bodies decide that the

City shall pay one-half of the expense of the abolition of these grade crossings. I of course am still of the opinion that the equities of the case would not put upon the City a greater burden than one-third of the entire cost, and the railroad company two-thirds, but inasmuch as the railroad company have receded from their position of demanding that the City should pay two-thirds and they only pay one-third, perhaps it will be for the public welfare that we should agree to pay one-half the expense of the abolition of these grade crossings, and if your Honorable Bodies approve of this division of the expense between the railroad company and the city and will pass a resolution to that effect, the City officials will co-operate with the railroad officials to consummate the plans for the elevation and we will also prepare and forward to you at the earliest possible moment a suggestion for the financing of the City's part of the undertaking.

I have also taken up with the President of the Philadelphia & Reading Railroad Company the subject of the abolition of the grade crossings on the Port Richmond Branch of their road, and while the railroad officials feel that the cost of the abolition of the Ninth street crossings, with the addition of the Tioga crossings, is all that they can possibly afford to undertake at the present time, we have submitted to them plans for the elevation of their tracks at three separate points, so that we can depress three streets underneath the Richmond Branch of their road, and thus give immediate relief to a very large portion of our population in the northeastern section of the City, and we have great hopes that the railroad officials will see their way clear to unite with the City in their efforts to give the relief sought for in the northeast section of the City at the same time that it is done on Ninth street. I have also asked the Philadelphia Rapid Transit Company, who will be greatly benefited by the abolition of the grade crossings, to contribute towards the City's share of the cost of this work. I hope to get a favorable answer from them.

Bureaus of Water and Filtration.

You will observe from the report of the Chief of the Bureau of Water that while the receipts for the year amounted to $3,643,671.13, the current expenses were only $1,526,954.06, but there was laid out during the year for extensions, $3,392,676.32.

I also call your attention to his report in which he says that the increase in the consumption of water in the sections of the City east of Schuylkill river has continued to such an extent that it has caused the Bureau great difficulty in keeping the locality supplied. This is being remedied, however, as fast as possible. You will also notice from the report that during the year the entire Belmont Filtration Plant was put into operation for the purpose of supplying West Philadelphia, the first filtered water being turned in on April 1, 1904, and the full capacity of the filtration plant without the preliminary filters being put into use of December 13th. Contracts have been let for the preliminary filters at Belmont, and when those are completed it will very much enlarge the capacity of the plant.

As you are aware, both Upper and Lower Roxborough Filtration Plants have been in operation for some time, and both these plants and the Belmont Filtration Plant are doing good work in the matter of filtering water, but there seems to be a deficiency in the pumping machinery, and I have requested the Director of Public Works to see what can be done to remedy this so that these plants can be kept up to their fullest capacity.

The work on the Torresdale Filtration Plant has been going along quite rapidly; the fifty-five original filter beds at Torresdale are practically completed, and the ten additional filters, known as the "Queen Lane Contingent," are approaching completion. Contracts have also been awarded for the preliminary filters at Torresdale, and work was commenced thereunder on November 15th.

Lardner's Point Pumping Station No. 2 was practically completed, and contracts were awarded for Lardner's Point Pumping Station No. 3. We shall push the completion of the filtration plant with the utmost vigor, as we believe that with the completion of the Torresdale Plant we shall give the entire City an adequate supply of pure water.

I call your attention, however, to the statement of the Chief of the Bureau of Water, in which he says:

> "The total consumption of water in 1904 was 120,-153,801,452 gallons, making a daily average of 328,-289,075 gallons, an increase over the previous year of 1,010,922 gallons per day."

We have always believed that there is a great waste of water in this City, and it seems to me that something should be done so that when we have filtered water all over the City, which is filtered at the rate of between $3.00 and $5.00 per million gallons, that the waste should be reduced to a minimum. It was supposed at one time that the adoption of water meters would solve the problem, but upon the introduction of some water meters, it was found that in the instances in which there was a decrease in the water bills that the bills were promptly paid, but where there was a very large increase, that the bills were not paid at all, and we have a number of suits pending at the present time growing out of this condition.

Until some satisfactory plan could be arrived at to solve this water problem it was thought best to abandon the installation of water meters, and this was done during the last year under an ordinance passed by your Honorable

Bodies. In most of the instances where the water bills were very largely increased by the installation of meters and the parties refused to pay and are now disputing the matter in courts, they were some of the large manufacturing establishments, and it has been stated to me by a number of people that if the manufacturing establishments are compelled to pay at the same rate that private houses pay by water meter that the cost would be prohibitory, and they would be compelled to move their factories outside of the City, where they could get water more cheaply. This, of course, would be a disaster to the City's interests, and it may be that the proper solution of the question will be to adopt a lower rate for manufacturing establishments than for private houses, and when that has been determined, a general meter system should be introduced, and there should be a test by experts of water meters to determine which was the best and most reliable, and such a meter should be placed in every house and establishment using City water. It seems to me that the whole question ought to be thoroughly examined, and we might look into the practice of other cities who are furnishing water to manufacturing establishments as well as to private houses, both as to whether there is any difference in the price charged to the two, and also as to the price paid by the consumer in the various cities for water compared to the price charged in our own City, and I would therefore suggest that your Honorable Bodies authorize me to appoint a committee of three, say, the Director of Public Works, Chief of the Bureau of Water and Chief of the Bureau of Surveys to collect data as to what they are doing in the large cities of the country and of Europe in regard to the furnishing of water, and also as to the best method for charging for water; to investigate the consumption of City water by the manufacturing establishments of Philadelphia, and to report on what, in their judgment, would be a proper charge per million gallons for the manufacturing establishments, and for the other consumers of water. I think this is important and should be done at once, so that we could have a general plan formulated to be put into effect as soon as we have the Torresdale Filtration plant completed. In any event something must be done to stop the excessive waste of water.

It is interesting to notice by the report of the Chief of the Bureau of Water that there are now in the City streets upwards of 1,466 miles of water mains, of which upwards of twenty-one miles were laid during 1904.

Both the Fairmount dam and the Flat Rock dam had to be repaired last summer, and in repairing the Fairmount dam it was found that it was in very bad shape, and after starting the work it had to be extended, so that we were compelled to expend $25,000 in its repair.

Attached to the report of the Director of Public Works will be found a statement of all the contracts for the improvement, extension and filtration of the water supply, containing the number of the contract, the name of the contractors, the date of the letting, the date of the contract, the limit of contract, what amount has been paid thereunder, and a statement whether the contract is completed or not.

DEPARTMENT OF PUBLIC HEALTH AND CHARITIES.

Inasmuch as this department was only organized in April, 1903, under the Act of April 8, 1903, which transferred the Bureau of Correction to the Department of Public Safety, and the Bureau of Health to a new Department, now known as the Department of Public Health and

Charities, under a Director, this is the first report of a full year's work of that Department. Of course, it took Dr. Martin, the brilliant Director, considerable time to organize the new department and to make the changes that he believed essential to the proper administration thereof, and it was not until the beginning of 1904 that a great many of his suggestions went into effect, the principal of which perhaps was the appointment of fifty assistant medical inspectors. The work done by the department is now showing splendid results. Smallpox has entirely disappeared, and there has been a very marked decrease in the death rate, which the Director attributes to the admirable work done by the medical inspectors, supplemented by that of the disinfectors; all of these as far as smallpox is concerned, being made possible, of course, through the instrumentality of vaccination. The Director also calls attention to the fact that the plans for the new contagious hospitals for diphtheria and scarlet fever—having a separate building for each of these contagious diseases—have been completed and advertised. The new smallpox hospital has been built, and I trust will be ready for occupancy in the very near future. As soon as the new hospitals for scarlet fever and diphtheria are completed we shall have a splendid hospital plant, for all contagious diseases, laid out in beautiful grounds, so as to make it as attractive as possible for those patients who are compelled to go to these hospitals, and they will be equipped with all modern conveniences, and we shall then be in a position to handle with the greatest efficiency any epidemic of contagious diseases that should occur.

In the Bureau of Charities, it is exceedingly important that something should be done as speedily as possible to relieve the congestion at the Philadelphia Hospital for the Insane and the Hospital for the Indigent. As you know, these two hospitals are now in the same group of buildings as the Philadelphia General Hospital for Surgical and other cases, and your Honorable Bodies passed an ordinance which was approved on the fourth of April, 1903, authorizing the Department of Charities and Correction to erect new buildings on so much of the land in the Forty-first Ward that was owned by the City as may be required for the purpose, and subsequently approved a contract of Doyle & Doak for the erection of an administration building, which has been erected on a plot of ground immediately opposite the Torreslale Filtration Plant. This administration building has been partially completed, there being only $94,608 appropriated. I said to your Honorable Bodies in my message last year:

> "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."

Your Honorable Bodies passed an ordinance authorizing the Department of Public Health and Charities to use the building being constructed as an administration building for the Hospital for the Insane, for an administration building for the Hospital for the Indigent, and there was appropriated out of the $16,000,000 loan on the 27th of June, 1904, $500,000 towards the buildings for the Hospital for the Indigent. Plans and specifications have been drawn, and we are in hopes of getting this well under way this year. That will still leave the problem of getting more adequate quarters for the insane. Of course when the Hospital for the Indigent is moved from the Blockley group of buildings, it will give very much more room to the Philadelphia Hospital for the Insane, and to the Philadelphia General Hospital for Surgical and other cases, but it is the belief of Dr. Martin and his Advisory Board that the Philadelphia Hospital for the Insane should also have new quarters, and leave only the Philadelphia General Hospital for Surgical and other cases in the present group of buildings.

I call your special attention to Dr. Martin's report referring to the increasing death rate from pneumonia, and the statement of the fact that the mortality from this disease is greater than that from tuberculosis of the lungs, and his recommendations in regard thereto.

It is with special pleasure that we notice the decrease in the death rate from diphtheria, which appears to have been due to the tendency on the part of physicians to use antitoxin more promptly and liberally than heretofore. It is a matter of congratulation for all of us that an antidote has been found for that dread disease of childhood, diphtheria, but the best way of fighting the contagious diseases is, as Dr. Martin suggests, the promptly reporting the same, popularizing knowledge as to its communicability, and the means of avoidance, the isolation of each case, followed, at the termination, by complete disinfection.

The Assistant Medical Inspectors have been doing good work in their inspection regularly of the public schools, as Dr. Martin so forcibly expresses it:

> "primarily for the purpose of promptly removing and isolating those afflicted with contagious diseases; secondarily, with the object of examining every pupil with a view to discovering deformities and disabilities, which, if allowed to continue, may permanently

cripple, but which, if attended to promptly, are remediable. During the year there have been 11,317 exclusions, the majority because of conditions, actively contagious. The beneficial effect of these inspections, both immediate and remote, can scarcely be overestimated."

I think the most casual glance at the general health conditions in our City during 1904 will give us all great cause for rejoicing over the great improvement that took place during the year, and the splendid health condition that we find it in in the opening of 1905.

DEPARTMENT OF SUPPLIES.

As your Honorable Bodies are aware, this is an entirely new department in the City government, having been created by the Act of General Assembly of April 4, 1903, and made effective by the ordinance passed by your Honorable Bodies approved on April 20, 1903. It has been splendidly managed by the Director, Mr. Frederick J. Shoyer. Of course, the whole of 1903, after the Director was appointed, was taken up in organizing the Department and devising ways and means for its administration, so that there was no actual work in the purchase of supplies done by the Department until the first of January, 1904.

Notwithstanding the fact that the Board of Education purchases its own supplies, that department not coming within the Act of Assembly creating the Department of Supplies, decided by the Supreme Court of Pennsylvania in 209 Pennsylvania Reports, page 51, the Department has been very successful, and in one year's work has more than justified its creation and its continued existence by the manner in which the most open competition has been brought about and the prices of supplies reduced. I am quite sure that it has not been an easy task, but the Director has stood to his guns manfully and is bringing about some results very advantageous to the City.

When you take into consideration the fact that some people will use all kinds of methods to get contracts, by making statements of all kinds that have no foundation in fact, to prevent others from bidding; that some will bid very low for the apparent purpose of having the contract awarded to them and then making some arrangements with the next highest bidder so that he can withdraw and the next highest bidder have the contract, or he will bid low in the expectation of furnishing a grade of article much below the standard, you can appreciate the difficulties we have to contend with. We have had these not only in the Department of Supplies, but in all the other departments. Fortunately they are few in number, but you can see how annoying they can be, not only to the City departments, but to legitimate bidders. We expect to get rid of all such contractors and are endeavoring to frustrate their plans; first, by letting it be known that every bidder has an equal chance; second, by awarding the contract to the lowest bidder and then if he refuses or is unable to go on with the work, to award the contract to the next highest bidder and bring suit against the lowest bidder and his bondsman for damages for the difference between his bid and the next lowest bid. A recent decision of the court will help us very much in this respect. A contract was awarded to the lowest bidder and he refused to go on with the work after notice. The contract was then awarded to the next lowest bidder. There was a difference of five thousand dollars between the two bids and this happened to be just the amount of the deposit made by the lowest bidder when he sent in his bid. This amount the City claimed to retain as the amount of the damages she had suffered by the failure of the lowest bidder to comply with his bid. This the Court held the City had the right to do. This we hope will have a very salutary effect as we are just as desirous of deterring people from bidding who would only do it for an improper purpose as we are of having every legitimate dealer bid. And third, we are having every department report on the quality of the supplies furnished it, as it is our purpose to reject all supplies furnished that do not come up to the sample or the standard adopted, and compelling contractors in all instances to live up to their contracts. This, of course, the legitimate contractor will do and is glad to do; it is only the man who seeks to get his profit by furnishing an inferior quality of goods that will be disturbed.

I call your attention to the Director's very interesting report of the work of his department during this first year. I call your special attention, however, to what he says in regard to appropriations. We must see to it that when we get legitimate dealers and contractors to bid that they should not be compelled to wait for their money at all, as such a course must have the effect pointed out by the Director and we shall be deprived of a large amount of legitimate and healthy competition.

LAW DEPARTMENT.

I call your special attention to the City Solicitor's report, showing the immense amount of work that has been done by this important department, under the direction of the very able City Solicitor, John L. Kinsey, Esquire. I could not do justice to the work done by his department except by re-writing here his entire report, which is so admirably and so succinctly set forth, that I take the liberty of referring you to it instead of re-writing the report.

COMMERCIAL MUSEUMS.

Great work was done during 1904 by the Commercial Museums. A change was made in the home of the Museums which ever since it was opened, in 1895, has occupied the office building of the Pennsylvania Railroad Company on Fourth street, below Walnut, which the Pennsylvania Railroad very generously offered to the Trustees without cost. During 1904 the offices were transferred from South Fourth street to the buildings of the Commercial Museums in West Philadelphia. The thanks of the City are certainly due to the Pennsylvania Railroad Company, who so generously gave the Commercial Museums the use of this large office building at Fourth and Willings alley for a period of almost ten years free of rent at a time when the Museums had neither lands nor buildings to display their collections and inaugurate their work.

The installation of exhibits in the central building was made during the year, in which are placed collections from China, Japan, Siam, Oceanica, India, Tropical Africa, West Indies, Mexico, Central America and several of South American Republics. The building is open on weekdays from 9 to 5 and on Sundays from 1 to 4, and the attendance has been very gratifying. The executive offices, Free Commercial Library and Bureau of Information have been installed in new offices fitted up on the second floor of the north building, and plans are now under consideration for the installation of the first floor with new collections presented to the City of Philadelphia from the Louisiana Purchase Exposition.

The Pennsylvania Commission of the Louisiana Purchase Exposition set aside a fund of five thousand dollars for an exhibit of the Commercial Museum at St. Louis. This enabled the Museum to install and maintain two exhibits, one in the Palace of Manufactures, showing the Bureau of Information and its work in behalf of assisting American manufacturers and merchants to extend their export trade, the other in the Palace of Education, reproducing the geographical collection or miniature museum as supplied by the Philadelphia Museums to the public schools of Pennsylvania. Both exhibits were highly commended, and upon them the international jury awarded the Museums two grand prizes.

The last session of the State Legislature made an appropriation to the Philadelphia Museums to continue the distribution to the public schools of the State of the educational collections or miniature museums designed as an aid in the teaching of geography and natural science. These collections contain about 325 specimens of important commercial materials belonging to the animal, vegetable and mineral kingdoms, and show the same articles in various stages of production, transportation and manufacture, and illustrate practically every staple article of commerce. In addition to the specimens there are in each collection 112 photographs showing the growth, origin and preparation of the materials, and maps and charts specially prepared to show their geographic distribution. The collections are greatly appreciated in the schools that have received them, and it is hoped that the present appropriation will make it possible to distribute about 500 collections, going into every county in the State.

During the coming year improvements authorized by your Honorable Bodies will enable the Trustees to occupy the south building. It is proposed to improve the footways and the approaches to the Museum, repair or rebuild the fences and the large plot of ground between the north and central buildings, formerly the site of the Auditorium, will be laid out as a public garden.

I hope that our citizens will become more familiar with the very interesting and important work that is being done by the Museums, and will also visit the buildings of the Museums in West Philadelphia that now contain such a large collection of exhibits.

THOMAS W. EVANS' MUSEUM AND INSTITUTE SOCIETY.

This society was organized for the purpose of taking over the legacy under the will of Dr. Thomas W. Evans, who died in Paris on November 14, 1897, leaving a last will and testament dated August 26, 1896, wherein he devised and bequeathed the bulk of his estate to provide a Museum and Dental Institute in this, his native City. Considerable litigation took place immediately after Dr. Evans's death by the heirs of Dr. Evans, but this was finally adjusted by agreement. We have had considerable difficulty, however, since that time, in getting the executors who are distributed in Paris, New York and Philadelphia, to dispose of the property in order to make distribution, and it has been necessary to send to Paris on several occasions, and it may be necessary again in order to force the executors to dispose of the real estate so that the Evans' Museum and Institute Society may receive the balance of the estate that is coming to them and carry out the provisions of Dr. Evans's will in establishing the Museum and Institute. It is the purpose of the Board of Directors of the Museum and Institute to push the matter now as vigorously as possible to compel the sale of the real estate and the winding up of the entire estate. It is now over seven years since the death of Dr. Evans and it is surely time that the matter was wound up. Unfortunately the Board of Directors are without funds for prosecuting the matter and I would suggest that your Honorable Bodies make an appropriation of ten thousand dollars to cover expenses of counsel and other expenses already incurred, and to be incurred, in securing for the City this legacy. Such amounts as may be advanced by the City of course would be returned as soon as we receive the legacy from the estate.

CITIZENS' PERMANENT RELIEF COMMITTEE.

I am happy to inform you that there was no public calamity during the year 1904 that necessitated the calling together of the Citizens' Permanent Relief Committee.

LIBERTY BELL.

At the request of some seventy thousand school children of St. Louis, your Honorable Bodies passed an ordinance appointing a committee to take to the Louisiana Purchase Exposition at St. Louis the Liberty Bell. It was taken from Independence Hall on the third day of June, 1904, and placed on exhibition in the Pennsylvania Building in the St. Louis Fair Grounds, where it remained until the nineteenth day of November, 1904, when the same committee went to St. Louis and brought it back and placed it again safely in Independence Hall.

I send herewith the annual reports of the Directors of Public Safety, Public Works, Public Health and Charities and Supplies. I also send herewith the annual reports of the Receiver of Taxes, the City Treasurer, City Controller, City Solicitor, Board of Public Education, Sinking Fund Commissioners, Board of Revision of Taxes and the Commercial Museums. I congratulate your Honorable Bodies upon the work that has been done during the past year and ask for your continued support during the coming year, in helping the City officials to work out satisfactorily the many municipal problems that will confront them.

Yours truly,

JOHN WEAVER,

Mayor.

ANNUAL REPORT

OF THE

DEPARTMENT OF PUBLIC WORKS

FOR THE

YEAR ENDING DECEMBER 31, 1904

4w

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.
ASSISTANT OFFICIAL PHOTOGRAPHER—WILLIAM SHANE.
MESSENGER—J. J. JOHNSTON.

Chiefs of Bureau:

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.

EIGHTEENTH ANNUAL REPORT

OF THE

DEPARTMENT OF PUBLIC WORKS

PETER E. COSTELLO, Director

Philadelphia, January 3, 1905

HON. JOHN WEAVER,

Mayor of Philadelphia.

DEAR SIR:—I have the honor to submit herewith, the report of the operations of the Department of Public Works for the year ending December 31, 1904—the Eighteenth Annual Report of the Department.

The reports of the Chiefs of the several Bureaus, which are transmitted herewith, give the details of operations and this report will be of a general nature only.

The expenditures during the past year for operation and maintenance, were $4,499,435.94, and for permanent improvements and extensions, $6,346,276.61, making the total expenditure for the year $10,845,712.55. Of the amount expended for extensions and improvements, the sum of $5,872,121.16 was obtained from loans authorized during 1904 and previous years and not appropriated from direct taxation.

The receipts amounted to $4,015,725.68, which was $86,459.11 greater than the previous year.

The total appropriation for the year, together with the balances carried from previous years, aggregated $11,155,-874.32. Included in this is an appropriation of $642,-720.00 made January 27, 1904, to pay deficiency bills of

1903, made necessary by inadequate appropriation in 1903 for materials and supplies; the principal item of deficiency was coal for the Bureau of Water, for which there was appropriated $467,000.00.

City Ice Boats.

The total expenditures of the City Ice Boats for the year 1904, were $119,426.80, which was expended as follows: for current expenses $45,926.80 and for extensions $73,500.00.

The winter of 1903-04 was one of extraordinary severity and the boats were worked to their utmost capacity. On January 1, 1904, Boats Nos. 1 and 3 were in commission, with the weather conditions very unfavorable and both boats working twenty-four hours daily. Boat No. 2 was still undergoing repairs at the hands of the Neafie and Levy Ship and Engine Building Company, but on January 21, 1904, on account of the serious conditions on the river, it was necessary to take the boat out of the shipyard before repairs were completed and place it in commission, the crews on the other two boats being utterly exhausted from the hard labor of the previous three weeks.

During the summer of 1904, The John Baizley Iron Works repaired the guards and rails of Boats Nos. 1 and 3 and sheathed the decks, built and placed in position a new donkey boiler and new steel paddle wheels on Boat No. 1 and strengthened the wheels on Boat No. 2.

In addition to the above work, the caretakers of the boats made extensive repairs to Boat No. 3 during the summer, at a cost of nearly $1,000.00 less than we could have had the same work done under contract.

The recommendation of the Superintendent for a new and powerful ice boat again has my approval, as the work of the past winter has demonstrated the necessity of a boat with more modern equipment. The strain on Boats No.

1 and 3 cannot be expected to be put up with indefinitely, as they have already been in use longer than the life of the average boat.

The following tables give a comparative summary of the receipts and expenditures of the Bureau of City Ice Boats for the years 1903 and 1904:

	1903.	1904.
Amount received for towage and sale of old material	$810 00	$2,319 46
Total paid to City Treasurer	$810 00	$2,319 46

	1903.	1904.
Total amount of warrants drawn	$41,662 26	$119,426 80
Deduct cash paid City Treasurer	810 00	2,319 46
Total	$40,852 26	$117,107 34

Bureau of Gas.

The appropriation of $10,000 for the use of the Bureau of Gas was entirely consumed. Under the terms of the lease of the City's Gas Works, the lessee is required to contribute $10,000 annually into the City Treasury for the maintenance of this Bureau.

The work of the Bureau, while not being brought prominently before the public, has been closely identified with the progress that has been made in the gas supply of the City. The duties of the Bureau in seeing that the quality of the gas and its illuminating properties are maintained and in testing the meters which consumers consider are registering fast, have been well performed.

The average candle power of the daily tests was as follows:

January	.22.79
February	22.70
March	22.97
April	23.24
May	23.03
June	23.13
July	22.76
August	22.95
September	23.01
October	22.91
November	22.82
December	22.86
Maximum monthly average	23.24
Minimum monthly average	22.70

Under the terms of the lease of the gas works, it was stipulated that the candle power must be not less than 22; from the above table it can be seen how well the candle power has been maintained.

The quality of the gas is uniform and the following results obtained from chemical analysis will indicate its average composition with considerable accuracy:

Carbon di-oxide	2.75
Illuminants	10.75
Oxygen	0.80
Hydrogen	33.10
Carbon mon-oxide	22.50
Methane	25.60
Nitrogen	4.50
	100.00

During the year there were 101 meters examined, which were presumed by the consumers to be registering fast. The inspection made by the Bureau proved that of this number 12 were slow and 89 fast.

At all points where the Bureau of Gas has come into contact with The United Gas Improvement Company, the lessee of the Philadelphia Gas Works, the business has been transacted in a prompt and efficient manner.

Bureau of Highways.

The expenditures of the Bureau of Highways for the year were $1,869,567.68, of which $647,112.16 were for current expenses and $1,222,455.52 for extensions. The receipts were $212,563.31, which were $33,374.82 greater than in 1903.

During the year there were opened and graded forty miles of streets, which aggregated 1,120,946 cubic yards.

There were 10.85 miles of new streets paved with sheet asphalt, granite blocks and vitrified fire clay blocks, upon a six inch cement concrete foundation, at an approximate cost of $400,000, of which $52,730.19 was paid by the City for paving intersections and in front of unassessable property.

An appropriation of $265,000 was made out of the Loan Bill for repaving streets with improved pavements, but owing to the delay of Councils in designating the streets to be repaved and the non-completion of underground structures, only 6.46 miles of streets were repaved. The balance of the appropriation will be utilized in repaving as early in the spring of 1905 as possible.

The unpaved and macadamized roads in the City are in splendid condition, due to the methods used in their care and maintenance. Long stretches of roads were entirely resurfaced, notably the Bensalem pike for its entire length and the Lancaster pike, which the City recently acquired in a dilapidated condition. There were resurfaced 21 miles of macadam roads and 6.25 miles of dirt roads were macadamized. The sprinkling of macadamized roads commenced on April 20, 1904, and continued until October 30, 1904; this sprinkling added much to the comfort and convenience of the public using the roads.

The paved streets of the City were kept in excellent repair. The work was done for a lump sum ($144,200) and included all classes of pavements except asphalt and granolithic, which were repaired under separate contracts. The appropriation for asphalt and granolithic repairs was entirely inadequate to properly do the work and many needed repairs could not be made. No appropriation was made for resurfacing with sheet asphalt and what little work was done, was under the contract for repairs to asphalt streets.

The work of repairing sewers, inlets and manholes was performed in a satisfactory manner. A number of serious breaks occurred which were repaired promptly; a dangerous one being in the abutment supporting the sewer along the Wissahickon drive below the Lincoln drive. This break threatened the City's water supply, but prompt action on the part of the Bureau of Highways prevented serious damage and repairs were started within an hour of the discovery of the break and in consequence of which, no pollution occurred.

There are over 300 bridges in the City under the care of the Bureau of Highways and the appropriation of $75,000.00 in 1904 for their repair and maintenance was totally insufficient; this amount was expended in making temporary repairs to the bridges in the most dangerous condition.

A number of important structures are in a ruinous state, due to want of paint and repairs, which could not be made with the limited means at our command.

Unless Councils make more liberal appropriations in the near future, many of the bridges will so deteriorate as to make it necessary for the Department to close them to travel.

In this connection I would call attention to the report of the Superintendent of Bridges, attached hereto, which gives a detailed statement of the condition of the bridges and the amount of money required to put them in a condition safe for public travel.

The construction of the Northeast Boulevard, starting at Broad and Cayuga streets, is being done under the supervision of the Bureau of Highways and upon the completion of this work there will be a magnificent diagonal highway running to Torresdale, which will develop the northeastern section of the City and bring additional revenue to the City in the way of taxes.

The improvement of South Broad street, from Moyamensing avenue to League Island Park is a work that is commended by all classes of our citizens. Rapid progress is being made with the work without inconvenience to the public using the street. The contractor is providing adequate facilities for travel while this work is in progress.

During the past year, the passenger railway companies made extensive repairs to streets upon which their tracks are laid, and the work was performed in an entirely satisfactory manner.

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, 1904, and totals for the year 1903:

Kinds of Pavements.	Laid During 1903.		Making Total in City, Dec. 31, 1903.		Laid During 1904.		Making Total in City Dec. 31, 1904.	
	Sq. Yards.	Miles.	Sq. Yards.	Miles.	Sq. Yards.	Miles.	Sq. Yards.	Miles.
Sheet asphalt	257,041	16.05	5,166,463	337,69	162,989	9.87	5,329,452	347.56
Asphalt block	....	....	180,702	19.30	....	....	178,238	19.
Granite block	62,797	3.02	6,169,984	367.80	78,557	6.58	6,248,541	374.38
Cobble or rubble	....	....	2,049,183	73.12	....	....	1,973,622	66.96
Vitrified brick	38,858	3.11	2,239,789	141.73	13,678	.86	2,253,467	142.59
Granolithic	....	....	72,726	12.77	....	....	72,726	12.77
Slag block	....	....	71,280	9.82	....	....	71,280	9.82
Macadam	269,197	26.87	2,722,976	262.66	63,443	6.25	2,786,419	268.91
Total	627,893	49.05	18,673,103	1,224.89	318,667	23.56	18,913,745	1,241.99

In addition to the paved and macadam streets, there are 467 miles of unpaved streets or dirt roads.

The following tables give a summary of work done during 1904 and of the receipts and expenditures of the Bureau of Highways for the same period and totals for the year 1903:

Statement of Work Done.

	1903.	1904.
New paving	117,099	91,348 linear feet.
Macadamizing (new)	141,888	82,990 linear feet.
Grading	1,097,522	1,120,946 cubic yards.
New footway paving	57,433	76,166 square yards.
Repairs to paved streets	391,064	370,868 square yards.
Footways repaved	18,491	37,135 square yards.
Ditches repaved	50,329	55,338 square yards.
Gutter stone laid	4,930	.........linear feet.
Crossing stone laid	8,394	7,384 linear feet.
Curbstone reset	106,244	155,991 linear feet.
Wooden trunks	12,467	10,147 linear feet.
Brick and stone drains	1,981	1,528 linear feet.
Hand railings	4,900	4,093 linear feet.
Curved curb corners	10,247	16,089 linear feet.
New curbstone set	175,921	219,756 linear feet.
Vitrified brick and stone gutters	5,670	23,963 linear feet.
Resurfacing sheet asphalt	10,672	15,807 square yards.
Resurfacing broken stone	132,809	110,765 linear feet.
Footway, curb and railroad notices served	25,732	31,705

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

	1903.		1904.	
	Square yards.	Linear feet.	Square yards.	Linear feet.
Granite blocks	19,594	4,725	28,797	10,758
Sheet asphalt	228,930	74,458	135,243	42,196
Vitrified brick	34,047	13,196	13,159	4,364
Macadamizing	269,197	141,888	63,443	32,990
Total	551,768	*234,262	240,642	†90,308

Replacing Cobblestones with Improved Pavements.—Old Streets,

	1903.		1904.	
	Square yards.	Linear feet.	Square yards.	Linear feet.
Granite blocks	43,203	11,198	49,760	23,968
Sheet asphalt	28,111	10,291	27,746	9,912
Vitrified bricks	4,811	3,236	519	240
Total	76,125	*24,725	78,025	†34,120

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

†1904—Total amount of new paving, 124,428 linear feet, equal to 23 miles 2,988 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 1904:

	Linear Feet.
Resurfacing sheet asphalt	21,962
Granite block repaving between tracks	37,978
Vitrified bricks repaving between tracks	5,406
Total	65,346

Equal to 12 miles 1,986 linear feet, at an estimated cost of $160,000.

Receipts and Expenditures.

The receipts of the Bureau of Highways during the past year were $212,563.31, an increase of $33,374.82 over the previous year.

Statements of Expenditures.

	1903.	1904.
Current expenses..................................	$647,082 61	$647,112 16
For extensions...	1,587,380 28	1,222,455 52
Total..	$2,234,462 89	$1,869,567 68

Board of Highway Supervisors.

The total amount of money earned by the draughtsmen of the Board of Highway Supervisors, was $25,822.68, and the expenses for the same time were $11,120, the excess of receipts over expenditures being $14,702.68.

Forty-seven plans of substructures were added to the records of the Board during the year, making a total of 317 miles of finished plans on file. The number of plans added to the records would have been much larger but for the fact that Councils failed to make an appropriation to the Department of Supplies for the requisite materials necessary for the work, consequently hampering the operations of the office.

These plans are becoming more valuable every year to the City Departments and to the corporations maintaining underground structures and no other City in the country has as complete a set of records.

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 years 1903 and 1904:

Transactions of the Board of Highway Supervisors.

	1903.	1904.
For vaults	8	8
For railroad tracks, curves and turnouts	149	110
For underground pipes	559	460
For electrical conduits	458	458
For erecting bridges	7	1
For tunnels	1	2
For drinking fountain	2	10
For subway	1	......
For connection to sewers	1	......
Foundations for elevated railroad	......	1

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

	1903.	1904.
New street record plans prepared	85	47
Blue print plans placed on file	402	375

Receipts and Expenditures.

	1903.	1904.
Receipts	$24,098 56	$25,822 68
Expenditures	11,369 83	11,120 00
Excess of receipts	$12,728 73	$14,702 68

Recapitulation.

	1903.	1904.
Amount of earnings	$18,382 98	$17,274 49
Amount outstanding from previous years	19,372 97	12,971 03
	$37,755 95	$30,245 52
Amount received and deposited with City Treasurer.	24,098 56	25,822 68
Amount outstanding	$13,657 39	$4,422 84

Bureau of Lighting.

The total appropriation to the Bureau of Lighting for the year 1904, was $369,139, of which sum there was $368,886.08 expended and $252.92 merged.

The total number of lamps lighted and under the supervision of this Bureau on December 31, 1904, was 34,390, divided as follows:

Gas lamps maintained by United Gas Improvement Co...	21,323
Gasoline lamps maintained by Penna. Globe Light Co....	12,870
Gas lamps supplied by the Northern Liberties Gas Co....	74
Gas lamps maintained by Bureau of Correction..........	123

In addition to the gas and gasoline lamps enumerated above, there are 10,312 electric arc lights under the care of the Department of Public Safety (Electrical Bureau) and 50 electric arc lights maintained by the Board of Directors of City Trusts, located on Delaware avenue, between Vine and South streets; and also, 97 electric arc lights are furnished free of cost to the City by the different electric light companies for privileges granted.

The 300 gas lamps which, under the terms of the lease of the Philadelphia Gas Works, the United Gas Improvement Company is required to erect annually, are entirely inadequate to meet the demands made upon the Department. Operative builders are constantly making requests for gas lamps on streets which are newly opened and built upon and Councils, in the near future, will have to provide some means by which the Department can erect gas lamps in addition to the 300 provided for.

The work of the United Gas Improvement Company has been satisfactorily performed, the lamps having been lighted and extinguished regularly and kept in good repair.

Bids were advertised for and contract awarded to the Pennsylvania Globe Gas Light Company for furnishing and lighting naphtha lamps during 1904, as follows:

For plate burner lamps of 20 candle power guaranteed, per lamp per year, $21.

For Welsbach incandescent lamps of 60 candle power guaranteed, per lamp per year, $29.50.

During the year 1904, all the plate burner lamps were changed to Welsbach incandescent lamps, and on September 6, 1904, after due advertisement, contract was awarded to the Pennsylvania Globe Gas Light Company, the only bidder, for 1905, as follows:

For Welsbach incandescent lamps of 60 candle power guaranteed, per lamp per year, $29.50.

The work of the Pennsylvania Globe Gas Light Company has been performed satisfactorily, the lamps having been maintained in good order and lighted with regularity.

The detailed report of the Chief of Bureau, transmitted herewith, gives a statement of the number of gas and gasoline lamps discontinued and relocated during the past year.

The following statement shows the number of gas and gasoline lamps, also expenditures of the Bureau of Lighting during the years 1903 and 1904:

	1903.		1904.	
	Number of Lamps.	Cost during the Year.	Number of Lamps.	Cost during the Year.
Gas lamps maintained by the United Gas Improvement Company........	21,142	....	21,444	
Gasoline lamps...........................	13,034	$315,650 35	12,870	$355,798 79
Gas lamps supplied by the Northern Liberties Gas Company.............	74	1,509 96	74	1,494 84
Gas lamps maintained by the Bureau of Correction..........................	231	....	231	
Salaries and office expenses............	....	11,762 13	....	11,592 45
Total...............................	34,481	$328,922 44	34,619	$368.886 08

	1903.	1904.
Of the gas lamps maintained by the United Gas Improvement Company there were not lighted, because of their proximity to electric lights..........	121	121
Of the gas lamps maintained by the Department of Charities and Correction there were not lighted, because of their proximity to electric lights.......	108	108
	229	229

Bureau of Street Cleaning.

The work of this Bureau during the year 1904 has been commended by the public for the satisfactory manner in which it has been performed.

During the year, $975,398 were expended for cleaning streets, inlets, etc., and the collection and disposal of ashes, and $538,165 for the collection and disposal of garbage, a total of $1,510,563.

For violations of contracts, the contractors were fined $7,327, which sum reverted back to the City Treasury.

During the year there were cleaned 294,501.10 miles of streets, 1,110,563 sewer inlets and 165,306 private alleys, from which were removed 230,271 cart loads of dirt. There were removed from buildings 644,973 cart loads of ashes and 29,737 cart loads of dry waste. There were also removed and disposed of 380,529 cart loads of kitchen garbage and 34,949 dead animals.

About 56,000 cart loads of snow were removed from the streets at a total cost of $8,726.75. Councils should make liberal appropriations for this purpose, as the accumulation of snow, owing to the collection of filth, is a menace to the public health. In most of the large cities to-day, the removal of snow from the principal thoroughfares is taken as a matter of course and is done regardless of cost.

The cost of cleaning streets, alleys and inlets and removal of ashes and dead animals, was $3.31 per running mile, an increase over 1903, for the reason that the severe winter of 1904 made regular cleaning impossible and the removal of ashes and household waste now requires from two to three carts for work formerly done by one, due to the increased distance of dumping grounds from points of collection. In this connection I would add the location of dumping grounds is an element which must enter largely into the future prices for cleaning streets and removal of ashes, as the cost for collecting ashes to-day is about 55 per cent. of the total contract price for cleaning streets, etc.

Contracts for 1905 have been awarded as follows: For cleaning streets, collection and removal of ashes, etc., for entire City, $950,000, and for the collection and disposal of garbage for the entire City, $560,000.

Owing to the greatly improved service rendered by the contractors in this Bureau during the year 1904, there were received by the Bureau of Street Cleaning from all sources, 1,311 complaints less than during the year 1903.

The following in a statement in detail of the operations of the Bureau of Street Cleaning during the year 1904 and totals for the year 1903:

Total Work During the Year 1904.

DISTRICTS.	CLEANED.						REMOVED.					Number of Complaints of all Kinds.
								NUMBER OF LOADS.				
	Squares.	Alleys.	Inlets.	Crossings.	Market Houses.	Snow from Fire Plugs.	Number of Dead Animals.	Dirt.	Ashes.	Dry Waste.	Garbage.	
First	600,360	25,599	290,227	189,928	610	4,850	6,186	49,800	126,800	5,776	51,089	447
Second	532,704	25,613	309,686	191,154	1,222	5,580	6,682	52,291	121,947	7,222	52,914	965
Third	481,446	31,933	167,180	112,029	355	3,608	7,406	29,997	110,020	5,196	94,788	453
Fourth	747,019	33,170	92,779	124,887	12	1,926	7,747	52,955	105,733	4,106	101,570	545
Fifth	554,388	48,991	231,058	119,321	....	2,871	6,928	33,555	180,473	7,437	80,168	421
Sixth	29,094	....	19,633	17,900	....	6,293	....	11,673	....	....	....	27
Total 1904	2,945,011	165,306	1,110.563	755,219	2,199	25,128	34,949	230,271	644,973	29,737	380,529	2,858
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.

The total expenditures of the Bureau of Surveys during the year 1904, were $1,164,698.02, of which sum $261,318.34 was to meet current expenses, and $903,379.68 was for extensions. The receipts were $131,337.10, or $934.55 greater than the previous year.

The Commission appointed in 1902 under authority of the Act of Assembly of June 14, 1897, to fix the location of the line dividing Philadelphia and Delaware Counties in the vicinity of Cobbs creek and to re-establish this line, has made its final report. The Commission held twenty sittings for the purpose of hearing testimony, examining records and discussing surveys. The report was submitted to the Courts of Quarter Sessions of the Peace for the Counties of Philadelphia and Delaware, December 30, 1904, accompanied by plans showing the boundary line and the markings thereof. The boundary line was fixed and is fully described in the report.

The amount appropriated for the construction of main sewers was $700,000 out of the $16,000,000 loan, which was apportioned amongst nineteen main sewers. These have all been placed under contract and work being performed, with the exception of three, for which proposals have been invited and bids will be received early this month.

The proposed sewer in Market street has not yet been placed under contract. The general and detailed designs for the sewer have been prepared but the possibility of certain changes in the Subway construction has caused the Department to withhold the advertising of this work.

The detailed statement of the work on the main sewers will be found in the report of the Chief Engineer, which is hereto attached. Satisfactory progress has been made on the various sewers which comprise the drainage system.

Drainage in First, Twenty-sixth, Thirty-sixth and Thirty-ninth Wards. The rapidity with which new buildings have been constructed in the southern section of the City, both east and west of Broad street, has made it necessary to build larger sewers on various parallel streets running from the Delaware river to Broad street, and also a relief sewer on McKean street to avoid overflow in certain territory. Work on McKean street sewer, designed to accomplish this purpose, has been prosecuted for several years, until the construction has been completed between the Delaware river and Twelfth street. By reason of additional appropriations, contracts were entered into and work is now progressing from Twelfth to Broad street. It is desirable to continue this work on Broad street, from McKean to Mifflin street, thence westward and northward to Sixteenth and Tasker streets.

Frankford Intercepting System.—This is one of the most important of the larger sewerage systems which is receiving the attention of the Department and upon which depends the giving to the residents of Frankford sanitary conveniences equal to that of other sections of the City. The system is large and will be costly, but its beneficial results will be far reaching.

It is intended to practically abolish the Little Tacony creek by intercepting the flow to the northward and carry it into Frankford creek, near its mouth. There are several large manufacturing plants along the present banks of the creek, the employees of which are affected more or less by the pollution of the stream.

The diversion of the flow of the creek will permit of the construction of an intercepting sewer and the ultimate opening of Torresdale avenue. Considerable progress has been made towards this end and with additional appropriation it will be a matter of short time before the object is accomplished. The completion of this system will eventually necessitate the construction of a large intercepting sewer on Wheatsheaf lane, to receive the dry weather flow of the Wingohocking creek, and finally, the construction of an intercepting sewer along the line of Frankford creek, emptying into the Wheatsheaf lane sewer. The importance of this work cannot be overestimated.

Branch Sewers and Inlets.—During the year 1904, there were constructed 21.499 miles of branch sewers at public expense, at a total cost of $423,549.84. There was appropriated for the reconstruction of inlets $5,000, which was placed under contract. Contracts were also entered into for the construction of new inlets, curved curbing, etc., to the amount of $13,000.

The total length of all sewers built and inspected during 1904 was 29.75 miles, divided as follows:

Main sewers	2.522	miles.
Branch sewers	21.499	"
Sewers built at private expense	5.730	"

The total length of sewers constructed to January 1, 1905, is as follows:

Main sewers	162.929	miles.
Branch sewers	754.193	"
Sewers built at private expense	91.612	"
	1008.734	"

Parks and Parkways.—The interest in the movement to increase the park areas of the City and to establish a system of connecting boulevards is growing constantly. Most of the large cities of the United States are actively engaged in the work of Park and Parkway extension.

Philadelphia possesses splendid natural advantages for work of this character and plans are gradually being evolved for the development of a comprehensive system which will add much to the attractiveness of our City.

Actual work has been begun on certain portions of the system.

By ordinance of September 8, 1903, an extension of Hunting Park was authorized, increasing its area from 43 to 96 acres.

The plans for Cobb's Creek Park and Parkway, which was authorized to be placed on City plan by ordinance of June 27, 1904, are now being prepared. These contemplate the laying out of an avenue 100 feet wide, from Market street to Woodland avenue, a distance of four miles. About 129 acres are included in the area of the avenue and park.

The ordinance of March 28, 1903, which authorized the placing of the Parkway, from City Hall to Fairmount Park, upon the City plan, was amended by an ordinance approved June 27, 1904, which provided for a slight change in location at the City Hall end and reduced the width west of Logan Square to 250 feet. The Board of Surveyors subsequently confirmed the plans on November 7, 1904.

Railroad Improvements and Extensions.—During the year there were no railroad grade crossings abolished. Plans looking to the abolishment of grade crossings on South Broad street, where the tracks of the Pennsylvania Railroad Company and Schuylkill River East Side R. R. cross this street, have been prepared, and conferences with the companies have been held on the subject.

Rapid Transit Subway.—The work of the Philadelphia Rapid Transit Company in constructing the subway on Market street, is progressing satisfactorily and studies are now in course of preparation for continuing the subway around City Hall and east on Market street to the Delaware river.

New York Short Line Railroad, etc.—An ordinance was approved during the yast year, authorizing certain underlying companies of the Philadelphia & Reading Railway Co. to make alterations in the location and grades of their tracks between Fifth street and Cheltenham Station and to construct a line of railroad across the Thirty-fifth Ward, from a point near Cheltenham station to the Poquessing creek, a distance of seven miles, the object being to facilitate the handling of traffic between Philadelphia and New York. All streets and roads are to be crossed by bridges and the railroad companies are obligated to pay all land damages by reason of said work. The company will also be required to pay one-half the expense of all bridges where streets will be opened in future under or over the railroad tracks.

Testing Laboratory.—The work of the testing laboratory grows in value annually and a comparison with the cost of testing by private laboratories shows a great saving to the City in this particular, while the value to the City in obtaining materials of high standard for its public works is incalculable.

Bridges.—There was available at the beginning of the year $103,508.90 for the construction of bridges, and by ordinance of June 27, 1904, $1,000,000 out of the loan of May 18, 1904, was appropriated for this purpose, $500,000 of which was apportioned as per ordinance of August 11, 1904, for constructing nine bridges.

Four bridges were completed during 1904 and six other contracts were entered into upon which work was not completed.

While the appropriation for the construction of bridges during the past year has been liberal, it will be necessary for Councils to provide additional funds to furnish facilities for transportation and intercommunication. In the report of the Chief Engineer will be found a list of bridges which it is important should be built as early as possible.

Improvement of Delaware Avenue.—During the past year the railroad companies having rights on the widened portion of Delaware avenue, laid three tracks of improved pattern on the street, of a design which will permit of as little obstruction to travel as is consistent with the operation of heavy cars upon the street. At the same time this work was going on, the street paving of a permanent character laid on a concrete foundation, was laid under directions of the Girard Estate, subject to supervision by the proper officials of this Department.

Improvement of Channel of Schuylkill River.—During the past year there was removed from the channel of the Schuylkill river 380,400 cubic yards other than rock or wreckage and 25.51 cubic yards of large boulders, making the total of dredging completed under Contract No. 10, 641,000 cubic yards of material other than rock, and 61.13 cubic yards of rock. This work is being done by authority of ordinance of June 27, 1902, under an appropriation of $400,000 made available from the loan of June 11, 1902.

There has been paid on account of the work done under this contract $261,449.04, which represents 80 per cent. of the money earned.

Removing the wreck of S. S. "Bermuda."—On August 15, 1900, the S. S. "Bermuda" sunk in the dock adjacent to Pier No. 19, North Wharves. Several unsuccessful attempts to raise the vessel by various owners having been made, she was abandoned in October, 1901. On December 31, 1903, Councils made an appropriation to remove this obstruction to commerce, and contract was awarded to the lowest bidder for doing the work, the City agreeing to make no claim for the vessel or its cargo.

Work on this contract is progressing, but no payments on account thereof will be made until the work is completed.

District Surveyors.—The Board of Surveyors held twenty-two regular meetings. Fourteen special meetings were held, in order to visit sections of the City where changes are contemplated in the City plan. Road day hearings were held in April and September, at which times property owners appeared before the Board and gave testimony for and against proposed changes of plans. At these hearings 78 plans were heard, which included three sectional plans of the Parkway, as revised by ordinance of June 27, 1904.

The Board confirmed 71 plans and rejected five. A number of plans for improvement to street passenger railways were also considered.

Work amounting to $152,439.89 was performed for the various Departments and Bureaus of the City, the combined credits and cash receipts being $73,308.36 more than the total expenses of the fourteen survey districts.

The following is a summary of the receipts and expenses of the District Surveyors for the year 1904 and totals 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 1903.	Increase.	Decrease.
					Salaries.	Pay of Assist'nts.	Miscel-laneous.	Total.				
1	John M. Nobre.........	$3,723 48	$9,313 96	$13,037 44	$3,000 00	$8,404 00	$1,238 03	$12,642 03	$395 41	$1,595 14	....	$1,199 73
2	Chas. W. Close..........	3,466 59	6,812 44	10,279 03	3,000 00	5,619 99	1,025 40	9,645 39	633 64	1,240 71	....	607 07
3	W. C. Cranmer.........	5,879 12	11,530 41	17,409 53	3,000 00	8,059 92	1,182 56	12,242 48	5,167 05	3,357 18	$1,809 87	....
4	F. Bloch.................	2,178 77	8,128 05	10,306 82	3,000 00	4,918 00	1,014 61	8,932 61	1,374 21	1,566 23	....	192 02
5	Walter Brinton........	13,594 37	7,945 74	21,540 11	3,000 00	9,820 58	1,711 30	14,531 88	7,008 23	10,534 34	....	3,526 11
6	Joseph Mercer.........	13,650 46	10,653 48	24,303 94	3.000 00	9,633 32	1,928 79	14,562 11	9,741 83	14,404 92	....	4,663 09
7	W. K. Carlile...........	2,638 47	6,324 34	8,962 81	3,000 00	4,000 00	1,021 81	8,021 81	941 00	325 36	615 64	....
8	C. A. Sundstrom.......	2,722 58	14,437 05	17,159 63	3,000 00	10,982 05	2,014 61	15,996 66	1,162 97	236 94	926 03	....
9	Joseph C. Wagner.....	7,093 08	11,048 19	18,141 27	3,000 00	11,282 96	1,392 13	15,675 09	2,466 18	1,818 26	647 92	....
10	John H. Webster, Jr..	4,811 27	15,995 31	20,806 58	3,000 00	8,949 93	1,155 82	13,105 75	7,700 83	6,162 30	1,538 53	....
11	Joseph Johnson........	13,195 50	9,308 18	22,503 68	3,000 00	9,631 67	1,685 74	14,317 41	8,186 27	7,510 85	675 42	....
12	J. H. Gillingham.......	15,929 49	15,660 09	31,589 58	3,000 00	7,977 50	1,592 39	11,569 89	19,019 69	10,900 59	8,119 10	....
13	H. M. Fuller............	9,037 18	9,022 46	18,059 64	3,000 00	9,780 00	1,672 77	14,452 77	3,606 87	1,556 19	2,050 68	....
14	C. B. Webster...........	3,084 41	16,260 19	19,344 60	3,000 00	8,647 33	1,793 09	13.440 42	5,904 18	6,784 88	....	880 65
	Total 1904...........	$101,004 77	$152,439 89	$253,444 66	$42,000 00	$117,707 25	$20,429 05	$180,136 30	$73,308 36	$67,993 84	$16,383 19	$11,068 67
	Total 1903...........	$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 operations of the Bureau of Surveys in the actual construction of work and the receipts and expenditures during the years 1903 and 1904:

Summary of Main, Branch and Private Sewers built during the years 1903 and 1904.

	1903.		1904.	
	No.	Linear feet.	No.	Linear feet.
Intercepting sewer extensions	3	12,497.48	3	1,332
Main sewers	29	30,933.93	23	11,984
Branch sewers	103	82,588.89	157	113,514
Private sewers	58	21,421.00	62	30,256
Total	193	*147,441.30	245	†157,086

* Equal to 27.92 miles. † Equal to 29.75 miles.

Statement of Work upon Bridges during the years 1903 and 1904.

	1903.	1904.
Finished	6	5
Begun	5	8
Authorized	3	9
Planned	5	9

Statement of Receipts.

Year.	Receipts of Bureau.	Receipts of District Surveyors.	Total.
1903	$28,005 94	$102,396 61	$130,402 55
1904	30,332 33	101,004 77	131,337 10

Statement of Expenditures.

	1903.	1904.
Current expenses	$275,701 08	$261,318 34
For extensions	1,560,003 80	903,379 68
Total	$1,835,704 88	$1,164,698 02

The following is a summary of the operations of the Registry Division of the Bureau of Surveys during the years 1903 and 1904:

Registry Division.

	1903.	1904.
Number of certificates of registered owners issued	4,223	4,396
Number issued for use of Law Department	547	575
Receipts from certificates of registered owners	$1,054 02	$1,102 00
Receipts from miscellaneous sources	$216 60	$383 10
Number of original lots plotted	10,171	12,099
Number of transfers registered	35,369	37,765
Number of plans made for use of City Departments, Bureaus, etc	501	62
Number of examinations of registry plan books made by the public	54 833	57,088
Number of descriptions of property filed for registry	45,540	49,864
Number of titles perfected	2,361	2,047
Number of certificates of legal opening of streets issued to Bureaus, etc	2,078	1,703
Number of certificates of registered owners in municipal lien cases for Law Department	1,181	668
Number of certificates of registered owners in municipal lien cases for Receiver of Taxes	....	1,086

Bureau of Water.

The total expenditures of the Bureau of Water for the year were $4,919,630.38, of which $1,526,954.06 were for current expenses and $3,392,676.32 were for extensions, the greater portion of the latter amount having been expended for work in connection with the Improvement, Extension and Filtration of Water Supply.

The receipts for the year were $3,643,671.13, or $48,917.16 in excess of 1903.

The increase in the consumption of water in the sections of the City east of the Schuylkill river still continues and great difficulty was experienced in keeping the locality supplied. Various expedients were resorted to and a failure of the supply was only prevented by partially shutting it off by closing the valves on some of the mains to save the water pumped during the night for use in day time. Notwithstanding these efforts, many complaints of short supply were received.

There has been no improvement in the quality of water furnished the above sections of the City and conditions became so serious early in the year, that pending the completion of the Torresdale Filter Plant, which will supply this locality with filtered water, arrangements were made to lay additional mains and to make the necessary pipe connections to supply a limited quantity of water from the Wentz Farm Reservoir. This work was completed the latter part of the year, but is not yet available for use, owing to the delay in operating the new engines at Lardner's Point Pumping Station, which are necessary to furnish the additional water.

West Philadelphia has been furnished with an ample supply of water and during the latter part of the year the quality has been very much improved. On April 1, 1904, the first filtered water (about 3,000,000 gallons per day) was turned into the West Philadelphia district, mixing with the raw water from George's Hill Reservoir.

As the filter basins were completed and put into service, the supply of filtered water was increased and on June 3, connections were made which enabled the Department to supply the section of West Philadelphia, east of Thirty-eighth street, with filtered water. It was not until December 13, however, that the entire district was supplied from the Belmont filter plant.

In this connection it was found that while the pumps at the Belmont Station were able to pump all the water necessary to supply West Philadelphia from George's Hill Reservoir, they were unable to deliver sufficient water into the sedimentation basins at the Belmont filter plant, which are 67 feet higher in elevation than George's Hill Reservoir; and there was, therefore, a steady depletion of the water stored in those basins to make up the deficiency in the pumpage. This deficiency must be provided for by additional boilers and also by new engines of modern type and efficiency.

Similar conditions exist at the Roxborough works, where new engines and boilers are also needed, although, in this instance, we have been able to reduce the territory supplied from these works and thus keep the demands for water within the limits of the capacity of the pumps. This arrangement, however, is unsatisfactory, as it deprives a large area of the use of water from a recently constructed filter plant and which is rendered partly useless by reason of inadequate pumping facilities at the Roxborough Station.

The delay in making additions to the pumpage systems, necessitated by the growth of the City, thus overworking the machinery, has resulted in numerous and serious breakdowns of the pumps and engines at all the large stations, crippling the service to such an extent that, in some instances, months were required to make repairs.

Owing to the breaks, the total pumpage during the year 1904 has not increased as would have been the case had all the pumps been in continual service. Neither was the water in the reservoirs maintained at as high a level as desired, thus reducing the head, or pressure, in the distribution systems and depriving many citizens of a full and ample water supply.

In connection with the consumption of water I desire to say that if the increase should continue during the present decade in proportion to that ending in 1900, we will have to provide by 1910, for a pumping capacity of 550,000,000 gallons per day, which will exceed our present capacity by about 198,000,000 gallons, to pump which it will require five new pumps of 10,000,000 gallons each, and the City will then be in no better condition to furnish an ample supply of water than it is doing to-day.

The total consumption of water in 1904 was 120,153,801,452 gallons, making a daily average of 328,289,075 gallons, an increase over the previous year of 1,010,922 gallons per day. The average per capita consumption per day was 233.2 gallons, a decrease of 4.9 gallons from that of the previous year.

The total pumpage during the year was 126,181,026,489 gallons, an increase over 1903 of 2,165,091,820 gallons.

The cost of pumping 1,000,000 gallons of water 100 feet high during 1904 was $5.11, or 0.09 less than the preceding year.

There are at present laid in the City 1,466.77 miles of water mains, of which 21 miles 890 linear feet were laid in 1904. There are 14,017 fire hydrants in service, 370 of which were installed during the past year. There were 5,780 new water attachments made during the year.

By ordinance of Councils approved June 27, 1904, the Department was prohibited from installing water meters in any premises in the City of Philadelphia. Until more equitable rates are arranged, this Department is opposed to the use of meters, as the present rate of 30 cents per 1,000 cubic feet is grossly inadequate.

The recommendations of the Chief of Bureau for new boilers, engines, etc., at the Belmont, Belmont High Service, Roxborough and Roxborough High Service Pumping Stations, at an estimated cost of $705,000, have my approval and should be provided for at an early date.

These recommendations provide for the following work:

Belmont Pumping Station:

New Boiler house, ten boilers and stack	$105,000
New engine house and three 10-million gallon engines	200,000
One 36-inch pumping main	65,000

Belmont High Service Station:

One 5-million gallon engine	$ 26,000

Roxborough Station:

New boiler house, eight boilers and stack	$ 83,000
Four 5-million gallon engines	175,000
Coal shed	55,000

Roxborough High Service Station:

New boiler house and two boilers	$25,000
One 5-million gallon engine	26,000

A 16-inch service main is needed in the Kensington and Oxford turnpike, from the Frankford High Service Station to Courtland street, the estimated cost of which is $38,000.

Suitable quarters should be provided for the transaction of business in the Seventh Purveyor's District. Their headquarters at present are located on the west side of the Schuylkill river below South street, where they are frequently flooded during times of freshet in the river. The lot on Parkside avenue, below Belmont avenue, which has been set aside for this purpose, should be fitted up, as the necessary buildings, fence, etc., can be erected at a cost of $9,000.

Fairmount and Flat Rock Dams.—On February 22, there occurred one of the periodical freshets in the Schuylkill river, breaking up the ice and carrying it over the

Flat Rock and Fairmount Dams, both of which structures were badly damaged, as may be seen by the illustrations accompanying the report of the Chief of Bureau.

An examination of the Fairmount Dam showed that only the new structure, erected in 1872, immediately in front of the old dam, was damaged. The new structure was originally built as close to the face of the old dam as possible, the intervening space being filled with earth and concrete. Considerable leakage occurred, which, for years, the Bureau has made ineffectual efforts to stop. On June 15 Councils made an appropriation of $15,000 for repairs, which was found to be insufficient, and on November 26, an additional sum of $10,000 was provided. The work was placed under contract and satisfactory progress has been made.

While the repairs to the dam were in progress, there was an opportunity for checking the leakage referred to and this has now been reduced to a minimum.

The Flat Rock Dam was also seriously injured by flood and ice. An examination showed that a large section of the eastern end of the dam was washed out and before repairs could be made it would be necessary to draw the water in the Flat Rock pool to so low a level that it would not flow into the pump wells at the Roxborough works, which would have deprived the greater part of Manayunk and all of Roxborough, Germantown and Chestnut Hill of water.

To overcome the difficulty, the erection of centrifugal and rotary pumps on the river bank was commenced immediately and prosecuted day and night until completed. The object of these pumps was to lift the water from the river and force it into the pump wells in the engine houses, so that it could be pumped into the reservoirs in the usual manner. This pumping plant was completed in seven days and on March 4, 1904, the centrifugal pumps were started.

These pumps were in continuous service until April 26, when temporary repairs to the dam were completed and the river restored to its normal level. No difficulty was experienced in supplying all the water necessary to keep the engines in the old engine house in continuous service. To furnish water to the new pump well in the new engine house, a similar station was erected back of the new engine house directly over the intake. The total cost of this work, for labor and materials, was $15,241.97.

The Flat Rock Dam, being the property of the Schuylkill Navigation Company, the duty and expense of making the repairs fell upon that company. The new structure is now finished and no apprehension need be felt as to its stability.

Distribution.—The Bureau has been much hampered by lack of appropriation with which to purchase and lay service mains. Delay in this work is exceedingly discouraging to builders and restricts the development of suburban sections of the City. Ample appropriation should be made for this purpose, as the money expended is more than returned to the City by the collection of frontage charges paid by the owners of property fronting on the streets in which water pipes are laid.

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 years 1903 and 1904:

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.
Old Station	5	Compound Rotary	20,000,000	
Old Station	6	Simpson 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	4,500,000	
Belmont	2	Worthington Duplex	4,500,000	
Belmont	3	Worthington Duplex	6,500,000	
Belmont	4	Worthington Duplex	20,000,000	
Belmont	5	Holly Horrizontal Compound	10,000,000	
Belmont	6	Holly Horizontal Compound	10,000,000	
Belmont	7	Holly Horizontal Compound	10,000,000	65,500,000

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	7,00,0000
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	33,290,000
Total				499,040,000

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. Reservoir No. 4, Section 3		1836		
Lehigh	Sixth and Lehigh avenue	1852, 1871	114 "	5,720,000
Spring Garden	Twenty-sixth and Master streets	1844	120 "	12,950,000
Corinthian	Corinthian avenue and Poplar street	1852	120 "	27,341,000
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	Port Royal avenue and Hagy street	1903	410 "	8,000,000
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				1,494,117,000

Statement of Pumpage for the years 1903 and 1904.

	1903. Gallons.	1904. Gallons.
Pumped to Reservoirs..............................	124,015,934,669	126,181,026,489
Equal to gallons pumped 100 feet high...........	248,768,806,094	251,214,168,044

NOTE.—The "pumped to Reservoirs," etc., includes 5,794,865,874 gallons or 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 120,386,160,615 gallons.

The quantity stored in reservoirs on December 31, 1904, was 232,360,163 gallons more than that stored on December 31, 1903. This quantity deducted from the total pumpage from rivers makes the total consumption for 1904, 120,153,801,452 gallons. The cost of pumpage is based on the total pumpage. The consumption per capita is computed from the average consumption during 1904 of 328,289,075 gallons per day.

	1903. Gallons.	1904. Gallons.
Pumped by water power..........................	7,736,381,403	6,965,281,094
Pumped by steam power..........................	116,279,553,266	119,215,745,395
Largest quantity pumped in twenty-four hours.	384,393,464	389,485,408
Smallest quantity pumped in twenty-four hours..	213,150,635	274,725,827

Year.	Average daily consumption.	Average consumption in gallons per capita per day.*	Cost of one million gallons pumped one hundred feet high.
	Gallons.	Gallons.	
1903..........	327,278,153	237.5	$5 20
1904..........	328,289,075	233.2	5 11

Estimating the population at *1903, 1,378,298; *1904, 1,407,690.

The cost of pumping one million gallons 100 feet high during 1904 was $5.11, or $.09 less than during the previous year. About five and one-half per cent. of the total pumpage was by water power, the turbine wheels using 208,958,432,820 gallons to pump 6, 965,281,094 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										
		Miles.	Feet.	Feet.	New Style.	Old Style.	Total.	New Style.	Old Style.	Total.		
1903	136,391	25	4,391	†15,254	348	......	348	190	....	190	13,647	5,637
1904	111,770	21	890	‡28,719	370	......	370	229	1	230	14,017	5,7[illegible]0

Total pipe laid, 1,466.77 miles.
*Adds nothing to feet in ground.

† 1903. Pipe taken up is less than quantity relaid 1,382 feet.
‡ 1904. Pipe taken up exceeds quantity relaid 462 feet.

Statement of Receipts and Expenditures for the years 1903 and 1904

	Receipts, 1903.	Receipts, 1904.
Receipts from water rents	$3,275,997 53	$3,368,408 06
Receipts from fractional rent	68,992 21	66,156 60
Receipts from water pipes	128,265 82	85,003 76
Receipts from City Solicitor's office	43,555 83	87,887 35
Receipts from penalties	31,512 60	32,539 27
Receipts from delinquent rent	31,041 32	86,607 50
Receipts from Chief Engineer's office	7,709 19	8,627 62
Receipts from searches	3,021 75	2,986 75
Receipts from delinquent penalties	4,657 72	5,454 22
Total	$3,594,753 97	$3,643,671 13
	Exp'nditures, 1903.	Exp'nditures. 1904.
Current expenses	$1,463,065 14	$1,526,954 06
For extensions	6,074,269 48	3,392,676 32
Total	$7,537,334 62	$4,919,630 38

Bureau of Filtration.

Work on the Improvement, Extension and Filtration of the Water Supply has been prosecuted with much vigor during the past year and many important branches of the work were put in commission.

There has been appropriated to date for this great improvement $22,500,000 from loans and direct taxation, which has been expended as follows:

Paid on completed contracts	$4,885,137.49
Paid on uncompleted contracts	9,227,209.01
Limits of uncompleted contracts, less payments	4,458,115.99
Land damages	876,435.55
Expenses, supplies, advertisements, etc	163,316.77
Inspections by contract	13,758.06
Salaries and wages of engineering staff	666,848.84
Expended by Bureau of Water	1,013,149.89
Damages to property on account of pipe laying	16,816.26
Repaving over pipe trenches	81,264.51
Available balance	1,097,947.63

There were 471,738 acres of land appropriated for filter and other works.

Lower Roxborough Filters.—The filters at Lower Roxborough Station were in continuous operation during 1904, an average of 8,430,000 gallons being filtered daily at a cost of $4.56 per million gallons of water.

The capacity of the station is 12,000,000 gallons per day, with the co-operation of the preliminary filters, but owing to inadequate pumping machinery at Shawmont, this capacity has not often been attained. When this quantity of water is filtered, it is estimated the cost of operation will be reduced to $3.22 per million gallons.

Upper Roxborough Filters.—During the past year we have filtered at this station a daily average of 9,530,000 gallons per day, at a cost of $5.32 per million gallons.

As at the Lower Roxborough plant, insufficient pumpage facilities at Shawmont prohibited a full utilization of the filter capacities at the Upper Roxborough Station, at which station it is possible to filter 20,000,000 gallons of water daily at a greatly reduced cost proportionately for maintenance.

In wards where filtered water is being used, there is a marked difference of the devastating effect of typhoid fever over those wards which are not so supplied, which indicates the great desirability of distributing the filtered water to a larger portion of the City than is now receiving same.

Belmont Filters.—The first of these filters were put in operation during March of 1904; all were in actual service on September 10, 1904. The filter plant is now in active operation, but the full capacity will not be reached until the preliminary filters are completed.

The daily average amount of water filtered at the Belmont Station was 26,600,000 gallons, at a cost of $3.58 per million gallons.

The work on the preliminary filters at the Belmont Station was started late in the season. The excavation is practically completed and it is thought within six months after commencing operations in the spring of 1905, the filters will be in operation.

From experiments conducted along this line, we anticipate being able to operate the preliminary filters at the rate of 80,000,000 gallons of water per acre per day.

The work done under Contract No. 66, Extension of Pipe Distribution System, embraced the laying of pipe of sizes 24-inch, 20-inch and 16-inch, to supply filtered water from the Lower Roxborough Filters to portions of the Twenty-eighth and Thirty-eighth Wards and the laying of 30-inch, 20-inch and 16-inch mains on various streets to afford an improved pressure in the business section of the City, which, for a long time, has suffered by reason of the poor supply.

On Contract No. 25, Torresdale Filters, the work is practically completed. This included the construction of fifty-five filters and appurtenances, and it is thought that what little remains to be done can be finished in ninety days. All the filters and the clear water basin have been tested for water tightness and accepted.

The work on Contract No. 54, Queen Lane Contingent of Filters at Torresdale, is of a similar character to that done under Contract No. 25 and is approaching satisfactory completion. Of the ten filters embraced in this contract, three have been accepted.

Work on the preliminary filters at Torresdale was not started until November 15, 1904, so that but an inconsiderable amount of work was done before severe winter weather set in.

Torresdale Conduit, Contract No. 14.—This contract was completed during the past year and at no time was there any indication of a lack energy on the part of the contractor to forward the work to the earliest possible completion.

Considerable delay was occasioned by the various conditions that were met from time to time during the progress of the work.

In the report of the Chief Engineer of Bureau of Filtration will be found an enlarged description of this great work.

Oak Lane Reservoir, Contract No. 27.—Work upon this contract was finished so far as construction features are concerned, during the year 1904. All that remains to be done at the present time to complete the contract for acceptance by the City, is the test for water tightness of the two divisions of the reservoir. These tests are now in progress.

Lardner's Point Pumping Station No. 2.—This contract, with the exception of some minor details, has been completed for the past six months and it is hoped that by the end of January, 1905, the work will be in condition to admit of the payment of the final estimate to the contractor.

Lardner's Point Pumping Station No. 3, Contract No. 68.—Bids for this work were received during the year 1904 and work has been progressing so satisfactorily, that 56 per cent. of the contract is completed.

Lardner's Point Pipe Distribution System, Contract No. 28.—The operations on this contract were continued during the year and nearly all possible work performed within the limits of the present contract. To complete the work contemplated under this contract will require an additional sum of about $283,000.

In the comprehensive report of the Chief Engineer will be found much valuable and interesting data in relation to this great undertaking as well as a description of the work necessary to be done to complete the system of filtration.

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 1904:

Item.	Description.	Quantity.	Lower Roxborough.	Upper Roxborough.	Torr Coı
1	Excavation	Cubic yards.	66,257	134,157	8
2	Embankment	Cubic yards.	22,000	59,500	....
3	Puddle	Cubic yards.	8,750	17,060	....
4	Concrete	Cubic yards.	12,974	24,336	2
5	Brick masonry	Cubic yards.	111	302	1
6	Rubble masonry	Cubic yards.	....	....	....
7	Cast iron pipe	Tons.	220	1,005	....
8	Special castings	Tons.	50	170	....
9	Stop valves, 4-inch to 72-inch.....	Each.	55	{ 1 sluice, 63 valves. }	. .
10	Cast iron fixtures, etc	Pounds.	43,021	52,860	1
11	Miscellaneous steel	Pounds.	70,040	131,512	3
12	Filter drains	Linear feet.	6,885	15,875	......
13	Filter gravel	Cubic yards.	4,298	9,490	......
14	Filter sand	Cubic yards.	13,247	26,367	......
15	Granolithic pavement	Square yards.	4.742	10,200	......
	Remarks	....	....	....	......

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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	A Testing Station.............	Thomas Parker.....	Feb. 27, 1900..	Mar. 6, 1900...	$9,000 00	$11,653 54	July 13, 1900.
1 Sup.	Extension to Testing Station.	Thomas Parker.....	....	May 7, 1900...	5,000 00		
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	165,784 49	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.
14	Torresdale conduit............	D. J. McNichol.	May 28, 1901..	Oct. 4, 1901....	$1,350,000 00	$1,245,153 48	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	1,969,136 18	Oct. 10, 1904.
17	Extension of Distribution 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	21,332 09	March 29, 1904.
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	10,490 00	Jan. 25, 1904.

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...	48,000 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	4,717,167 05	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	$446,159 46	Not completed
28	Lardner's Point Distribution.	Daniel J. McNichol.	Feb. 16, 1903..	Mar. 4, 1903...	1,300,000 00	1,180,660 43	Not completed.
29	Lardner's Point Pumping Station, No. 2...............	Geo. C. Deitrich.....	Sept. 17, 1902.	Oct 4. 1902 ...	565,000 00	466,342 26	Not completed.
30	Lardner's Point Pumping Station, No. 2...............	....	Feb. 26, 1902..	Readvertised as Contract No. 29.			
32	Addition to Testing Station at Sp. Garden Pump'g 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.
34	Torresdale Intake............	D. J. McNichol......	Aug 2, 1904...	Aug. 8, 1904 ..	180,000 00	....	No payments made.
37	Preliminary Filters, Lower Roxborough................	Maignen Filt't'n 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	$47,076 48	April 8, 1904.
38	Prelim'y Filters for Belmont.	....	Feb. 18, 1904..	No award			
39	Prelim'ry Filters for Belmont and Torresdale..............	D. J. McNichol......	Nov. 1, 1904...	Nov. 22, 1904..	1,580,000 00	13,262 40	Not completed.
40A	Low Service Drainage for the Belmont Filters..............	Camden Iron Wks..	June 30, 1903..	July 27, 1903..	7,000 00	7,298 44	Dec. 30, 1904.
40B	Sand Washer, Pumps and Boilers for Belmont Filters.	I. P. Morris Co......	June 30, 1903..	July 24, 1903..	29,000 00	16,543 12	Not completed.
42	Administration Building and Pumping Station at Belmont Filters..................	H. B. Shoemaker & Co..................	June 30, 1903..	July 17, 1903..	55,000 00	51,488 36	Sept. 24, 1904.
44	Electric Lighting System for the Upper and Lower Roxborough Filters..............	Pa. Equipment Co..	Mar. 24, 1903..	Apr. 22, 1903..	15,500 00	14,577 48	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.
45	Electrical Generators, Driving Engines, etc., for Lardner's Point Pumping Station, No. 2	J. F. Buchanan & Co	Feb. 18, 1904	Aug. 5, 1904	$9,000 00	....	No payments made.
46	Electric Lighting System for the Belmont Filters	Pa. Equipment Co.	June 30, 1903	July 21, 1903	20,000 00	$13,773 37	Not completed.
48	Electric Traveling Crane for Lardner's Point Pumping Station, No. 3	Alfred Box Co.	Aug. 2, 1904 Nov. 1, 1904	No award. Nov. 17, 1904	6,500 00	....	No payments made.
49	Filtering Materials and Underdrains for the Belmont Filters	Daniel J. McNichol.	Feb. 16, 1903	March 4, 1903.	365,000 00	349,736 91	Sept. 28, 1904.
50	Filtering Materials and Underdrains for the Torresdale Filters	Daniel J. McNichol	Feb. 16, 1903	March 4, 1903.	500,000 00	167,620 00	Not completed.
54	Queen Lane Conting'nt—Torresdale Filters	D. J. McNichol	Feb. 18, 1904	July 28, 1904	570,000 00	467,873 45	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.
59	Sand Washers and Ejector Pipes for Torresdale Filters...........................	E. M. Nichols........	Aug. 11, 1904..	Sept. 8, 1904..	$37,000 00	$21,397 77	Not completed.
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	2,700 00	Aug. 4, 1904.
66	Pipe Line "U"—Extension of the Roxborough Distribution System...................	J. H. Louchheim....	Sept. 4, 1903.. Feb. 18, 1904..	No award made. Aug. 3, 1904.	110,000 00	85,474 83	Not completed.
67	Pumping Machinery for Lardner's Point Pumping Station, No. 2................	Holly M'f'g. Co....	Feb. 18 1904..	Aug. 18, 1904.	440,000 00	....	No payments made.

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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.
68	Lardner's Point Pumping Station No. 3..............	Ryan & Kelly.......	Feb. 18, 1904..	Aug. 17, 1904..	$350,000 00	$155,663 68	Not completed.
73	Washers, boxes and pipes for Foundation Bolts of Engines at Lardner's Point Pumping Station, No. 3...	J. Alfred Clarke.....	Aug. 15, 1904..	Aug. 29, 1904..	2,050 00	2,048 25	Nov. 17, 1904.
74	Removal of Laboratories from Spring Garden Testing Station to Belmont Filters....................		Aug. 15, 1904.. Sept. 6, 1904...	No Award...	Work done	by Water	Bureau.
75	Furnishing Electric Ducts for Torresdale Filters......	Standard Vitrified Conduit Co........	Aug. 15, 1904..	Sept. 2, 1904..	1,000 00	924 75	Oct. 10, 1904.
76	Furnishing and placing Ventilator Screens for Torresdale Filters..........	De Witt Wire Cloth Co..................	Aug. 15, 1904...	Aug. 30, 1904..	7,750 00	7,619 96	Dec. 22, 1904.

Director's Office.

The work of this office increases from year to year, in keeping with the increase in operations of the several Bureaus of the Department. My assistant and the clerks are at work early and late and the business of the office is conducted intelligently and with despatch.

The work of the Official Photographer, who is attached to this office, grows in volume and proves itself more valuable to the City each year.

The following table shows the work performed during the year:

Photo negatives made	904
Photo prints made	2,385
Prints mounted	837
Lantern slides made	110
Negatives indexed	386
Enlargements made	54
Blue printing, square feet	117,000

This work was done at a cost to the City of about \$4,500, while if done under contract would have cost \$6,000, a saving of \$1,500 and the service given is better, as no tracings for blue printing leave the building, thus saving a risk of damage or loss by fire. In addition to being part of the records, the many negatives taken are invaluable to the City in case of damage suits arising from excavations for sewers, etc.

PUBLIC WORKS DURING THE YEAR 1904

-ansfers from.	Balance Available, 1905.	Total.	Amount Merging.	Receipts.	Number of Employes Dec. 31, 1904.
....	$5,000 00	$32,106 67	$63 33	....	11
$1,000 00	....	120,426 80	3 20	$2,319 46	24
....	....	10,000 00	....	12 00	6
529,980 18	1,399,692 95	3,799,240 81	937 77	212,563 31	109
....	....	....	....	25,822 68	12
....	....	368,886 08	252 92	....	8
32,677 98	....	1,580,587 40	1,779 78	....	17
14,393 61	2,763,609 75	3,942,701 38	410 73	131,337 10	270
....	....	....	....	....	14
23,480 32	1,984,639 60	6,877,750 30	7,913 89	3,643,671 13	1,218
611,000 00	3,649,512 50	5,079,000 00	....	....	184
212,532 09	$9,752,454 80	$21,810,699 44	$11,361 62	$4,015,725 68	1,873
330,893 08	6,700,238 74	$20,247,074 57	$64,794 26	3,920,266 57	1,807

‡ Also Included in the appropriation and in the expenditures of the Bureau of Water.

The following is a summary of the expenditures of the Directors office for the years 1903 and 1904:

Items.		1903.	1904.
1	Salaries	$22,720 00	$24,320 00
2	Horsekeep	1,399 98	1,400 00
3	Printing, stationery, etc	3,299 87	....
4	Advertising, incidentals, etc	....	1,450 00
5	Fitting up room for Official Photographer	2,498 75	....
	Total	$29,918 60	$27,170 00

I desire to express my thanks for the valuable assistance given me at all times and to make acknowledgement of the splendid service rendered by the Chiefs of the several Bureaus of this Department.

Respectfully submitted,

PETER E. COSTELLO,

Director.

ANNUAL REPORT

OF THE

BUREAU OF WATER

FOR THE YEAR 1904

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,
John R. Gorman,
Andrew P. Peterson,
James H. Hand, Jr.,
Charles B. F. Waller,
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 Conner,
Harrison D. Bates,
Edw. Blum,
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—Jos. F. Ogden.
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—Peter Carrigan.
Foreman of Repairs—W. W. Wellington.
Hydrant Inspector—James Preston.
Watchman—John H. Peterson.

SECOND DISTRICT OFFICE, 918 Cherry Street.

Purveyor—Joel M. Paullin.

Clerk—John G. Campbell.
Assistant Clerk—Albert Mancher.
General Foreman—Fred. J. Gheen.
Foreman of Repairs—Edw. Homan.
Hydrant Inspector—Robert S. Hughes.
Watchman—J. D. Kirkpatrick.

THIRD DISTRICT OFFICE, Beach St. and Susquehanna Ave.

Purveyor—Charles J. Lowry.

Clerk—Edwin Green.
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 H. Zepp, Jr.
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.
Foreman of Repairs—David Anderson.
Watchman—John C. Bishop.
Watchman—Jacob H. Boon.

ANNUAL REPORT

OF THE

BUREAU OF WATER

FOR THE YEAR 1904

EIGHTEENTH ANNUAL REPORT

OF THE

BUREAU OF WATER

ONE HUNDRED AND THIRD ANNUAL REPORT

OF

OPERATIONS CONNECTED WITH THE CITY WATER SUPPLY

Philadelphia, January 19, 1905.

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

DEAR SIR:—I have the honor to present herewith my annual report of the general condition of, and the work performed by, the Bureau of Water for the year ending December 31, 1904:

The water supply has been maintained throughout the City as effectively as the facilities at my command would permit.

Serious difficulty was experienced in supplying water to the older section of the City, between Vine and South streets and the Delaware and Schuylkill rivers. A failure of the supply in that locality was only prevented by resorting to the expedient of partially shutting it off, by closing the valves on some of the mains and partly closing others, to save, as much as possible, the water pumped during the night for use in daytime; yet, notwithstanding these efforts, there were many justifiable complaints of a shortage of water, causing inconvenience to householders, business establishments and manufactories, also a considerable risk from fires, losses from which were, providentially, small, owing to their limited number and to prompt extinguishment in incipient stages.

No improvement has been effected in the quality of the water supplied to that section. On the contrary, it has been deteriorating from year to year, so that at times of freshets in the rivers it is practically unfit for use unless it is first "settled," filtered, or treated in some manner to clarify it; and when, in addition to the objectionable quality of the water, there is added considerable difficulty in obtaining it, even in the most limited quantities, the conditions become unbearable, and many of the wealthier residents threaten to move permanently to their country homes unless some improvement is effected.

The gravity of this condition became so acute early in the year that, pending the completion of the construction of the Torresdale filter plant, which is eventually to supply that section of the City with filtered water, provision was made, under the supervision of the Bureau of Filtration, to lay additional mains and to make the necessary pipe connections to supply a limited quantity of water from the Wentz Farm reservoir. This work was not completed until the latter part of the year, and it is not as yet available for use, owing to the delay in operating the new engines at the

Lardner's Point pumping station, which are necessary to furnish the additional water as proposed.

The water supply in West Philadelphia has been ample in quantity, and, during the latter part of the year, very much improved in quality.

Pumpage from the Belmont Works to the new sedimentation basins was begun, and on April 1 the first filtered water (about 3,000,000 gallons per day) was turned into the West Philadelphia district, mixing with raw water from George's Hill reservoir.

As the filter basins were completed and put into service from time to time, the supply of filtered water was increased until June 3, when a connection was made between the 48-inch supply main, at Belmont and Monument avenues, to the old 20-inch supply main extending south in Belmont avenue, and through this pipe the section of West Philadelphia, east of Thirty-eighth street, has been receiving filtered water. It was not, however, until December 13 that West Philadelphia was entirely supplied from the Belmont filter plant.

It was found, in this connection, that while the pumps at the Belmont works were able to pump all the water necessary to supply West Philadelphia from George's Hill reservoir, they were unable to deliver a sufficient quantity of water into the sedimentation basins at the Belmont filter plant, which are at an elevation of 67 feet higher than George's Hill reservoir, and there was, therefore, a steady depletion of the water stored in those basins to make up the deficiency in the pumpage. This deficiency must be provided for by additional boilers and also by new engines of a modern type and efficiency, as hereafter stated in my estimate of the improvements and extensions required by this Bureau.

Similar conditions exist at the Roxborough works, where new engines and boilers are also needed, although, in this instance, we have been able to reduce the territory supplied from these works, and thus keep the demands for water within the limits of the capacity of the pumps. This arrangement, however, is unsatisfactory, as it deprives a large area of the use of water from a recently-constructed filter plant, and which is rendered partly useless by reason of inadequate pumping facilities at the Roxborough pumping station.

In my report for last year I stated:

"The delay in making important additions to the pump-
"age 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 cor-
"responding inadequate water supply, thus inconvenienc-
"ing and annoying water takers and retarding, instead of
"stimulating, enterprise throughout the several localities
"most affected."

The above predictions have been abundantly verified by numerous and serious breakdowns of the pumps and engines at all our large stations, crippling the service to such an extent that in some instances weeks, and even months, were required to make the repairs.

Owing to these breaks the total pumpage during 1904 was not increased, as would have been the case if all the pumps had continued in good condition. Neither was the water in the reservoirs maintained at as high a level as desired, thus reducing the head, or pressure, in the several distribution systems, and by reason thereof depriving many citizens of a full and ample supply of water.

The following table shows the average daily pumpage from the Delaware and Schuylkill rivers during the years 1895 and 1904, a period of ten years:

Average Pumpage per Day at the Several Pumping Stations, 1895–1904.

Years.	Fairmount.	Spring Garden.	Belmont.	Queen Lane.	Roxborough.	Frankford.	Totals.
1895	20,786,830	188,915,593	23,116,379	359,276	17,029,941	12,911,930	213,199,949
1904	19,030,823	189,324,495	40,605,755	70,913,134	25,053,425	33,996,304	328,923,936
Increase	.....	408,902	17,489,376	69,604,858	8,023,484	21,084,874	115,723,987
Decrease	1,756,007	.....	.....	.....	.....	.....	1,756,007
Million gallons per day increase in ten years							113,967,980

As a Further Illustration of the Rapid Growth of Important Features Pertaining to the Water Works, the following Table is Submitted:

	1860.	1870.	1880.	1890.	1900.	*1904.
Population	565,529	674,022	847,542	1,046,964	1,293,697	1,407,690
Per cent. of increase	....	19.1	25.8	23.5	23.6	8.1
Average daily pumpage	20,400,000	36,700,000	57,700,000	137,200,000	287,200,000	328,900,000
Per cent. of increase	....	80	58	138	109	14
Per capita consumption	36	55	68	131	222	233
Per cent. of increase	....	53	24	93	69	5
Reservoir capacity	90,298,480	137,894,480	195,414,200	869,288,814	1,417,860,000	1,494,117,000
Per cent. of increase	....	53	42	345	63	5.4
Pumpage capacity	....	96,000,000	127,000,000	185,290,000	405,540,000	439,040,000
Per cent. of increase	....	....	32	46	109	8.5
Miles of pipe in service	....	497.4	746	959.5	1,338.4	1,466.8
Per cent. of increase	....	....	50	28	39	9.6
Total collections of water rents, etc	$558,531 53	$935,370 96	$1,446,341 53	$2,381,037 70	$3,249,195 24	$3,643,671 13
Per cent. of increase	....	68	55	64	37	12
Total expenditures during each decade	....	$5,414,816 07	$8,949,325 04	$9,441,510 33	$16,717,275 74	$6,182,521 96
Per cent. of increase	....	....	65	6	78	

* Four years.

Both of the above tables are worthy of careful consideration, for they show conclusively the rapid growth of our water system, and that if the increase in the consumption (including waste of water) should continue during the present decade in proportion to that ending in 1900 (and I have every reason to believe that it will), it will then be necessary to provide, by the year 1910, for a pumping capacity of 550,000,000 gallons per day, which would exceed our present theoretical pumping capacity by 110,000,000 gallons, and our practical pumping capacity by about 198,000,000 gallons; or, in other words, during the next six years we shall require five new pumps of 10,000,000 gallons capacity each, and will then be in no better condition to furnish an ample supply of water to the City than we are doing to-day.

I have carefully considered this question of increased pumpage, and have concluded that in view of the great expenditures that will be required for additional pumps, engine and boiler houses, supply and pumping mains, it would be far better to reduce the consumption of water by the adoption of the "meter system" for regulating the charges to consumers.

Meters.

By inclination I am personally opposed to the use of water meters, if for no other reason than that they are, to a greater or less extent, annoying to the water works engineer, and, owing to the variation in the amount of the meter rent bills, to the consumer also. Moreover, I do not believe that any engineer, or any consumer who could obtain fair schedule rates, would desire to use water meters if it were possible for him to get along without them, and this is the point upon which the whole matter hinges, for there is no other device nor means by which the charges for water can be so fairly made for water consumed, nor any other contrivance that will so effectively check the waste of water by making the consumer pay for it.

All matters relating to the adoption of water meters in this City must be similar to those applying to all other large cities, and it will be found here, as has been the case elsewhere, that, for financial reasons, it is not practical to provide and maintain a satisfactory water supply without water meters.

There are many arguments for and against the use of the meter system which are not without merit on either side, but perhaps no final conclusion on this subject will ever be reached until decided by the logic of necessity.

Under the system of charges based upon the character and number of openings from which water may be drawn, and generally known as "schedule rates," the consumption and waste of water may be unlimited. There is no incentive to prevent waste, unless it should happen to cause annoyance to the occupants of the premises, although, even in such cases, it is often allowed to continue for a long time before applying the remedy.

The effect of "schedule rates" is to divide consumers into three classes, viz.:

First. Those who are charged a fair rate for the quantity of water they consume.

Second. Those who pay for more water than they consume, and

Third. Those who consume far more water than they pay for.

From experiments made, these three classes may be divided into percentages of the whole population, *approximately* as follows:

First Fair Charge.	Second Overcharged.	Third Undercharged.
3%	80%	17%

The consumption of water by the three divisions named, allowing for "slip" of pumps and the estimated quantity of water used for municipal purposes, is *estimated* as follows:

	First.	Second.	Third.
Per capita consumption....	110 gals.	65 gals.	635 gals.
Consumption in M. gallons per day	5 M. gals.	73 M. gals.	153 M. gals.
Percentage of total consumption	2.2	31.6	66.2
Approximate receipts	$109,310 00	$2,914,937 00	$619,424 00
Receipts per M. gals...... .	$70 70	$117 87	$3 84

From the above statement it is apparent that the "schedule rates" are unfair to about 80 per cent. of the water-takers, who consume only from 31 to 32 per cent. of the total water supply and yet pay rents to the amount of $2,914,937, or at the rate of $117.87 per million gallons, while 17 per cent. of the population consume and waste over 66 per cent. of the total supply and only pay rents to the amount of $619,424, or at the rate of $3.84 per million gallons, a disproportion of rates and consumption that is not only unjust to the careful and economical citizen, but, by increasing the burden of maintaining the works, it also deprives him of the benefits of the proper improvement and extension of the pumpage and water systems, which, with each succeeding year, is necessary to provide for the additional demands for water.

The inequality of the charges by "schedule rates" is admitted by all who supply and consume water under this method of determining the ratings to be paid, and while this system of rating is unfair and unjust, as shown, and for moral and business reasons should be corrected, the greatest objection to it is owing to the lack of every restraint upon the waste of water, which becomes so great that it paralyzes every effort on the part of the Bureau to maintain the necessary pressures on the mains and furnish a satisfactory supply to the people.

For many years every chief of this branch of the City service has stated eloquently, in his annual reports, the difficulties experienced by reason of the unnecessary (often called criminal) waste of water, and they all advocate the same remedy—the application of the meter.

At the present time it is absolutely necessary that immediate steps be taken either to increase the pumping capacity, or to restrict the waste of water; otherwise the present unsatisfactory conditions will increase and become extremely critical to water consumers.

In 1901 ten new pumping engines were put into service, and already within four years nine new pumps are needed with additional boilers, boiler houses, pumping and supply mains, etc., in order to provide for the demands at present and in the immediate future.

Large sums of money are necessary to furnish this machinery and appurtenances, and taking into consideration the rate of increase of the consumption, it is probable that other large sums will be needed for extending the filter plants, which, with the additional operating expenses, will require an outlay that, in the present condition of the City's finances, will be exceedingly difficult to obtain.

There is no question that provision must soon be made for additional machinery, which, with the unrestricted use of water, will give relief for a short period of time, or that some action must be taken to restrict the inordinate waste of water. This can be most effectually and economically accomplished by adopting the meter system, which will not only justly apportion the rates to be paid by the consumers, but, by greatly reducing the waste of water, will render the present pumping facilities, reservoirs, mains and filter plants adequate to supply all sections of the City for many years to come.

I am of opinion, however, that in the event of the adoption of the meter system, the charge per 1,000 cubic feet of water should be increased from 30 cents, the present rate, to 60 cents; otherwise there would be a considerable reduction in the revenue as compared with the receipts from schedule rates.

Consumption.

The total consumption of water during 1904 was 120,153,801,452 gallons, or at an average rate of 328,289,075 gallons per day; an increase as compared with that of 1903 of 1,010,922 gallons per day.

The average per capita consumption was 233.1 gallons, a decrease as compared with that of 1903 of 4.4 gallons.

The following table shows the average daily pumpage of water (computed from the pump registers) to the several distribution systems named, and the increase and decrease in each section:

Distribution System.	Average daily consumption in M. gallons.	Average increase or decrease in M. gallons per day.	Percentage of increase or decrease.
East Park	154,432,075	— 1.897	— 1.22
Belmont	40,606,000	+ 1.656	+ 4.25
Queen Lane	75,728,000	— 2.846	— 3.62
Roxborough	25,053,000	+ 1.847	+ 7.96
Frankford	32,470,000	+ 2.275	+ 7.53

There was a decrease in pumpage at the Fairmount Station of 2.3 million gallons per day, which was partly due to inability to run the turbines at times on account of low water in the Fairmount pool, and to the shutting down of Nos. 5 and 9 wheels for repairs.

The pumpage at the Spring Garden works was practically the same as during the preceding year, and, combined with that at Fairmount, together with water drawn from the Frankford system, makes a total average consumption per day, in the East Park system, of 154,432,075 gallons, or about 227.8 gallons per capita.

In the Belmont, or West Philadelphia, district, the average daily pumpage was 40,606,000 gallons per day, an increase of 1,656,000 gallons per day, and the per capita rate 252 per day.

A large part of the additional pumpage of water in this district is probably due to sand washing, etc., at the filter plant.

In the Queen Lane system there was a decrease in the pumpage of 3.62 per cent., due entirely to disabled machinery.

The deficiency in pumpage at the Queen Lane station was made up by direct pumpage from the Spring Garden works, Nos. 8 and 10 engines at the latter station being used for that purpose.

The per capita rate of consumption in the Queen Lane district was 237 gallons, a slight decrease as compared with that of 1903.

At the Roxborough pumping station there was an increase of nearly 8 per cent. in the pumpage, and the per capita rate was 237.9 gallons. In this district, also, the greater part of the additional water pumped was for sand washing, etc., at the filter plant.

The increase in pumpage at the Frankford works was 7.5 per cent., nearly all of which was diverted into the East Park system.

The per capita rate of consumption in the Frankford distribution system was 251 gallons.

Revenue Collected.

The total collections during the year 1904 and the increased amount, as compared with that for 1903, were as follows:

Water rents	$3,167,470 53
Meter rents	290,969 63
Frontage	85,003 76
Amount collected by City Solicitor	37,887 35
Penalties	37,993 49
New connections	12,732 00
Searches	2,986 75
Miscellaneous	8,627 62
Total collections 1904	$3,643,671 13
Total collections 1903	3,594,753 97
Net increase 1904	$48,917 16

Expenditures.

Expenditures for maintenance, service mains, etc., were	$1,526,954 06
Expenditures for improvements and extensions	3,392,676 32
Total expenditures 1904	$4,919,630 38
Total expenditures 1903	7,329,613 87

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, 1904, was $87,442,321 39

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 $68,748,113 38

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, 1904, was $18,694,208 01

Extensions.

I have already referred to the necessity for increasing boiler and pumpage capacities of the Belmont and Roxborough stations, and submit the following statement covering those, as well as other, improvements for which immediate provision should be made.

Belmont Pumping Station.

New boiler house, ten boilers and stack........	$105,000
New engine house and three 10,000,000 gallon engines..............................	200,000
One 36-inch pumping main.................	65,000

Belmont High Service Station.

One 5,000,000 gallon engine	$26,000

Roxborough Station.

New boiler house, eight boilers and stack......	$83,000
Four 5,000,000 gallon engines..............	175,000
Coal shed	55,000

Roxborough High Service Station.

New boiler house and two boilers.............	$25,000
One 5,000,000 gallon engine.................	26,000
A 16-inch service main is needed in the Kensington and Oxford pike, from Frankford High Service Station to Courtland street; estimated cost	38,000

No adequate provision has been made for office, yard and other necessary conveniences for the transaction of business in the Seventh Purveyor's District. Their headquarters are now located on the west side of the Schuylkill river below South street, where they are flooded during times of freshet in the river, and otherwise inconvenienced for want of room, housing, etc.

I earnestly recommend that suitable quarters be furnished them, on the lot which has been set aside for this purpose, on Parkside avenue above Belmont avenue, the improvements thereon to consist of an office, stable, storehouse, sheds, fencing, etc.; estimated cost.......... $9,000

Total $752,000

In accordance with the request of the Fire Underwriter's Association, to have the high pressure fire service system extended so as to cover all streets running north and south, east of Broad street, and from Walnut to Race streets, I recommend for this purpose an appropriation of $100,000.

Fairmount and Flat Rock Dams.

In my report for last year I stated:

"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." * * * *

"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 safeguard 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."

On February 22 there occurred one of the usual periodical freshets in the Schuylkill river, breaking up the ice and carrying it over the Flat Rock and Fairmount dams, both of which were badly damaged, as may be seen by the following illustrations.

Examination of the Fairmount dam showed that only the new structure, erected in 1872, immediately in front of the old dam, was injured, the old dam remaining intact, and there was, therefore, no serious interruption of the pumpage by reason of low water in the Fairmount pool.

The new structure was originally built as closely to the face of the old dam as conditions would permit, the intervening space being partly filled with earth, and the balance of the distance, to the top of the dam with concrete.

Either by settlement, or from the pressure of the water, the new dam had receded a short distance from the old structure, leaving an opening between the concrete and the face of the old dam, through which considerable water found its way and passed under the concrete, and thence through the cribbing of the new structure to the river below.

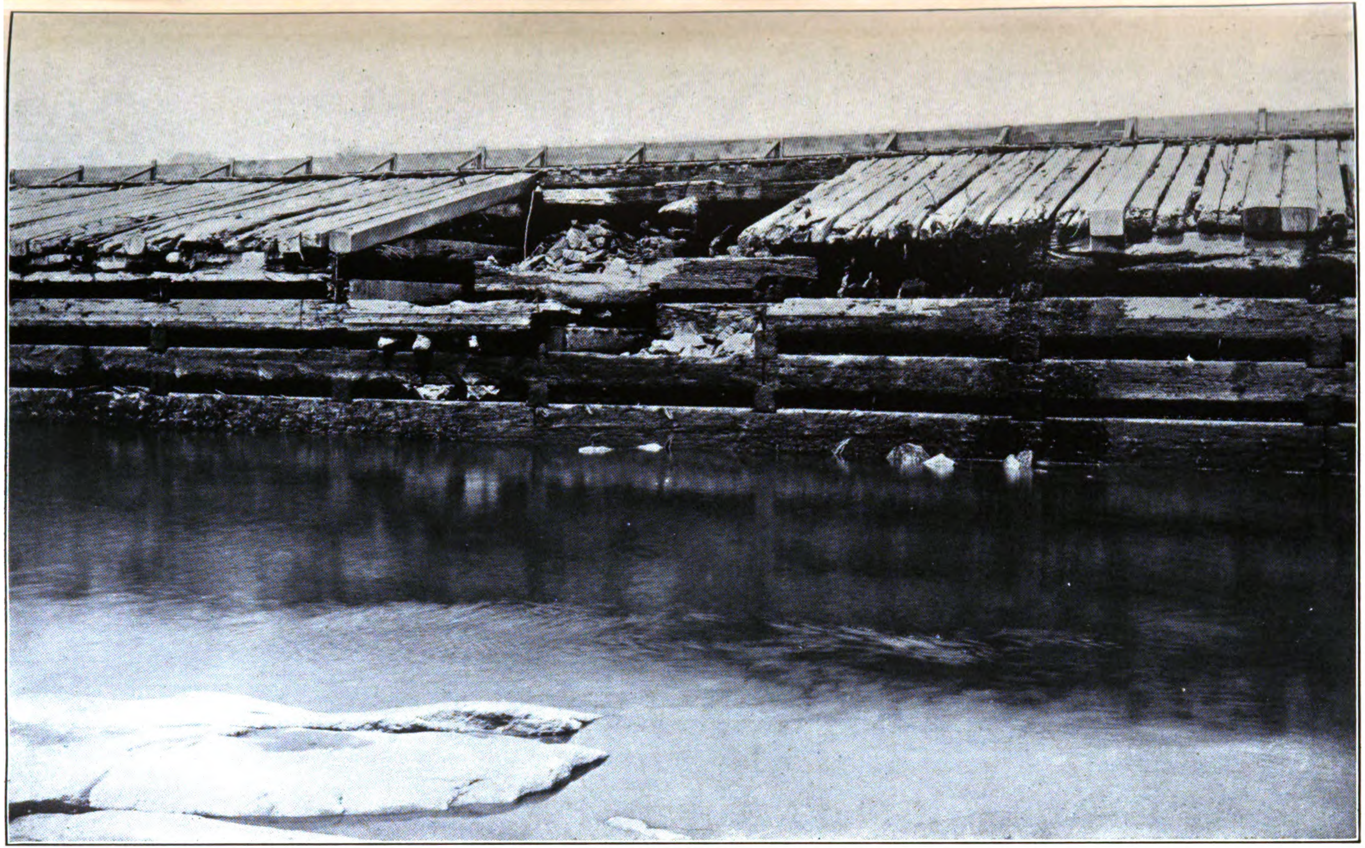
For years this Bureau has made ineffectual efforts to stop the leakage, which was at times of such volume that the Fairmount pool was drawn down below the boating level, and the City has frequently been embarrassed by law suits brought by the Schuylkill Navigation Company on account of the low water interfering with the navigation.

Some of the cribbing of the damaged structure was found to be decayed, and nearly all the timber sheathing on top of it needed renewing.

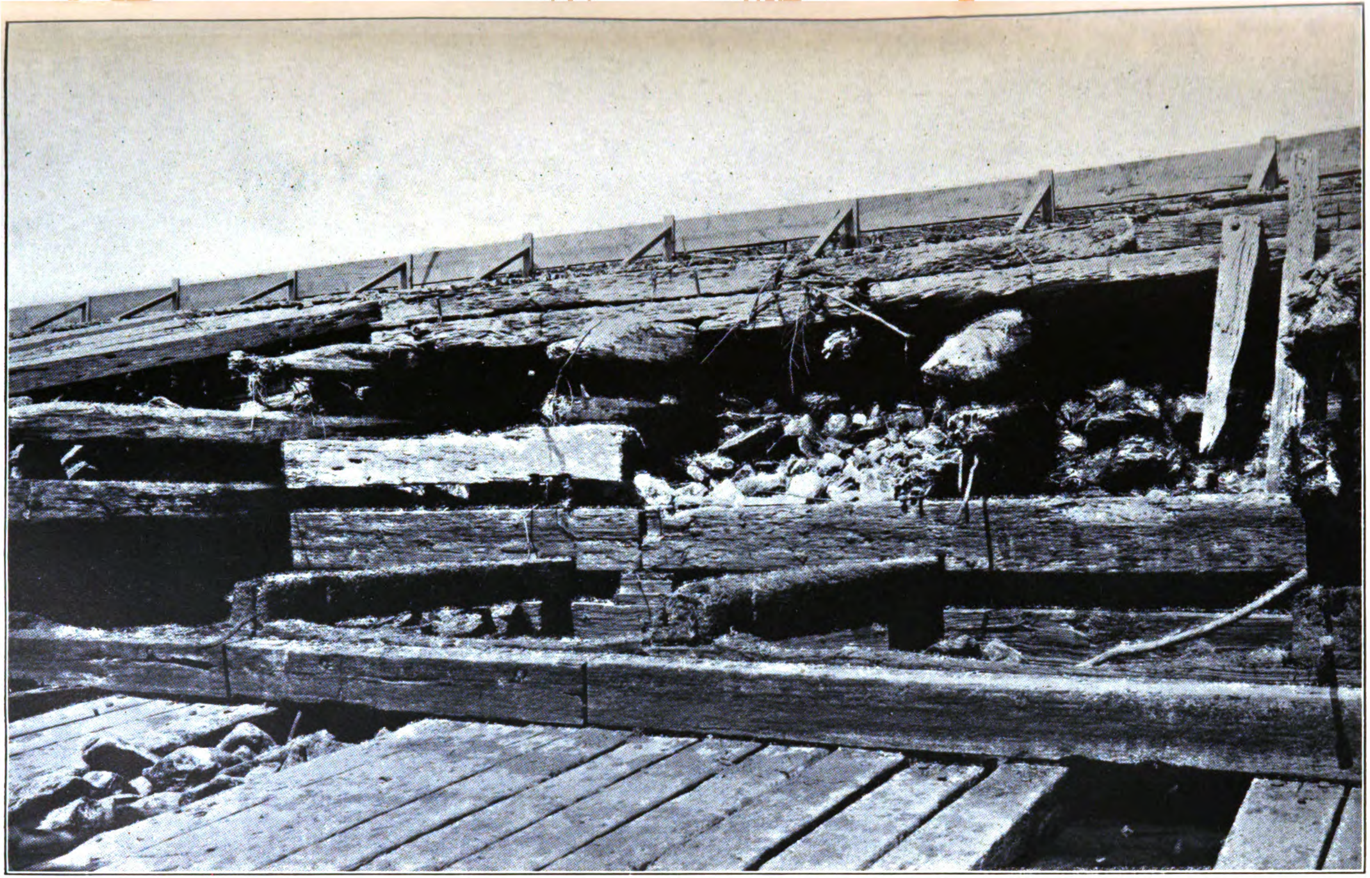
On June 15 an appropriation of $15,000 was made by Councils for repairs, but, during the prosecution of the

General View of Fairmount Dam, Showing General Condition and Breaks Caused by Freshet in the River.

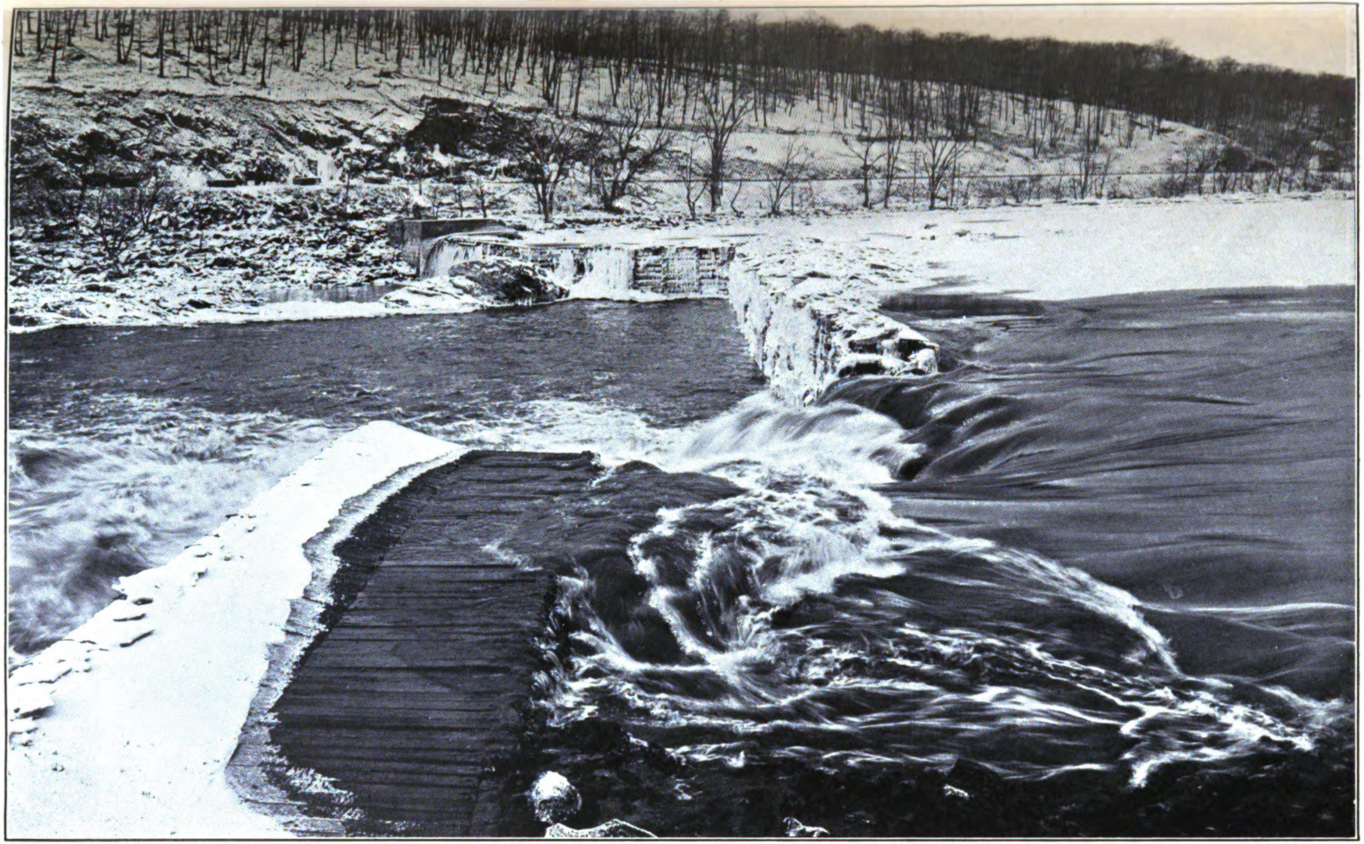
VIEW OF NO. 1 BREAK.



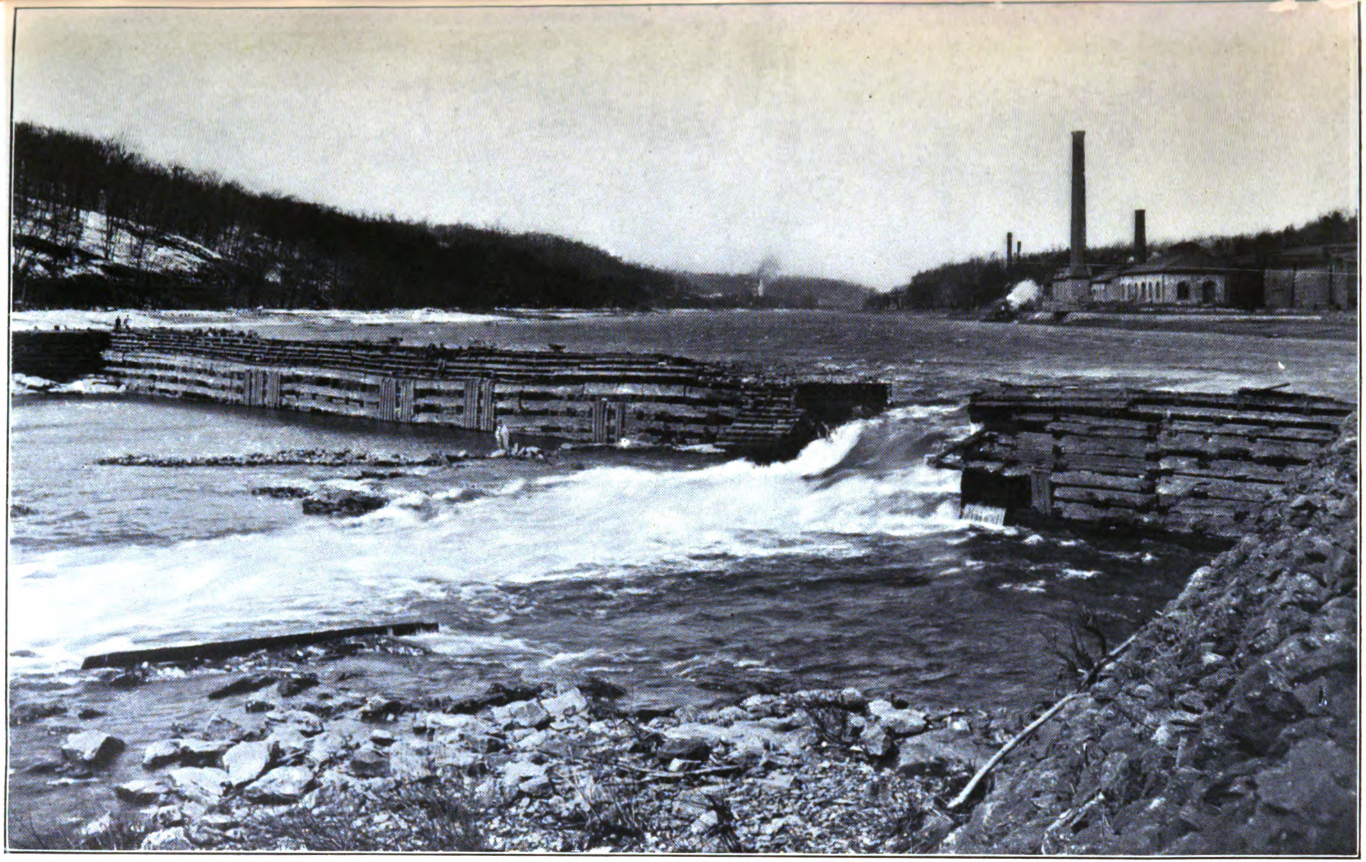
View of No. 2 Break.



View of No. 3 Break.

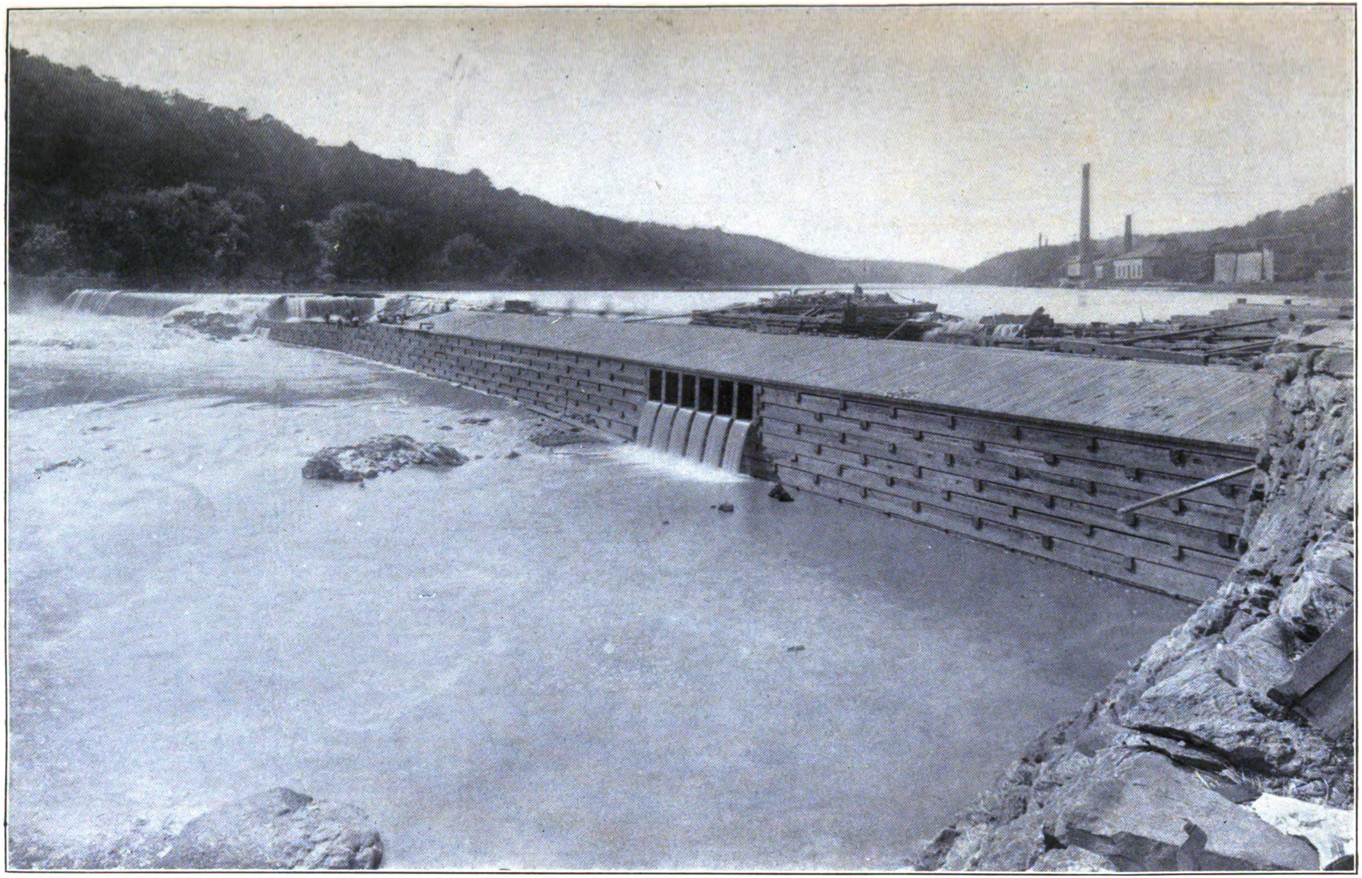


Break in Flat Rock Dam as it Appeared after the Freshet in the River Subsided.



View Showing Break, with one of the new Cribs used to Close the Gap in Place.

New Dam Partly Finished in Front of the Old Structure and View of Cribbing Constructed Across the Break in the Old Dam.



View of the New Dam Partly Finished.

work it was found that this amount would be insufficient, and, on November 26, an additional sum of $10,000 was made available to complete the work. The Messrs. Peoples Brothers were awarded a contract to make the repairs, and up to the present time they have reconstructed and ballasted all the damaged crib work and have removed and renewed part of the 10-inch timber sheathing on top of the dam. The total expenditures for this purpose amounted to $14,862.80.

While the repairs to the dam were in progress there was an opportunity for checking the leakage referred to above.

A temporary coffer dam was built on the old (or submerged) dam, and exposed the openings through which most of the water escaped. The space between the two dams was supposed to have been filled with concrete, but, as a matter of fact, the surface was merely covered.

Many settlements and cracks were found, and the remedy for these consisted in thoroughly ramming into all interstices a mixture of finely broken stone and cement, and, for a finish, forcing in a rich grout mixture, tamping until a float was obtained.

This work was done by this Bureau, with the result that the leakage has been reduced to a minimum.

The renewal of the balance of the old 10x10 inch timbers on top of the dam is yet to be finished, and this work is awaiting a favorable opportunity, when the water in the Fairmount pool shall be sufficiently low to permit it to be done.

As stated above, on the night of February 22 the Flat Rock dam was also seriously injured by flood and ice. Examination showed that a large section of the dam at the eastern end was washed out, and that before repairs could be made the water in the Flat Rock pool would be drawn to so low a level that it would not flow into the pump-wells at the Roxborough works, in which event most of Manayunk and all of Roxborough, Germantown and Chestnut Hill would soon be entirely deprived of water.

To overcome this difficulty, the erection of centrifugal and rotary pumps on the river bank was immediately begun and prosecuted day and night until completed. The object of the pumps was to lift the water from the river and force it into the pump wells in the engine houses, from which points it could then be pumped to the reservoirs in the usual manner.

Back of the old engine house, at the river edge, a wooden platform, extending partly over the river, was erected, upon which a rough board house was built, and within this structure were placed three 10-inch centrifugal pumps, with their independent steam engines, all of which, on two former occasions, were used at the same place under similar conditions.

The suction pipes of these pumps extended some distance from the shore to deep water. The discharge pipes converged to a large wooden tank, from which the water was conducted through a 30-inch pipe laid underground (which had remained in position since using it for a like purpose in 1902) to the pump wells in the old engine house.

The work of constructing this pumping plant was completed in seven days, and on March 4 the centrifugal pumps were started, by which time the water in the river had receded to 38 inches below the comb of the Flat Rock dam.

These pumps were in service continuously until the temporary repairs to the dam were completed and the river restored to its normal level (April 26.) The daily average pumpage was between 11 and 12 million gallons, and no difficulty was experienced in supplying all the water necessary to keep Nos. 2 and 3 Worthington engines, in the old engine house, in constant service.

To furnish water to the new pump well in the new engine house, a similar station, consisting of platform, rough board house, pumps and engines, was erected back of the new engine house directly over the intake.

The pumping machinery at this station consisted of one 8-inch centrifugal pump, with self-contained engine (borrowed for the purpose from Messrs. Dietrich & Co.,) one 12-inch centrifugal pump and independent engine, belonging to the Bureau of Water, and two positive rotary pumps, driven by two 40-horse power 250-volt electric motors, purchased from the Southwark Foundry and Machine Company.

The electric current for driving the rotary pumps was obtained from the Shawmont Power House, through cables erected especially for the purpose.

This station was completed and put into service on March 21, and furnished an ample supply of water in the pump wells to run three of the four 5-million gallon high-duty Worthington engines, and from this date the water in the Roxborough reservoirs began to increase, instead of diminishing, from day to day, as had previously been the case.

The total expenses for this work, for labor and materials, was $15,241.97.

The following diagram shows from February 22, when the Flat Rock dam broke, to March 21, when the Worthington engines were supplied with water from the centrifugal pumps, the depth of water in the Upper Roxborough reservoir, the water level in the river, in inches above and below the comb of the Flat Rock dam, and also the suction lift of the Worthington high-duty engines.

The Flat Rock dam is the property of the Schuylkill Navigation Company, and upon that company devolved the duty and expense of making the repairs.

The first effective work in this direction was accomplished by constructing cribs and filling them with stone ballast, then launching them overboard in the crevasse successively, until a roughly-constructed arch was made across the opening, which was braced and strengthened with timbers and backed with spawls and earth to dam off the water.

After the construction of these preliminary repairs, a new dam was built from the east to the west shore, directly below the old dam, two good views of which work, partly completed, are shown in the illustrations.

The new structure is now entirely finished, and for some time to come there need be little apprehension as to its stability, or of any serious break that would affect the operation of the pumps at the Roxborough pumping station.

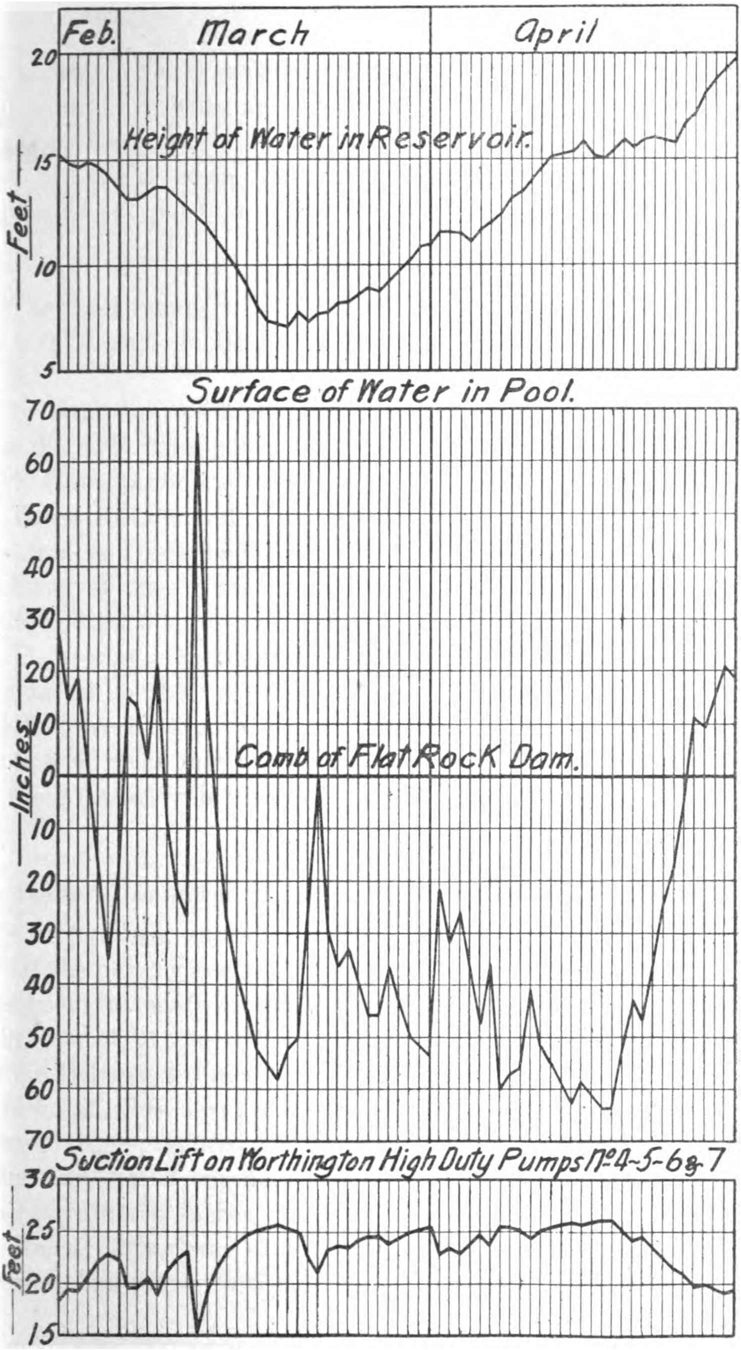
Fairmount Station.

The total pumpage at the Fairmount pumping station was 6,965,281,094 gallons, a decrease as compared with that of 1903 of 771,100,309 gallons.

The cost of pumping 1,000,000 gallons 100 feet high was $2.78, an increase of 30 cents per million gallons.

This increased cost is due to the fact that, owing to low water in the river, there was less pumpage at this station, while the expense of operating the works was practically the same as if all the pumps were in constant service.

Owing to leakage through the roof, the old wheel house, in which are located Nos. 7, 8 and 9 wheels, has, for a number of years, been in a very dilapidated condition, and failing to obtain the necessary funds to have it re-covered with asphalt and concrete in a substantial manner, repairs were made with such labor and materials as this Bureau possessed. In making these repairs the entire roof surface of concrete was removed and replaced with one of cement, laid to new grade lines, for the better shedding of the water. This surface was then washed with three complete coats of Sylvester's wash, consisting of castile soap and water and alum and water, which effectively sealed the pores in


Feb.
March
April
Height of Water in Reservoir.
Feet
20
15
10
5
Surface of Water in Pool.
Inches
70
60
50
40
30
20
10
0
10
20
30
40
50
60
70
Comb of Flat Rock Dam.
Suction Lift on Worthington High Duty Pumps No. 4-5-6 & 7
Feet
30
25
20
15

the cement. The cement was blocked four feet square and the joints filled with tar. Up to the present time, extending from warm to cold weather, the roof has remained tight, and the engine room, with its machinery, is now being repainted and put in a creditable condition.

Spring Garden Station.

The total pumpage at the Spring Garden station was 50,992,765,300 gallons, an increase of 112,400,360 gallons.

In June last the high pressure piston of No. 5 engine and the right hand pump rod broke. These were replaced with a new piston and a new rod.

Three suction and discharge pipes between the high pressure and intermediate pumps of No. 2 engine broke, and two of these were replaced with pipe made of boiler plate and the other one of cast iron.

There were numerous other minor accidents and repairs incidental to the operation of pumping engines, all of which have received attention, and the machinery at this station is in as fair a condition as the limited time for making repairs will permit.

Belmont Station.

The total pumpage at the Belmont works was 14,861,-706,422 gallons, an increase of 608,300,196 gallons.

Of the old engines at this station, Nos. 1, 2 and 3 were designed to pump to the George's Hill reservoir, at an elevation of 212 feet C. D., and to enable them to pump to the Belmont sedimentation basin, at an elevation of 279 feet C. D., Nos. 1 and 2 engines have been equipped with new plungers, reduced from 22.5 to 19.75 inches in diameter, and No. 3 engine with plungers reduced from 28 inches to 24.25 inches diameter.

No. 4 engine was originally designed as a high duty engine, but owing to the difficulty in keeping this pump in good condition, the high duty attachment has been removed and new plungers, reduced from 36½ to 34 inches diameter, are now being constructed for the pump.

Nos. 5, 6 and 7 engines are modern quarter-crank fly-wheel engines, and pump to the Belmont sedimentation basins, for which work they were constructed.

Queen Lane Station.

The total pumpage at these works was 25,954,207,050 gallons, a reduction, as compared with that of the preceding year, of 1,187,650,150 gallons.

The principal reason for the great reduction in the pumpage at this station was due to the breaking down of the machinery.

On February 26 the low pressure discharge chamber of No. 3 engine cracked. It was patched with a plate of ⅞ inch boiler iron, riveted securely over the fracture, and the chamber was further strengthened with iron bands. On March 18 the intermediate discharge chamber cracked. On March 22 this chamber was strengthened with bands, and connections to the low pressure pump were blanked off. The engine was then started "two-legged," but within a short time the intermediate chamber went to pieces. The connections were then blanked off so as to run the high pressure pump only, or one-third of the total pumping capacity of the engine, and in this condition it was continued in service until June 7, when the new chambers were installed.

Among other important repairs to the engines at this station was the installation of one new suction and three intermediate chambers.

Extensive repairs are needed to all the machinery at this station, but it is impossible to make them, owing to inability to shut down for a sufficient length of time to prosecute the work thereon.

Roxborough Station.

The total pumpage at the Roxborough Station was 9,169,553,425 gallons, an increase as compared with that of 1903 of 654,067,375 gallons.

A great many repairs have been made to the machinery at this station, the most important of which was the installation of five new pump chambers, one on No. 2 engine and four on Nos. 5 and 7 engines.

The engines and pumps are now in a fairly good condition, but, as is the case at Queen Lane Station, there are many repairs that should have immediate attention and which are prevented by inability to shut down the engines a sufficient length of time to prosecute the work.

Frankford Station.

The total pumpage at this station was 12,442,647,324 gallons, an increase as compared with that of 1903 of 1,369,523,943 gallons.

On two occasions the foundation bolts of No. 1 engine broke and the right hand discharge chamber cracked.

No. 2 engine was repaired in January and the foundations supporting the fly-wheel pedestal placed in proper condition, since which time this pump has given good service.

No. 3 engine was out of service from March to June, and was thoroughly overhauled during that period. For the last six months of the year this engine gave good service, but, owing to its peculiar construction, it is easily put out of adjustment by slight wear of its working parts, and it now requires considerable attention to keep it in good repair.

No. 4 engine also requires a complete overhauling, but most of this class of work is awaiting the operation of the pumps at the new Lardner's Point Station No. 2, which can then furnish water to the Wentz Farm distribution district while repairs to the pumps at the old station are in progress.

High Service Stations.

The total pumpage at the High Service Stations was 5,794,865,874 gallons, an increase as compared with that of 1903 of 1,379,550,405 gallons.

The increase and the decrease in the pumpage at the several High Service Stations were as follows:

High Service Stations.	Pumpage.	Increase.	Decrease.
Belmont...........................	830,781,770	....	36,339,235
Roxborough........................	1,400,300,670	....	145,629,475
Roxborough Annex..............	3,485,172,000	1,554,492,000	
Mt. Airy............................	28,223,750	....	8,489,396
Chestnut Hill......................	264,480	75,060	
Frankford..........................	50,123,204	15,441,451	
Totals...............	5,794,865,874	1,570,008,511	190,458,106

All the engines at the High Service Stations are in excellent condition as are also the buildings and grounds; but serious complications are likely to arise at the Belmont High Service Station if any accident should occur to No. 2 engine; and at the Roxborough High Service Station also, if at any time the consumption should exceed the capacity of one of the two pumps, for there is only boiler power sufficient to run one engine at this station.

Two new boilers and a new engine (in place of No. 1 pump) should be installed at this station at as early a date as possible.

Distribution.

This Bureau has been very much hampered by lack of funds with which to purchase and lay service mains in all parts of the City. Delay in this work is exceedingly annoying to builders, and restricts instead of encourages progress in the development of the suburban sections of the City.

Ample provision should be made for laying water mains, especially as the money expended for this purpose is more than returned to the City by the amounts collected for the frontage charges paid by the owners of property fronting on the streets in which water pipes are laid.

The total quantity of new pipe laid for the distribution of water was 111,770 feet, or 18,621 feet less than during the preceding year.

The total quantity of pipe now in use is 1466.77 miles, and the total number of fire hydrants 14,017.

Very respectfully yours,

F. L. HAND,
Chief of Bureau.

Comparison of Pumpage for the Delaware and Schuylkill Rivers for 1903 and 1904.

	Gallons.		Gallons.	
	1903.	1904.	Increase.	Decrease.
Annual pumpage:				
From rivers	119,600,619,200	120,386,160,615	785,541,415	
High service	4,415,315,469	5,794,865,874	1,379,550,405	
Total	124,015,934,669	126,181,026,489	2,165,091,820	
Maximum daily pumpage:				
From rivers	376,550,938	373,311,527	....	3 239,411
High service	7,842,526	16,173,881	8,331,355	
Total	384,393,464	389,485,408	5,091,944	
Average daily pumpage:				
From rivers	327,672,929	328,923,936	1,251,007	
High service	12,096,755	15,832,966	3,736,211	
Total	339,769,684	344,756,902	4,987,218	
Average daily pumpage from rivers, per capita.	238	234	....	

Volume and Cost of Pumpage for Years 1894 and 1904, 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.
1894..........	72,078,724,238	121,199,588,387	$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	187,371,927,277	3 16	185	1,385,734
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	239,698,545,013	4 80	232	1,349,500
1903..........	124,015,934,669	248,768,806,094	5 20	238	1,378,298
1904..........	126,181,026,489	251,214,168,044	5 11	234	1,407,690

* United States Census.

† Including repumpage or high service.

Cost of Raising 1,000,000 Gallons 100 Feet during 1903 and 1904.

Pumping Stations.	1903.	1904.	Increase.	Decrease.
Fairmount	$2.48	$2.78	$0.30	
Spring Garden	5.16	5.07	....	$0.09
Belmont	5.40	5.04	....	.36
Queen Lane	3.83	3.61	....	.22
Roxborough	6.70	6.99	.29	
Frankford	6.93	6.19	....	.74
Average	$5.04	$4.93	....	.11
High Service Stations.				
Belmont	$12.72	$14.52	$1.80	
Roxborough	9.17	9.61	.44	
Roxborough Annex	8.63	13.71	5.08	
Mt. Airy	221.76	296.46	74.70	
*Chestnut Hill	13,520.65	10,091.48	....	$3,429.17
Frankford	216.67	130.08	86.59	
Average	$15.56	$16.99	....	$1.43
Total average	$5.20	$5.11	....	$0.09

* This station is practically out of service.

Comparison of the Nominal, Maximum, Minimum and Average Daily Pumpage for 1903 and 1904.

Pumping Stations.	Nominal.		Maximum.		Minimum.		Average.	
	1903.	1904.	1903.	1904.	1903.	1904.	1903.	1904.
Fairmount	33,290,000	33,290,000	35,039,521	34,570,409	886,937	496,650	21,195,565	19,030,823
Spring Garden	170,000,000	170,000,000	159,402,160	154,597,230	82,518,740	98,659,890	139,398,260	139,324,495
Belmont	68,000,000	65,500,000	50,110,920	52,813,760	15,818,040	6,673,480	39,050,428	40,605,755
Queen Lane	80,000,000	80,000,000	80,990,750	80,506,050	17,527,800	41,338,150	74,361,243	70,913,134
Roxborough	35,500,000	35,500,000	30,702,720	32,064 095	5,278,755	11,793,725	23,330,099	25,053,425
Total from Schuylkill	386,790,000	384,290,000	356,246,071	854,551,544	122,030,272	158,961,895	297,335,605	294,927,632
Increase						36,931,623		
Decrease		2,500,000		1,694,527				2,407,973
Frankford	57,000,000	57,000,000	43,920,980	43,601,620	5,627,190	17,045,790	30,337,324	33,996,304
Total from Delaware	57,000,000	57,000,000	43,920,980	43,601,620	5,627,190	17,045,790	30,337,324	83,996,304
Increase						11,418,600		3,658,980
Decrease				319,360				
Totals from Delaware and Schuylkill	443,790,000	441,290,000	400,167,051	398,153,164	127,657,462	176,007,685	327,672,929	328,923,936
Increase						48,350,223		1,251,007
Decrease		2,500,000		2,013,887				

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

High Service Stations.	Nominal.		Maximum.		Minimum.		Average.	
	1903.	1904.	1903.	1904.	1903.	1904.	1903.	1904.
Belmont	7,000,000	7,000,000	3,341,440	2,341,440	1,891,200	1,153,440	2,375,674	2,269,895
Roxborough	10,000,000	10,000,000	5,096,520	5,113,485	3,817,495	2,849,280	4,235,425	3,825,958
Roxborough Annex	30,000,000	30,000,000	11,361,666	14,700,000	9,583,548	7,080,000	5,289,535	9,522,328
Mt. Airy	3,000,000	3,000,000	1,618,750	2,160,000	48,750	45,000	100,584	77,114
Chestnut Hill	750,000	750,000	78,720	132,240	36,900	132,240	519	723
Frankford	7,000,000	7,000,000	173,228	2,497,737	85,104	85,176	95,018	136,948
Total High Service	57,750,000	57,750,000	21,670,324	26,944,902	15,462,997	11,345,186	12,096,755	15,832,966
Total Daily	501,540,000	499,040,000	421,837,375	425,098,066	143,120,459	187,352,821	339,769,684	344,756,902
Increase	....	....	....	3,260,691	....	44,232,362	....	4,987,218
Decrease	....	2,500,000						

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 19, 1905.

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 from the appropriation made directly thereto, an itemized list of miscellaneous receipts and a table of the revenues derived from the operations of the Bureau during the year 1904.

The transfer from this Bureau to a Department created for the purpose of authority to purchase supplies, has made inaccessible the data from which a detailed account of the supplies furnished could be made with accuracy.

A statement taken from the books of the City Controller shows the amounts expended for the various items.

Yours respectfully,

J. T. HICKMAN,
Chief Clerk.

Detailed Expenditures of the Bureau for 1904.

General Appropriation	Amount appropriated.	Amount expended.	Amount merging.	Amount not merging.
An Ordinance to make an appropriation to the Bureau of Water, approved December 31, 1903 .... $923,503 00				
Balance from books of 1903................ 4,714,282 99				
Additional appropriations and transfers.. 1,247,878 20				
$6,885,664 19				
Diminished by transfer.................... 23,480 32				
Net appropriation................	$6,862,183 87			
Item 1.—Salaries...... $393,203 00				
Diminished by transfer.................... 13,000 00				
Net appropriation................	380,203 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	1,000 00		
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	21,916 67		
Permit clerks,.................	2,300 00	2,300 00		
Purveyors......................	10,680 00	10,628 28		
Clerks to purveyors..........	5,600 00	5,230 15		
Purveyors' assistant clerk...	5,250 00	5,250 00		
Hydrant inspector............	7,050 00	7,050 00		
General foremen..............	7,573 00	7,573 00		
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, offices and yards	6,075 00	6,069 44		
Storekeepers..................	1,600 00	1,600 00		
Foreman machinist..........	1,800 00	1,800 00		
Foreman bricklayer..........	1,400 00	1,361 11		
Foreman carpenter...........	1,100 00	1,100 00		
Foreman stone mason.......	900 00	868 55		
Foreman painter.............	900 00	900 00		
Foreman rigger..............	900 00	900 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		
Yardman (Fourth District)..	915 00	915 00		

Detailed Expenditures of the Bureau—Continued.

General Appropriation.	Amount appro-priated.	Amount expended.	Amount merging.	Amount not merging.
Item 1.—Continued.				
SALARIES AT PUMPING STATIONS.				
Fairmount	$12,790 00	$12,062 82		
Spring Garden	83,840 00	78,279 73		
Belmont	34,120 00	81,639 91		
Belmont High Service	7,380 00	7,043 41		
Queen Lane	40,360 00	38,000 39		
Roxborough	33,260 00	29,241 39		
Roxborough High Service	10,480 00	9,723 84		
Mt. Airy	4,620 00	4,595 15		
Chestnut Hill	2,550 00	2,550 00		
Frankford	24,920 00	23,445 30		
Frankford High Service	7,660 00	7,416 09		
Uniforms for policemen and watchmen	1,600 00	1,600 00		
Total	....	$376,430 23	$3,772 77	
Item 2. For the wages of mechanics, laborers, and other workmen employed upon repairs to machinery, the maintenance of and repairs to buildings, grounds, and reservoirs, and the transportation of workmen incident thereto, $180,000 00				
Increased by transfer.. 9,500 00				
Net appropriation	$189,500 00			
Transportation	....	$4,720 20		
Wages:				
Assistant engineer	....	720 76		
Assistant paymaster	....	941 75		
Bricklayers	....	15,945 60		
Carpenters	....	7,788 50		
Clerk and copyist	....	426 00		
Helpers	....	6,842 63		
Horses, carts, and drivers	....	2,949 46		
Laborers	....	101,844 70		
Machinists	....	35,913 08		
Painters	....	4,651 37		
Stone masons	....	5,764 57		
Stop attendant	....	991 05		
Total	....	$189,499 67	$0 33	
Item 3. For the wages of mechanics, drillers, laborers and other workmen connected with repairs to and improvement of the distribution and the laying of service mains, the transportation of workmen engaged in repairs and the traveling expenses of pipe inspectors $270,000 00				
Diminished by transfer 9,500 00				
Net appropriation	$260,500 00			

Detailed Expenditures of the Bureau—Continued.

General Appropriation.	Amount appropriated.	Amount expended.	Amount merging.	Amount not merging.
Item 3—Continued.				
Traveling expenses	....	$413 74		
Transportation	....	3,674 85		
Wages:				
Improvement	....	26,496 19		
First District	....	28,037 44		
Second District	....	23,897 32		
Third District	....	69,702 55		
Fourth District	....	21,845 20		
Fifth District	....	28,566 80		
Sixth District	....	33,155 84		
Seventh District	....	24,654 90		
Total	....	$260,444 33	$55 67	
Item 4. For wages of mechanics, helpers and other workmen at the City construction and repair shop	$34,000 00	$33,999 50	$0 50	
Item 5. For wages Hydrographic corps and expenses incident thereto	$1,600 00	1,596 00	4 00	
Item 6. For repairs to boilers, 15,000 00				
Increased by transfer. 12,000 00				
Net appropriation	27,000 00			
Bureau Filtration	....	5 50		
Fairmount	....	81 64		
Roxborough High Service	....	216 00		
Belmont High Service	....	820 55		
City Shop	....	588 97		
High Pressure Fire Service	....	1,028 70		
Frankford	....	1,848 21		
Belmont	....	4 592 76		
Roxborough	....	4,699 20		
Queen Lane	....	5,148 56		
Spring Garden	....	8,625 39		
		$27,155 48		
Less 9.16 tons old tubes @ $15.57	....	155 70		
Total	....	$26,999 78		
Item 7. For hauling water pipe and machinery........ $4,000 00				
Increased by transfer... 3,000 00				
Net appropriation	$7,000 00	$6,998 79	$1 21	
Item 8. For repairs to roofs	2,500 00			
Belmont High Service		18 00		
Fourth District	....	13 00		
Fairmount	....	19 50		
Seventh District	....	29 25		
Sixth District	....	61 75		
Roxborough	....	61 75		
Queen Lane	....	65 00		

Detailed Expenditures of the Bureau—Continued.

General Appropriation.	Amount appro-priated.	Amount expended.	Amount merging.	Amount not merging.
Item 8—Continued.				
Belmont	....	$87 75		
Shop	....	159 25		
Frankford	....	172 25		
Spring Garden	....	1,816 75		
Total	....	$2,499 25	$ 75	
Item 9. For clerk hire and writing up duplicates...... $2,500 00 Diminished by transfer. 80 32	$2,419 68	$2,419 68		
Item 10. Keep of horse for Chief of Bureau, General Superintendent and Assistant	1,200 00	1,200 00		
Item 11. For advertising, horse shoeing, miscellaneous expenses, repairs to wagons, carts, harness, tools, pipes, pavements, etc., ground rent No. 918 Cherry street, rent of office, shop and stable, Fifth District, electric current, etc., $3,500 00 Increased by transfer.... 3,500 00				
Net appropriation	$7,000 00			
Advertising	....	$255 85		
Analysis of oil	....	12 00		
Binding books	....	29 60		
Care of clocks	....	20 00		
Carriage hire	....	3 75		
Disinfectors (rental)	....	144 00		
Electric current	....	865 99		
Fire insurance	....	302 49		
Fire extinguishers (rental)	....	67 50		
Freight	....	1 51		
Glazing	....	7 50		
Ground rent, 918 Cherry street	....	26 66		
Hardware	....	60 83		
Horse shoeing	....	1,496 37		
Incidentals	....	14 08		
Incidentals, hydrographic corps	....	82 72		
Machine tools	....	36 00		
Machine work	....	130 00		
Maps	....	125 00		
Meals for workmen	....	518 20		
Morning papers	....	15 60		
Plants	....	40 40		
Plumbing	....	109 00		
Professional services, V. S.	....	138 35		
Repairs to camera	....	2 60		
Repairs to clocks	....	8 75		
Repairs to copper pipe	....	104 73		
Repairs to diving apparatus	....	18 75		
Repairs to electrical plants	....	237 77		
Repairs to engines	....	213 14		
Repairs to gauge	....	24 23		
Repairs to harness	....	855 20		
Repairs to meters	....	40 67		
Repairs to roadbed	....	85 10		
Repairs to siding	....	3 03		
Repairs to stops	....	52 82		

Detailed Expenditures of the Bureau—Continued.

General Appropriation.	Amount appropriated.	Amount expended.	Amount merging.	Amount not merging.
Item 11—Continued.				
Repairs to scales		91 50		
Repairs to valves		4 25		
Repairs to wagons		908 62		
Rent of offices and shop		194 00		
Rent of stable		96 00		
Services of diver		80 00		
Subscription (periodicals)		42 00		
Text book		5 00		
Tolls		2 82		
Washing towels		86 00		
Totals	....	$6,999 98	02	
Item 12. For asphalt and granolithic paving and repairs thereto $1,000 00				
Diminished by transfer 900 00				
Net appropriation	100 00	$54 15	45 85	
Item 13. For emergencies $5,000 00				
Increased by transfer.. 15,000 00				
Net appropriation	20,000 00			
Repairs to engines	....	17,602 15	2,397 85	
Item 14. For hauling coal and ashes at pumping stations $10,000 00				
Increased by transfer.. 4,700 00				
Net appropriation	14,700 00			
Hauling ashes:				
Queen Lane		2,700 00		
Belmont		3,300 00		
Spring Garden		7,000 00		
Hauling coal:				
2920 tons Roxborough to High Service, @ 44 cents		1,284 80		
Totals	....	$14,284 80	$415 20	
Item 15. For buildings and fence, Seventh District. Vetoed by his Honor the Mayor.				
Item 16. Sand for filtration purposes, Torresdale beds, balance Jan. 1	$500,000 00	$167,620 00	....	$332,380 00
Item 16½. Sand for filtration purposes, Torresdale beds. By transfer, Dec. 22, 1904.	200,000 00	....	....	200,000 00
Item 17. Improvement in West Philadelphia. Balance Jan. 1..	845 70	845 70		

Detailed Expenditures of the Bureau—Continued.

General Appropriation.	Amount appropriated.	Amount expended.	Amount merging.	Amount not merging.
Item 18. Improvement, extentension and filtration of the water supply. Balance Jan. 1..	565,051 97			
Advertisements	....	$933 50		
Affidavits	....	13 00		
Ammonia	....	52 25		
Asphalt	....	93 42		
Bricks	....	504 75		
Burlap strips	....	84 00		
Carpenter work	....	234 24		
Chandlery	....	44 05		
Chemicals	....	145 52		
Collectors	....	10 00		
Clocks	....	9 00		
Coal	....	235 68		
Drainage pumps, Belmont filters	....	7,298 44		
Drilling	....	98 90		
Drilling test holes	....	128 90		
Electric crane, Belmont filters..	....	2,700 00		
Electric current	....	619 22		
Electric plant, Belmont filters..	....	13,773 37		
Electric supplies	....	618 76		
Filtering material, etc., Belmont filters	....	265,059 65		
Fire doors	....	7 50		
Freight	....	20 40		
Gasoline and oil	....	303 53		
Gas for fuel	....	152 80		
Grate bars	....	119 09		
Gravel	....	99 15		
Gauges	....	19 85		
Gum goods	....	622 67		
Hauling	....	774 60		
Hardware	....	468 51		
Hire of auto	....	20 00		
Hire of horse and carriage	....	40 00		
Hire of pumps	....	1,890 14		
Incidentals	....	1,518 18		
Inspection	....	1,528 16		
Insurance	....	113 00		
Iron baskets	....	10 00		
Iron castings	....	258 65		
Iron supports	....	12 00		
Laboratory supplies	....	500 15		
Land damages	....	85,744 48		
Luncheon	....	147 20		
Lumber	....	1,942 32		
Machine work	....	17 65		
Maps	....	20 50		
Office and engineer supplies	....	2,052 80		
Packing	....	44 60		
Paints	....	2 94		
Photo supplies	....	122 78		
Paper hanging	....	19 00		
Plastering	....	9 50		
Pipe and fittings	....	486 89		
Plunger pump	....	563 55		
Plumbago	....	80 96		
Preliminary filters, Lower Roxborough	....	7,361 52		
Pumps and boilers, Belmont filters	....	16,543 12		
Pumping station, Belmont filters	....	27,337 62		
Pumps and engines, Upper Roxborough	....	1,573 50		
Reducer	....	9 00		

Detailed Expenditures of the Bureau—Continued.

General Appropriation.	Amount appropriated.	Amount expended.	Amount merging.	Amount not merging.
Item 18.—Continued.				
Refrigerator	....	$4 50		
Regulator	....	20 00		
Rent of office	....	110 00		
Repairs to boilers	....	318 90		
Repairs to joints	....	50 00		
Salt	....	327 50		
Sand ejector	....	156 00		
Separators	....	22 50		
Services of experts	....	575 00		
Services of jurors	....	288 00		
Stationery and printing	....	1,178 17		
Steel floor plates	....	217 64		
Stone cover for tank	....	47 00		
Sundry repairs	....	25 11		
Subscription (periodicals)	....	11 00		
Text books	....	58 85		
Transportation	....	1,060 46		
Traveling expenses	....	772 43		
Towel service	....	206 42		
Typewriter	....	77 25		
Valves	....	1,204 97		
Wire screens	....	15 30		
Salaries	....	123,748 87		
Wages (Bureau of Water)	....	3,803 72		
Wages (Bureau of Filtration)	....	17,180 52		
			....	$19,509 49
		$545,542 48		
Item 19. For the improvement and filtration of the water supply.				
Balance January 1st	$2,695,388 84			
Advertising	....	$9 80		
Affidavits	....	57 50		
Ammonia	....	8 25		
Binding books	....	4 50		
Brass fittings	....	28 47		
Brick work	....	34 69		
Cement	....	98 40		
Chandlery	....	13 50		
Coal	....	201 95		
Drain pipe	....	106 00		
Electric current	....	158 77		
Electric supplies	....	4 10		
Fire clay	....	8 00		
Freight	....	35 35		
Gas for fuel	....	59 20		
Glass	....	18 63		
Gum goods	....	210 12		
Hardware	....	190 54		
Hauling	....	14 59		
Hire of horse and wagons	....	88 50		
Hire of pumps	....	738 00		
Hydrants	....	165 00		
Incidentals	....	421 63		
Incubator	....	170 00		
Iron castings	....	173 70		
Iron fittings	....	407 71		
Iron plates	....	51 00		
Inlet	....	70 00		
Insurance	....	50 00		
Laboratory supplies	....	599 67		
Lumber	....	463 28		
Manure	....	8 00		
Mill work	....	105 00		
Mineral wool	....	24 44		
Oak stakes	....	800 86		
Office supplies	....	458 28		

Detailed Expenditures of the Bureau—Continued.

General Appropriation.	Amount appropriated.	Amount expended.	Amount merging.	Amount not merging.
Item 19.—Continued.				
Oil	....	$85 83		
Packing	....	188 06		
Paints	....	2 18		
Pipe covering	....	25 58		
Plumbing	....	20 50		
Photo supplies	....	100 00		
Pumps	....	24 00		
Rent of office	....	20 00		
Stationery and printing	....	680 00		
Towel service	....	69 60		
Transportation	....	218 80		
Traveling expenses	....	111 71		
Use of boilers	....	700 00		
Use of locomotive	....	25 00		
Ventilators	....	24 00		
Pumping machinery, Upper Roxborough	....	350 00		
Inspection	....	708 02		
Valves	....	3,444 80		
Electric plant, Upper and Lower Roxborough	....	6,220 49		
Sand ejector, Belmont Filters	....	7,815 00		
Torresdale conduit	....	50,849 40		
Pumping engines, etc., Frankf'd.	....	65,632 45		
Pumping station, Frankford	....	151,224 61		
Oak Lane Reservoir	....	163,419 44		
Belmont filters	....	210,288 04		
Torresdale filters	....	1,161,820 63		
Salaries	....	11,600 49		
Wages: Bureau of Water	....	856 96		
Wages: Bureau of Filtration	....	2,529 85		
Total	....	$1,844,590 42	....	$850,798 42
Item 20. High pressure fire service. Balance January 1st	$103,908 02			
Gasket	....	11 63		
Gas for fuel	....	271 70		
Incidentals	....	17 35		
Pumps and engines	....	102,989 97		
Total	....	$103,290 65	....	$617 37
Item 21. Furnishing and laying mains for filtered water. Balance January 1 ..... $847,626 64 Increased by transfer 400,000 00				
Net appropriation	$1,247,626 64	728,287 07	....	$519,339 57
Item 22. High Pressure Fire Service. Balance January 1	1,461 82	1,000 00	461 82	
Item 23. Repairs to Fairmount Dam. Appropriations June 15 and Nov. 26	25,000 00	13,005 25	....	11,994 75

Detailed Expenditures of the Bureau—Continued.

General Appropriation.	Amount appropriated.	Amount expended.	Amount merging.	Amount not merging.
Item 24. High Pressure Fire Station.				
Appropriation June 27.......	$1,500 00	$1,500 00		
Item 25. To pay Dunlap Printing Co. for diagrams for report of 1903.				
Appropriation Nov. 26........	553 20	553 20		
DEFICIENCIES OF 1903.				
Appropriation Jan. 27, 1904.				
Item 16. For the purchase of coal.................. $466,600 00				
Increased by transfer. 400 00				
Net appropriation................	467,000 00			
28.12 tons buck, Spring Garden, @ $2 88........................	....	80 94		
94.12 tons pea, Chestnut Hill, @ $3 85........................	....	364 21		
149.17 tons buck, Belmont, @ $2 81	....	421 08		
186.06 tons pea, Frankford High Service, @ $4 10................	....	763 88		
1,520.18 tons buck, Frankford @ $3 11........................	....	4,730 00		
11,256.11 tons pea, Frankford, @ $4 24........................	....	47,727 77		
18,698.05 tons pea, Belmont, @ $3 55........................	....	66,378 79		
24,557.15 tons pea, Roxborough @ $3 56........................	....	87,425 57		
31,723 04 tons pea, Queen Lane, @ $3 81........................	....	120,865 39		
38,706.10 tons pea, Spring Garden, @ $3 56	....	137,795 14		
Freight upon coal..............	....	432 39		
Total........................	....	$466,985 11	$14 89	
Item 17. For purchase of oil, lubricants, paints, etc. $11,000 00				
Diminished by transfer 400 00				
Net appropriation................	$10,600 00			
Brushes......	....	$8 38		
Coke............................	....	372 10		
Grease, 50 lbs, @ 4c., $2 00.				
Grease, 124 lbs. @ 9¼c., $11 47.				
Grease, 6,674 lbs. @ 10c., $667 40..	....	680 87		
Oil, 2,611½ gals., head light, @ 11¾c........................	....	306 87		
Oil, 106 gals, lard, @ 80c......	....	84 80		
Oil, 2,187½ gals., cylinder. @ 55c.	....	1,203 14		
Oil, 6,384 gals., engine. @ 35c.....	....	2,234 41		
Oil, 9,506 gals., cylinder, @ 45c...	....	4,277 72		
Paints..........................	... .	1,428 26		
Total........................	....	$10,596 55	$3 45	

Detailed Expenditures of the Bureau—Continued.

General Appropriation.	Amount appropriated.	Amount expended.	Amount merging.	Amount not merging.
Item 18. For the purchase of hardware, bolts and nuts......	$3,000 00	$3,000 00		
Item 19. For the purchase of gum goods and packing	23,000 00			
Gum goods........................	....	2,891 97		
Packing........................	....	13,989 16		
Valves...........................	....	6,099 79		
Totals......................	....	$22,980 92	$19 08	
Item 20. For repairs to boilers ..	$20,000 00			
Shop...............................	....	$7 56		
Fire mains........................	....	12 00		
Roxborough high service........	....	30 00		
Belmont high service............	....	141 00		
Fairmount........................	....	481 49		
Frankford	....	1,524 45		
Belmont	....	2,335 11		
Roxborough.......................	....	2,646 99		
Spring Garden....................	....	5,096 62		
Queen Lane.......................	....	7,876 62		
		$20,151 84		
Less 9.16 tons old tubes, @ $15.57..	....	152 58		
Totals......................	....	$19,999 26	$0 74	
Item 21. For the purchase of chandlery......................	$1,200 00	$1,137 14	$62 86	
Item 22. For the purchase of wrought iron pipe and fittings.	1,300 00	1,244 25	55 75	
Item 23. For the purchase of brass fittings, cocks and valves.	5,800 00			
5,275 ½-inch corporation cocks, @ 32c............................	....	1,688 00		
500 ⅝-inch corporation cocks, @ 40c............................	....	200 00		
100 ¾-inch corporation cocks, @ 56c............................	....	56 00		
200 1-inch corporation cocks, @ 90c............................	....	180 00		
50 1½-inch corporation cocks, @ $1.86c........................	....	93 00		
100 2-inch corporation cocks, @ $2.64.........................	....	264 00		
1,240 ⅝-inch curb stops, @ 35c....	....	434 00		
Fittings..........................	....	2,885 85		
		$5,800 85		
Less amount deducted..........	....	85		
			5,800 00	
Item 24. For the purchase of lumber..........................	12,000 00	$11,555 34	444 66	
Item 25. For the purchase of forage...........................	5,500 00	5,500 00		

Detailed Expenditures of the Bureau—Continued.

General Appropriation.	Amount appropriated.	Amount expended.	Amount merging.	Amount not merging.
Item 26. For hauling water pipe and machinery	$4,000 00	$3,919 79	$80 21	
Item 27. For the purchase of iron and steel	600 00	572 62	27 38	
Item 28. For the purchase of electric supplies	300 00	299 84	16	
Item 29. For repairs to roofs	550 00			
Belmont High Service	....	13 00		
Frankford	....	26 00		
Fairmount	....	32 50		
Spring Garden	....	477 75		
Totals	....	$549 25	$0 75	
Item 30. For the purchase of stationery, printing, etc	$450 00	$448 83	$1 17	
Item 31. For the purchase of horses and horse shoeing	1,000 00	1,000 00		
Item 32. For the purchase of stable supplies and harness	325 00	290 80	34 20	
Item 33. For advertising, office supplies, etc	1,000 00			
Advertising	....	113 25		
Care of clocks	....	15 00		
Electric current	....	313 49		
Fire insurance	....	302 49		
Incidentals Hydrographic Corps	....	34 62		
Meals for workmen	....	47 42		
Morning papers	....	7 80		
Office supplies	....	9 33		
Professional services V. S	....	44 90		
Rent of stable (Fifth District)	....	24 00		
Text book	....	5 00		
Tolls	....	35 45		
Towel service	....	47 25		
Totals	....	$1,000 00		
Item 34. For the purchase of special articles	$3,000 00			
Cleaning well		20 00		
Hauling		10 00		
Ice		1,111 11		
Meals for workmen		26 58		
Plants		25 00		
Plumbing		5 50		
Repairs to engines		235 00		
Repairs to hoist		14 10		
Repairs to meters		196 50		
Repairs to range		59 67		
Repairs to traps		6 48		
Rent of extinguishers (fire)		32 50		

Detailed Expenditures of the Bureau—Continued.

General Appropriation.	Amount appropriated.	Amount expended.	Amount merging.	Amount not merging.
Rent of disinfectors..............		36 00		
Rent of office and shop, 5th Dist.		48 50		
Services of diver..................		10 00		
Special articles...................		161 57		
Totals........................	....	$1,988 51	11 49	
Item 35. For the purchase of lead pipe, etc.				
7,619 lbs. lead pipe @ 5¼ c.........	$4,000 00	4,000 00		
Item 36. For emergencies.......	9,500 00			
Repairs to engines................	....	9,499 09	91	

Statement of the Amount Expended by the Department of Supplies for this Bureau during the year 1904. Taken from the Books of the City Controller.

	Amount appropriated.	Amount expended.	Amount merging.
Item 14. For stationery, office and engineer supplies, printing and text books..........	$7,000 00	$6,194 28	805 72
Item 15. For coal..............................	675,000 00	672,053 60	2,946 40
Item 16. For oil, lubricants, paints, brushes, wood and coke.....................	15,000 00	11,466 62	3,533 38
Item 17. For iron water pipe, special castings and pig lead............................	40,000 00	37,464 98	2,535 02
Item 18. For hardware, bolts, nuts, iron, steel, and malleable castings...............	25,500 00	25,384 95	115 05
Item 19. For gum goods and packing......	18,000 00	17,770 57	229 43
Item 20. For chandlery......................	4,000 00	3,991 58	8 42
Item 21. For wrought-iron pipe and fittings..	3,000 00	2,949 44	50 56
Item 22. For fire brick and fire clay........	800 00	462 27	337 73
Item 23. For brass fittings and castings, cocks and valves for steam and water, expansion metal and lead coating.........	13,000 00	12,731 73	268 27
Item 24, For covering steam pipes and boilers..	1,000 00	79 64	920 36
Item 25. For lumber..........................	8,000 00	7,987 06	12 94
Item 26. For forage...........................	6,000 00	5,963 30	36 70
Item 27. For iron and steel..................	1,500 00	1,494 52	5 48
Item 28. For cement, bricks, blocks, lime, sand and building stone.................... .	6,000 00	5,679 30	320 70
Item 29. For electric supplies...............	1,500 00	1,481 65	18 35
Item 30. For granite curb and coping stone	300 00	....	300 00
Item 31. For tapping and pipe cutting machines and fittings..........................	1,200 00	474 35	725 65
Item 32. For horses, wagons, carts, stable supplies and harness........................	1,500 00	1,451 38	48 62
Item 33. For donkey pumps, machine tools and condensers	2,500 00	1,434 50	1,065 50
Item 34. For special articles and small stores..	1,250 00	724 10	525 90
Item 35. For lead pipe, block tin and sheet lead..................................	6,000 00	5,428 07	571 93
	$838,050 00	$822,667 89	$15,382 11

Amount Expended by Department of Supplies—Continued.

RECAPITULATION.			
Balance from books of 1903	$4,714,282 99		
Additional appropriations and transfers	1,247,878 20		
Annual appropriation	923,503 00		
Appropriation to the Department of Supplies for Bureau of Water	838,050 00	....	$7,723,714 19
Expended for high pressure fire service	$105,790 65		
Expended for deficiencies	572,920 50		
Expended for filtration	3,286,885 67		
Expended for maintenance	954,033 56		
Expended for supplies	822,667 89	$5,742,298 27	
Amount merging, Bureau Water	$7,913 89		
Amount merging, Department of Supplies	15,382 11		
Transferred	23,480 32		
Amount not merging	$1,934,639 60	$1,981,415 92	$7,723,714 19

List of Miscellaneous Receipts for the Year 1904.

Jan. 13	Fuller Eng. Co.	Plugging 6-inch main	$109 19
18	Penna. R. R. Co.	Fire hydrant	40 41
Feb. 10	U. G. I. Co	Plugging 20-inch main	5 98
Mar. 3	Jos. Perna	Repairing leak	7 45
4	J. & G. Bromley	Removing stop box	4 63
18	Wetherill Bros	Lead dross	113 85
21	Ryan & Kelly	Stop keys	10 41
21	Rapid Transit Co	Plugging 6-inch main, etc.	131 87
21	Rapid Transit Co	Locating fire hydrant, etc.	82 90
26	Geo. V. Cresson & Co.	Repairing 4-inch stop	1 70
April 8	Edwin F. Merritt	Empty oil barrels	351 00
14	Girard Iron and Metal Co.	Old iron	905 28
15	J. R. Nelson	Brass turnings	360 32
15	Haddington Quarry Co.	Moving 8-inch pipe	43 46
15	Haddington Quarry Co.	Repairing 10-inch main	74 92
16	Hess Brewing Co	Raising 4-inch stop	2 25
20	Bureau of Water	Overdrawn warrant	51 08
May 1	Bureau of Water	Overdrawn warrant	18 62
3	Penna R. R. Co	No. 2 fire hydrant	16 54
3	Penna. R. R. Co	No. 1 fire hydrant, etc	35 58
12	Geo. A. Vare	Pipe	4 25
12	J. H. Loucheim & Co	6-inch pipe	3 50
12	Geo. A. Vare	Transferring 14½-inch ferrules	34 62
12	Geo. A. Vare	Repairing 6-inch main	23 91
12	Geo. A. Vare	Repairing 6-inch main, etc.	50 72
18	Mint Arcade Co	Two meters	22 00
19	Powers and Weightman	Repairing four private connections	17 40
20	Girard Trust Co	Repair'g 4-in. private stop.	14 63
21	David McMahon	Repairing 10-inch main	4 97
23	Dornan Bros	Hydrant	26 01
June 1	Geo. A. Vare	Repairing 6-inch main, etc.	23 31
1	Geo. A. Vare	Repairing 6-inch main, etc.	20 03
1	Geo. A. Vare	Repairing 6-inch main, etc.	34 17
1	Geo. A. Vare	Repairing 6-inch main	18 75
1	Geo. A. Vare	Raising 8-inch pipe, etc	27 90

List of Miscellaneous Receipts—Continued.

June	1	Geo. A. Vare	Repairing 6-inch main, etc.	$16 77
	8	Penna. R. R. Co	Moving 8-inch stop, etc	76 48
	8	U. G. I. Co	Making shut-off	8 05
	8	Wm. Cramp Ship and Engine Co	Moving fire hydrant, etc	7 71
	20	Phila. Rapid Transit Co	10-inch stop, etc	135 75
	22	Geo. A. Vare	Repairing 6-inch main, etc.	11 53
	22	Burnham, Williams & Co.	Iron stop	2 21
July	1	David McMahon	Repairing 6-inch main, etc.	17 58
	1	U. G. I. Co	Repairing 6-inch main, etc.	13 78
	1	U. G. I. Co	Repairing 6-inch main, etc.	13 78
	13	Geo. A. Fuller Co	Locating fire hydrant, etc.	78 03
	13	Geo. A. Fuller Co	Remov'g fire hydrant, etc.	18 29
	21	Phila. Rapid Transit Co	Fire hydrant,	6 67
	21	Phila. Rapid Transit Co	6-inch main, etc	7 25
	21	Phila. Rapid Transit Co	Removing 6-inch stops, etc.	47 71
	21	Phila. Rapid Transit Co	Shifting 6-inch pipe, etc	107 79
	21	Phila. Rapid Transit Co	Removing 6-inch stop	22 30
	27	Phila. Toilet Laundry Co.	Testing meter	2 00
	28	David McMahon	Repairing break in main.	28 59
	28	David McMahon	Shutting off main, etc	11 12
	28	David McMahon	Repairing ferrule	5 25
	28	Robert Lombard	Repairing 6-inch main	17 87
Aug.	11	Richard Bennis	Cutting out 6-inch pipe	19 33
	17	Geo. A. Fuller Co	Repairing 6-inch main	39 88
	29	Bureau of Water	Overdrawn warrant	8 10
Sept.	12	Ripka Mills Co	Repairing 4-inch stop	4 54
	14	Smith, Drum & Co	Testing meter	2 00
	16	M. J. Hogan & Co	Shut off, etc	3 00
	16	M. J. Hogan & Co	Shut off, etc	3 00
	16	M. J. Hogan & Co	Repairing 6-inch main	12 66
	22	United Gas Imp. Co	Repairing 6-inch main	13 78
	24	United Gas Imp. Co.	Repairing 6-inch main, etc.	19 06
Oct.	21	Phila. Rapid Transit Co	Locating 12-inch pipe, etc.	66 45
	21	Phila. Rapid Transit Co	Locating 12-inch pipe	166 48
	21	Phila. Rapid Transit Co	Removing 6-inch stop, etc.	51 54
	21	Phila. Rapid Transit Co	Removing 6-inch stop, etc.	39 71

List of Miscellaneous Receipts—Continued.

Nov. 12	Richard Bennis	Repairing private connection	$5 31
25	E. A. Smith & Co	Remov'g No. 1 fire hydrant	9 85
28	Penna. R. R. Co	Removing 4-inch stop	23 30
28	Phila. & Reading Ry. Co	Repairing 4-in. connection.	23 11
Dec. 1	Delaware River Ferry Co	Repairing 6-in. fire connection	12 26
2	Girard Iron & Metal Co	Scrap iron	2,000 00
3	Penna. R. R. Co	No. 1 fire hydrant	35 00
8	W. P. Oglesby	4-inch supply	27 00
20	Phila. Rapid Transit Co	Removing stop box	7 32
20	Phila. Rapid Transit Co	Locating 6-inch pipe	28 08
20	Phila. Rapid Transit Co	Repairing 12-in. connection	18 63
20	Phila. Rapid Transit Co	Putting in 6-inch stop, etc.	307 19
20	Phila. Rapid Transit Co	Locating 6-inch connection	36 22
20	Phila. Rapid Transit Co	Changing pipe	29 61
20	Phila. Rapid Transit Co	Changing pipe	56 60
20	Phila. Rapid Transit Co	Changing pipe	27 58
20	Peter Kugler	Locating No. 1 fire hydrant	28 98
29	Henderson & Co	6-inch service main	11 64
29	Henderson & Co	Repairing 6-inch main	5 87
29	Henderson & Co	Repairing private connection	12 22
30	Girard Iron & Metal Co	Scrap iron	2,122 20
	Total		$8,627 62

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

1904.	Schedule Rates.	Penalties.	Delinquent.	Penalties.	New Connections.	Meters, Current and Delinquent.	Ferrules: New Connections.	Searches.	Pipe Frontage.	Specials.	Collected by City Solicitor.	Totals.
January	....	....	$7,021 50	$1,064 19	$2,189 47	$4,071 98	$461 00	$191 25	$3,457 17	$149 60	$2,185 44	$20,791 60
February	$202,019 40	....	3,742 50	518 94	4,383 50	13,178 83	242 00	190 25	3,129 82	5 98	3,726 33	231,137 55
March	255,457 75	....	5,938 00	898 05	7,193 80	34,163 90	644 00	260 75	11,314 55	352 81	5,738 11	321,961 72
April	319,401 94	....	5,928 00	896 16	6,589 40	10,803 31	961 00	304 00	7,389 72	1,788 31	4,798 49	358,860 33
May	1,948,020 02	....	3,369 00	526 56	7,712 38	36,018 68	1,094 00	318 00	9,081 37	272 75	3,475 61	2,009,888 37
June	59,220 65	$2,654 95	1,133 50	170 19	5,454 45	31,366 69	1,960 00	302 50	9,280 04	382 66	3,327 29	115,252 92
July	38,794 70	1,970 89	2,850 00	391 58	4,058 05	34,633 65	1,027 00	249 25	5,205 85	398 01	3,062 19	92,641 17
August	97,512 05	4,919 33	1,711 00	260 06	4,012 23	52,442 44	1,612 00	196 75	7,674 08	67 31	2,989 90	173,397 15
September	32,898 35	4,648 47	1,234 50	174 39	3,340 44	7,073 65	2,168 00	223 75	6,502 80	58 04	2,185 07	60,507 46
October	77,561 12	11,541 34	1,759 00	263 71	2,826,68	8,509 28	931 00	246 75	6,303 44	324 18	3,411 65	113,678 15
November	24,900 35	3,583 14	687 50	105 28	2,537 90	52,091 34	802 00	257 00	8,731 66	61 57	1,358 29	95,116 03
December	21,652 10	3,221 15	1,233 00	185 11	3,126 30	6,615 88	830 00	246 50	6,933 26	4,766 40	1,628 98	50,438 68
Total, 1904	$3,077,438 43	$32,539 27	$36,607 50	$5,454 22	$53,424 60	$290,969 63	$12,732 00	$2,986 75	$85,003 76	$8,627 62	$37,887 35	$3,643,671 13
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
Increase	$78,016 37	$1,026 67	$5,566 18	$796 50	....	$14,394 16	$938 00	....	....	$918 43	$5,668 48	$48,917 16
Decrease	....	....	....	....	$3,773 61	....	....	$35 00	$43,262 06			
Net increase	....	....	....	....	....	....	....	....	....	....	....	$1,846 49

APPENDIX B

REPORT

OF THE

GENERAL SUPERINTENDENT

SUBMITTING

TABLES OF EXPENSES, PUMPAGE AND CONSUMPTION OF WATER DURING 1904

Philadelphia, December 31, 1904.

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

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 1904:

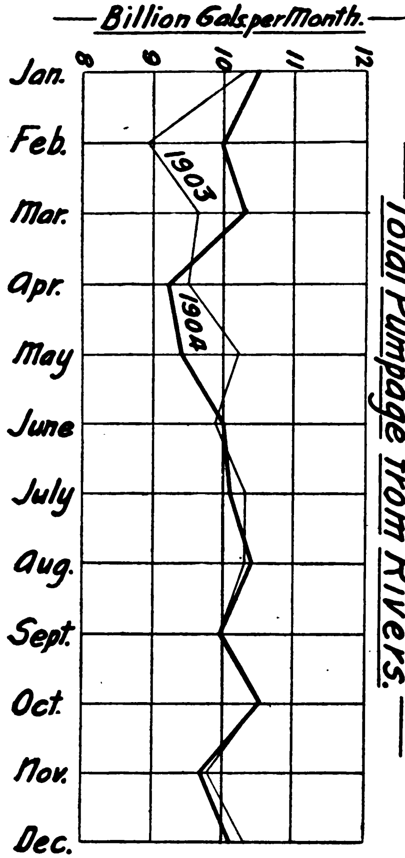
There has been an increase in the pumpage averaging 4,987,218 gallons per day, and an increase of 13,727 tons in the quantity of coal consumed, yet notwithstanding the greater quantity consumed the expense for this item, owing to a reduction of 25 4/5 cents per ton in the price, was $10,866.54 less than during the preceding year.

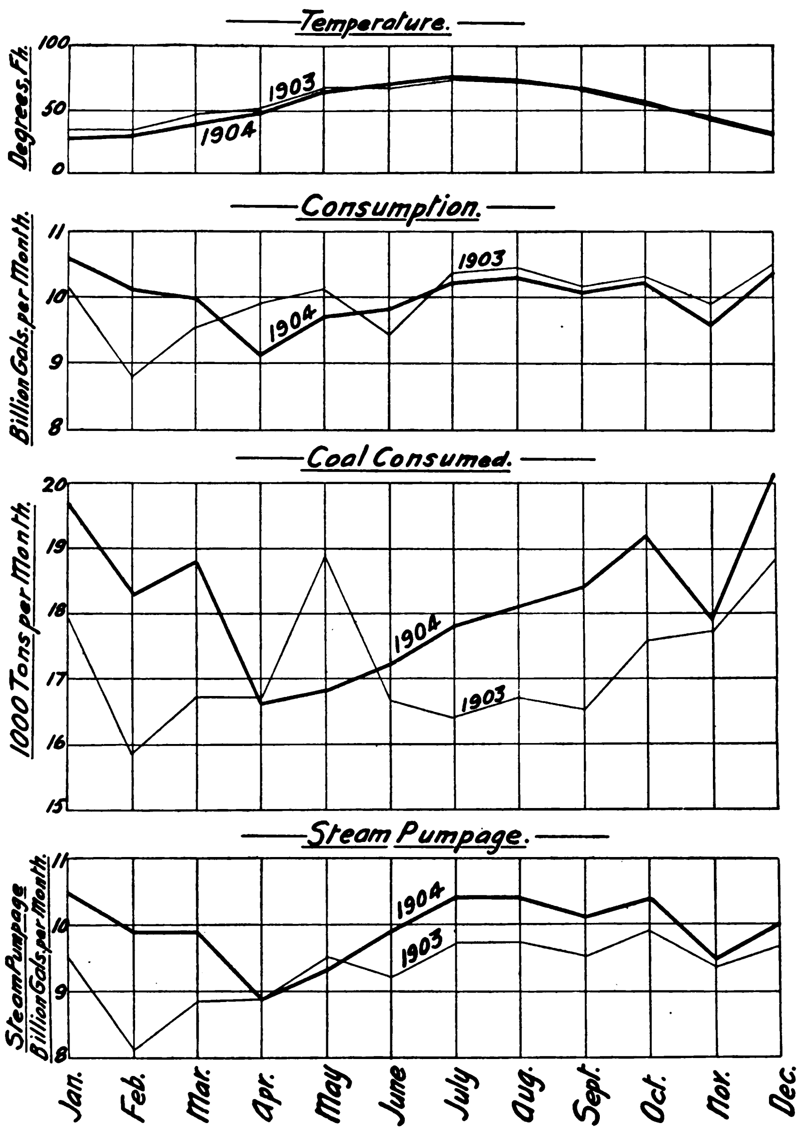
There was also a reduction in the cost of labor and of oils, amounting to $12,699.09, and an increase in the cost of electric lighting, repairs to boilers, machinery, etc., amounting to $15,098.68, and a reduction of $8,451.95 in the total expenses for maintenance, repairs and operating all the works.

The following tables show the details of the pumpage, expenses and other data, all of which are respectfully submitted.

Very respectfully yours,

ALLEN J. FULLER,
General Superintendent.


Billion Gals per Month.
8
9
10
11
12
Jan.
Feb.
Mar.
Apr.
May
June
July
Aug.
Sept.
Oct.
Nov.
Dec.
1903
1904
Total Pumpage from Rivers.



Temperature.
Degrees, Fh.
100
50
0
1903
1904
Consumption.
Billion Gals. per Month.
11
10
9
8
1903
1904
Coal Consumed.
1000 Tons per Month.
20
19
18
17
16
15
1904
1903
Steam Pumpage.
Steam Pumpage / Billion Gals. per Month.
11
10
9
8
1904
1903
Jan.
Feb.
Mar.
Apr.
May
June
July
Aug.
Sept.
Oct.
Nov.
Dec.

Quantity and Prices of Coal Consumed during 1904.

Pumping Stations.	Tons.	Price per ton.	Cost.
Spring Garden	68,388	$3 18	$217,473 84
Belmont	36,850	3 20	117,920 00
Queen Lane	47 358	3 43	162,437 94
Roxborough	44,861	3 18	142,657 98
Frankford	21,650	3 25	70,362 50
Totals and averages	219,107	$3 20	$710,852 26
HIGH SERVICE STATIONS.			
Belmont	1,561	$3 86	6,025 46
Roxborough	1,418	3 62	5,133 16
Roxborough Annex	2,437	3 62	8,821 94
Mt. Airy	322	3 50	1,127 00
Chestnut Hill	110	3 45	379 50
Frankford	362	3 75	1,357 50
Totals and averages	$6,210	$3 68	$22,844 56
Grand total	$225,317	$3 22	$733,696 82
Increase, 1904	$13,727	....	....
Decrease, 1904	....	25½	$10,866 54

Pea coal used at all the stations.

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

BELMONT HIGH SERVICE STATION, 1904.

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

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

1904.	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	432	312	30,438,720	21,648,920	52,087,640	1,680,246	154	1,190	.25	186	8	73	72	213.74
February	....	696	....	67,901,760	67,901,760	2,341,440	130	925	.25	174	7	....	73	332.39
March	....	744	....	72,584,640	72,584,640	2,341,440	136	490	.25	186	8	....	72	334.70
April	....	720	....	70,243,200	70,243,200	2,341,440	131	80	.25	180	7	....	73	342.22
May	....	744	....	72,584,640	72,584,640	2,341,440	135	750	.25	186	8	....	73	342.72
June	....	720	....	70,243,200	70,243,200	2,341,440	128	830	.25	180	7	....	73	349.32
July	....	736	....	71,849,830	71,849,830	2,317,736	130	1,285	.25	186	8	....	73	351.28
August	....	737	....	72,006,570	72,006,570	2,322,792	128	10	.25	186	8	....	73	359.12
September	....	708	....	69,242,130	69,242,130	2,308,071	121	1,460	.25	180	7	....	73	363.36
October	....	744	....	71,792,640	71,792,640	2,315,891	123	990	.25	186	8	....	73	371.28
November	....	708	....	69,072,480	69,072,480	2,302,416	119	510	.25	180	8	....	73	369.84
December	....	737	....	71,173,040	71,173,040	2,295,904	122	1,540	.25	186	8	....	73	372.43
Totals and averages..	432	8,306	30,438,720	800,343,050	830,781,770	2,269,895	1,561	1,060	.25	2,196	92	73	73	334.36

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

ROXBOROUGH HIGH SERVICE STATION, 1904.

Total capacity, 10,000,000 gallons per day.

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

1904.	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	1,520,640	139,518,480	141,039,120	4,549,649	122	2,120	25	155	23	54	54	577.68
February	5	691	1,033,560	134,717,185	135,750,745	4,681,060	117	1,350	25	145	22	54	54	581.28
March	5	739	1,113,750	141,992,770	143,106,520	4,616,339	120	1,680	25	155	23	54	54	596.81
April	117	603	24,167,780	114,150,620	138,318,400	4,610,613	135	340	25	150	22	54	54	515.37
May	25	719	5,316,300	114,596,160	119,912,460	3,868,143	110	740	25	155	23	56	56	571.82
June	155	555	28,767,420	86,603,065	115,370,485	3,845,682	120	1,650	25	150	22	56	56	501.24
July	20	724	4,057,020	110,269,665	114,326,685	3,687,957	112	1,860	25	155	24	56	56	531.51
August	8	736	1,541,430	108,753,305	110,294,735	3,557,894	112	2,050	25	155	24	56	56	512.38
September	14	706	2,827,440	95,168,805	97,996,245	3,266,541	114	1,730	25	150	23	56	56	447.88
October	9	733	1,737,450	96,944,695	98,682,145	3,183,295	113	330	25	155	24	56	56	457.49
November	10	710	2,138,400	89,161,175	91,299,575	3,043,319	108	1,080	25	150	22	56	56	441.47
December	6	738	1,179,090	93,024,465	94,203,555	3,038,824	127	2,190	25	155	23	56	56	386.12
Totals and averages	381	8,391	75,400,280	1,324,900,390	1,400,300,670	3,825,958	1,417	1,440	25	1,830	275	55	55	510.09

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, 1904.

Total Capacity, 3,000,000 gallons per day.

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

1904.	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	114	124	......	5,077,500	5,647,500	......	10,725,000	345,967	49	240	.25	18	6	50	50	......	87.55
February	87	49	......	1,665,000	2,125,000	......	3,790,000	130,689	33	1,080	.25	10	5	50	50	......	45.38
March	24	62	......	1,155,000	2,895,000	......	4,050,000	130,645	29	2,040	.25	9	3	50	50	......	55.92
April	32	37	......	1,590,000	1,393,750	......	2,983,750	99,458	26	760	.25	6	2	50	50	......	45.41
May	26	......	......	1,170,000	....	......	1,170,000	37,741	23	1,480	.25	2	1	50	......	......	19.82
June	6	6	......	270,000	270,000	......	540,000	18,000	21	960	.25	3	1	50	50	......	10.10
July	8	4	.....	360,000	180,000	......	540,000	17,419	22	220	.25	3	1	80	50	......	9.80
August	12	4	......	540,000	180,000	......	720,000	23,225	22	1,220	.25	4	2	50	50	......	12.80
September	9	8	......	405,000	360,000	......	765,000	25,500	22	2,220	.25	4	2	50	50	......	13.34
October	9	4	......	405,000	180,000	......	585,000	18,870	22	1,220	.25	3	2	50	50	......	10.40
November	9	4	......	405,000	180,000	......	585,000	19,500	21	760	.25	3	1	50	50	......	10.94
December	6	32	......	270,000	1,500,000	......	1,770,000	57,096	27	20	.25	7	2	50	50	......	22.67
Totals and averages.	292	334	......	13,312,500	14,911,250	......	28,223,750	77,114	322	1,020	.25	72	28	50	50	......	28.68

CHESTNUT HILL PUMPING STATION, 1904.

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

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

Total Capacity, 750,000 gallons per day.

1904.	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. Cylinder.	Oils. Engine.	Mean Water Pressure per Square Inch less Mean Pressure on Suction Pipe.		Gallons raised 100 feet per pound of Coal.
Month.	No. 1.	No. 2	No. 1.	No. 2.	Gallons.	Gallons.	Tons.	Lbs.		Qts.	Qts.	No. 1.	No. 2.	
January	....	6	....	264,480	264,480	8,531	9	1,730	.25	1	....	....	50	13.63
February	....	....	....	....	....	....	8	1,686	.25	....	....	....	....	....
March	....	....	....	....	....	....	9	1,925	.25	....	....	....	....	....
April	....	....	....	....	....	....	8	2,080	.25	....	....	....	....	....
May	....	....	....	....	....	....	9	1,015	.25	....	....	....	....	....
June	....	....	....	....	....	....	8	1,375	.25	....	....	....	....	....
July	....	....	....	....	....	....	8	1,880	.25	....	....	....	....	....
August	....	....	....	....	....	....	8	1,985	.25	....	....	....	....	....
September	....	....	....	....	....	....	8	1,625	.25	....	....	....	....	....
October	....	....	....	....	....	....	9	1,001	.25	....	....	....	....	....
November	....	....	....	....	....	....	8	1,957	.25	....	....	....	....	....
December	....	....	....	....	....	....	9	1,003	.25	....	....	....	....	....
Totals and averages	....	6	....	264,480	264,480	723	109	1,342	.25	1	....	....	50	1.13

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

FRANKFORD HIGH SERVICE STATION, 1904.

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

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

1904.	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 ft. per lb. 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	24	1,336,680	1,353,296	2,689,976	86,773	32	740	.25	14	12	71	71	52.26
February	21	22	1,222,920	1,248,192	2,471,112	85,210	29	1,910	.25	13	10	71	71	51.99
March	24	23	1,336,680	1,304 928	2,641,608	85,213	27	1,380	.25	12	11	71	71	60.08
April	23	24	1 308,240	1 333,296	2,641,536	88 051	24	2,210	.25	13	12	71	71	66.40
May	29	29	1,667,295	1,652,436	3,319,731	107,088	26	110	.25	16	13	71	71	80.05
June	27	27	1,528,562	1,512,960	3,041,522	101,384	24	1,960	.25	15	16	71	71	78.21
July	29	29	1,669,672	1,662,010	3,331,682	107,473	25	1,970	.25	18	19	71	71	80.86
August	29	28	1,654,852	1,593,995	3,248,847	104,801	26	1,590	.25	19	17	71	71	76.40
September	28	28	1,586,421	1,608,702	3,195,123	106,504	26	1,005	.25	22	16	71	71	75.88
October	29	28	1,663,729	1,619,340	3 283,069	105,905	27	985	.25	16	15	71	71	75.15
November	38	28	2,462,607	1,706,808	4,169,415	138,980	29	260	.25	14	16	71	71	89.95
December	47	155	3,307,926	12,781,657	16,089,583	519,018	60	1,310	.25	37	35	71	71	166.81
Totals and averages...	347	445	20,745,584	29,377,620	50,123,204	136,948	361	1,990	.25	209	192	71	71	79.50

Pumping Stations.	Pay of Employees at the Stations.	Coal Consumed.		
		Tons.	Average Price per Ton.	Total Cost.
Fairmount	$20,427 45	....	....	....
Spring Garden	107,639 16	68,388	$3 18	$217,473 84
Belmont	53,960 90	36,850	3 20	117,920 00
Queen Lane	54,961 65	47,358	3 43	162,437 94
Roxborough	57,020 01	44,[illegible]61	3 18	142,657 98
Frankford	43,369 43	21,650	3 25	70,362 50
Totals and averages	$337,378 60	219,107	$3 24	$710,852 26
High Service Stations.				
Belmont	$9,573 61	1,561	$3 86	$6,025 46
Roxborough	9,565 46	1,418	3 62	5,133 16
Roxborough Annex	3,684 75	2,437	3 62	8,821 94
Mt. Airy	5,835 03	322	3 50	1,127 00
Chestnut Hill	2,588 50	110	3 45	379 50
Frankford	7,314 70	362	3 75	1,357 50
Totals and averages	$38,562 05	6,210	$3 68	$22,844 56
Grand totals and averages, 1904	$375,940 65	225,317	$3 26	$733,696 82
Increase during 1904	....	13,727	....	....
Decrease during 1904	$5,774 20	....	25$\frac{4}{5}$	$10,866 54

ATI

ons

27
25
27
257
268
202
267,
280
184,
264,
267,
294,
3,087,

No

No wark Vertical Triple Expansion. Capacity, 20,000,000
er day.

wark Vertical Triple Expansion. Capacity, 20,000,000
er day.

	Percentage of Ashes.	Oils. Cylinder.	Oils. Engine.	Mean Water Pressure and Mean Suction Lift in Lbs. per Square Inch. No. 1.	No. 2.	No. 3.	No. 4.	Gallons raised 100 Feet per Pound of Coal.
		Qts.	Qts.	No. 1.	No. 2.	No. 3.	No. 4.	
Jan	25	699	965	105	105	105	105	631.82
Feb	25	638	795	105	105	105	105	665.25
Mar	25	570	870	105	105	105	105	670.85
Apr	25	423	744	105	105	105	105	669.05
May	25	419	743	105	105	105	105	611.40
June	25	748	1,009	105	105	105	105	742.66
July	25	792	1,156	105	105	105	105	724,23
Aug	25	781	1,028	105	105	105	105	735.86
Sept	25	756	1,000	105	105	105	105	715.18
Octo	25	784	1,128	105	105	105	105	655.03
Nove	25	764	1,000	105	105	105	105	697.97
Dece	25	706	1,074	105	105	105	105	596.50
	25	8,080	11,512	105	105	105	105	676.32

verag
mpa
er day

allon

Ja	:8,089,
Fe	:7,973,
Ma	4,484,
Ap	3,584,
Ma	1,978,
Ju	6,700,
Ju	4,147,
Au	7,686,
Sep	7,993,
Oct	4,407,
Nov	1,741,
Dec	2,035
Tot	5,053

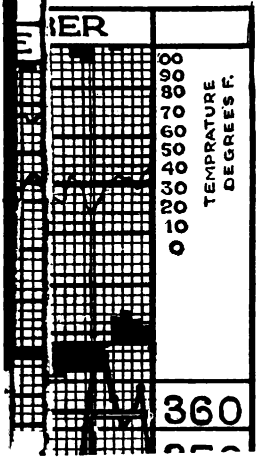
l Rotary. Capacity 22,000,000

l Rotary. Capacity 15,000,000

ean Water Pressure and Mean Suction Lift in ounds per Square Inch.				Gallons Raised 100 Feet per Pound of Coal.
. 1.	No. 2.	No. 3.	No. 4.	
70	70	70	70	441.32
70	70	70	70	472.59
70	70	70	70	403.92
70	70	....	70	439.08
70	70	....	70	516.22
70	70	70	70	536.99
70	70	70	70	502.60
70	70	70	70	474.95
....	70	70	70	452.52
70	70	70	70	480.29
70	70	70	70	485.04
70	70	70	70	426.50
70	70	70	70	469.34

D (

elmont.
52,087,640
67,901,760
72,584,640
70,243.200
72,584,640
70,243,200
71,849,830
72,006,570
69,242,130
71,792,640
69,072,480
71,173,040
30,781,770
....
36,339,235


TEMPRATURE DEGREE'S F.
360

APPENDIX C

REPORT

OF THE

Assistant in Charge of Distribution

Philadelphia, January 15, 1905.

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 1904:

Mains.

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

New Work.

By Bureau of Water:

Service mains laid	79,720 feet.
Supply mains laid	26,029 feet.
Pumping mains laid	97 feet.
Connections, etc.	5,924 feet.
Total	111,770 feet.

By Bureau of Filtration:

Supply mains laid	26,029 feet.
Connections	535 feet.
Total	26,564 feet.

Comparison of Conditions Relative to the Distribution, 1903-1904.

	1903.	1904.	Increase.	Decrease.
Service mains, 4-in. to 12-in..........	125,219	79,720	....	45,499
Supply mains, 10-in. to 48-in.........	1,877	26,029	24,152	
Fire main, 20-in........................	1,500	....	....	1,500
Pumping mains, 36-in...............	....	97	97	
Connections and miscellaneous work..............................	7,795	5,924	....	1,871
Totals in feet....................	136,391	111,770	24,249	48,870
Re-laid, 6-in. to 36-in..................	12,205	25,555	13,350	
Miscellaneous repairs, 3-in. to 48-in.	8,049	3,164	115	
Taken up, 3-in. to 48-in...............	7,980	19,179	11,199	
Lowered, raised, and shifted, 6-in. to 48-in..............................	5,606	5,009	....	597
Totals in feet....................	28,840	52,907	24,664	597
Pipe cut off and abandoned, 3-in. to 20-in..............................	5,892	10,002	4,110	

Meters.

	1903.	1904.	Increase.	Decrease.
Meters in use.........................	1,775	1,763	....	12

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

	1903.	1904.	Increase.	Decrease.
Dwellings with water...........	249,980	255,481	5,501	
Dwellings without water.........	11,750	11,778	28	
Water closets.....................	293,497	309,049	15,552	
Baths..............................	270,759	296,453	25,694	
Wash paves......................	96,092	95,513	....	579
Basins and sinks..................	114,271	120,076	5,805	
Urinals............................	6,001	6,233	232	

Repairs.

Mains relaid	25,555 feet.	
Repairs and connections	3,164 feet.	
		28,719 feet.
Old pipe taken up	19,179 feet.	
Pipe lowered, raised and shifted	5,009 feet.	
		24,188 feet.
Total		52,907 feet.

Abandoned.

Three-inch	2,247 feet.	
Four-inch	3,828 feet.	
Six-inch	3,262 feet.	
Twelve-inch	665 feet.	
Total		10,002 feet.

The total quantity of pipe handled, for all purposes, throughout the year, was 164,677, weighing 14,103,961 pounds.

The total quantity of new pipe laid was 111,770 feet, or 21.13 miles, making, in addition to that previously laid, 1,466.77 miles now in use.

Fire Hydrants.

New style fire hydrants in new locations............	412
New style fire hydrants in place of old style........	229
Total	641
New style fire hydrants taken out..................	35
Old style fire hydrants taken out	7
Total	42

The total number of new style fire hydrants added to the distribution system was 370, and the total number in use December 31, 1904, was 14,017, of which 493 are of the old style and 13,524, or 96.48 per cent. are of the new pattern.

Drills for Attachments.

One-half inch	5,107 area of openings	1,003 square inches
Five-eighth inch	251 area of openings	77 square inches
Three-quarter inch..	147 area of openings	65 square inches
One inch	115 area of openings	90 square inches
One and one-quarter inches	24 area of openings	29 square inches
One and one-half in..	36 area of openings	64 square inches
Two inches	65 area of openings	204 square inches
Three inches	9 area of openings	64 square inches
Four inches	7 area of openings	88 square inches
Six inches	19 area of openings	537 square inches
Total	5,780 area of openings	2,221 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, SUPPLY AND PUMPING MAINS LAID DURING 1904.

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	Total in feet and pounds.
New pipe or feet added.	Service Mains		....	....	3,290	....	....	526	3,816
	Fire hydrant connections		....	....	179	....	....	....	179
	Fire connections (private)		....	....	11	....	....	....	11
	Supply connections (private)		16	17	....	....	....	....	33
	Motor connections (private)		....	17	....	....	....	....	17
	Total	Feet	16	34	3,480	....	....	526	4,056
		Pounds	240	680	114,840	....	....	39,450	155,210
Pipe used, but adding nothing to feet in ground.	Pipe relaid		....	512	557	....	....	....	1,069
	Repairs, general		....	....	286	13	15	6	320
	Pipe taken up		403	13	8	....	....	....	424
	Pipe shifted		....	....	505	....	....	....	505
	Total	Feet	403	525	1,356	13	15	6	2,318
		Pounds	6,045	10,500	44,748	546	825	450	63,114
	Total handled	Feet	419	559	4,836	13	15	532	6,374
		Pounds	6,285	11,180	159,588	546	825	39,900	218,324
	Pipe cut off and abandoned		637	10	6	....	....	....	653

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	10	12	20	Total in feet and pounds.
New pipe or feet added.	Service Mains	...	...	472	...	254	...	726
	Supply main connections	...	...	...	...	12	...	12
	Bye-pass connections	...	...	...	...	21	...	21
	Fire hydrant connections	...	...	163	...	...	...	163
	Fire connections (private)	25	29	76	...	...	...	130
	Supply connections (private)	34	72	...	...	...	...	106
	Motor connections (private)	...	44	...	...	...	...	44
	Drains	...	...	6	...	...	...	6
	Total — Feet	59	145	717	...	287	...	1,208
	Total — Pounds	885	2,900	23,661	...	21,525	...	48,971
Pipe used but adding nothing to ft. in ground.	Pipe relaid	...	...	1,134	2,957	2,644	...	6,735
	Repairs, general	...	...	208	25	44	3	280
	Pipe taken up	158	144	3,347	...	1,361	...	5,010
	Pipe raised	...	...	...	...	335	...	335
	Pipe shifted	...	...	*1,407	...	...	...	1,407
	Total — Feet	158	144	6,096	2,982	4,384	3	13,767
	Total — Pounds	2,370	2,880	201,168	164,010	328,800	465	699,693
	Total handled — Feet	217	289	6,813	2,982	4,671	3	14,975
	Total handled — Pounds	3,255	5,780	224,829	164,010	350,325	465	748,664
	Pipe cut off and abandoned	190	10	1,213	...	426	...	1,839

*Omitted in 1903 report

Third District.

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

Purposes for which used.		Size in Inches. 3	4	6	8	10	12	16	30	48	Total in feet and pounds.
New pipe or feet added.	Service mains	......	367	10,612	834	7,792	1,938	......	......	......	21,543
	Supply mains	......	......	......	......	......	......	2,244	......	4,700	6,944
	Service main connections	......	......	37	......	......	......	......	......	......	37
	Supply main connections	......	......	18	225	......	13	......	......	......	256
	Fire hydrant connections	......	......	734	34	......	......	......	......	......	768
	Fire connections (private)	......	37	57	......	......	......	......	......	......	94
	Supply connections (private)	30	301	......	......	......	......	......	......	......	331
	Motor connections (private)	19	......	......	......	......	......	......	......	......	19
	Drains	......	......	71	......	......	......	......	......	......	71
	Total { Feet	49	705	11,529	1,093	7,792	1,951	2,244	......	4,700	30,063
	Total { Pounds	735	14,100	380,457	45,906	428,560	146,325	258,060	......	3,055,000	4,329,143
Pipe used but adding nothing to ft. in ground.	Pipe relaid	......	406	7,619	280	......	1 409	......	145	......	9,859
	Repairs, general	3	17	203	......	183	73	......	12	20	511
	Pipe taken up	......	706	6,076	280	......	1,389	......	145	......	8,596
	Pipe lowered	......	......	......	......	......	......	......	470	......	470
	Pipe raised	......	......	257	......	......	60	......	......	......	317
	Total { Feet	3	1,129	14,155	560	183	2,931	......	772	20	19,753
	Total { Pounds	45	22,580	467,115	23,520	10,065	219,825	......	254,760	13,000	1,010,910
Total handled { Feet		52	1,834	25,684	1,653	7,975	4,882	2,244	772	4,720	49,816
Total handled { Pounds		780	36,680	847,572	69,426	438,625	366,150	258,060	254,760	3,068 000	5,340,053
Pipe cut off and abandoned		......	448	1,099	......	......	16	......	......	......	1,563

Fourth District.

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

Purposes for which used.		Size in Inches. 3	4	6	8	10	12	16	20	30	36	Total in Feet and Pounds.
New pipe or feet added.	Service mains	....	292	4,868	36	675	2,569	....	....	....	....	8,440
	Supply mains	....	....	....	....	....	....	2,830	3,579	1,666	....	8,075
	Supply main connections	....	....	14	192	165	18	....	....	....	....	389
	Fire hydrant connections	....	....	265	9	....	....	....	....	....	....	274
	Fire connections (private)	....	35	178	....	....	....	....	....	....	....	213
	Supply connections (private)	24	14	....	....	....	....	....	....	....	....	38
	Motor connections (private)	14	13	....	....	....	....	....	....	....	....	27
	Drains	....	....	71	....	....	75	....	....	....	....	146
	Total — Feet	38	354	5,396	237	840	2,662	2,830	3,579	1,666	....	17,602
	Total — Pounds	570	7,080	178,068	9,954	46,200	199,650	325,450	554,745	549,780	....	1,871,497
Pipe used but adding nothing to feet in ground.	Pipe relaid	....	400	889	881	....	94	....	....	....	....	2,264
	Repairs general	....	15	600	12	37	....	....	....	....	....	664
	Pipe taken up	....	1,207	794	12	....	....	....	....	....	30	2,043
	Pipe shifted	....	....	179	....	....	....	....	....	....	....	179
	Total — Feet	....	1,622	2,462	905	37	94	....	....	....	30	5,150
	Total — Pounds	....	32,440	81,246	38,010	2,035	7,050	....	....	....	12,600	173,381
Total handled — Feet		38	1,976	7,858	1,142	877	2,756	2,830	3,579	1,666	30	22,752
Total handled — Pounds		570	39,520	259,314	47,964	48,235	206,700	325,450	554,745	549,780	12,600	2,044,878
Pipe cut off and abandoned		....	....	364	....	....	....	....	....	....	....	364

Fifth District.

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

	Purposes for which used.		Size in Inches. 3	4	6	8	10	12	20	30	36	Total in feet and Pounds.
New pipe or feet added.	Service mains			200	2,121		3,522					5,843
	Pumping main connections								31	41		72
	Fire hydrant connections				201							201
	Fire connections (private)			18	30							48
	Supply connections (private)				7							7
	Drains							177				177
	Total	Feet		218	2,359		3,522	177	31	41		6,348
		Pounds		4,360	77,847		193,710	13,275	4,805	13,530		307,527
Pipe used, but adding nothing to feet in ground.	Pipe relaid			1,070	305	215	108		1,228			2,926
	Repairs general			2	115		27	4	16	16	2	182
	Pipe taken up		2	236	36	215		372	1,683			2,544
	Pipe lowered				595							595
	Total	Feet	2	1,308	1,051	430	135	376	2,927	16	2	6,247
		Pounds	30	26,160	34,683	18,060	7,425	28,200	453,685	5,280	840	574,363
Total handled		Feet	2	1,526	3,410	430	3,657	553	2,958	57	2	12,595
		Pounds	30	30,520	112,530	18,060	201,135	41,475	458,490	18,810	840	881,890
Pipe cut off and abandoned			1,070		163							1,233

Sixth District.

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

Purposes for which used.		Size in Inches. 3	4	6	8	10	12	16	20	24	Total in Feet and Pounds.
New pipe or feet added.	Service mains		443	6,228		2,085	1,811				10,567
	Supply mains								2,942	8,068	11,010
	Service main connections			8							8
	Supply main connections				89	16	45	20	33		203
	Bye-pass connections				184	55	39				278
	Fire hydrant connections			497							497
	Fire connections (private)			36							36
	Supply connections (private)		34	10							44
	Total — Feet		477	6,779	273	2,156	1,895	20	2,975	8,068	22,643
	Total — Pounds		9,540	223,707	11,466	118,580	142,125	2,300	461,125	2,501,080	3,469,923
Pipe used but adding nothing to feet in ground.	Pipe relaid			454	688	13	1,462				2,617
	Repairs, general		3	539	14	34	110	24	15	23	762
	Pipe taken up		58	123		15	262				458
	Pipe lowered			802			15				817
	Total — Feet		61	1,918	702	62	1,849	24	15	23	4,654
	Total — Pounds		1,220	63,294	29,484	3,410	138,675	2,760	2,325	7,130	248,298
Total handled	Feet		538	8,697	975	2,218	3,744	44	2,990	8,091	27,297
	Pounds		10,760	287,001	40,950	121,990	280,800	5,060	463,450	2,508,210	3,718,221
Pipe cut off and abandoned		350	3,243	377			223				4,193

SEVENTH DISTRICT.

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

Purposes for which used.		Size in Inches. 3	4	6	8	10	12	16	20	30	36	Total in feet and pou'ds.
New pipe or feet added.	Service mains	....	1,676	23,974	1,919	1,216	....	....	....	....	....	28,785
	Pumping mains	....	....	....	....	....	....	....	....	....	97	97
	Supply main connections	....	....	....	....	....	17	....	....	....	....	17
	Bye-pass co nections	....	....	72	....	....	....	....	201	....	....	273
	Fire hydrant connections	....	....	467	....	....	....	....	....	....	....	467
	Fire connections (private)	18	....	....	....	....	....	....	....	....	....	18
	Supply connections (private)	17	....	....	....	....	....	....	....	....	....	17
	Drains	....	104	72	....	....	....	....	....	....	....	176
	Total { Feet	35	1,780	24,585	1,919	1,216	17	....	201	....	97	29,850
	Total { Pounds	525	35,600	811,305	80,598	66,880	1,275	....	31,155	....	40,740	1,068,078
Pipe used but adding nothing to feet in ground.	Pipe relaid	....	....	55	30	....	....	....	....	....	....	85
	Repairs, general	....	4	266	15	74	10	....	24	22	30	445
	Pipe taken up	....	48	80	....	....	....	....	....	26	....	104
	Pipe lowered	....	....	100	....	60	....	224	....	....	....	384
	Total { Feet	....	52	451	45	134	10	224	24	48	30	1,018
	Total { Pounds	....	1,040	14,883	1,890	7,370	750	25,760	3,720	15,840	12,600	83,853
Total handled { Feet		35	1,832	25,036	1,964	1,350	27	224	24	48	127	30,868
Total handled { Pounds		525	36,640	826,188	82,488	74,250	2,025	25,760	34,875	15,840	53,340	1,151,931
Pipe cut off and abandoned		....	117	40	....	....	....	....	....	....	....	157

Alterations to Water Pipes on the line of the Market Street Subway.

Pipe Relaid.	Pipe. Size.	Pipe. Feet.
Ludlow street, from 95 feet east of east house line of Twenty-third street, west..........	6	411
Market street, south side, from 137 feet west of west house line of Sixteenth to Twentieth street..........	10	1,620
Market street, south side, from 20-inch main on Twenty-first street (18 feet east of west house line), west..........	12	8
Market street, south side, from 10 feet east of west house line of Twenty-first street to 237 feet west of centre of Twenty-second street..........	10	678
Market street, south side, from 237 feet west of centre of Twenty-second street, to Twenty-third street..........	12	94
Market street, south side, from Twenty-third street to 334 feet west of house line of Twenty-third street..........	10	359
Market street, north side, from 7 feet east of west house line of Twenty-first street to Twenty-second street..........	10	305
Market street, north side, from centre of Twenty-second street, west..........	6	235
Market street, from 12-inch main south side of Market at a point 237 feet west of centre of Twenty-second street, and 88 feet north of south house line, north 76 feet 6 inches to north side of Market street, thence west 97 feet to connect with 12-inch main on Twenty-third street (21 feet east of west house line)..........	12	174
Market street, from 12 feet west of west house line of Twenty-first street, west. (City Hall main.)..........	12	1,123
Twenty-second street, from 28 feet north of south house line of Market street, north..........	12	60
Twenty-third street, from 10 feet north of south house line of Ranstead to 38 feet north of south house line of Market street.	12	271
Twenty-third street, from 3 feet south of north house line of Market street, north..........	12	130
Total..........	......	5,463

	Purposes for which used.		3	4
New pipe or feet added.	Service mains		....	2,978
	Supply mains		....	....
	Pumping mains		....	....
	Service main connections		....	....
	Supply main connections		....	....
	Pumping main connections		....	....
	Bye-pass connections		....	....
	Fire hydrant connections		....	....
	Fire connections (private)		43	119
	Supply connections (private)		121	438
	Motor connections (private)		33	74
	Drains		....	104
	Total	Feet	197	3,713
		Pounds	2,955	74,260
Pipe used but adding nothing to feet in ground.	Pipe relaid		....	2,388
	Repairs, general		3	41
	Pipe taken up		563	2,412
	Pipe lowered		....	....
	Pipe raised		....	....
	Pipe shifted		....	....
	Total	Feet	566	4,841
		Pounds	8,490	96,820
	Total handled	Feet	763	8,554
		Pounds	11,445	171,080
	Pipe cut off and abandoned		2,247	3,828

Pipe Laid by Contract by the Bureau of Filtration during 1904.

Purposes for which used.	Size in Inches.								Total.
	6	8	12	16	20	24	30	48	
Third District.									
Supply mains	......	......	......	2,244	......	......	......	4,700	6,944
Supply main connections	18	212	13	......	......	......	......	......	243
Total	18	212	13	2,244	......	......	......	4,700	7,187
Fourth District.									
Supply mains	......	......	......	2,830	3,579	......	1,666	......	8,075
Supply main connections	......	192	18	......	......	......	......	......	210
Total	......	192	18	2,830	3,579	......	1,666	......	8,285
Sixth District.									
Supply mains	......	......	......	......	2,942	8,068	......	......	11,010
Supply main connections	......	72	10	......	......	......	......	......	82
Total	......	72	10	......	2,942	8,068	......	......	11,092
Grand Total	18	476	41	5,074	6,521	8,068	1,666	4,700	26,564

Total Feet of Pipe in Use December 31, 1904.

Size in Inches.	Total in used Dec. 31, 1903.	Extensions and Relays during 1904.			Deductions during 1904.			Total in use Dec. 31, 1904.
		Laid.	Relaid.	Total.	Taken up.	Abandoned.	Total.	
1	175	....	....	....	....	....	....	175
1½	3,566	....	....	....	....	....	....	3,566
2	3,655	....	....	....	....	....	....	3,655
3	80,101	197	3	200	568	2,247	2,810	77,491
4	185,034	3,713	2,429	6,142	2,412	3,828	6,240	184,936
6	5,114,361	54,845	13,230	68,075	10,414	3,262	13,676	5,168,760
8	309,036	3,522	2,148	5,670	507	....	507	314,249
10	443,103	15,526	3,478	18,999	15	....	15	462,087
12	470,619	7,515	5,856	13,371	3,384	665	4,049	479,941
16	144,733	5,094	24	5,118	....	....	....	149,851
18	16,085	....	....	....	....	....	....	16,085
20	268,781	6,786	1,286	8,072	1,683	....	1,685	275,170
22	606	....	....	....	....	....	....	606
23	27	....	....	....	....	....	....	27
24	5,058	8,068	23	8,091	....	....	....	13,149
30	294,484	1,707	195	1,902	171	....	171	296,215
36	101,392	97	32	129	30	....	30	101,491
48	192,391	4,700	20	4,720	....	....	....	197,111
Total	7,683,257	111,770	28,719	140,489	19,179	10,002	29,181	7,744,565

STATEMENT OF THE NUMBER OF FIR

	First District.									Second D						
	Wards.								Total.	Wards.						
	1	2	3	4	26	30	36	39		5	6	7	8	9	10	11
Prior to 1904	....	....	....	....	....	....	....	....	2,159	....	....	....	....	....	....	....
During 1904	2	....	....	....	....	4	1	6	13	18	49	....	27	41	22	1
Total	....	....	....	....	....	....	....	....	2,172	....	....	....	....	....	....	....
Taken out, 1904	1	....	....	....	....	....	....	....	1	1	....	....	2	3	....	....
Total in city	....	....	....	....	....	....	....	....	2,171	....	....	....	....	....	....	....

Number of attachme

Made during 1904......

Total..........

Recapitulation of Fire Hydrants Set, Renewed and Removed.

	Districts.	Style.					Total.
		O. S.	No. 1.	No. 2.	No. 3.	High Pressure.	
Set.	First	....	12	1	....	....	13
	Second	....	9	7	1	144	161
	Third	....	49	5	8	....	62
	Fourth	....	16	11	1	....	28
	Fifth	....	36	....	....	....	36
	Sixth	....	40	4	....	....	44
	Seventh	....	47	11	10	....	68
	Total	....	209	39	20	144	412
Renewed.	First	....	3	....	....	....	3
	Second	....	34	17	1	....	52
	Third	....	11	12	8	....	31
	Fourth	....	....	1	....	....	1
	Fifth	....	55	....	1	....	56
	Sixth	....	33	....	2	....	35
	Seventh	1	35	14	2	....	52
	Total	1	171	44	14	....	230
	Total new fire hydrants	1	380	83	34	144	642
Removed.	First	....	....	1	....	....	1
	Second	....	5	3	....	....	8
	Third	1	6	4	3	....	14
	Fourth	2	2	....	....	....	4
	Fifth	1	1	....	....	....	2
	Sixth	2	6	1	....	....	9
	Seventh	1	2	1	....	....	4
	Total	7	22	10	3	....	42
	Total added during 1904	....	....	....	....	....	370

Fire Hydrants by Wards.

Wards.	Style.							Total.
	O. S.	No. 1.	No. 2.	No. 3.	No. 4.	No.5.	High Pressure	
First	3	201	67	8	......	......	....	279
Second	2	122	91	15	......	......	....	230
Third	3	76	42	6	......	......	....	127
Fourth	1	64	33	14	......	......	....	112
Fifth	17	100	61	7	......	......	17	202
Sixth	8	76	49	8	......	......	49	190
Seventh	6	142	85	7	......	1	....	241
Eighth	10	119	100	5	......	1	24	259
Ninth	......	119	85	3	......	1	32	240
Tenth	......	108	70	......	......	4	22	204
Eleventh	4	77	26	......	......	......	....	107
Twelfth	7	60	29	5	......	......	....	101
Thirteenth	23	62	70	9	......	......	....	164
Fourteenth	......	87	91	......	......	......	....	178
Fifteenth	......	236	210	6	1	2	....	455
Sixteenth	2	82	40	3	1	......	....	128
Seventeenth	11	81	34	......	......	......	....	126
Eighteenth	12	202	61	9	......	......	....	284
Nineteenth	31	332	124	4	......	......	....	491
Twentieth	19	132	139	......	......	......	....	290
Twenty-first	51	383	45	6	......	......	....	485
Twenty-second	64	1,124	153	21	......	......	....	1,362
Twenty-third	38	322	77	5	......	......	....	442
Twenty-fourth	44	299	154	13	......	......	....	510
Twenty-fifth	......	542	135	5	......	......	....	682
Twenty-sixth	1	229	123	14	......	......	....	367
Twenty-seventh	22	337	118	8	......	1	....	486
Twenty-eighth	1	163	140	23	......	......	....	327
Twenty-ninth	17	200	200	11	......	1	....	429
Thirtieth	5	123	110	6	......	......	....	244
Thirty-first	......	237	70	6	......	......	....	313
Thirty-second	9	127	97	10	......	1	....	244
Thirty-third	23	683	174	21	1	......	....	902

Fire Hydrants by Wards—Continued.

Wards.	Style.							Total.
	O. S.	No. 1.	No. 2.	No. 3.	No. 4.	No. 5	High Pressure	
Thirty-fourth	25	523	124	15	......	1	....	688
Thirty-fifth	......	104	12	4	......	......	....	120
Thirty-sixth	6	317	102	29	......	......	....	454
Thirty-seventh	5	96	80	6	......	......	....	187
Thirty-eighth	16	396	101	8	......	......	....	521
Thirty-ninth	......	220	90	7	......	......	....	317
Fortieth	7	212	54	3	......	......	....	276
Forty-first	......	51	8	9	......	......	....	68
Forty-second	......	166	8	11	......	......	....	185
Total	493	9,332	3,682	350	3	13	144	14,017

Fire Hydrants by Purveyors' Districts.

Districts.	Style.							Total.
	O. S.	No. 1.	No. 2.	No. 3.	No. 4.	No. 5.	High Pressure.	
First	18	1,362	689	102	......	......	....	2,171
Second	81	1,121	739	50	1	7	144	2,143
Third	107	2,356	634	63	1	......	....	3,161
Fourth	57	1,022	901	48	1	4	....	2,033
Fifth	53	476	46	7	......	......	....	582
Sixth	79	1,624	223	41	......	......	....	1,967
Seventh	98	1,371	450	39	......	2	....	1,960
Total	493	9,332	3,682	350	3	13	144	14,017

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 PERMIT.							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 Attachments.	Re-driven.	Discontinued.	Transfer.	Not Drawn.	Drawn and Re-driven.	Total.	Discontinued and Abandoned.	Delinquent.	Leak.	Transfer.	Total.	Drawn and Re-driven.
First..........	608	26	20	19	2	4	8	1	....	1	689	......	92	46	28	......	30	196	26	......	143	......	169	
Second........	165	48	41	37	11	20	14	....	....	....	331	98	20	120	......	......	104	337	51	......	97	......	148	90
Third..........	867	19	22	20	3	6	13	4	2	2	958	......	3	14	......	......	48	65	113	......	173	129	415	100
Fourth........	559	17	9	7	2	4	12	2	4	13	629	33	131	19	......	5	122	310	5	......	179	......	184	110
Fifth..........	146	1	1	1	....	1	1	....	....	....	151	6	16	2	8	4	34	70	5	......	......	......	5	22
Sixth..........	783	103	20	14	4	....	6	....	1	3	934	29	29	51	2	13	35	159	......	......	67	......	67	
Seventh.......	1,979	42	34	17	2	1	11	2	....	....	2,088	21	9	5	3	......	91	129	6	2	39	......	47	
Total........	5,107	251	147	115	24	36	65	9	7	19	5,780	182	300	257	41	22	464	1,266	206	2	698	129	1,035	322

Permits Issued during the year 1904.

Aquaria	4	Lawn Sprinklers	4
Bakeries	26	Laundries	22
Barber shops	84	Laboratories	2
Bars	22	Machines for scouring, rinsing, etc.	50
Basins and sinks in dwellings	4,284	Milk houses	38
Basins and sinks in offices, stores, etc	1,730	Motors (beer)	18
		Motors (organ)	30
Baths in dwellings	5,280	Photograph galleries	4
Baths in hotels, etc	497	Pantry sinks	497
Baths (shower)	46	Pools (swimming)	1
Bidets	2	Pools (in churches)	8
Boats, etc. (supply of)	90	Restaurants and eating saloons	46
Bottling establishments	14		
Building purposes	296	Slaughter houses	3
Carriages and wagons	168	Stables	18
Cellar drainers	10	Stalls (in stables)	856
Dwellings	5,513	Stalls (cow)	8
Dwellings (half)	30	Steam boilers (number)	128
Drug stores	20	Steam boilers (H. P.)	5,668
Dye houses	1	Steam engines (number)	64
Factories	12	Steam engines (H. P.)	381
Ferrules (number)	6,435	Street sprinklers	80
Filters	3	Tubs, vats and tanks	86
Fire hydrants (use of)	200	Urinals in dwellings	10
Fish troughs and stands	4	Urinals in stores, offices, etc.	204
Forges	14	Urinal troughs	42
Fountains (counter)	19	Wash paves and screw nozzles	1,685
Fountains (garden)	6		
Green houses	23	Wash paves for watering horses	22
Heating boilers	52	Wash tubs (stationary)	4,076
Hydrants in new dwellings	4,713	Water closets in dwellings	14,456
Hydraulic elevators	10	Water closets in stores, etc.	1,363
Ice cream saloons	17		

Premises Supplied and Appliances in Use January 1, 1905.

Aquaria	26	Engines (railoads)	360
Arsenals	2	Factories, foundries, mills	2,100
Asylums	7	Filters	28
Bakeries	1,315	Fire stations	71
Barber shops	1,847	Fountains (garden)	55
Bars	1,829	Fountains (counter)	549
Basins and sinks in dwellings	87,642	Forges	1,216
		Furnaces	20
Basins and sinks in offices and stores	32,434	Gas works holders	8
Baths (in dwellings)	294,146	Glass works	15
Baths (public)	1,871	Green houses	1,118
Baths (shower)	340	Grindstones	120
Baths (foot)	96	Halls and club houses	250
Beam houses and tanneries	24	Hatters' planks (per set)	19
Bidets	436	Hydrants	265,116
Bottling establishments	686	Hospitals	60
Brick yards	13	Hotels	65
Brick yards (gangs of men)	70	Hydraulic elevators	273
Breweries	90	Ice cream saloons	338
Barrels (brewed)	2,450,320	Institutions (charitable)	96
Cars (steam and electric)	1,700	Ice machines	150
Carriages and wagons	9,395	Laundries	804
Cellar drainers	64	Lawn sprinklers	278
Cemeteries	23	Laboratories	88
Churches	690	Machines for washing and scouring	183
Coal yards	247	Marble yards	85
Coloring rooms	125	Malt houses	19
Condensers	27	Market houses	40
Depot and railway stations	100	Milk houses	441
Dwellings (with water)	255,481	Mints	1
Dwellings (without water)	2,015	Motors (beer)	1,902
Dwellings half (without water)	9,763	Motors (organ)	216
		Photograph galleries	142
Dyers	741	Photograph galleries (operators)	180
Drug stores	417		
Dye houses	650	Polishing wheels	15

Premises Supplied and Appliances in Use—Continued.

Police stations and patrols..	68	Steam engines (H. P.).......	25,000
Pools (swimming)...........	28	Steam saws..................	65
Pools (in churches)..........	88	Steam presses and hammer	50
Printing (establishments)...	172	Shops and stores (with water).........................	5,946
Prisons.......................	4	Shops (without water).....	946
Rectifying (establishments)	6	School houses...............	350
Restaurant and oyster saloons........................	1,206	Theaters......................	23
Shot towers....................	1	Tubs, vats and tanks.......	2,366
Slaughter houses.............	486	Turbine wheels	40
Soap boiling (establishments)......................	18	Urinals in dwellings........	280
		Urinals in stores, offices, etc.	5,211
Stand pipes for watering engines........................	60	Urinals (troughs)...........	742
Stables........................	8,358	Vinegar (establishments)..	10
Stalls (in stables)............	53,655	Wash paves and screw nozzles.........................	94,813
Stalls (cow)..................	187		
Stalls (fish and trough)......	100	Wash paves for watering horses.......................	700
Steam boilers (number)	3,841	Wash tubs (stationary)....	44,622
Steam boilers (H. P.)........	135,930	Water closets in dwellings.	279,749
Steam boilers (heating).....	997	Water closets in stores, etc.	29,300
Steam boilers heating (H.P.)	5,900	Wool washers...............	105
Steam engines (number) ...	2,200		

Repairs to Mains, Stops and Fire Hydrants, also Stops and Fire Hydrants Removed during 1904.

Districts.	Repairs to Mains.	Stops.			Fire Hydrants.		
		Repaired.	Renewed.	Removed.	Repaired.	Renewed.	Removed.
First	42	888	2	2	211	3	1
Second	115	139	22	12	500	52	8
Third	461	109	12	21	95	31	14
Fourth	230	462	1	3	2,187	1	4
Fifth	99	20	7	6	30	56	2
Sixth	72	20	3	23	14	35	9
Seventh	139	151	....	4	137	52	4
Totals	1,158	1,789	47	71	3,174	230	42

Check Valves Put In.

Street.	Location.	Ward.	Size.
Nixon (River Road)	448 feet southeast of southeast house line of Shawmont avenue	21	30

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.	1-inch.		⅝-inch.	1-inch.	
First	194	....	194	1,778	....	1,778
Second	....	....	....	....	....	....
Third	732	1	733	8,593	20	8,613
Fourth	78	....	78	1,030	....	1,030
Fifth	98	....	98	1,174	....	1,174
Sixth	151	....	151	2,103	....	2,103
Seventh	364	....	364	6,545	....	6,545
Total	1,617	1	1,618	21,223	20	21,243

Account of Iron Stop Boxes, New Stops and Check Valves for 1904.

Districts.	Iron Stop Boxes.	Stops.									Check Valves.	Total.
		Bureau of Water.		Smith.	Eddy.	Eddy Rotary.	Ludlow.	Williamsport.	Rensselaer.	Viney.		
		Dept.	Butterfly.									
First	....	34	....	....	....	....	....	....	....	....	....	34
Second	12	46	1	22	31	....	4	263	....	....	....	367
Third	11	160	....	6	5	....	3	....	6	2	....	182
Fourth	24	49	3	16	9	2	....	....	26	1	....	106
Fifth	8	29	1	....	60	....	....	....	....	....	1	91
Sixth	....	84	1	1	56	....	....	....	17	....	....	159
Seventh	....	79	1	4	73	....	2	....	....	....	....	159
Total	55	481	7	49	234	2	9	263	49	3	1	1,098

Total Number of Stops and Valves, arranged by Districts.

Pattern.	Size.	Outlets.	Districts. 1	2	3	4	5	6	7	Total.
Single Gate. Bureau of Water.	3	2-way.	1	185	5	21	2	15	12	241
	4	2-way.	102	254	52	159	48	87	82	784
	6	2-way.	3,762	2,581	4,318	3,145	714	2,502	3,082	20,104
	8	2-way.	160	118	162	120	10	78	295	943
	10	2-way.	227	358	260	230	34	180	198	1,487
	12	2-way.	133	193	324	154	49	226	208	1,287
	16	2-way.	38	44	45	21	5	40	19	212
	18	2-way.	......	......	5	......	......	1	......	6
	20	2-way.	24	35	19	37	14	16	29	174
	30	2-way.	8	9	29	37	15	3	3	104
	36	2-way.	3	2	8	12	11	......	8	44
	48	2-way.	......	......	3	9	......	......	......	12
		Totals...	4,458	3,779	5,230	3,945	902	3,148	3,936	25,398
Butterfly. Bureau of Water.	20	2-way.	......	1	5	8	4	4	5	27
	30	2-way.	2	2	7	7	9	2	4	33
	36	2-way.	......	......	5	17	2	......	......	24
	48	2-way.	......	2	7	30	22	......	1	62
		Totals...	2	5	24	62	37	6	10	146
Butterfly Eddy.	30	2-way.	......	......	......	......	......	1	......	1
		Totals...	......	......	......	.....	......	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.	......	5	......	......	......	......	......	5
		Totals...	15	32	......	17	......	......	13	77

Total Number of Stops and Valves—Continued.

Pattern.	Size.	Outlets.	Districts. 1st.	2d.	3d.	4th.	5th.	6th.	7th.	Total.
Viney.	6	2-way.	5	......	6	3	......	......	......	14
	6	3-way.	49	55	31	232	5	9	19	400
	8	3-way.	......	......	...	......	......	......	5	5
	10	3-way.	......	......	......	3	......	......	......	3
	12	3-way.	......	1	......	3	......	......	1	5
	6	4-way.	22	28	22	100	4	10	22	208
	8	4-way.	1	......	2	......	......	......	5	8
	10	4-way.	......	......	......	14	......	......	3	17
	12	4-way.	......	......	......	......	......	2	......	2
	6	5-way.	24	5	1	26	......	......	3	59
	Totals ...		101	89	62	381	9	21	58	721
Smith's Patent.	3	2-way.	1	40	1	3	......	......	6	51
	4	2-way.	4	36	2	7	......	......	5	54
	6	2-way.	1	59	25	26	9	7	20	147
	8	2-way.	1	......	11	......	......	......	......	12
	10	2-way.	......	5	9	1	2	1	4	22
	12	2-way.	1	9	8	......	......	......	1	19
	16	2-way.	4	......	2	......	......	......	......	6
	20	2-way.	......	1	1	......	......	......	4	6
	Totals..		12	150	59	37	11	8	40	317
Ludlow.	3	2-way.	......	......	9	......	......	1	9	19
	4	2-way.	......	......	......	1	......	......	......	1
	6	2-way.	......	......	......	......	5	......	3	8
	Totals..		......	......	9	1	5	1	12	28

Total Number of Stops and Valves—Continued.

Pattern.	Size.	Outlets.	Districts. 1st.	2d.	3d.	4th.	5th.	6th.	7th.	Total.
Eddy.	6	2-way.	......	11	1	6	33	10	15	76
	8	2-way.	......	......	1	......	1	5	......	7
	10	2-way.	......	8	......	1	8	9	21	47
	12	2-way.	......	5	1	......	2	2	4	14
	16	2-way.	......	2	......	......	2	15	15	34
	20	2-way.	......	4	......	1	2	11	9	27
	24	2-way.	......	......	......	......	4	......	......	4
	30	2-way.	......	1	2	1	15	4	2	25
	36	2-way.	......	.....	......	......	4	......	8	12
	Total....		......	31	5	9	71	56	74	246
Eddy Rotary.	30	2-way.	......	......	......	2	......	......	......	2
	Total....		......	......	......	2	......	......	......	2
Rensselaer.	8	2-way.	......	......	4	16	......	13	......	33
	12	2-way.	......	......	......	3	......	......	......	3
	16	2-way.	......	......	2	4	......	......	......	6
	20	2-way.	......	......	......	2	......	2	......	4
	24	2-way.	......	......	......	......	......	2	......	2
	30	2-way.	......	......	......	1	......	......	......	1
	Total		.....	......	6	26	......	17		49

HIGH PRESSURE STOPS.

Pattern.	Size.	Outlets.	1st.	2d.	3d.	4th.	5th.	6th.	7th.	Total.
Williamsport.	8	2-way.	......	190	......	......	......	......	......	190
	12	2-way.	......	54	......	......	......	......	......	54
	16	2-way.	......	19	......	......	......	......	......	19
	Total		......	263	......	......	......	......	......	263
Ludlow.	20	2-way.	......	4	......	......	......	......	......	4
	Total		......	4	......	......	......	......	......	4
Total number of stops....			4,588	4,353	5,395	4,480	1,035	3,258	4,143	27.252

Total Number of Stops and Valves—Continued.

Pattern.	Size.	Outlets.	Districts. 1st.	2d.	3d.	4th.	5th.	6th.	7th.	Total.
Check Valves Bureau of Water.	12	....	......	1	......	.....	......	......	......	1
	20	....	......	......	......	......	......	......	1	1
	30	....	......	......	1	......	5	......	3	9
	36	....	......	......	1	......	4	......	2	7
	48	....	......	......	4	4	6	......	......	14
	Total.....		......	1	6	4	15	......	6	32

Number of Valves Raised in the Several Districts during the year 1904.

Districts.	Barton. 4-way.	Barton. 5-way.	Viney. 3-way.	Viney. 4-way.	Viney. 5-way.	Single Gate. 6-inch.	Single Gate. 16-inch.	Total.
First..............................	......	......	......	......	1	......	......	1
Second	1	2	3	1	1	9	1	18
Third..............................	......	......	......	1	......	3	......	4
Fourth	2	......	......	2	......	5	......	9
Total.....................	3	2	3	4	2	17	1	32

Number of Complaints and Examinations during 1903 and 1904.

MONTHS.	HYDRANTS.		SERVICE PIPES.		WASH PAVES.		SPIGOTS		WATER CLOSETS.		HORSE TROUGHS.		NO. LEAKS.		TOTAL.	
	1903.	1904.	1903.	1904.	1903.	1904.	1903.	1904.	1903.	1904.	1903.	1904.	1903.	1904.	1903.	1904.
January	201	253	206	340	10	14	13	10	38	55	2	3	9	12	479	687
February.........	112	263	117	257	4	20	12	10	44	47	....	....	11	8	300	605
March	128	183	110	309	4	15	13	21	71	80	....	....	7	8	333	616
April..............	130	218	118	193	4	7	6	15	43	57	....	....	8	10	309	500
May..........	159	193	120	158	1	5	21	20	52	67	....	....	11	9	364	452
June	132	188	89	141	5	7	12	17	46	62	....	....	6	5	290	420
July....	173	178	124	129	8	7	24	27	37	40	....	....	13	14	379	395
August............	226	211	128	118	5	4	26	24	65	62	....	....	18	13	468	432
September	193	157	132	119	7	3	22	9	34	38	....	....	11	9	399	335
October.	162	186	117	100	10	12	40	37	50	76	....	....	3	12	382	423
November.........	200	158	102	101	3	1	29	22	50	70	....	1	6	19	390	366
December	220	132	132	149	7	5	27	17	58	48	1	....	11	8	456	359
Total..........	2,036	2,315	1,495	2,114	68	100	245	229	588	702	3	4	114	127	4,549	5,590

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.	Meter Rents.	Remarks.
6	Cyrus H. K. Curtis..	412-16 Cherry street....................	Publication office..	June 29..	Hersey.								1		1	766,400	$473 35	
6	Ida V. C. Hilles	424 Appletree street....................	Publication office...	Aug. 2..	Hersey.								1		1	150,700	318 46	
8	Edward Perry.......	1530-32 Chestnut street.................	Clothing and offices	June 13..	Gem ...							1			1	685,400	283 78	
8	Edward Perry.......	1530-32 Chestnut street.................	Clothing and offices	June 14..	Gem ...							1			1	186,200	143 27	
9	Mint Arcade Co....	1325-39 Chestnut street.................	Office building......	May 1..	Empire				1						1	28,200	9 94	
9	Mint Arcade Co....	1329-39 Chestnut street.................	Office building......	May 1..	Gem ...							1			1	817,300	245 19	
10	Henry R. Shoch....	136-44 North Broad street.............	Club house, etc......	June 6..	Hersey					1					1	249,700	74 71	
10	Henry R. Shoch....	136-44 North Broad street.............	Automobile repairs	June 7..	Hersey.							1			1	782,390	234 72	
12	Equitable Ware-house Co..........	429-35 N. Fifth street, cor. Willow.....	Store house, etc.....	Mar. 31	Worth-ington				1						1	126,400	87 92	
18	A J. Reach & Co....	N E. cor. Tulip and Palmer streets...	Base Ball goods.....	July 25..	Empire					1					1	11,600	8 45	
18	A. J. Reach & Co....	N. E. cor. Tulip and Palmer streets...	Base Ball goods.....	July 29..	Gem ...						1				1	390,000	117 00	
22	Germant'wn Hospital and Dispensary	N. E. side Penn st. west of Chew st...	Hospital............	April 21..	Gem ...							1			1	11,900	32	
23	Barrett Mfg. Co.....	Bermuda and Margaret streets.......	Chemicals...........	April 19..	Trident		1								1	18,200	....	Experimental.
23	Quaker City Rubber Co.................	N. E. cor. Comly and Milnor streets..	Rubber goods.......	Oct. 25..	Gem ...								1		1	....	....	Experimental.

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.	Meter Rents.	Remarks.
27	Universal Light Co.	3220 Chestnut street	Water gas burners	Mar. 2	Keyst'e	..	1	..	..	..	..	..	..	..	1	11,200	....	Experimental.
27	Hamilton Court Apartm't House	S. E. cor. 39th and Chestnut streets	Apartment house	Sept. 13	Gem	..	..	..	..	..	..	1	..	..	1	280,700	....	Experimental.
33	Holy Cross Lutheran Church	N. E. cor. Ninth st. and Lehigh ave.	Church organ	Sept. 28	Gem	..	..	..	..	..	..	1	..	..	1	4,700	....	Experimental.
36	W. K. Mitchell & Co.	S. E. s. Schuylkill ave. & Ellsworth st.	Iron works	Jan. 20	Union	..	..	..	..	..	1	..	..	..	1	221,000	$80 00	
38	James Martin	4352 Wayne street	Dwelling and store	Mar. 29	Crown	..	..	1	..	..	..	..	..	..	1	3,200	5 00	
38	J. & J. Dobson	E. side Ridge ave. cor. P. & R. R. R., Richmond Branch	Woolen mill	Sept. 4	Hersey	..	..	..	..	..	..	..	..	1	1	17,900	....	Fire connection.
	Total					..	2	1	2	2	2	7	3	1	20			

Size of Meters.	In Use January 1, 1904.													
	Crown.	Gem.	Nash.	Union.	Venturi.	Thomson.	Hersey.	Trident.	Empire.	Deacon.	Standard.	Keystone.	Columbia.	W...
½-inch	20		3	4										
⅝-inch			3	15				74	4			4	161	
¾-inch	210		9	16			1	18	2			5	1	
1-inch	218		2	5			1	6	6				4	
1½-inch	127		3	36			2	13	4			4		
2-inch	168	103		13			1	5	2			1		
3-inch	69	105		3		3	4	11	1		1			
4-inch	50	183		1						1	3			
6-inch	7	30					2			6	4			
12-inch					1									
20-inch					2									
30-inch					1									
36-inch					1									
48-inch					2									
Total	869	421	20	93	7	3	11	127	19	7	8	14	166	1

METERS TESTED.

Gem.	Union.	Trident.	Anderson.	Hersey.	Keystone.	Worthington.	Empire.	Standard.	Columbia.	Crest.	Total.
.....	......	......	......	......	......	......	......	......	......	......	....
.....	1	5	2	......	1	......	......	......	3	......	12
.....	......	4	......	......	......	......	......	......	......	......	29
.....	......	1	......	......	......	1	1	......	1	......	25
.....	4	2	......	......	......	......	1	1	......	......	15
17	4	1	......	1	......	2	2	1	......	......	32
20	......	......	......	3	......	1	......	......	......	1	29
14	......	......	......	2	......	......	......	......	......	......	19
1	......	......	......	1	......	......	......	......	......	......	2
.....	......	......	......	......	......	......	......	......	......	......	....
.....	......	......	......	......	......	......	......	......	......	......	....
52	9	13	2	7	1	4	4	2	4	1	163

Schedule of Pipe and Special Castings Ordered, Accepted and Rejected during the Year 1904.

	Manufacturer.	Size in Inches.		Ordered.	Inspected.	Rejected.	Cancelled.	Accepted.
		Pipe.	Special Castings.					
Bureau of Water.	Donaldson Iron Co.	6 in.	....	5,550	5,902	902	550	5,000
		....	4 in. to 18 in.	1,096	1,371	325	50	1,046
		....	20 in. to 30 in.	40	40	....	....	40
		....	20-in. Y. pipe.	1	1	....	....	1
		....	20-in. ¼-turns.	5	5	....	....	5
	Harmer & Quinn.	10 in.	....	100	111	11	....	100
		....	36-in. Y. pipe.	1	1	....	....	1
		....	30 in. to 48 in.	48	36	....	12	36
	United States Cast Iron Pipe and Foundry Co.	....	20 in. to 48 in.	1	1	....	....	1
	J. Alfred Clark.	....	Frames & covers	600	642	42	....	600
		....	Stop boxes.	100	102	2	....	100
	Total.	....	....	7,542	8,212	1,282	612	6,930

Schedule of Pipe and Special Castings, etc.—Continued.

	Manufacturer.	Size in Inches. Pipe.	Special Castings.	Ordered.	Inspected.	Rejected.	Cancelled.	Accepted.
Filtration.	Donaldson Iron Co.	8 in.	....	10	30	20	....	10
		16 in.	....	49	80	31	....	49
		20 in.	....	443	670	227	....	443
		24 in.	....	537	871	334	....	537
	Reading Foundry Co.	16 in.	....	22	151	129	....	22
		20 in.	....	21	75	54	....	21
	J. Alfred Clark	....	Stop boxes	64	66	2	....	64
	Total	....	....	1,146	1,943	797	....	1,146
Charities and Correction.	Warren Foundry and Machine Co.	3 in.	....	167	187	20	....	167
		8 in.	....	17	22	5	....	17
		12 in.	....	9	11	2	....	9
		....	3 in. to 18 in.	28	34	6	....	28
	Total	....	....	221	254	33	....	221

Schedule of *Pipe and Special Castings, etc.*—Continued.

	Manufacturer.	Size in Inches.		Ordered.	Inspected.	Rejected.	Cancelled.	Accepted.
		Pipe.	Special Castings.					
Surveys.	R. D. Wood & Co.	10 in.		9	9			9
		16 in.		9	9			9
		20 in.		8	9	1		8
			5 in. to 20 in.	36	36			36
	Total			62	63	1		62
Contractors.	Donaldson Iron Co.	6 in.		418	465	47		418
		12 in.		34	37	3		34
	Total			452	502	50		452
	Grand Total			9,423	10,974	2,163	612	8,811

Attachments Made and Delivered to the Districts during the year 1904.

Districts.	Attachments Made and Delivered.	Feet of Lead P.PE. 5/8-inch.
First	394	5,480
Second	....	....
Third	1,076	15,342
Fourth	290	4,340
Fifth	150	1,875
Sixth	84	516
Seventh	200	3,800
Total	2,144	31,353

DISTRIBUTION EXPENSES DURING THE YEAR 1904,

Including Expenses of Main Office, Purveyors' Districts, and Meter Shop.

Material and Labor.	First District.	Second District.	Third District.	Fourth District.	Fifth District.	Sixth District.	Seventh District.	Distribution.	Meter Shop.	Main Office.	Total.
Lead	$897 99	$447 24	$1,569 75	....	....	$899 38	$1,477 94	....	$2,750 00	....	$8,042 30
Gasket	44 41	58 77	39 33	$13 34	....	26 39	55 57	....	....	....	232 81
Coke	12 60	51 35	72 90	107 60	$44 20	87 60	66 75	....	....	....	443 00
Wood	17 60	26 40	....	....	....	35 20	....	....	....	....	79 20
Straight pipes	....	....	....	....	....	....	....	$23,125 75	....	....	23,125 75
Small specials	....	....	....	....	....	....	....	5,095 10	....	....	5,095 10
Large specials	....	....	....	....	....	....	....	2,573 73	....	....	2,573 78
Breeches and quarter turns	....	....	....	....	....	....	....	707 32	....	....	707 32
Frames and covers	281 36	178 84	325 51	240 44	266 62	192 48	295 44	....	....	....	1,780 19
Cast-iron stop boxes	146 70	....	295 58	....	....	....	147 17	....	....	....	589 45
Hauling, transportation, and hotel	....	....	37 77	....	....	....	....	11,243 27	....	....	11,281 04
Supplies, tools, small stores, etc	503 99	849 97	715 14	806 93	895 70	1,029 85	699 07	688 77	4,325 02	$30 41	10,544 85
Plumbing and plumbing supplies	....	....	....	....	18 29	78 15	....	59 67	....	....	151 11
Meters, etc	....	....	....	....	....	....	....	....	39 30	....	39 30
Bricks, stone, lime, and cement	6 80	143 00	171 55	99 00	8 00	44 50	157 60	....	18 00	....	648 45
Lumber	3,451 97	98 57	402 89	481 76	357 40	514 49	123 32	24 13	488 15	....	5,942 66
Hay, Feed, etc	928 00	629 82	816 02	711 05	93 95	180 29	732 75	....	....	....	4,041 88

Distribution Expenses during the year 1904.—Continued.

Material and Labor.	First District.	Second District.	Third District.	Fourth District.	Fifth District.	Sixth District.	Seventh District.	Distribution.	Meter Shop.	Main Office.	Total.
Stable supplies	$12 43	$212 37	$37 85	$63 50	$5 98	$151 59	$302 29	....	....	....	$786 01
Stable repairs	224 80	194 63	126 00	254 45	46 75	7 65	188 85	....	....	....	1,043 13
Stable medicines	17 60	19 10	25 25	....	....	....	30 15	....	....	....	92 10
Stable shoeing	312 75	182 50	177 25	162 50	21 75	25 00	130 50	....	....	....	1,012 25
Supplies, stationery	84 32	492 85	193 64	103 37	65 06	181 77	282 91	$455 87	$85 87	$500 02	2,425 68
Wages: Per diem	28,037 34	18,578 74	51,356 99	18,450 92	17,002 23	32,398 09	17,889 97	....	....	....	183,714 28
Wages: Salary	4,649 00	4,560 61	7,419 16	7,059 38	3,160 88	3,974 00	4,327 08	....	....	....	35,150 11
Total cost of labor and material on account of distribution	$39,629 66	$26,699 26	$68,782 56	$28,554 24	$21,986 81	$39,771 43	$26,907 36	$43,973 61	$7,706 34	530 43	$299,541 70
Buildings, grounds, and reservoirs	....	$2,191 93	$18,231 70	$3,394 38	$11,147 33	757 75	$6,885 35	....	....	....	$42,608 44
High pressure fire service	....	3,129 43	113 75	....	....	....	106 50	....	....	....	3,349 68
Total labor and material	$39,629 66	$32,020 62	$82,128 01	$31,948 62	$33,134 14	$40,529 18	$33,899 21	$43,973 61	$7,706 34	$530 43	$345,499 82

APPENDIX D

REPORT

OF THE

Operations at the Construction and Repair Shop, Bureau of Water, during the year 1904

Philadelphia, January 12, 1905.

Mr. F. L. Hand,

Chief, Bureau of Water.

Sir :—I herewith submit the annual report of the operations at the Construction and Repair Shop, Twelfth and Reed streets, for the year ending December 31, 1904.

Respectfully,

JAS. H. DEAN,

Superintendent of Shop.

Merchandise.		Dr.
Inventory, January 1, 1904		$21,537 36
Bolts and nuts	$759 57	
Hardware	441 11	
Steel	1,396 65	
Wrought iron	1,089 12	
Iron castings	12,340 59	
Brass castings	3,877 39	
Lead coating	252 15	
Chandlery	211 54	
Gum goods	84 48	
Coal	1,495 50	
Coke	16 80	
Lumber	988 22	
Paints, brushes, oils, etc	107 84	
Brass fittings	515 67	
Oils and tallows	108 80	
Wrought iron pipe and fittings	18 85	
Lead	670 78	
Plug valves	350 50	
Forage, stable supplies, etc	194 30	
Miscellaneous	1,042 37	
Wages	33,999 50	
		$59,961 73
Total		$81,499 09

Merchandise.		Cr.
First District	$4,146 73	
Second District	3,256 54	
Third District	5,565 83	
Fourth District	3,128 80	
Fifth District	2,633 51	
Sixth District	4,062 02	
Seventh District	4,971 45	
		$27,764 88
Spring Garden machinery	5,139 65	
Spring Garden boilers	2,916 33	
		8,055 98
Fairmount machinery	523 74	
Fairmount buildings and grounds	23 75	
		547 49
Belmont machinery	4,909 59	
Belmont boilers	838 53	
		5,748 12

Queen Lane machinery	$7,397 78	
Queen Lane boilers	532 68	
		$7,930 46
Roxborough machinery	3,613 62	
Roxborough boilers	967 79	
Roxborough buildings and grounds.	810 18	
		5,391 59
Frankford machinery	3,237 64	
Frankford boilers	404 82	
Frankford buildings and grounds...	102 55	
		3,745 01
Mt. Airy machinery	69 73	
		69 73
East Park Reservoir	56 88	
		56 88
General buildings and grounds......	833 58	
		833 58
Distribution	326 01	
		326 01
Main office	67 17	
		67 17
Meter department	35 03	
		35 03
High pressure fire service	1,683 90	
		1,683 90
Extension, improvement and filtration	192 49	
		192 49
Holmesburg Water Company........	107 10	
		107 10
City Ice Boats	83 27	
		83 27
Fixed patterns	812 38	
		812 38
Shop machinery	1,044 38	
		1,044 38
Construction and repair shop	1,577 95	
		1,577 95
Old metals	2,622 86	
		2,622 86
		$68,696 25
Credit		$68,696 25
Inventory January 1, 1905		18,976 50
Total Cr.		$87,672 75
Total Dr.		81,499 09
Balance		$6,173 66

INVENTORY, JANUARY 1, 1905.

3	16-inch stop valves, at $65	$195 00	
2	30-inch stop valves, at $192	384 00	
1	36-inch stop valve, at $300	300 00	
2	6-inch stop valves, hat flanged, at $18	36 00	
1	10-inch stop valve, hat flanged, at $33	33 00	
1	6-inch globe valve, at $30	30 00	
4	8-inch globe valves, at $40	160 00	
1	10-inch globe valve, at $55	55 00	
2	20-inch check valves, at $170	340 00	
1	small drilling machine, at $45	45 00	
4	bell cranks, at $15	60 00	
			$1,638 00
1	48-inch rotary valve, unfinished	536 00	
5	20-inch rotary quadrants, at $10	50 00	
6	30-inch rotary quadrants, at $10	60 00	
6	48-inch rotary quadrants, at $16	96 00	
			$742 00
	Finished parts of fire hydrants	924 36	
	Finished parts of stop valves	1,105 50	
	Finished parts of rotary valves	183 50	
			2,213 36
72	old style stop screws	492 25	
46	Viney stop screws, at $1.75	80 50	
8	Viney stop screws, at $2	16 00	
31	Viney stop screws, at $4,50	139 50	
13	Barton stop screws, at $4	52 00	
12	Barton stop screws and bonnet, at $8	96 00	
			876 25
247	new style stop screws, 4 inches to 48 inches	955 00	
78	socket screws	156 00	
28	spindles	63 00	
			1,174 00
454	iron bands, 4 inches to 48 inches	1,238 50	
			1,238 50
40	4-inch fire hydrant valves, at 59 c.	23 60	
35	6-inch fire hydrant valves, at $1.59	55 65	
			79 25
	Screws, nuts, etc., for high pressure fire service	302 25	
			302 25

20	air pump rod straps, $9	$180 00	
60	air pump rod brasses, $2.50	150 00	
61	Sets gibs and keys, $4.50	274 50	
7	spindles for drilling machine, $6.50	45 50	
175	fire hoe heads, $1.75	306 25	
			$956 25
	Articles and tools carried in stock, issued to districts	1,795 55	
			1,795 55
30,026	lbs. wrought iron, 2¼ cts	675 59	
847	lbs. Norway iron, 3 cts	25 41	
3,716	lbs. American cast steel, 7 cts	260 12	
250	lbs. English cast steel, 13 cts	32 50	
441	lbs. shear steel, 8 cts	35 28	
1,020	lbs. spring steel, 4 cts	40 80	
482	lbs. self-hardening steel, 35 cts	168 67	
14,597	lbs. machinery steel, 2½ cts	364 82	
19	hammered steel pump rods	559 44	
1,254	lbs. expansion metal, 24½ cts	307 23	
10,500	lbs. lead, 4.485 cts	470 93	
			2,940 79
21,550	lbs. stop castings, 2 2-10 cts	474 10	
15,920	lbs. machine and miscellaneous castings, 3 cts	477 60	
426	lbs. yellow brass castings, 11½ cts.	48 99	
2,513	lbs. red brass castings, 13 1-8 cts	329 83	
7,336	lbs. Ajax metal castings, 22⅜cts.	1,648 15	
1,117	lbs. round rolled brass, 17½ cts	195 46	
			3,174 13
	Hardware	137 67	
	Bolts and nuts	719 63	
	Oils and tallows	20 35	
	Chandlery	37 65	
	Paints, oils, brushes, etc	26 15	
	Gum goods	60 40	
	Lumber	844 32	
			1,846 17
	Total		$18,976 50

Principal Articles Delivered to the Districts and Works.

Districts.	No. 1 Fire Hydrants.	No. 2 Fire Hydrants.	Wedge Stop Valves.							36-inch Check Valve.	Plugs.		Globe Valves.			Iron Bands.	Stop Screws.
			4-inch.	6-inch.	8-inch.	10-inch.	12-inch.	20-inch.	36-inch.		Wood.	Brass.	6-inch.	8-inch.	10-inch.		
First	32	2	1	84	7	10	9	....	....	....	....	306	....	....	....	8	29
Second	20	8	....	24	2	23	5	....	....	....	32	421	....	....	....	....	85
Third	43	2	5	53	19	27	12	....	....	....	74	216	....	....	....	2	....
Fourth	17	9	....	23	2	5	10	....	....	....	51	186	....	....	....	....	7
Fifth	87	....	8	84	2	4	....	....	....	....	....	....	....	....	....	....	....
Sixth	39	....	....	44	5	7	15	....	....	....	24	181	....	....	....	19	12
Seventh	34	4	6	44	12	10	....	2	....	....	36	192	....	....	....	4	....
Works	....	....	....	....	....	....	....	....	1	1	....	....	1	....	....	4	....
Extension, Improvement and Filtration	....	....	....	....	1	....	....	....	....	....	....	....	....	....	....	....	....
Holmesburg Water Company	8	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
Totals	225	25	15	256	50	86	51	2	1	1	217	1,502	1	....	....	32	[illegible]

PRINCIPAL ARTICLES MANUFACTURED DURING 1904.

10	4-inch stop valves, $13	$130 00	
258	6-inch stop valves, $14.50	3,741 00	
53	8-inch stop valves, $22	1,166 00	
87	10-inch stop valves, $30	2,610 00	
50	12-inch stop valves, $37	1,850 00	
2	20-inch stop valves, $120	240 00	
1	36-inch stop valve, $700	700 00	
2	48-inch check valves	2,413 73	
225	No. 1 fire hydrants, $33.50	7,537 50	
25	No. 2 fire hydrants, $42	1,050 00	
1,104	brass plugs, various sizes	310 00	
504	wood plugs, various sizes	252 00	
			$22,000 23

APPENDIX E

REPORT

OF THE

CHIEF DRAUGHTSMAN

FOR THE YEAR 1904.

Philadelphia, January 11, 1905.

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 1904 is respectfully submitted.

A large number of diagrams, tables of statistics, sketches, etc., were made which were not recorded as drawings, but were placed on temporary file if of any value for future reference.

There are now about three thousand five hundred recorded drawings in sheets, to which reference is being made daily. In order to facilitate the finding of any drawing, considerable more work has been done in cross-indexing the card index.

Drawings relating to the following-named subjects were made and recorded during the year:

Plans and details of buildings	28
Details of engines	15
Details of boilers	2
Details of intakes and conduits	2

Special machinery	1
Special castings	2
Check valves and details	4
High pressure fire service	10
Reservoirs	4
Surveys	6
Maps	3
Perspectives (water color)	1
Pumpage diagram (water color)	1
Fire hydrant details	2
Repairs, Fairmount dam	2

About 1,800 blue prints of the various drawings required for repairs and new work have been made with the aid of the electric light printing frame.

Specifications and drawings were made for bidders on the repairs to Fairmount dam, and one draughtsman was detailed to superintend the work.

Drawings and specifications for a new boiler house and stack, ten (10) new boilers, an enlargement of the engine house to accommodate four (4) more engines, and a new forebay and intake for the Belmont Pumping Station have been prepared.

Plans and specifications were also prepared for a new boiler house and new boilers at the Roxborough Pumping Station.

From data prepared by the inspectors of the Bureau, one hundred and forty-one (141) 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.

Two draughtsmen were assigned, when required, to the work of taking indicator cards.

The daily pumpage and storage charts, showing the height of water in Fairmount pool, the water flowing over the flash boards, the rain fall and the temperature of the air and water, and the daily stream flow charts of the Perkiomen, Neshaminy and Tohickon creeks, for the year 1904, have been prepared as in previous years.

During the year I tested the coupons representing the grade of steel made by the Midvale Steel Co. and inspected the following named forgings made from the steel: 9 piston rods, 23 crank pins, 28 cranks and crank ends, 5 crosshead pins, 3 sliding blocks, 18 connecting rods, 6 main shafts and 24 cams and lifting toes.

At the Works of the Seaboard Steel Casting Co., Chester, Pa., I inspected and tested the coupons representing the steel used in 39 valve decks and 9 cross heads.

At the works of the American Steel Manufacturing Co., Lebanon, Pa., I inspected and tested the iron representing 534 wrought iron bolts.

At the works of the George F. Blake Mfg. Co., East Cambridge, Mass., I tested the coupons and inspected the material representing 36 cast iron columns and housings.

All the above mentioned castings and forgings were for the three engines being constructed by the Holly Mfg. Co., Buffalo, N. Y., for the Bureau of Filtration.

On March 1st and 2d I made the endurance test of the gas engines and pumps at the High Pressure Fire Service Station, Delaware avenue and Race street, in accordance with paragraph No. 60, page 21, of the specification for same.

The test for gas consumed and number of B. T. U. used per brake horse power was made in E. Pittsburg, at the works of the Westinghouse Co., in May, 1903, and was witnessed by yourself and the Chief draughtsman; also by Messrs. M. R. Muckle, Jr., and J. C. Smith.

The limited time and facilities for making a test of the engines at the station were not conducive to satisfactory results. The gas meter was of a new design, made by the United Gas Improvement Co., and had not been used before, and no matter how carefully or elaborately the test might be made, a doubt would be cast upon the results obtained.

Engine No. 6, although one of the last to be erected, was selected for the trial, as the gas meter and connections were ready for use.

The engine was started at 9.30 A. M., and the adjustment of the pressure valves and gauges made and tide and meter readings taken before 10 A. M., at which time readings were again taken and continued every 30 minutes for 24 hours, ending at 10 A. M. on the 2nd inst.

Readings were also taken of the temperature of the air, cooling water and exhaust water in the engine room, and of the revolution counter. The engine ran smoothly, without heating in any of the journals on either pump or engine for the full 24 hours.

The pump pressure averaged over 300 pounds per square inch, and including the suction lift, averaged 309.7 pounds for the run. The contract conditions were satisfactorily fulfilled and even exceeded.

The engine was not stopped during the run, and nothing occurred to indicate that it could not have been run indefinitely, under the same conditions, if required.

I was assisted in the work by the following-named draughtsmen from the Bureau: Messrs. James H. Hand, Jr., C. B. F. Waller and Martin Murphy. Mr. John R. Muckle represented the contractors.

REPORT
ON THE
HYDROGRAPHIC WORK
FOR THE YEAR 1904

The following report on hydrographic work in charge of the Chief Draughtsman, and on data collected during the year 1904 is respectfully submitted:

Rainfall observations at twenty-two stations, from which the Bureau obtained this data, have been carried on, completing twenty-two years of continuous records.

Nine of these stations are maintained by the Bureau and furnished with instruments, stationery and postage. 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 on which they are placed.

Stream flow observations were continued on the Perkiomen, Neshaminy and Tohickon creeks and on the Schuylkill river, making twenty-one years of continuous records relating to stream flow on the three streams first named and six years on the Schuylkill river.

No observations were taken on the Wissahickon creek during the year, the gateway through the dam having been open until December.

Observations were continued on the Schuylkill river with the automatic gauge put in operation in the wheel house at the east end of Fairmount dam. With City Datum as a base, this gauge records the height of water in the pool above the dam.

Daily computations of the amount of water flowing over the flash boards were made from the records of the automatic gauge, the known pumpage from the river, the quantity used for power through the wheels, the leakage and lockage (both estimated), which gives an approximation of the monthly flow of the Schuylkill river at Fairmount dam.

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	21.03	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
1904	23.07	23.37	18.84

At present there is no method available by which the low water flow for periods of less than one month can be determined.

The daily average 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 river during the year 1904 was 6.18″, being the average of 18 stations for the month of August. The greater part of this rainfall was on streams flowing into the Schuylkill below Pottsville, and more than one-half of the amount fell in the two (2) storms of August 10th and 20th. The rainfall at points near Philadelphia was over nine (9) inches for the month, and gradually decreased, up the valley, to less than two and one-half inches.

There was a storm of wind and rain on September 14th and 15th in which there were recorded over six (6) inches in the valley below Reading, and not quite two (2) inches on the Upper Valley. The flow of the river was apparently greatly reduced as compared with the average rainfall over the whole valley, and with the average run off of preceding years, or as compared with the flow of smaller tributaries in the lower valley for the year 1904.

The rainfall for the year was about the average for the past twenty-two (22) years, but the unequal distribution, both through the year and on the watershed of the Schuylkill river, produced a low yearly average flow in the main stream and flood flows in the lower main tributaries.

I quote as follows from the report of Mr. John C. Beans, Moorestown, N. J.:

"Rainfall measurements are taken by means of four gauges in an open field, nearly level, and are scarcely to be doubted. These rain and snow gauges and all available means and places are employed to get reliable data of water precipitation by snow, etc., but with less assurance in windy storms.

"Some of the precipitation of the early months of the year falling on ground made impervious by ice in it, escaped by surface to streams. The heaviest rains of summer and fall also ran off, of course, but less than in the years immediately preceding.

"Atmospheric moistures seemed much maintained throughout and there was seldom any tendency to droughty conditions."

The stream flow for the Perkiomen and Neshaminy creeks, for the year, is above the average for the twenty-two years of observation, due to several heavy rainfalls in August and September, for short periods of time during which the water ran off rapidly, causing high water in the creeks at a period of the year when extreme low water is usually found.

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 $\frac{1}{4}$ inch per hour	Philadelphia. Forks of Neshaminy. Spring Mount.
V. VI. VII.	Inches of rainfall flowing in the... Average annual yield of streams .. Comparative stream flow.........	Perkiomen. Neshaminy. Tohickon. Wissahickon. 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. John C. Beans, Moorestown, N. J.

Mr. Benjamin H. Shoemaker, Pennsylvania Hospital.

During the years 1903 and 1904 all observations on rainfall were taken uniformly in accordance with the 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 1904.

Date of Observation, Philadelphia.	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.	
February 21, rain storm.....	0.41	13—30	.15	.20	0.45	
March 7, rain storm.........	1.05	11—40	.10	.15	0.40	
May 15, rain storm..........	0.52	8—30	.05	.10	0.30	
May 31, rain storm..........	1.33	12—00	.20	.20	0.60	
June 7, rain storm...........	1.60	5—00	.70	.30	1.40	
July 7, shower...............	0.88	—30	.25	.30	0.50	
July 25, rain storm...........	0.69	11—10	.15	.20	0.45	
August 2, rain storm........	1.01	6—15	.30	.20	0.90	
August 10, rain storm.......	1.85	4—00	.40	.20	1.20	
August 20, rain storm.......	1.61	7—50	.55	.30	1.10	
August 22, shower...........	0.15	1—20	.15	.20	0.45	
September 2, shower........	0.47	1—30	.20	.20	0.60	
Sept. 14 and 15, rain storm..	6.47	25—00	......	......	....	Automatic gauge overflowed.
October 12, rain storm.......	1.63	....	......	......	....	Repairing roof—automatic gauge taken down
October 21, rain storm.......	2.16					

Monthly Precipitation on Sundry Watersheds

	PHILADELPHIA SERIES.					
	U. S. Weather Bureau.	Water Bureau Auto.	Water Bureau Frankford Pu'p'g Station.	Pennsylvania Hospital.	Shawmont.	Lebanon.
ELEVATIONS ARE IN FEET ABOVE SEA LEVEL.	207	66	49	25	368	480
1904.	Precipitation in Inches.	Inches.	Inches.	Inches.	Inches.	Inches.
January	3.14	3.67	3.67	2.37	3.07	3.58
February	2.21	2.43	2.43	2.52	2.30	2.22
March	3.24	3.63	3.63	3.37	3.23	3.50
April	1.89	1.83	2.22	3.12	1.34	2.48
May	2.08	2.36	4.39	2.38	2.62	5.60
June	2.88	2.77	2.73	3.27	2.90	5.52
July	3.82	3.37	3.09	3.98	2.11	5.89
August	4.43	5.40	7.39	5.63	9.26	5.56
September	7.21	6.91	6.11	6.90	3.65	3.81
October	4.03	4.06	4.48	4.81	4.37	3.06
November	2.55	1.63	2.23	2.38	1.91	1.63
December	2.28	....	2.69	2.46	1.88	2.71
Total	39.76	....	45.06	43.69	38.64	45.56
Percentage	100	....	113	110	97	115
22 Years Yearly Average. Inches	40.16	....	44.29	45.09	43.91	45.50
22 Years Yearly Average. Percentages	100	....	111	112	110	113
Average Deficiency or Increase	0.40	....	0.87	1.40	5.27	0.06
Percentage Deficiency or Increase	1	....	2	3	12	....

TABLE III.

Rain Storms Exceeding in Rate 0.25 Inches per Hour as Recorded by the Automatic Rain Gauge at Forks of Neshaminy, for the year 1904.

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.	
February 22d, rain storm...	1.99	14—15	.10	25	0.24	
February 28th, rain storm..	0 61	8—00	.10	20	0.30	
March 7th, rain storm.......	1.12	17—00	.05	10	0.30	
April 27th, rain storm.......	0.90	20—00	.10	10	0.60	
May 30th, shower...........	0.45	1—35	.35	15	1.40	
May 31st, rain storm........	1.00	13—00	.10	10	0.60	
June 5th, rain storm........	1.23	2—30	1.00	50	1.20	
June 7th, rain storm	1.42	4—30	1.20	40	1.80	
July 6th, shower.............	0.40	1—25	.15	15	0.60	
July 8th, shower.............	1.32	9—15	0.90	40	1.35	
July 18th, shower............	0.77	2—50	0.70	30	1.40	
July 28th, shower............	0.47	0—10	0.25	10	1.50	
August 1st, shower..........	0.68	1—10	0.55	35	0.94	
August 10th, shower.........	1.15	3—40	1.50	60	1.50	
August 14th, shower.........	1.01	1—10	0.90	20	2.70	
August 20th, rain storm....	3.00	13—00	0.80	25	1.92	
September 14th and 15th, rain storm	4.18	25—25	0.80	45	1.07	
	....	....	0.83	35	1.42	
October 12th, rain storm....	4.15	10—30	0.10	40	0.40	

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 1904.

Date of Observation.	Automatic Rain Gauge. Total Fall: Amount in Inches.	Total Fall: Duration—Hours. Minutes.	Maximum Fall: Amount in Inches.	Maximum Fall: Duration in Minutes.	Maximum Fall: Rate per Hour During Maximum Fall.	Remarks.
February 28th, rain storm..	0.65	20—00	.05	10	0.30	
March 7th, rain storm......	0.90	7—00	.05	10	0.30	
April 1st, rain storm........	0.60	7—40	.15	20	0.45	
April 28th, rain storm.......	0.43	28—10	.15	15	0.60	
May 15th, rain storm........	0.76	7—30	.15	20	0.45	
May 30th, shower............	1.57	3—00	1.35	40	2.02	
May 31st, rain storm........	1.28	12—40	.25	15	1.00	
June 5th, rain storm........	0.48	6—30	.35	30	0.70	
June 7th, rain storm........	2.00	2—30	.50	25	1.20	
July 5th, rain storm.........	0.44	1—45	.20	15	0.80	
July 7th, shower.............	0.71	0—30	.20	20	0.90	
August 10th, shower.........	0.60	0—30	.60	30	1.20	
August 14th, shower.........	0.81	1—30	.70	30	1.40	
August 20th, rain storm.....	1.23	7—50	.45	40	0.68	
August 22d, shower..........	0.75	1—50	.70	40	1.05	
September 12th, shower.....	0.22	1—10	.10	10	0.60	
September 14th and 15th, rain storms..............	6.18	25—30	2.15	48	2.69	
	......	....	1.50	32	2.81	
October 21st, rain storm.....	2.13	7—15	1.00	40	1.50	

TABLE V.—*Inches of Rainfall Flowing in the Perkiomen, Neshaminy, and Tohickon Creeks.*

Watersheds.		Area in Miles.	Percentage of Total Area.				Average for 21 Years—1883-1904.												
			Woodland.	Cultivated.	Flats.	Roads.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Annual.
Perkiomen at Frederick, 21 years		152	25	71	2	2	2.90	3.63	3.77	2.19	1.35	0.93	1.19	1.00	1.03	1.05	1.51	2.26	23.20
Neshaminy, below Forks, 21 years		139.3	6	92	¼	1¾	3.25	4.05	3.63	2.15	1.57	0.77	1.02	1.03	0.86	1 05	1.38	2.40	22.99
Tohickon, 21 years		102.2	24	72	2	2	3.82	4.51	4.70	2.55	1.86	0.85	1.24	1.20	1.22	1.10	1.81	2.88	27.78
Perkiomen at Frederick.	Maximum, 21 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	
	Minimum, 21 years.	....	....	....	....	....	0.50	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, 21 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	
	Minimum, 21 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, 21 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	
	Minimum, 21 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 1, 1904.*

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 square mile of drainage area.	Average yield in cubic feet per second per square mile of drainage area for each inch of rainfall.
Perkiomen at Frederick	21	152.0	47.63	23.204	48.500	61,291,420,000	167,870,000	1.7088	0.0351
Neshaminy below Forks	21	139.3	47.988	22.986	47.800	55,643,547,000	152,388,000	1.6927	0.0352
Tohickon	21	102.2	49.172	27.776	56.410	49,329,880,000	135,036,400	2.0445	0.0412
Wissahickon	....	....	....	No rec	ord.				
Schuylkill	6	1,915.0	48.441	22.797	47.100	....	2,068,044,000	1.6708	0.0345
Sudbury, Mass.	29	75.2	46.34	22.820	49.250	....	81,667,000	1.6803	0.0362
Croton, N. Y.	32	338.0	48.07	22.930	47.700	....	362,960,000	1.660	0.0346

Table VII.—*Comparative Daily Stream Flow, 1903 and 1904.*

Watersheds.	Area of water-shed.	Maximum Gallons.		Date.	Minimum Gallons.		Date.
		Per Day.	Per Sq. Mile.		Per Day.	Per Sq. Mile.	
Perkiomen	152.0	2,737,800,000	18,200,000	October 9	26,000,000	172,000	June 28
Neshaminy	139.3	4,514,500,000	32,000,000	October 9	8,350,000	60,200	May 28
Tohickon	102.2	3,210,900,000	32,000,000	October 9	4,300,000	43,000	May 29
Wissahickon	64.6	....	No Record.				
Schuylkill	1,915.0	19,400,000,000	10,000,000	October 10			

DATE.	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 sq. mile.
				Cubic Feet.	Cubic Feet.	Gallons.	
1903.							
October	6.50	2.671	41	11,886,400,000	383,432,000	2,868,210,000	2.3174
November	1.36	0.753	55	3,349,220,000	111,641,000	835,130,000	0.6747
December	3.83	1.588	42	7,065,920,000	227,933,000	1,705,060,000	1.3776
1904.							
January	3.89	1.926	50	8,562,760,000	276,220,000	2,066,250,000	1.6694
February	2.34	2.107	90	9,376,750,000	323,336,000	2,418,620,000	1.9503
March	3.86	3.721	96	16,540,300,000	533,560,000	3,991,300,000	3.2248
April	2.61	1.878	72	8,839,720,000	277,957,000	2,079,300,000	1.6799
May	4.01	0.872	22	3,879,700,000	125,152,000	936,890,000	0.7564
June	4.37	1.671	38	7,432,470,000	247,750,000	1,853,300,000	1.4974
July	4.71	0.474	10	2,108,250,000	68,007,900	508,740,000	0.4111
August	6.18	1.310	21	5,826,820,000	187,962,000	1,406,050,000	1.360
September	4.82	1.279	26	5,689,900,000	189,660,000	1,418,800,000	1.1464
Totals	48.48	20.357	42	90,558,210,000	247,427,000	1,850,880,000	1.4954
October	4.33	1.389	32	6,180,300,000	199,360,000	1,491,400,000	1.2049
November	2.02	1.192	59	5,304,300,000	176,810,000	1,322,620,000	1.0686
December	2.83	0.917	32	4,078,770,000	131,573,000	984,236,000	0.7952
Totals for	45.97	18.836	40	83,820,040,000	229,644,000	1,717,860,000	1.3879

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Showing Flow over Flashboards

DATE. 1904.	January.	Inches.	February.
1		0	
2		0	
3		0	
4		0	
5		*2	
6		*2	
7		*1	994
8		*1	4,742
9		*2	1,752
10		0	579
11		*2	
12		*3	
13	123	1¼	
14	1,607	6¾	
15	1,912	8¾	
16	761	4	
17		*1	
18		*2	
19		*3	
20		*4	
21		*3	
22	2,635	9½	21,368
23	25,904	42½	19,975
24	12,749	26¾	5,092
25	5,700	15¾	3,613
26	2,450	9	3,146
27	4,066	12½	1,113
28	643	8¾	1,209
29	130	1¼	3,029
30		0	
31		*1	
Total over flashboards	58,680		66,612
Total pumpage, leakage and lockage	40,426		41,915
Grand Total	99,106		108,527

*Below top of Flashboards.

AND TOHICKON WA

	ES.		AR	
	YIELD			
	ons.	Average Yield in Cubic Feet per Second per Square Mile.	Rainfall in Inches.	Inches of Rainfall Flowing Off.
Octobe	88,000	3.5742	8.375	3.567
Novem	05,000	0.3722	1.463	0.412
Decem	80,000	2.4488	4.180	2.666
Januar	98,000	3.3821	3.492	4.642
Februa	68,000	2.2544	2.182	2.255
March	13,000	3.1046	3.255	3.992
April ..	21,000	1.5708	2.680	1.998
May ...	46,000	0.3104	3.610	0.529
June ...	01,000	1.3183	4.602	1.659
July....	43,000	0.6991	4.892	0.559
August	61,000	2.0788	6.890	2.580
Septem	21,000	1.4286	6.235	2.819
To	40,000	1.8842	51.856	27.676
October	40,000	2.1864	4.235	1.748
Novemb	94,000	1.4495	1.832	1.264
Decemb	15,000	0.8199	2.135	0.906
To	10,000	1.7217	16.040	24.952

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ANNUAL REPORT

OF THE

CHIEF ENGINEER

OF THE

BUREAU OF FILTRATION

FOR THE YEAR 1904

DEPARTMENT OF PUBLIC WORKS

BUREAU OF FILTRATION

(Improvement, Extension and Filtration of the Water Supply)

OFFICERS, 1904

Chief Engineer,

JOHN W. HILL.

First Assistant Engineers,

HENRY C. HILL,

LA MONTE LLOYD.

Clerical.

CHESTON M. STUART, Assistant in charge of Accounts.

WILLIAM J. LOGAN, Assistant in charge of Estimates.

JAMES F. MCCRUDDEN, Custodian in charge of Documents.

M. E. VAUGHAN, Chief Clerk.

AGNES K. LUCKENBILL, Stenographer.

ALICE C. CODY, Stenographer.

ANDREW J. HAAG, JR., Messenger.

ANNUAL REPORT

OF THE

CHIEF ENGINEER

OF THE

BUREAU OF FILTRATION

FOR THE YEAR 1904

Philadelphia, December 31, 1904.

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, 1904.

For convenience of stating the matter relating to the improvement, extension and filtration of the water supply, I have arranged the subjects as follows:

1. Financial Statement.
2. Lower Roxborough Filters.
3. Upper Roxborough Filters.
4. Completion and Operation of Belmont Filters.
5. Extension of Pipe System—Contract No. 66.
6. Torresdale Filters—including Contracts Nos. 25, 39, 50, 54 and 59.
7. Torresdale Intake—Contract No. 34.

8. Torresdale Conduit—Contract No. 14.
9. Lardner's Point Pumping Stations—Contracts Nos. 29 and 68.
10. Lardner's Point Pumping Machinery—Contracts Nos. 11, 67 and 31.
11. Electric Lighting and Power Equipment—Contracts Nos. 44, 45 and 46.
12. Lardner's Point Pipe Distribution System—Contract No. 28.
13. Oak Lane Reservoir—Contract No. 27.
14. Principal items in the contracts for the Improvement, Extension and Filtration of the Water Supply.
15. Recapitulation of Contracts required to complete the work.
16. Capacity of Works.
17. Sand Scraping, Upper and Lower Roxborough and Belmont Filters.
18. Testing Station.
19. Experimental Investigations with Preliminary Filter No. 12.
20. Results of Operation, Preliminary Filters—Contract No. 37.
21. Influence of filtered water on typhoid fever case rates.
22. Changes in Staff.
23. Appendices:

    Table showing contracts executed to date, including amounts paid thereon.

    Table showing lump sum and unit prices paid on various contracts entered into during 1904.

FINANCIAL STATEMENT.

The total fund provided by Councils for the Improvement, Extension and Filtration of the Water Supply, is as follows:

By ordinance of June 17 and July 12, 1898..	$500,000 00
By ordinance of January 12, 1900...........	3,200,000 00
By ordinance of March 23, 1900.............	12,000,000 00
By ordinance of June 30, 1902...............	1,300,000 00
By ordinance December 29, 1902............	500,000 00
By ordinance of June 27, 1904...............	5,000,000 00
Total	$22,500,000 00

Of the fund provided there has been paid out and charged off as limits of contracts to December 31, 1904, the following amounts:

Paid on completed contracts...............	$4,885,137 49
Paid on uncompleted contracts............	9,227,209 01
Limits of uncompleted contracts, less payments	4,458,115 99
Land damages	876,435 55
Expenses, supplies, advertisements, etc....	163,316 77
Inspections by contract	13,758 06
Salaries and wages of engineering staff....	666,848 84
Expended by Bureau of Water.............	1,013,149 89
Damages to property on account of pipe laying	16,816 26
Repaving over pipe trenches	81,264 51
Available balance	1,097,947 63
Total	$22,500,000 00

APPROPRIATION FOR OPERATION AND MAINTENANCE OF FILTERS, 1904.

Roxborough Filters.

Appropriation	$41,000 00
Expended for operation and maintenance.....	32,628 93
Transferred October 4........................	4,000 00
Balance available for operation and maintenance, 1905	4,371 07

Belmont Filters.

Appropriation	$38,000 00
Expended for operation and maintenance	19,894 71
Transferred October 4	7,000 00
Balance available for operation and maintenance, 1905	11,105 29

Land Appropriated.

The land appropriated for filters and other works comprises 471.738 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.

Section.	Acres appropriated.	Land Damages. and Costs.
Upper Roxborough	34.578	$78,768 66
Shawmont Pumping Station, (account Bureau of Water)	2.800	16,810 13
Belmont	60.572	351,664 39
Torresdale	343.500	323,737 18
Lardner's Point	9.525	40,250 21
Oak Lane	20.823	65,204 98
Total		$876,435 55

LOWER ROXBOROUGH FILTERS.

All contracts pertaining to the Lower Roxborough Filters were completed and in service by the 22d of December, 1903. These filters were operated for the year 1904, under an appropriation of Councils providing for their operation and maintenance.

During the year there were filtered at this station 3,086,910,000 gallons of water; an average of 257,242,000 gallons per month, or 8,430,000 gallons per day.

Dividing the total cost of operating this station for the year, viz., $14,082.18, by the total gallons filtered, the cost becomes $4.56 per million gallons of water filtered.

The capacity of this station is 12,000,000 gallons a day, and without an increase of the cost of operation of the filters this capacity can be readily maintained, in which event the cost per million gallons instead of being $4.56, by reason of the reduced capacity of the station, will be $3.22 per million gallons.

Under the original plans for the Lower Roxborough Filters, they were expected as plain sand filters to yield not in excess of 6,000,000 gallons per day of 24 hours. They have been operating since starting (August 1, 1902) at an average rate considerable in excess of the original estimated capacity, and with the preliminary filters can readily furnish 12,000,000 gallons of filtered water per day. For short intervals of time this capacity has been reached, but owing to the insufficiency of the pumping machinery at Shawmont, the capacity is limited to the quantity shown.

During the year 1904 the Preliminary Filters built under Contract No. 37, were constantly in operation excepting for an interval of nine days during April, at which time the bacterial content of the water was so high and the turbidity content so low that it was deemed advisable in order to provide a proper "Schmutzedecke" on the recently scraped sand beds to run the raw water direct from the settling basin at Lower Roxborough to the filters. At times the bacterial content of the Schuylkill river was largely increased with but little change in the turbidity excepting for short intervals of time, when in order to provide a sufficient amount of suspended matter on the surface of the sand bed, it became necessary to run raw water on some of the filters for a short time. It is probable that this condition will again occur when the surface of the ground on the watershed of the Schuylkill river is frozen and covered with ice, at which time the runoff of rainfall will carry large numbers of bacteria into the water without carrying much material useful in forming a "Schmutzedecke" on a new filter.

The wisdom of covering the filters for the Philadelphia works was shown during the very severe weather of the winter of 1903-04, at which time excepting for the vaulting over the filters it is probable that the Roxborough Filters would have come to a complete standstill, certainly those that required scraping. In the most severe weather, however, filters have been laid bare for two days for the purpose of scraping and removal of the sand. During such interval of time without the covers, the sand bed would have frozen to such a depth as to have made it impossible to start the filter in satisfactory service until such time as the frost was entirely out of the sand.

With the vaulting it is possible to open a filter in the coldest of weather, lay the bed dry, put the laborers in it, and scrape and transport the sand almost with as much convenience and comfort as during the moderate months, the temperature at no time being so near the freezing point as to seriously interfere with the comfort of the laborers.

While the vaulted filters possess other advantages than that just mentioned, if the only advantage was found in the facility with which the filters can be taken out of service, scraped and recovered within usually a period of two days during the winter, this alone would justify the expense involved in the vaulting and protective covering of earth above.

In Hamburg, where the winter temperatures are quite like those in Philadelphia, some trouble has been experienced in laying the open filters bare for scraping during the months of December, January and February. Indeed to such an extent did this interfere with the operation of the filters during the first year of operation that since that time attemps have been made, with only partial success, to scrape the filters during the winter without drawing off the water. This is done by an apparatus floating between the sand bed and the cake of ice on the filters, operating same upon the principal of a mower, and taking off an uncertain and irregular thickness of the dirty sand. This apparatus is the invention of Mr. Mager, one of the engineers of the Hamburg works, and notwithstanding it does not give the results in restoring the filter to service that are obtained when scraped in the ordinary way with the sand bed laid bare for the purpose, the conditions at Hamburg are such that the officials are compelled to resort to the use of the Mager apparatus during the winter in order to keep the filters in service.

It therefore appears that these filters, the latest and in some respects the best plain sand filters in Europe, are seriously handicapped during the winter months for the lack of covers, which it was early decided to adopt as a part of the Philadelphia filters.

The operation of the preliminary filters constructed under Contract No. 37, has been very satisfactory during the year, and if the capacity of the Shawmont Pumping Station had been such as to supply water to the Lower Roxborough Reservoir at the rate of 12,000,000 gallons per day, no difficulty would have been experienced in maintaining this as a daily capacity of the station. At times when the pumpage has been such as to maintain the supply, the filters have been running at between 11,000,000 and 12,000,000 gallons per day, with a very satisfactory condition of the effluent, both with respect to the reduction of bacteria and turbidity.

UPPER ROXBOROUGH.

The Upper Roxborough Filters have been in constant operation since the 1st of July, 1903, a period of eighteen months.

For the past year the work at this station amounted to

3,487,270,000 gallons, being an average of 290,690,000 gallons per month, or 9,530,000 gallons per day.

The cost of operation for the year was $18,546.75, or at the rate of $5.32 per million gallons filtered.

The capacity of the filters at Upper Roxborough could very readily be maintained at 20,000,000 gallons per day, provided it was possible for the machinery at the Shawmont Pumping Station to supply water to the Upper Roxborough sedimentation reservoirs at this rate. In fact the capacity of the filters at both Upper and Lower Roxborough is dependent not upon the filters themselves but upon the pumping machinery at the Shawmont Station. The maximum amount of work performed at the two stations (November, 1903) was about 22,000,000 gallons per day, but it is very rare indeed that the total pumpage to the Upper and Lower Roxborough basins, and therefore the filtration of the two Roxborough stations, exceeds 19,000,000 gallons per day.

It it unfortunate that this condition exists in the pumping machinery at Shawmont because the expense of operation at both the Upper and Lower Roxborough stations would not be largely increased if the yield at Lower Roxborough was 12,000,000 gallons per day, and the yield at Upper Roxborough 20,000,000 gallons per day. The number of filter attendants, laborers, and certain items of expense will be just the same whether the work of the station is up to the full capacity or less. Certain items, as for example, steam, oil and waste expended in pumping water to the Upper Roxborough filters from the Upper Roxborough reservoirs, and the expense for gasoline for the engines and triplex pumps which pump water to the sand ejectors and washers at Upper Roxborough, of course, would increase with the work of the station, but these items are in themselves small when compared with the item of filter attendants and labor for operation of the

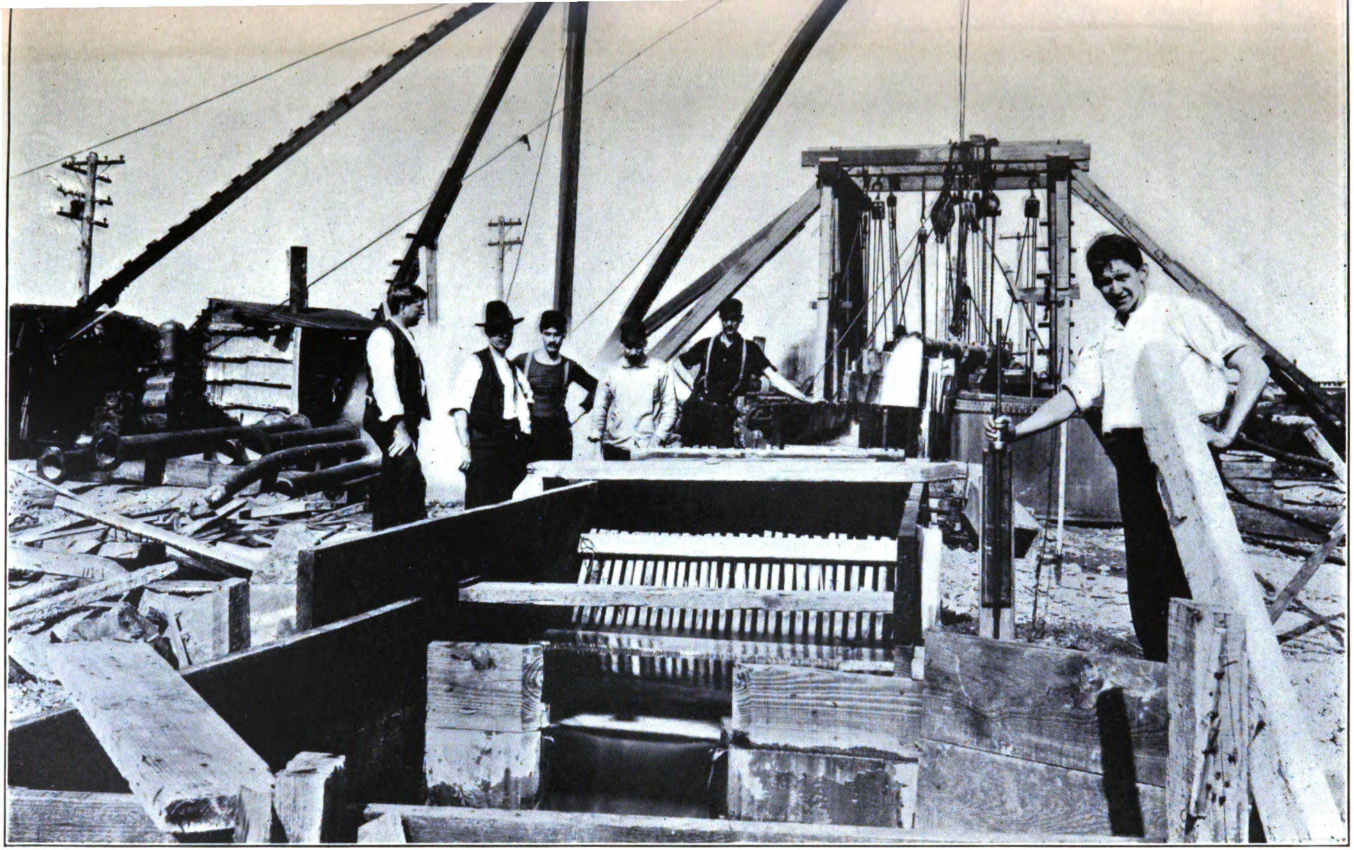

Plate No. 1.—Temporary Head House, Shaft No. 1.

filters which remains unchanged with the smaller yield of the filters. If the Upper Roxborough station could be operated up to its rated capacity of 20,000,000 gallons per day, I have no doubt but that the cost of filtering the water would be reduced to two-thirds the figures given above, or $3.55 per million gallons, notwithstanding the necessity of supplying water to the filters by low lift pumpage from the Upper Roxborough reservoirs.

In the insert table which follows are given the bacterial and turbidity content of the water flowing from the:

Subsiding Basins—Upper and Lower Roxborough,
Preliminary Filters—Lower Roxborough,
Each of the five filters at Lower Roxborough, and
Each of the eight filters at Upper Roxborough,
Clear Water Basins—Upper and Lower Roxborough,

for each week of the year from January 2d to December 31st.

These tables are very instructive as showing the influence of the low temperature months upon the bacterial content of the raw and filtered waters, and further as showing that notwithstanding the bacterial content of filtered water is much higher during the months of low temperature than during moderate or high temperature, the percentage reduction does not vary largely between the different months of the year. During the first two months of the past year the preliminary filters at Lower Roxborough were not operating to the best advantage, and some trouble arose in this respect until it was rectified by applying for a short period of time raw water direct to the plain sand filters.

The influence of filtered water from the two Roxborough stations upon the typhoid fever rates of Wards Twenty-first and Twenty-second, when compared with the remainder of the City, and of other isolated districts, indicates the great desirability of bringing both these stations up to their maximum capacity at the very earliest possible date, and thus distributing the filtered water to a larger population than has thus far been receiving it.

When it is considered that the evidence which we have already gathered is conclusive that the use of filtered water has had a marked effect in reducing the typhoid fever rates, and of course in saving life and decreasing disease, it can be seen that every day the filters are operated at less than their maximum capacity involves a peril to the health of some of the people of Philadelphia, to whom relief in this respect would be furnished, provided these two stations were delivering as they should 32,000,000 gallons of water per day instead of less than 20,000,000 gallons.

Weekly Averages of Bacteria and Turbidity of Filters at Lower Roxborough for the Year 1904.

	WEEK ENDING.													
	JAN. 2.		JAN. 9.		JAN. 16.		JAN. 23.		JAN. 30.		FEB. 6.		FEB. 13.	
	Bact.	Turb.	Bact.	Turb.	Bact.	Turb.	Bact.	Turb.	Bact.	Turb.	Bact.	Turb.	Bact.	Turb.
Applied water	32,000	18	35,000	6	21,000	5	27,000	9	110,000	110	51,000	6	96,000	21
*Pre-Filters	12,000	8	11,000	2	7,400	2	13,000	4	47,000	50	7,300	2	24,000	7
Filter No. 1	280	2	190	0.5	120	0+	270	0.5	990	2	42	0+	60	0+
Filter No. 2	49	0.5	36	0+	31	0+	100	0+	3,000	4	93	0.5	220	0.5
Filter No. 3	66	1	31	0.5	17	0+	49	0+	580	2	30	0.5	260	1
Filter No. 4	40	0.5	33	0+	21	0+	39	0+	1,500	1	250	0.5	350	1
Filter No. 5	1,200	2	500	1	470	0.5	990	2	3,400	6	110	0.5	340	1
Average of Filters	330	1	160	0.5	130	0+	290	0.5	1,900	3	100	0.5	250	1
Filtered water basin	200	2	160	0.5	200	0+	470	0.5	2,500	3	150	0.5	360	1

*Applied to final filters.

Lower Roxborough Filters.—Continued.

	WEEK ENDING.													
	FEB. 20.		FEB. 27.		MAR. 5.		MAR. 12.		MAR. 19.		MAR. 26.		APR. 2.	
	Bact.	Turb.	Bact.	Turb.	Bact.	Turb.	Bact.	Turb.	Bact.	Turb.	Bact.	Turb.	Bact.	Turb.
Applied water	16,000	4	140,000	100	290,000	95	170,000	400	17,000	48	23,000	90	14,000	19
*Pre-Filters	2,000	2	58,000	40	110,000	30	70,000	210	5,800	24	8,800	42	2,900	8
Filter No. 1	38	0.5	450	1	310	2	200	3	42	1	160	1	100	0.5
Filter No. 2	39	0.5	280	1	950	2	1,600	16	37	1	120	0.5	94	0.5
Filter No. 3	33	0.5	1,400	3	320	2	75	2	43	1	93	2	74	1
Filter No. 4	74	0.5	1,800	2	260	1	260	8	37	1	96	1	82	0.5
Filter No. 5	39	0.5	510	2	100	1	390	14	53	1	200	2	83	1
Average of Filters	45	0.5	890	2	390	2	500	9	42	1	130	1	87	0.5
Filtered water basin	55	0.5	1,100	2	450	2	790	9	91	1	100	1	85	1

*Applied to final filters.

Lower Roxborough Filters—Continued.

	WEEK ENDING.													
	APRIL 9.		APRIL 16.		APRIL 23.		APRIL 30.		MAY 7.		MAY 14.		MAY 21.	
	Bact	Turb.	Bact.	Turb.	Bact.	Turb.	Bact.	Turb.	Bact.	Turb.	Bact.	Turb.	Bact.	Turb.
Applied water	17,000	80	6,100	19	29,000	18	31,000	11	7,000	6	6,400	5	3,700	4
*Pre-filters	5,100	34	1,200	6	26,000	10	....	....	4,800	4	1,100	1	560	1
Filter No 1	150	0.5	250	0.5	210	0.5	120	0+	130	0.5	99	0.5	88	0.5
Filter No. 2	110	0.5	140	0.5	130	0.5	110	0.5	120	0.5	88	0.5	46	0.5
Filter No. 3	64	0.5	58	0.5	46	0.5	42	0.5	140	0.5	52	0.5	69	0.5
Filter No. 4	80	0.5	110	0.5	110	0.5	220	0+	200	0.5	95	0.5	45	0.5
Filter No. 5	91	1	170	0.5	220	0.5	240	0+	....	....	340	0.5	81	0.5
Average of filters	99	0.5	150	0.5	140	0.5	150	0+	150	0.5	130	0.5	66	0.5
Filtered water basin	90	0.5	160	0.5	180	0.5	130	0.5	110	0.5	100	0.5	130	0.5

*Applied to final filters.

Lower Roxborough Filters—Continued.

	WEEK ENDING.													
	MAY 28.		JUNE 4.		JUNE 11.		JUNE 18.		JUNE 25.		JULY 2.		JULY 9.	
	Bact.	Turb.	Bact.	Turb.	Bact.	Turb.	Bact.	Turb.	Bact.	Turb.	Bact.	Turb.	Bact.	Turb.
Applied water..............	4,000	4	9,500	130	7,900	120	6,100	48	2,000	7	1,700	6	950	5
Pre-Filters*.................	490	1	2,300	50	2,200	60	1,200	21	760	4	1,000	2	590	1
Filter No. 1..................	630	0.5	79	0.5	45	1	24	1	11	0.5	10	0.5	25	0.5
Filter No. 2..................	75	0.5	52	2	63	2	28	2	19	1	18	1	30	0.5
Filter No. 3..................	41	0.5	29	0.5	41	2	14	2	....	....	....	....	76	0.5
Filter No. 4..................	39	0.5	50	1	45	2	24	1	18	0.5	16	0.5	43	0.5
Filter No. 5..................	150	0.5	36	2	48	3	32	2	21	1	12	1	11	0.5
Average of filters...........	200	0.5	49	1	48	2	24	2	17	1	14	1	37	0.5
Filtered water B	130	0.5	63	1	58	3	52	2	36	1	25	1	41	0.5

* Applied to final filters.

Lower Roxborough Filters—Continued.

	WEEK ENDING.													
	JULY 16.		JULY 23.		JULY 30.		AUGUST 6.		AUGUST 13.		AUGUST 20.		AUGUST 27.	
	Bact.	Turb.	Bact.	Turb.	Bact.	Turb.	Bact.	Turb.	Bact.	Turb.	Bact.	Turb.	Bact.	Turb.
Applied water	2,000	21	860	7	2,900	8	3,300	10	4,900	32	5,800	60	5,900	55
Pre-filters*	1,400	5	220	1	420	2	530	3	1,000	9	1,500	32	2,300	25
Filter No. 1	37	0.5	25	0.5	14	0.5	10	0.5	27	0.5	27	1	16	0.5
Filter No. 2	62	0.5	51	0.5	51	0.5	45	0.5	36	0.5	31	0.5	150	2
Filter No. 3	39	0.5	20	0.5	26	0.5	18	0.5	29	0.5	21	2	23	1
Filter No. 4	26	0.5	30	0.5	28	0.5	32	0.5	98	0.5	57	2	27	1
Filter No. 5	10	0.5	12	0.5	12	0.5	10	0.5	19	1	19	0.5	19	0.5
Average of filters	35	0.5	28	0.5	26	0.5	23	0.5	42	0.5	31	1	47	1
Filtered water B	22	0.5	40	0.5	35	0.5	50	0.5	34	0.5	22	2	38	1

* Applied to final filters.

Lower Roxborough Filters—Continued.

	WEEK ENDING													
	SEPT. 3.		SEP. 10.		SEP. 17.		SEP. 24.		OCT. 1.		OCT. 8.		OCT. 15.	
	Bact.	Turb.	Bact.	Turb.	Bact.	Turb.	Bact.	Turb.	Bact.	Turb.	Bact.	Turb.	Bact.	Turb.
Applied water.............	6,900	26	3,100	8	12,000	45	5 200	21	4,200	6	6,600	6	18,000	20
Pre-filters*..................	1,800	14	740	8	4,000	22	1,700	10	1,100	8	1,700	1	9,100	10
Filter No. 1..................	21	0.5	32	0.5	51	0.5	17	0.5	15	0.5	16	0.5	450	1
Filter No. 2..................	28	1	13	0.5	30	1	15	1	16	0.5	13	0.5	13	0.5
Filter No. 3..................	22	1	15	0.5	24	0.5	14	1	13	0.5	10	0.5	8	0.5
Filter No. 4..................	16	1	19	0.5	18	0.5	14	0.5	17	0.5	18	0.5	14	0.5
Filter No. 5..................	180	0.5	18	0.5	33	1	21	1	10	0.5	7	0.5	17	0.5
Average of filters..........	53	1	19	0.5	31	0.5	16	1	14	0.5	13	0.5	100	0.5
Filtered water basin.......	32	0.5	21	0.5	30	1	24	1	20	0.5	15	0.5	150	1

* Applied to final filters.

Lower Roxborough Filters—Continued.

	WEEK ENDING.													
	Oct. 22.		Oct. 29.		Nov. 5.		Nov. 12.		Nov. 19.		Nov. 26.		Dec. 3.	
	Bact.	Turb.	Bact.	Turb.	Bact.	Turb.	Bact.	Turb.	Bact.	Turb.	Bact.	Turb.	Bact.	Turb.
Applied water.............	8,500	17	11,000	55	1,400	6	7,500	5	18,000	12	17,000	7	24,000	5
*Pre-Filters.	3,300	8	5,500	34	750	4	2,800	4	7,900	7	4,600	4	9,200	3
Filter No. 1..................	58	1	77	1	8	0.5	11	0.5	39	0.5	17	0.5		
Filter No. 2..................	15	0.5	19	0.5	....	....	....	....	390	0.5	230	1	110	0.5
Filter No. 3..................	71	0.5	120	2	7	0.5	8	0.5	7	0.5	150	0.5	51	0.5
Filter No. 4..................	12	0.5	82	3	14	0.5	7	0.5	36	0.5	18	0.5	10	0.5
Filter No. 5..................	9	0.5	8	0.5	10	0.5	8	0.5	21	0.5	16	0.5	9	0.5
Average of Filters.........	33	0.5	61	2	10	0.5	8	0.5	99	0.5	86	0.5	45	0.5
Filtered water basin.......	39	1	45	2	15	0.5	26	0.5	20	0.5	41	0.5	25	0.5

* Applied to final filters.

Lower Roxborough Filters.—Continued.

	WEEK ENDING.									
	DEC. 10.		DEC. 17.		DEC. 24.		DEC. 31.		AVERAGE.	
	Bact.	Turb.	Bact.	Turb.	Bact.	Turb.	Bact.	Turb.	Bact	Turb.
Applied water	29,000	4	39,000	4	61,000	4	67,000	9	29,000	35
*Pre-Filters	8,500	3	22,000	2	23,000	3	24,000	5	11,000	16
Filter No. 1	....	....	700	0.5	190	0.5	1,100	1	160	1
Filter No. 2	73	0.5	220	0.5	110	0.5	57	0.5	190	1
Filter No. 3	57	0.5	170	0.5	59	0.5	39	0.5	98	1
Filter No. 4	12	0.5	490	0.5	510	0.5	700	1	160	1
Filter No. 5	7	0.5	16	0.5	22	0.5	550	1	210	1
Average of Filters	37	0.5	310	0.5	180	0.5	490	1	160	1
Filtered water basin	40	0.5	58	0.5	310	0.5	130	1	180	1

* Applied to final filters

Weekly Averages of Bacteria and Turbidity of Filters at Upper Roxborough for the Year 1904.

	WEEK ENDING													
	JAN. 2.		JAN. 9.		JAN. 16.		JAN. 23.		JAN. 30.		FEB. 6.		FEB. 13.	
	Bact.	Turb.	Bact.	Turb.	Bact.	Turb.	Bact.	Turb.	Bact.	Turb.	Bact.	Turb.	Bact.	Turb.
Applied water.............	30,000	28	13,000	8	11,000	8	24,000	7	79,000	80	44,000	26	21,000	13
Filter No. 1................	190	0.5	110	0.5	30	0+	22	0+	2,400	3	890	2	70	0.5
Filter No. 2................	79	1	29	0.5	16	0+	41	0+	410	0+	850	0.5	86	0.5
Filter No. 3................	61	2	43	1	27	0+	180	0.5	58	0+	28	0+	170	0.5
Filter No. 4................	66	2	38	0.5	29	0+	45	0+	150	0.5	85	0.5	98	0.5
Filter No. 5................	40	1	29	0+	16	0+	41	0+	3,800	2	1,300	2	100	1
Filter No. 6................	62	2	30	0.5	22	0+	91	0.5	860	2	590	1	34	0.5
Filter No. 7................	820	4	89	1	68	0+	72	0+	180	0.5	120	0.5	41	0.5
Filter No. 8................	69	0+	34	0+	18	0+	42	0+	1,800	3	590	1	50	0.5
Average of Filters.........	110	2	50	0.5	28	0+	67	0+	1,200	2	560	1	81	0.5
Filtered water basin.......	180	3	50	1	30	0+	74	0.5	1,600	2	770	1	90	0.5

Upper Roxborough Filters—Continued.

	WEEK ENDING.													
	FEB. 20.		FEB. 27.		MARCH 5.		MARCH 12.		MARCH 19.		MARCH 26.		APRIL 2.	
	Bact.	Turb.	Bact.	Turb.	Bact.	Turb.	Bact.	Turb.	Bact.	Turb.	Bact.	Turb.	Bact.	Turb.
Applied water	16,000	11	14,000	28	38,000	55	34,000	120	9,300	100	11,000	80	2,600	30
Filter No. 1	54	0.5	36	0.5	85	1	90	2	40	2	50	1	47	0.5
Filter No. 2	37	0.5	36	0.5	170	2	99	3	39	3	20	1	27	0.5
Filter No. 3	68	0.5	33	0.5	80	2	45	2	41	3	28	1	16	1
Filter No. 4	48	1	40	1	140	2	110	4	43	3	31	1	25	1
Filter No. 5	41	1	58	1	170	3	180	4	22	1	140	1	240	1
Filter No. 6	49	0.5	73	1	350	3	160	5	100	6	33	2	31	1
Filter No. 7	46	0.5	....	....	650	2	980	7	220	5	51	1	43	1
Filter No. 8	45	0.5	24	0.5	47	0.5	61	0.5	86	1	29	0.5	32	0.5
Average of Filters	48	0.5	43	0.5	210	2	220	3	74	3	48	1	58	1
Filtered water basin	61	0.5	39	0.5	200	2	240	4	73	4	46	1	61	1

Upper Roxborough Filters—Continued.

	WEEK ENDING.													
	APRIL 9.		APRIL 16.		APRIL 23.		APRIL 30.		MAY 7.		MAY 14.		MAY 21.	
	Bact.	Turb.	Bact.	Turb.	Bact.	Turb.	Bact.	Turb.	Bact.	Turb.	Bact.	Turb.	Bact.	Turb.
Applied water.............	3,200	34	2,800	32	2,900	15	4,300	11	610	4	710	5	270	4
Filter No. 1................	38	0.5	20	0.5	19	0.5	18	0.5	29	0.5	100	0.5	130	0.5
Filter No. 2................	23	0.5	38	0.5	25	0.5	18	0+	21	0.5	27	0.5	47	0.5
Filter No. 3................	17	0.5	19	0.5	21	0.5	34	0+	25	0.5	38	0.5	100	0.5
Filter No. 4................	18	0.5	22	0.5	27	0.5	23	0.5	19	0.5	110	0.5	270	0.5
Filter No. 5................	47	1	26	0.5	21	0.5	23	0.5	28	0.5	48	0.5	77	0.5
Filter No. 6................	17	0.5	19	0.5	28	0.5	46	0.5	46	0.5	150	0.5	93	0.5
Filter No. 7................	17	1	18	0.5	22	0.5	67	0.5	360	0.5	....	....	1,100	0.5
Filter No. 8................	26	0.5	18	0.5	14	0.5	14	0+	47	0+	210	0.5	290	0.5
Average of Filters.........	25	0.5	22	0.5	22	0.5	30	0.5	72	0.5	98	0.5	260	0.5
Filtered water basin.......	*250	6	39	1	25	0.5	27	0.5	60	0.5	89	0.5	180	0.5

*Contaminated with back water from sewer.

Upper Roxborough Filters—Continued.

	WEEK ENDING.													
	MAY 20.		JUNE 4.		JUNE 11.		JUNE 18.		JUNE 25.		JULY 2.		JULY 9.	
	Bact.	Turb.	Bact.	Turb.	Bact.	Turb.	Bact.	Turb.	Bact.	Turb.	Bact.	Turb.	Bact.	Turb.
Applied water	270	3	560	16	980	46	850	40	500	15	440	9	660	6
Filter No. 1	130	0.5	85	0.5	82	0.5	55	0.5	85	0.5	17	0.5	10	0.5
Filter No. 2	81	0.5	80	0.5	54	0.5	26	0.5	19	0.5	11	0.5	10	0.5
Filter No. 3	120	0.5	120	0.5	92	0.5	86	0.5	56	0.5	36	0.5	21	0.5
Filter No. 4	240	0.5	110	0.5	120	0.5	96	0.5	49	0.5	30	0.5	18	0.5
Filter No 5	140	0.5	180	0.5	120	0.5	59	0.5	24	0.5	14	0.5	12	0.5
Filter No. 6	88	0.5	40	1	81	1	41	1	35	1	29	1	15	1
Filter No. 7	290	1	180	1	130	1	68	2	88	1	16	1	81	1
Filter No. 8	490	0.5	100	0.5	110	0.5	82	0.5	57	0.5	32	0.5	28	0.5
Average of Filters	190	0.5	110	0.5	92	0.5	61	1	39	0.5	23	0.5	18	0.5
Filtered water basin	160	0.5	120	0.5	92	0.5	59	0.5	52	0.5	27	0.5	16	0.5

Upper Roxborough Filters—Continued.

	WEEK ENDING.													
	JULY 16.		JULY 23.		JULY 30.		AUG. 6.		AUG. 13.		AUG. 20.		AUG. 27.	
	Bact.	Turb.	Bact.	Turb.	Bact.	Turb.	Bact.	Turb	Bact.	Turb.	Bact.	Turb	Bact.	Turb.
Applied water	690	9	460	10	280	8	260	7	350	11	530	22	670	51
Filter No. 1	11	0.5	....	....	90	0.5	17	0.5	20	0.5	120	0.5	85	0.5
Filter No 2	6	0.5	7	0.5	320	0.5	28	0.5	28	0+	28	0.5	71	0.5
Filter No. 3	17	0.5	25	0.5	36	0.5	180	0.5	32	0.5	22	0.5	29	0.5
Filter No. 4	20	0.5	19	0.5	12	0.5	180	0.5	42	0.5	74	0.5	160	0.5
Filter No. 5	200	1	42	0.5	11	0.5	30	0.5	130	0.5	51	0.5	69	0.5
Filter No. 6	11	1	14	1	22	0.5	28	0.5	37	0.5	95	1	34	0.5
Filter No. 7	7	1	10	1	25	1	30	0.5	200	1	17	0.5	30	0.5
Filter No. 8	20	0.5	19	0.5	19	0+	22	0.5	230	0.5	16	0.5	15	0.5
Average of Filters	36	0.5	19	0.5	67	0.5	64	0.5	90	0.5	53	0.5	55	0.5
Filtered water basin	19	0.5	25	0.5	32	0.5	58	0.5	55	0.5	32	0.5	60	0.5

Upper Roxborough Filters.—Continued.

	WEEK ENDING													
	SEPT. 3.		SEPT. 10.		SEPT. 17.		SEPT. 24.		OCT. 1.		OCT. 8.		OCT. 15.	
	Bact.	Turb.	Bact.	Turb.	Bact.	Turb.	Bact.	Turb.	Bact.	Turb.	Bact.	Turb.	Bact.	Turb.
Applied water............	360	24	270	15	1,200	27	550	25	490	18	350	17	1,000	11
Filter No. 1................	42	0.5												
Filter No. 2................	30	0.5	37	0.5	31	0.5	53	0.5	31	0.5	13	0.5	14	0.5
Filter No. 3................	83	0.5	30	0.5	58	0.5	31	0.5	21	0.5	28	0.5	40	0.5
Filter No. 4................	51	0.5	99	0.5	62	0.5	80	0.5	45	0.5	55	0.5	29	0.5
Filter No. 5................	50	0.5	43	0.5	39	0.5	310	0.5	27	0.5	18	0.5	9	0.5
Filter No. 6................	60	0.5	23	1	16	0.5	20	0.5	16	0.5	19	0.5	17	0.5
Filter No. 7................	44	1	14	0.5	12	0.5	14	0.5	19	0.5	28	0.5	22	0.5
Filter No. 8................	17	0.5	20	0.5	12	0.5	24	0.5	64	0.5	16	0.5	7	0.5
Average of filters..........	47	0.5	38	0.5	33	0.5	76	0.5	32	0.5	25	0.5	20	0.5
Filtered water basin.......	51	0.5	29	0.5	30	0.5	85	0.5	29	0.5	22	0.5	19	0.5

Upper Roxborough Filters—Continued.

	WEEK ENDING.													
	OCT. 22.		OCT. 29.		NOV. 5.		NOV. 12.		NOV. 19.		NOV. 26.		DEC. 3.	
	Bact.	Turb.	Bact.	Turb.	Bact.	Turb.	Bact.	Turb.	Bact.	Turb.	Bact.	Turb.	Bact.	Turb.
Applied water	820	9	710	14	150	7	160	8	480	9	810	18	1,200	12
Filter No. 1	37	0.5	14	0.5	21	0.5	26	0.5	27	0.5	32	0.5	35	0.5
Filter No. 2	8	0.5	6	0.5	9	0.5	18	0.5	....	....	480	0.5	82	0.5
Filter No. 3	60	0.5	....	....	....	....	430	0.5	87	0.5	50	0.5	27	0.5
Filter No. 4	9	0.5	13	0.5	17	0.5	20	0.5	19	0.5	....	....	670	0.5
Filter No. 5	7	0.5	6	0.5	6	0.5	7	0.5	48	0.5	34	0.5	21	0.5
Filter No. 6	12	0.5	9	0.5	12	0.5	33	0.5	18	0.5	18	0.5	10	0.5
Filter No. 7	....	....	430	0.5	26	0.5	17	0.5	9	0.5	9	0.5	7	0.5
Filter No. 8	7	0.5	6	0.5	6	0.5	17	0.5	8	0.5	13	0.5	9	0.5
Average of filters	20	0.5	69	0.5	14	0.5	71	0.5	31	0.5	91	0.5	110	0.5
Filtered water basin	13	0.5	10	0.5	16	0.5	30	0.5	24	0.5	30	0.5	26	0.5

Upper Roxborough Filters—Continued.

	WEEK ENDING.									
	DEC 10.		DEC. 17.		DEC. 24.		DEC. 31.		AVERAGES.	
	Bact.	Turb.	Bact.	Turb.	Bact.	Turb.	Bact.	Turb.	Bact.	Turb.
Applied water	3,800	6	8,100	5	29,000	5	34,000	6	8,500	22
Filter No. 1	31	0.5	39	0.5	210	0.5	110	0.5	130	1
Filter No. 2	63	0.5	96	0.5	420	0.5	140	0.5	85	1
Filter No. 3	18	0.5	23	0.5	49	0.5	60	0.5	61	1
Filter No. 4	240	0.5	110	0.5	130	0.5	150	0.5	85	1
Filter No. 5	39	0.5	140	0.5	690	0.5	200	0.5	170	1
Filter No. 6	13	6.5	35	0.5	170	0.5	85	0.5	74	1
Filter No. 7	12	0.5	40	0.5	160	0.5	96	0.5	130	1
Filter No. 8	14	0.5	36	0.5	210	0.5	85	0.5	100	1
Averages of Filters	54	0.5	65	0.5	260	0.5	120	0.5	100	1
Filtered water basin	43	0.5	56	0.5	290	0.5	130	0.5	110	1

Plate No. 2.—Foot of Shaft No. 1.

BELMONT FILTERS.

J. A. Vogleson, Assistant Engineer in charge.

All contracts pertaining to the construction of the Belmont filters, excepting Contract No. 39, preliminary filters for this station, were completed during the past year. The filtering materials were sufficiently advanced to enable the starting of four filters during the last week of March, but all the filters were not in continuous daily service until the 10th of September.

The number of filters in service by the 10th of June was sufficient to supply nearly 20,000,000 gallons of filtered water per day, by which date arrangements had been made to supply an isolated district in West Philadelphia with filtered water only, while the remainder of West Philadelphia received a mixture of filtered and unfiltered water, varying in quantity, depending upon the daily consumption and capacity of the pumping machinery at the Belmont river station.

This filter station is now in full operation, but not working up to the capacity which is anticipated when the preliminary filters are completed. The results from the operation of the Belmont filters have been very satisfactory after the first few weeks of service of each filter. Of course it is well recognized that with the plain sand filters some time is required to ripen the sand bed. With care, however, in the grading, washing and placing of the filtering materials at Belmont, in which respect it was regarded as being superior to the work as performed at Lower and Upper Roxborough, these filters reached an efficiency of operation much earlier than did the Roxborough filters.

The total yield of the Belmont Filters from March 26th to December 31, inclusive, was 5,551,170,000 gallons, or an average yield per month (April to December inclusive) of 616,360,000 gallons. The yield per month since the entire number of filters were put in service, September to December inclusive, was 815,180,000 gallons, or an average yield per day, September to December inclusive, 119 days, of 26,600,000 gallons.

This station is capable of furnishing without the aid of the preliminary filters about 33,000,000 gallons of filtered water per day, but its capacity is at present limited by the capacity of the pumping machinery pumping to the new Belmont sedimentation reservoir. With the completion of the preliminary filters now in process of construction the station can easily be raised to 40,000,000 gallons per day, or more than the apparent maximum consumption of West Philadelphia at the present time; but in order to render this amount of filtered water available it will be necessary to increase the pumping capacity at the Belmont river station.

The total cost of operating Belmont for the year was $19,894.71, or at the rate of $3.58 per million gallons of water filtered, and comparison of the figures from the different stations will show that when each of the Roxborough stations is operating fairly up to its capacity as at Belmont, the cost of filtration can readily be kept within $3.50 per million gallons.

In the following table are given the results of operation of all the filters since the first four were started in the spring.

WEEK ENDING.

	April 2.		April 9.		April 16.		April 23.		April 30.		May 7.		May 14.	
	Bact.	Turb.	Bact.	Turb.	Bact.	Turb.	Bact.	Turb.	Bact.	Turb.	Bact.	Turb.	Bact.	Turb.
Applied water	250	20	10,000	75	3,400	46	17,000	12	7,000	9	4,100	10	3,700	6
Filter No. 1	......	......	1,700	5	350	3	200	2	110	2	42	1	28	0.5
Filter No. 2	......	......	......	......	......	......	......	......	......	......	......	......	......	......
Filter No. 3	240	1	820	2	420	4	190	4	170	3	67	2	26	2
Filter No. 4	490	4	1,400	4	310	4	300	4	260	3	75	2	32	1
Filter No. 5	780	3	1,400	5	190	4	280	4	190	3	51	2	46	2
Filter No. 6	210	2	850	6	100	5	140	4	160	3	37	2	21	2
Filter No. 7	......	......	......	......	......	......	......	......	......	......	......	......	......	......
Filter No. 8	......	......	......	......	1,200	2	580	3	280	3	110	3	68	2
Filter No. 9	......	......	......	......	......	......	......	......	1,300	1	390	3	100	3
Filter No. 10	......	......	......	......	......	......	......	......	......	......	......	......	1,400	1
Filter No. 11	......	......	......	......	......	......	......	......	......	......	......	......	......	......
Filter No. 12	......	......	......	......	......	......	......	......	......	......	......	......	......	......
Filter No. 13	......	......	......	......	......	......	......	......	......	......	......	......	......	......
Filter No 14	......	......	......	......	......	......	......	......	......	......	......	......	......	......
Filter No. 15	......	......	......	......	......	......	......	......	......	......	......	......	......	......
Filter No. 16	......	......	......	......	......	......	......	......	......	......	......	......	......	......
Filter No. 17	......	......	......	......	......	......	......	......	......	......	......	......	......	......
Filter No. 18	......	......	......	......	......	......	......	......	......	......	......	......	......	......
Average of all Filters	430	2	1,200	4	430	4	280	4	350	3	110	2	220	2
Filtered water basin	......	......	......	......	......	......	......	......	......	......	......	......	......	......

Belmont Filters.—Continued.

	WEEK ENDING.													
	MAY 21.		MAY 28.		JUNE 4.		JUNE 11.		JUNE 18.		JUNE 25.		JULY 2.	
	Bact.	Turb.	Bact.	Turb.	Bact.	Turb.	Bact.	Turb.	Bact.	Turb.	Bact.	Turb.	Bact.	Turb.
Applied water	1,900	8	1,000	5	2,800	40	7,600	100	5,200	140	790	14	510	10
Filter No. 1	52	0.5	85	0.5	77	0.5	33	2	22	2	24	1	30	1
Filter No 2	......	......	3,400	2	320	4	260	11	180	7	64	4	22	2
Filter No. 3	17	1	710	1	150	1	55	5	46	6	16	2	28	1
Filter No. 4	30	1	190	1	58	1	64	3	48	4	29	2	140	2
Filter No. 5	280	1	110	1	110	1	63	4	46	4	33	3	29	2
Filter No. 6	47	1	68	1	49	1	230	3	32	4	11	2	24	2
Filter No. 7	......	......	......	......	......	......	......	......	......	......	......	......	1,500	2
Filter No. 8	52	1	200	2	45	2	41	5	33	5	25	8	19	2
Filter No. 9	55	2	58	1	67	2	71	7	82	6	18	3	14	2
Filter No. 10	290	2	140	4	85	4	260	9	90	9	34	4	11	3
Filter No. 11	......	......	......	......	......	......	......	......	......	......	460	2	120	5
Filter No. 12	......	......	......	......	......	......	1,000	3	240	9	120	7	30	2
Filter No. 13	......	......	......	......	......	......	......	......	......	......	......	......	......	......
Filter No. 14	......	......	......	......	......	......	......	......	......	......	......	......	......	......
Filter No. 15	......	......	......	......	......	......	......	......	......	......	......	......	......	......
Filter No. 16	......	......	......	......	......	......	......	......	......	......	......	......	......	......
Filter No. 17	......	......	......	......	......	......	......	......	......	......	......	......	......	......
Filter No. 18	......	......	......	......	......	......	......	......	......	......	......	......	......	......
Average of all Filters	100	1	550	1	110	2	210	5	77	6	76	8	160	2
Filtered water basin	......	......	......	......	......	......	800	9	540	6	880	4	810	4

WEEK ENDING.

	July 9.		July 16.		July 23.		July 30.		August 6.		August 13.		August 20.	
	Bact.	Turb.	Bact.	Turb.	Bact.	Turb.	Bact.	Turb.	Bact.	Turb.	Bact.	Turb.	Bact.	Turb.
Applied water..............	430	6	1,200	19	280	5	1,500	12	1,800	14	3,100	50	4 300	75
Filter No. 1..................	42	0.5	36	0.5	9	0.5	10	0.5	120	0.5	88	0.5	45	2
Filter No. 2..................	36	2	180	1	19	2	11	1	18	1	38	1	31	3
Filter No. 3..................	44	1	52	1	38	1	30	0.5	170	0.5	29	0.5	22	2
Filter No. 4..................	55	1	67	1	77	1	40	0.5	190	0.5	57	0.5	18	2
Filter No. 5..................	30	1	23	1	14	1	9	1	15	0.5	120	1	26	3
Filter No. 6..................	46	2	58	2	44	1	41	1	47	0.5	45	1	22	1
Filter No. 7..................	140	4	48	4	23	4	21	3	26	2	26	2	61	4
Filter No. 8..................	37	2	33	2	25	1	32	1	28	0.5	43	1	....	....
Filter No. 9..................	26	2	26	2	....	....	96	1	21	1	46	1	110	3
Filter No. 10................	21	2	55	3	....	....	590	2	94	2	24	2	20	3
Filter No. 11................	39	3	33	3	20	2	35	1	26	1	22	1	35	3
Filter No. 12................	21	1	72	2	70	2	37	1	40	1	49	1	620	2
Filter No. 13................	1,300	1	160	2	46	4	79	3	83	2	110	2	60	4
Filter No. 14................	....	....	....	....	....	....	....	....	1,100	3	260	2	140	8
Filter No. 15................	....	....	....	....	....	....	....	....	....	....	....	....	1,900	2
Filter No. 16................	....	....	....	....	....	....	1,600	2	390	0.5	97	4	87	8
Filter No. 17................	....	....	....	....	980	2	130	4	68	4	40	3	68	5
Filter No. 18................	....	....	....	....	....	....	....	....	....	....	....	....	....	....
Average of all Filters......	140	2	65	2	110	2	180	2	170	1	68	1	200	3
Filtered water basin.......	2,700	8	1,100	2	65	8	38	2	61	2	47	3	78	4

Belmont Filters—Continued.

	WEEK ENDING.													
	AUG. 27.		SEPT. 3.		SEPT. 10.		SEPT. 17.		SEPT. 24.		OCT. 1.		OCT. 8.	
	Bact.	Turb	Bact.	Turb.	Bact.	Turb.	Bact.	Turb.	Bact.	Turb.	Bact.	Turb.	Bact.	Turb.
Applied water	7,300	90	4,900	32	1,000	8	9,000	44	2,700	27	3,000	8	2,300	6
Filter No. 1................	69	0.5	200	0.5	12	0.5	30	1	25	1	33	0.5	35	0.5
Filter No. 2................	47	2	110	2	23	1	17	1	18	2	21	1	28	0.5
Filter No. 3................	19	1	41	1	47	0.5	58	0.5	68	0.5	110	1	18	0.5
Filter No. 4................	18	1	36	1	48	0.5	47	0.5	31	1	27	0.5	28	0.5
Filter No. 5................	19	2	52	2	86	1	72	0.5	28	1	14	1	22	1
Filter No. 6................	920	2	43	2	11	1	21	1	18	2	21	1	21	0.5
Filter No. 7................	54	2	76	2	20	1	650	2	48	3	18	1	13	0.5
Filter No. 8................	450	2	44	3	15	1	41	1	39	2	27	1	39	0.5
Filter No. 9................	190	2	460	3	33	1	30	1	18	2	22	1	37	1
Filter No. 10..............	16	1	26	2	83	1	90	1	17	2	17	1	17	0.5
Filter No. 11..............	180	2	51	2	19	1	39	1	37	2	81	0.5	38	0.5
Filter No 12..............	38	2	22	2	27	0.5	50	1	47	1	36	0.5	32	0.5
Filter No. 13..............	59	2	70	2	160	1	62	1	22	2	21	0.5	17	0.5
Filter No. 14..............	120	7	93	5	41	2	33	0.5	25	2	340	0.5	62	0.5
Filter No. 15..............	170	7	110	6	44	2	57	1	50	3	35	1	270	1
Filter No. 16..............	110	5	71	4	25	1	16	1	150	3	21	1	12	0.5
Filter No. 17..............	110	3	52	2	13	1	20	0.5	170	2	35	1	9	0.5
Filter No. 18..............	....	....	....	....	380	1	110	4	48	10	39	4	27	2
Average of all Filters.....	150	3	92	2	59	1	80	1	48	2	48	1	40	1

	October 15.		October 22.		October 29.		November 5.		November 12.		November 19.		November 26.	
	Bact.	Turb.	Bact.	Turb.	Bact.	Turb.	Bact.	Turb.	Bact.	Turb.	Bact.	Turb.	Bact.	Turb.
Applied water............	18,000	23	6,800	23	7,600	63	830	8	3,100	6	16,000	11	13,000	8
Filter No. 1................	31	0.5	31	0.5	100	1	18	1	9	0.5	47	0.5	20	0.5
Filter No. 2................	21	0.5	23	0.5	78	3	10	1	6	0.5	46	0.5	18	0.5
Filter No. 3................	23	0.5	13	0.5	24	0.5	52	0.5	19	0.5	....	....	1,200	0.5
Filter No. 4................	....	....	580	1	170	4	17	1	13	0.5	18	0.5	89	0.5
Filter No. 5................	....	....	370	2	130	3	13	1	14	0.5	46	0.5	34	0.5
Filter No. 6................	63	0.5	84	0.5	31	0.5	61	1	11	0.5	46	0.5	21	0.5
Filter No. 7................	24	0.5	37	0.5	140	2	22	1	25	0.5	66	0.5	25	0.5
Filter No. 8......	29	0.5	24	1	72	1	20	2	8	0.5	61	0.5	25	0.5
Filter No. 9................	34	0.5	75	1	65	3	9	1	7	0.5	29	0.5	58	0.5
Filter No. 10................	22	0.5	21	0.5	22	1	31	1	23	0.5	85	0.5	37	1
Filter No. 11................	31	0.5	29	0.5	23	0.5	18	0.5	....	....	1,700	2	1,100	2
Filter No. 12................	29	0.5	150	0.5	66	3	9	0.5	5	0.5	63	0.5	34	0.5
Filter No. 13................	21	0.5	25	0.5	30	0.5	38	0.5	51	0.5	....	....	....	....
Filter No. 14................	64	0.5	30	0.5	16	1	9	0.5	7	0.5	14	0.5	75	0.5
Filter No. 15................	67	0.5	22	0.5	51	2	12	1	34	0.5	62	0.5	18	0.5
Filter No. 16.	56	0.5	47	0.5	21	1	15	1	63	0.5	58	0.5	35	1
Filter No. 17................	66	0.5	21	0.5	25	0.5	64	1	12	0.5	130	0.5	35	0.5
Filter No. 18................	130	1	35	2	76	2	39	2	9	1	66	0.5	22	1
Average of all Filters......	44	0.5	87	1	68	2	25	1	19	0.5	160	1	170	1
Filtered water basin	53	1	64	1	74	3	30	1	19	1	83	1	63	1

Belmont Filters—Continued.

	WEEK ENDING.											
	DEC. 3.		DEC. 10.		DEC. 17.		DEC. 24.		DEC. 31.		AVERAGE.	
	Bact.	Turb.	Bact.	Turb.	Bact.	Turb.	Bact.	Turb.	Bact.	Turb.	Bact.	Turb.
Applied water	9,200	4	15,000	4	27,000	4	53,000	5	70,000	9	8,700	26
Filter No. 1	11	0.5	18	0.5	310	0.5	160	0.5	70	0.5	110	1
Filter No. 2	9	0.5	21	0.5	150	0.5	31	0.5	390	0.5	180	1
Filter No. 3	280	1	170	1	450	0.5	48	0.5	37	0.5	150	1
Filter No. 4	36	0.5	57	0.5	340	0.5	180	0.5	160	0.5	160	1
Filter No. 5	41	0.5	110	0.5	400	0.5	45	0.5	46	0.5	140	1
Filter No. 6	7	0.5	10	0.5	130	0.5	190	0.5	250	0.5	100	1
Filter No. 7	10	0.5	120	0.5	390	0.5	64	0.5	80	0.5	140	1
Filter No. 8	13	0.5	30	0.5	420	0.5	110	0.5	70	0.5	120	1
Filter No. 9	57	0.5	62	0.5	230	0.5	110	0.5	170	1	120	1
Filter No. 10	12	0.5	19	0.5	250	0.5	420	0.5	85	0.5	130	1
Filter No. 11	95	1	120	0.5	230	0.5	120	0.5	330	0.5	180	1
Filter No. 12	100	0.5	180	0.5	160	0.5	34	0.5	50	0.5	110	1
Filter No. 13	......	......	1,500	1	610	0.5	130	0.5	87	0.5	210	1
Filter No. 14	250	0.5	220	0.5	580	0.5	89	0.5	76	0.5	170	1
Filter No. 15	12	0.5	20	0.5	49	0.5	38	0.5	760	0.5	190	1
Filter No. 16	24	0.5	65	0.5	240	0.5	260	0.5	130	0.5	160	1
Filter No. 17	11	0.5	19	0.5	280	0.5	730	0.5	150	0.5	180	1
Filter No. 18	8	0.5	9	0.5	290	0.5	280	0.5	79	0.5	94	2
Average of all Filters	57	0.5	150	0.5	300	0.5	170	0.5	170	0.5	110	1
Filtered water basin	44	0.5	190	0.5	340	0.5	210	0.5	180	0.5	240	2

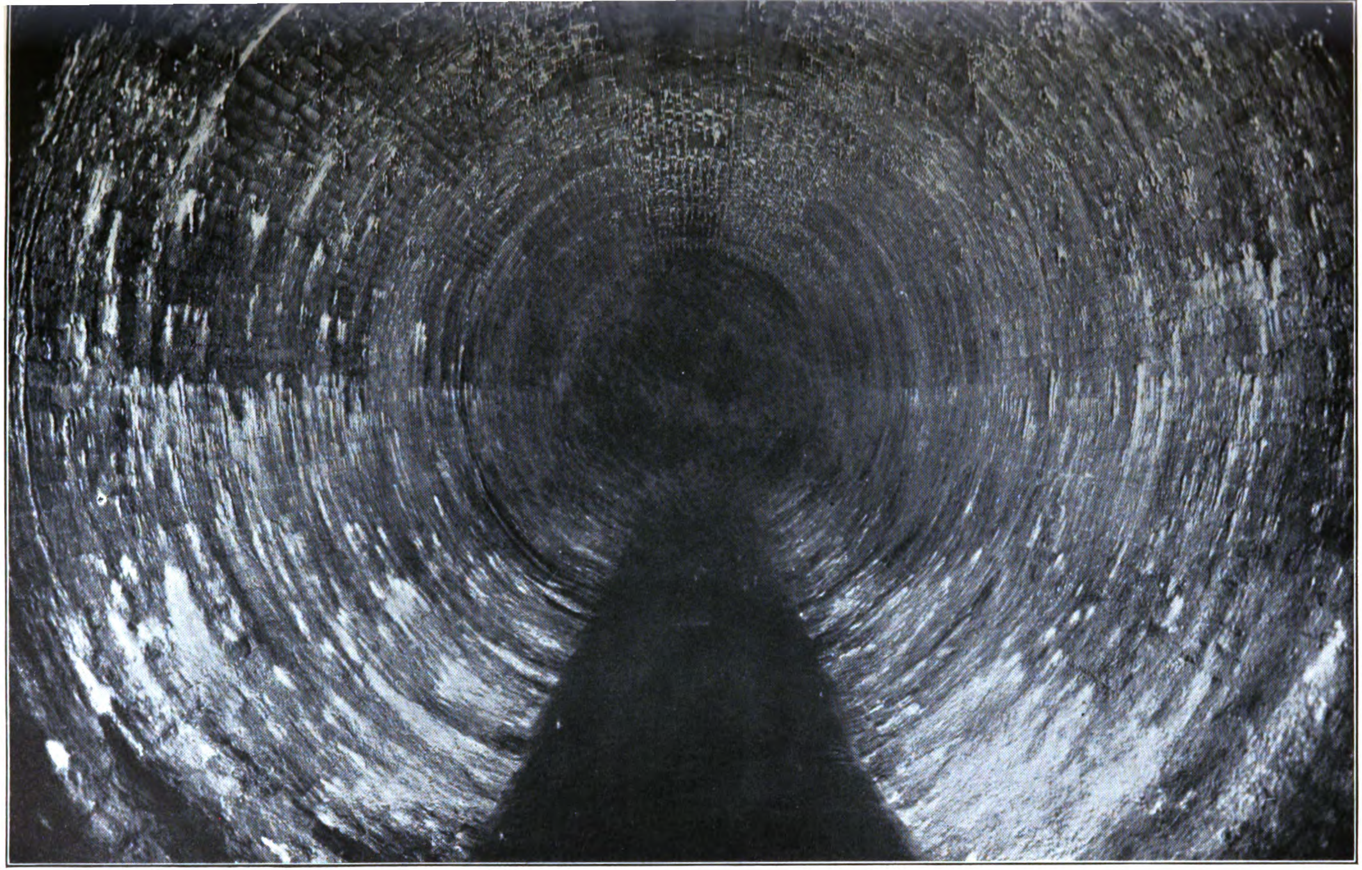

Plate No. 3.—Lining of Tunnel under Shaft No. 2.

During the year some trouble was experienced in the operation of the sand washer pumps by reason of air collecting in the main effluent pipe of the filters. The trouble, however, was less with the pumps than with the high level filters Nos. 5 and 6 and Nos. 7 and 8. To remedy this and at the same time remove the air from the system of effluent pipes, a new suction connection was made with the pipe which will convey water from the preliminary filters to the final filters for supply to the sand washer pumps, and a special air vent was run from the northerly end of the main effluent pipe between filters Nos. 6 and 7 up under the eave of the roof of the Administration Building for the removal of air.

The result of this work has been very satisfactory, both in improving the operation of pumping to the sand washers and in improving the operation of the four filters previously affected by the accumulation of air in the lines of effluent pipe.

WORK OF THREE OPERATING STATIONS.

The total yield of all the filters for 1904 was 12,125,350,000 gallons, or an average yield per day of 44,560,000 gallons.

The total yield of filtered water since the Lower Roxborough Filters were started in service (August, 1902) to December 31, 1904, from all the filters is given in the following table:

Lower Roxborough, 1902	677,950,000
Lower and Upper Roxborough, 1903	4,164,390,000
Lower and Upper Roxborough and Belmont, 1904	12,125,350,000
Total	16,967,690,000

In the following statement I have shown the bacteria and turbidity changes between the raw water in the Schuylkill river and the filtered water from all the filters, and also the changes that are effected in the plain sand filters after the water has passed the preliminary filters.

LOWER ROXBOROUGH.

Comparing the filtered water and the water flowing from the preliminary filters, the reductions for the past year were as follows:

	Per Cent.
Average reduction, turbidity	83.20
Average reduction, bacteria	96.40
Maximum reduction, turbidity	100.00
Maximum reduction, bacteria	99.76
Minimum reduction, turbidity	50.00
Minimum reduction, bacteria	73.47

Comparing the effluents of the plain sand filters and the water from the Schuylkill river, the reductions were as follows:

	Per Cent.
Average reduction, turbidity	96.02
Average reduction, bacteria	99.66
Maximum reduction, turbidity	100.00
Maximum reduction, bacteria	99.95
Minimum reduction, turbidity	81.81
Minimum reduction, bacteria	98.33

UPPER ROXBOROUGH.

Comparing the filtered water and the water flowing from the Upper Roxborough sedimentation reservoir, the reductions were as follows:

	Per Cent.
Average reduction, turbidity	94.56
Average reduction, bacteria	92.56
Maximum reduction, turbidity	100.00
Maximum reduction, bacteria	99.73
Minimum reduction turbidity	82.35
Minimum reduction, bacteria	33.33

Comparing the effluents of the Upper Roxborough Filters with the raw water pumped from the Schuylkill river, the reductions were as follows:

	Per Cent.
Average reduction, turbidity	89.78
Average reduction, bacteria	98.81
Maximum reduction, turbidity	95.65
Maximum reduction, bacteria	99.81
Minimum reduction, turbidity	83.33
Minimum reduction, bacteria	95.70

BELMONT FILTERS.

Comparing the effluent from the Belmont Filters with the water flowing from the new Belmont sedimentation basins, the reductions were as follows:

	Per Cent
Average reduction, turbidity	89.78
Average reduction, bacteria	98.81
Maximum reduction, turbidity	95.65
Maximum reduction, bacteria	99.81
Minimum reduction, turbidity	83.33
Minimum reduction, bacteria	95.70

Comparing the effluents from the filters with the raw water in the Schuylkill river above Fairmount dam, as determined by tests of water at the Spring Garden Testing Station, the reductions were as follows :

	Per Cent.
Average reduction, turbidity	89.20
Average reduction, bacteria	99.27
Maximum reduction, turbidity	98.94
Maximum reduction, bacteria	99.85
Minimum reduction, turbidity	78.56
Minimum reduction, bacteria	95.61

It will be seen from the last two sets of figures that the one and one-half day's subsidence in the new Belmont sedimentation reservoir does not seem to have a very marked effect on the water of the Schuylkill river taken below Flat Rock dam. This is partly due to the fact that we find considerable subsidence in the river between Fairmount and Flat Rock dams, and probably partly to the fact that more or less disturbance of the water in the settling basins, has been going on, by reason of operations at different times, in connection with our effluent pipes, there being many occasions during the past year, when the water from the Belmont sedimentation reservoir, was worse in point of turbidity and bacterial content, than the water from the Schuylkill river entering the Testing Station at Spring Garden.

The filters consist of twenty tanks of the same dimensions as those embraced in the Torresdale Filters, Contract No. 39, 20 feet wide, 60 feet long and 8½ feet deep, inside dimensions; each tank being provided with 12 inches of coarse underdrain material, the usual influent and effluent pipes, a system of wash pipes and 24 inches of fairly coarse filtering sand.

From the experiments conducted during the past year upon a preliminary filter, upon which the plans for Contract No. 39 were based, there seems to be no difficulty in operating such a filter at the rate of 80,000,000 gallons per acre per day, with a reduction in the turbidity of from 60 to 80 per cent., an average reduction of from 55 to 70 per cent. can easily be obtained.

Preliminary Filters for the Belmont Filters—Contract No. 39.

Mr. Daniel J. McNichol, Contractor.

J. A. Vogleson, Assistant Engineer in charge.

This contract embraces a system of preliminary filters for the treatment of the subsided water from the new Belmont sedimentation basins before it passes to the plain sand filters, the preliminary filter houses and all the necessary pipes to connect with the existing lines of pipe and sewers at Belmont constructed under Contract No. 16.

In ordinary operation the sand bed is washed from time to time by reverse currents of water, as in the ordinary mechanical filter, but no chemical will be used, and the rate is less than that usually applied to mechanical filters operating with a coagulant.

Operating at the rate of 80,000,000 gallons per acre per day it becomes necessary several times during the year to entirely remove the sand bed, wash it in the same manner as sand from the plain sand filters is washed, and replace the sand in an empty filter of the system.

At Belmont, with twenty filters, nineteen will always be charged with sand, and excepting for a few hours' time when the washing of the sand is taking place, always in service. When the sand bed becomes clogged with mud balls, the filter is stopped for a period of five or six hours, ejectors are placed in the filters, the dirty sand thrown into the ejector, transported by a current of water under pressure to the washer, washed and delivered to the empty filter of the system. When so washed the sand is in condition as good as new. It is thought that this washing will be required four or five times during the year, and based upon the experience of Pre-filter No. 12 at the Testing Station, there should be no difficulty in maintaining the charge for the preliminary treatment of water at less than 75c. per million gallons of water treated. This charge will cover all expense for the operation of the pre-filters.

At the present time the excavation is practically completed for the Belmont pre-filters. The contractors have assembled their working outfit, and it is thought that within six months after starting operations in the spring, the filters will be in operation.

The financial statement with reference to this contract is as follows:

Limit of contract	$222,000 00
Face of estimates	8,066 00
Amount paid	7,259 40

Administration Building and Pumping Station for the Belmont Filters—Contract No. 42.

H. B. Shoemaker & Co., Contractors.

J. A. Vogleson, Assistant Engineer in charge.

The Administration Building, Belmont, was completed August 28th, and with the exception of the second floor of the administration end of the building has been in continuous use since.

The financial statement with reference to this contract is as follows:

Limit of contract	$55,000 00
Face of estimates	51,488 36
Amount paid	51,488 36

Centrifugal Pumps and Driving Engines for the Belmont Filters—Contract No. 40A.

Camden Iron Works, Contractors.

H. M. Hillegas, Assistant Engineer in charge.

This contract embraces two sets of centrifugal pumps and vertical driving engines installed in the Administration Building, Belmont Filters, and is described on page 105 of the Annual Report for 1903.

This machinery was installed 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, 1904.	Units.	Engine No. 1. Aug. 28, 1904.	Engine No. 2. Sept. 11, 1904.
Diameter steam cylinder.............	Inches...	10.00	10.00
Stroke of steam pistons..............	I ches...	12.00	12.00
Diameter of piston rod................	Inches...	$1\frac{11}{16}$	$1\frac{11}{16}$
Steam pressure by contract..........	Pounds..	130.00	130.00
Steam pressure by test................	Pounds..	127.80	129.20
R. P. M. by contract..................	....	300.00	300.00
R. P. M. by test.........................	....	301.93	299.30
Suction lift from pump well to centre of pressure gauge...............	Feet......	17.70	17.33
Discharge, head pressure gauge......	Feet......	28.77	27.915
Total head..............................	Feet......	46.47	45.245
Total head, by contract...............	Feet......	45.00	45.00
Excess head, by test...................	Feet......	1.47	0.245
Per cent. excess head, by test........	Feet......	3.25	0.54
Water, H. P............................	....	53.98	50.756
I. H. P..................................	....	84.49	80.98
Pumpage, per hour....................	Gallons..	275,944.00	263,470.00
Pumpage, per hour, by contract......	Gallons..	208,333.00	208,333.00
Excess, by test.........................	Gallons..	67,610.00	55,137.00
Per cent., increased capacity.........	....	32.45	26.46
Rate pumpage by contract...........	Gallons..	5,000,000.00	5,000,000.00
Rate pumpage, by test (24 hours)....	Gallons..	6,622,666.00	6,323,297.00
Efficiency, by test.....................	Per cent.	63.88	62.68
Efficiency, by contract................	Per cent.	54.00	54.00

Each of the centrifugal pumps under the terms of the contract was expected to readily deliver against a head of 45 feet at the rate of 5,000,000 gallons per day of 24 hours. It will be seen that without overtaxing the machinery in any respect the work can be readily increased to 6,000,000 gallons per day of 24 hours for each of the pumps if this volume of water should be required. It is gratifying to state that the work under this contract has been well performed in all respects.

The financial statement with reference to this contract is as follows:

Limit of contract	$7,300 00
Face of estimates	7,298 44
Amount paid	7,298 44

Duplex Direct Acting Pumps and Steam Boilers—Contract No. 40-B.

I. P. Morris Company, Contractors.

H. M. Hillegas, Assistant Engineer in charge.

This contract is described in the report for 1903, and has been completed so far as it relates to the four 200 horse power internally fired marine boilers, which have now been in service since the 1st of June, supplying steam to the sand washer pumps, to the engines driving the electrical generators, for steam heating of the building, and for the tests of the centrifugal pumps required to pump wash water to the preliminary filters.

All the machinery at this station with the exception of the sand washer pumps is now completed and either in or ready for operation.

The sand washer pumps furnished as a part of Contract No. 40-B, were in all respects unsatisfactory; did not comply with the terms of the contract, and the contractor was ordered to furnish new machinery to take their place. This is now under construction, and when ready for erection the present pumps, upon which only a partial payment has been made (42.50 per cent. of contract price) will be removed, and taken away by the contractor.

Each boiler under the terms of the contract was required to easily and economically evaporate 6,000 pounds of water per hour from feed at 100 degrees Fahr, to steam at 130 pounds pressure by gauge, and in making this test where the chief interest centered in demonstrating their economy, using for the purpose a good grade of coal, an economy was obtained that compares favorably with that of any other boilers where the tests have been conducted under more favorable conditions than were these, and as matter of interest in this connection I include the results of the test in the following table:

Results of Test of Boilers Nos. 1 and 3—
Contract No. 40-B.

Belmont Administration Building, Belmont Filters.
Fuel: George's Creek Semi-bituminous Coal.
(Boilers Nos. 1 and 3 operated together.)

1.	Date of trial	Nov. 23, 1904.
2.	Duration of trial	10 hours.
3.	Grate surface, two boilers	82 sq. ft.
4.	Water heating surface, two boilers	2,604.8 sq. ft.
5.	Ratio heating surface to grate surface	31.76
	PRESSURES:	
6.	Steam pressure in boiler by gauge	129.41 pounds.
7.	Absolute steam pressure	144 pounds.
8.	Draught gauge	0.695 inch.
	TEMPERATURES:	
9.	External air	44° Fahr.
10.	Smoke flue	516.85° Fahr.
11.	Feed water after passing heater	118.88° Fahr.
	FUEL:	
12.	Wood used in starting fire, 412 pounds, equivalent to	165 lbs. coal.
13.	Total amount of coal consumed	12,877 lbs. coal.
	Total	13,042 lbs. coal.
14.	Moisture in coal	Not determined.
15.	Total refuse, ash, clinkers, etc	1,237 pounds.
16.	Total combustible	11,805 pounds.
17.	Dry coal consumed per hour	1,304.2 pounds.
18.	Combustible consumed per hour	1,180.5 pounds.

CALORIMETRIC TEST OF STEAM:

19. Quality of steam, based on saturation......98.69 per cent.
20. Percentage of moisture in steam........... 1.31 per cent.

WATER:

21. Total weight of water pumped into boilers and apparently evaporated .... 123.392 pounds.
22. Water actually evaporated, corrected for quality of steam .... 121.776 pounds.
23. Equivalent water evaporated into dry steam from and at 212° F.................... 139.110 pounds.
24. Equivalent water evaporated into dry steam from and at 212° F. per hour............ 13,911 pounds.
25. Water actually evaporated per pound of coal from actual pressure and temperature .... 9.34 pounds.
26. Equivalent water evaporated per pound of coal from and at 212° F................. 10.67 pounds.
27. Equivalent water evaporated per pound of combustible from and at 212° F......... 11.78 pounds.
28. Equivalent water evaporated per pound of combustible at 130 pounds gauge pressure from temperature of 100° F....... 10.14 pounds.
29. Coal per square foot of grate surface, per hour .... 15.904 pounds.

CONSUMPTION OF COMBUSTIBLE PER HOUR:

30. Per square foot of grate surface........... 14.396 pounds.

RATE OF EVAPORATION:

31. Water evaporated from and at 212° F. per sq. ft. of heating surface per hour...... 5.34 pounds.

WATER EVAPORATED PER HOUR FROM TEMPERATURE OF 100° F. INTO STEAM OF 130 LBS. GAUGE PRESSURE:

32. Actual evaporation per hour from 100° F. to 130 pounds gauge pressure ....11,970.25 pounds.
33. Per square foot of water heating surface... 4.95 pounds.
34. H. P., two boilers, by test, on a basis of equivalent evaporation from and at 212° F., using 34.50 pounds evaporation per hour, equivalent to one H. P........... 403.237

35. H. P., two boilers, by contract, on a basis of 12,000 pounds of water per hour from 100° F., to 130 pounds gauge pressure, reduced to the equivalent evaporation from and at 212° F., using 34.50 pounds per hour, equivalent to one H. P.	404.208
36. Per cent. developed below rated capacity...	0.247

Builder's Guarantee.—Two boilers guaranteed to economically evaporate 12,000 pounds of water per hour from feed water at 100° F., into steam at 130 pounds gauge pressure.

The financial statement with reference to this contract is as follows:

Limit of contract	$29,000 00
Face of estimates	19,462 50
Amount paid	16,543 12

BELMONT FILTERS AND RESERVOIRS—CONTRACT NO. 16.

RYAN & KELLEY, Contractors.

Charles H. Paul, Assistant Engineer in charge.

This contract embraced the eighteen plain sand filters, and two sedimentation basins and clear water basin, together with all lines of pipe conduits, sewers and regulating apparatus for Belmont. During the year the contract was entirely completed and final payment made.

The financial statement is as follows:

Limit of contract	$1,979,697 00
Face of estimates	1,969,136 18
Amount paid	1,969,136 18

FILTERING MATERIALS AND UNDERDRAINS FOR THE BELMONT FILTERS—CONTRACT NO. 49.

MR. DANIEL J. MCNICHOL, Contractor.

Charles H. Paul, Assistant Engineer in charge.

This contract embraced the perforated collector pipes, underdrain gravel and filtering sand for the Belmont Filters, and was entirely completed about the 1st of September, 1904.

The financial statement with reference to this contract is as follows:

Limit of contract	$365,000 00
Face of estimates	349,736 67
Amount paid	349,736 67

SAND EJECTOR PIPES FOR THE BELMONT FILTERS.

MR. E. M. NICHOLS, Contractor.

Charles H. Paul, Assistant Engineer in charge.

This contract is described on page 115 of the report for 1903, and the furnishing and placing of the materials required was completed during the past year.

The financial statement with reference to this contract is as follows:

Limit of contract	$7,900 00
Face of estimates	7,815 00
Amount paid	7,815 00

SCREENS FOR THE VENTILATOR OPENINGS—BELMONT FILTERS.

DE WITT WIRE CLOTH COMPANY, Contractors.

Charles H. Paul, Assistant Engineer in charge.

The screens to prevent the entrance to the filters of field mice, and objectionable material, were furnished and placed during the current year; total cost, $3,642.30.

Fence Around Belmont Reservoir.

The fence around the Belmont reservoir as mentioned on page 115 of the report for 1903, for which the materials were purchased by this Bureau on the Water Bureau schedule, and the labor of placing performed by the employees of the Water Bureau has been completed during the past year; total expenditures, $3,498.49.

Extension of Pipe Distribution System—Contract No. 66.

Mr. J. H. Louchheim, Contractor.

W. I. Klein, Assistant Engineer in charge.

This contract embraced the laying of pipe line "U," forming part of the work of this Bureau, and three lines of pipe for the Water Bureau, designated as Water Bureau Lines Nos. 1, 2 and 3.

Pipe line "U" was an extension from pipe line "A," laid under Contract No. 17, on Wissahickon avenue, from Chelten avenue to Nicetown lane; on Nicetown lane to Venango street; on Venango street to Twenty-second street, and on Twenty-second street to Lehigh avenue.

The purpose of this line, consisting of 24-inch, 20-inch and 16-inch pipe, was to supply filtered water from Lower Roxborough to a portion of Wards Twenty-eight and Thirty-eight, taking in more than half of Ward Thirty-eight and about one-half of Ward Twenty-eight. Of course this line cannot be utilized until such time as the capacity of the two Roxborough stations has been raised by means of increased pumpage from the river, at which time, in addition to supplying all the water for Wards Twenty-one and Twenty-two, a portion of the Wards above mentioned also will be supplied.

Pipe line "U" consists of:

8,068 linear feet of 24-inch pipe in Wissahickon avenue.
676 linear feet of 20-inch pipe in Venango street.
2,266 linear feet of 20-inch pipe in Twenty-second street.
2,755 linear feet of 16-inch pipe in Twenty-second street.

Water Bureau Line No. 1 consisted of 1,798 linear feet of 30-inch pipe on Twelfth street, from Girard avenue to Thompson street.

Water Bureau Line No. 2 consisted of 3,696 linear feet of 20-inch pipe in Diamond street, from Germantown avenue to Broad street.

Water Bureau Line No. 3 consisted of 2,282 linear feet of 16-inch pipe on Ninth street, from Lehigh avenue to Clearfield street.

The lines of pipe above mentioned required:

1750.1545 tons cast iron pipe.
59.6790 tons special castings.
50 stop valves, ranging from 30 inches to 8 inches diameter.

The financial statement with reference to this contract is as follows:

Limit of contract	$110,000 00
Face of estimates	100,558 62
Amount paid	85,474 83

TORRESDALE FILTERS.

Torresdale Filters—Contract No. 25.

Mr. Daniel J. McNichol, Contractor.

Fred. C. Dunlap, Assistant Engineer in charge.

This contract embraced the original fifty-five filters and clear water basin, including all cast iron water pipes, concrete conduits, terra cotta and brick sewers, regulator houses, regulating apparatus, paved courts, and everything required to complete the filters excepting the filtering materials and the smaller accessories.

The work on this contract, with the exception of the completion of the granolithic pavement and adjustment of the regulating apparatus, is substantially completed.

This contract is divided into two principal items: Item 1, fifty-five filters, and Item 2, clear water basin. Item 1 is 96.79 per cent. completed, and Item 2 is 99.21 per cent. completed. It will thus be noticed that very little remains to complete this contract, and such work as was not performed during the latter part of the season of 1904 was purposely deferred until the spring of 1905 to guard against incomplete or unsatisfactory work during the latter part of the past year. It is thought that ninety days' work in the early part of the present year will entirely finish this contract. All filters have been tested for watertightness and accepted; the clear water basin has been tested for watertightness and accepted, and with the exception of the effluent and refill lines of cast iron water pipe in South Court No. 3, and the concrete clear water conduit from Court No. 3 to the clear water basin along State road, all of which are still to be tested for watertightness, the remainder of the pipe lines and conduits operating under pressure have been tested for watertightness and accepted.

The financial statement with reference to this contract is as follows:

Limit of contract	$5,000,000 00
Face of estimates	4,852,708 81
Amount paid	4,717,167 05

Queen Lane Contingent of Filters at Torresdale—Contract No. 54.

Mr. Daniel J. McNichol, Contractor.

Fred. C. Dunlap, Assistant Engineer in charge.

This contract embraces ten filters of about the same dimensions as the original fifty-five filters constructed under Contract No. 25, including all necessary connecting pipes, extensions of sewers and concrete conduits, and extension of granolithic pavement in Court No. 3. All the excavation, puddle, concrete and brick masonry, embankment and earth fill required under this contract was completed during the past working season, and all that remains to be done is the placing of the granolithic pavement in the courts; the placing and adjustment of the apparatus in the regulator houses; grading about the filters, and furnishing and placing of the curbing. The contract is 87.71 per cent. completed.

Of the ten filters, three have been tested for watertightness and accepted; the effluent and supply lines of cast iron water pipe have been tested and accepted for watertightness.

The financial statement with reference to this contract is as follows:

Limit of contract	$570,000 00
Face of estimates	484,935 23
Amount paid	467,873 45

Filtering Materials and Underdrains for the Torresdale Filters—Contract No. 50.

Mr. Daniel J. McNichol, Contractor.

Fred. C. Dunlap, Assistant Engineer in charge.

This contract embraces the perforated lateral collectors, gravel underdrains, and filtering sand for the Torresdale filters. The progress on this work during the past year was as follows:

Of the fifty-five original filters embraced in Contract No. 25, and known as the Torresdale filters, six have received all the filtering materials and are ready for the reception of water. Of the remaining forty-nine filters, two have received only the lateral collectors; nineteen have received the lateral collctors, and No. 1 and No. 2 gravel; two have received the lateral collectors and No. 1, No. 2 and No. 3 gravel; five have received the lateral collectors and No. 1, No. 2, No. 3 and No. 4 gravel, and twenty-one have not been supplied with any part of the lateral collectors or filtering materials.

This contract, based on the original appropriation of Councils, December 29, 1902, and extension authorized by the Director of the Department of Public Works, is now about 40 per cent. completed.

The financial statement with reference to this contract is as follows:

Limit of contract	$700,000 00
Face of estimates	197,200 00
Amount paid	167,620 00

Sand Washers and Ejector Pipes—Contract No. 59.

Mr. E. M. Nichols, Contractor.

Fred. C. Dunlap, Assistant Engineer in charge.

This contract embraced the sand washers and ejector pipes for the sixty-five filters at Torresdale, constructed under Contracts Nos. 25 and 54. The plans required seventeen double washers:

Six in Court No. 1;
Six in Court No. 2;
Five in Court No. 3.

Substantially all the materials for the washers have either been furnished and placed, or furnished and ready to place early in the spring of 1905.

This contract embraces two items: Item No. 1, sand washers; Item No. 2, ejector pipes.

Item No. 1 is 92.50 per cent. completed, and Item No. 2, 85.00 per cent. completed. The remainder of this contract will probably be finished within thirty days after the working season opens in 1905.

The financial statement with reference to this contract is as follows:

Limit of contract	$37,000 00
Face of estimates	23,775 30
Amount paid	21,397 77

Electric Ducts—Contract No. 75.

Standard Vitrified Conduit Company, Contractors.

Fred. C. Dunlap, Assistant Engineer in charge.

This contract embraced the furnishing of the ducts for the electric lighting cables for all the Torresdale filters, and was entirely completed during the past year.

The financial statement with reference to this contract is as follows:

Limit of contract	$1,000 00
Face of estimates	924 75
Amount paid	924 75

Ventilator Screens—Contract No. 76.

DeWitt Wire Cloth Company, Contractors.

Fred. C. Dunlap, Assistant Engineer in charge.

This contract embraced the furnishing and placing of the ventilator screens for the Torresdale filters, and was completed during the past year.

The financial statement with reference to this contract is as follows:

Limit of contract	$7,750 00
Face of estimates	7,619 97
Amount paid	7,619 97

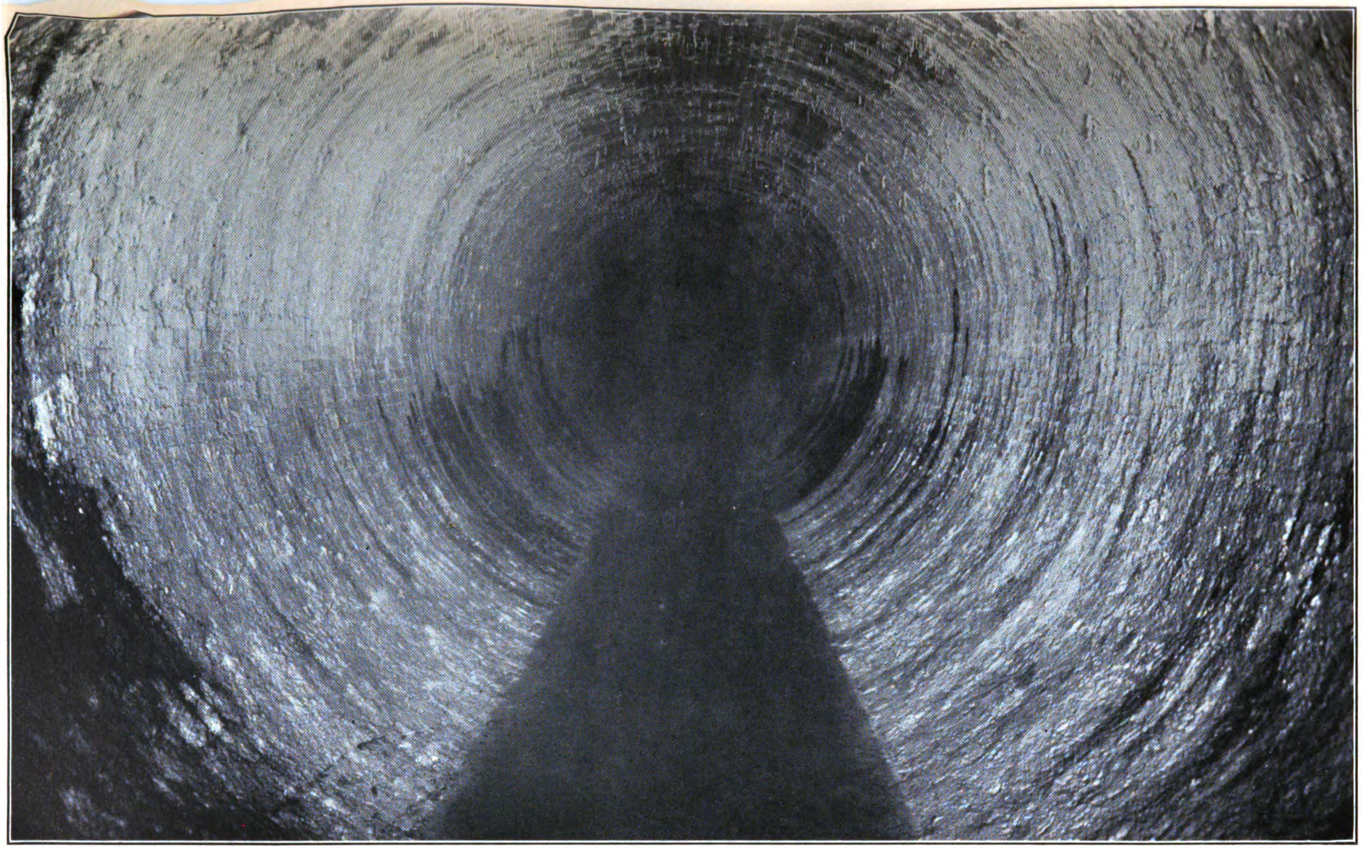

Plate No. 5.—Lining of Tunnel under Shaft No. 4.

Preliminary Filters for the Torresdale Station—Contract No. 39.

Mr. Daniel J. McNichol, Contractor.

Fred. C. Dunlap, Assistant Engineer in charge.

This contract embraces the preliminary filters which consist of four groups of thirty filters, arranged in four separate adjacent filter houses. The unit size of the filter tank is the same as that adopted for the Belmont pre-filters, viz., 20 feet wide, 60 feet long, and 8½ feet deep, inside dimensions.

Each of these filters is furnished with the usual arrangement of pipes to convey the water to and from the filters, with a 12-inch depth of underdrain material; a system of wash pipes, and a 24-inch bed of coarse filter sand. The contract embraces all the work connected with the filters, including the houses; the necessary conduits and pipes for connection to the low service pumping stations and to the main influent pipes of the Torresdale filters in Delaware avenue.

The contract was awarded November 15, 1904, and at the end of the working season less than 1 per cent. of the work had been completed.

The financial statement with reference to this contract is as follows:

Limit of contract	$1,358,000 00
Face of estimates	6,670 00
Amount paid	6,003 00

Torresdale Intake—Contract No. 34.

Mr. Daniel J. McNichol, Contractor.

T. Nelson Spencer, Assistant Engineer in charge.

This contract embraces a river pier and conduit to conduct the raw water from the Delaware river to the low service pumping station from which it will be lifted to the preliminary filters now being constructed under Contract No. 39—Torresdale.

The work consists of the construction of a concrete pier, upon which is placed a pier house, corresponding in materials and design with the regulator houses built under Contract No. 25 and Contract No. 54. The pier will be placed in the river outside the Port Warden's line by authority from the Secretary of War, and will be provided with openings protected with heavy wrought iron gratings, and removable wrought iron screens arranged to drop vertically in iron grooves. The intake pier will be connected with the pump well of the low service pumping station, through a steel reinforced concrete conduit of horse shoe shape, having an internal section equivalent to a circle 11 feet diameter.

The construction of the cofferdam was well advanced during the past year, and a portion of the materials of excavation removed, and excepting some unforeseen difficulties occur it will be possible to complete this contract within five months after work is resumed in the spring of 1905. The work performed amounts to about 12 per cent. of the requirements of the contract.

The financial statement with reference to this contract is as follows:

Limit of contract	$180,000 00
Lump sum bid	159,000 00

Torresdale Conduit—Contract No. 14.

Mr. Daniel J. McNichol, Contractor.

T. Nelson Spencer, Assistant Engineer in charge.

History of the Contract.

The history of the contract is shown in the following table, including the assumed date of completion:

Date of letting, May 28, 1901.

Date of award, August 28, 1901.

Date of contract, October 4, 1901.

Date of revision of paragraphs 24 and 30 of the specification, October 21, 1901.

Time limit for completion of work, nine (9) months.

Notice to begin work, January 9, 1902.

Expiration of contract time, October 9, 1902.

Date of completion, April 23, 1904.

Default in time of completion, 424 working days.

There was at no time any indication of lack of energy on the part of the contractor to forward the work to the earliest possible completion. From its inception, about December 1, 1901, to the 23rd of April, 1904, at no time was the work even temporarily abandoned, although certain of the shafts, like Shaft No. 4 and Shaft No. 7, were, for reasons hereafter to be explained, abandoned for short lengths of time.

The first cause of delay was due to the decision of the City to deepen all the shafts by ten feet, which conclusion was reached March 25, 1902, after Shaft No. 9 had been driven to the line of the tunnel. The terms of the contract provided that the first shaft (No. 9) which seemed to show from the diamond drill borings the poorest material in the rock, should be driven in advance of the other shafts to the line of the tunnel, in order to determine whether the centre line, as shown by the original plans, could be safely adopted for the prosecution of the work. Upon sinking this shaft to the elevation originally shown, the material was found to be of such a treacherous character that it was determined to lower the centre line of the tunnel everywhere by ten feet. Although several of the other shafts were in progress simultaneously with Shaft No. 9, they were not advanced as rapidly as this shaft for the reason given.

In the construction of Shaft No. 7, in Eugene street, between Cottman and Princeton streets, and about opposite St. Vincent's Orphan Asylum, when the steel shell reached the rock, and the work of driving into the rock was begun, it was regarded as unsafe for use, and work was temporarily suspended upon orders of the City until such time as the shaft might be made safe for the use of the engineers and inspectors, as well as the men in the employ of the contractor. Nearly one month's time was lost between the date when the work was suspended and the operations again resumed.

In carrying forward the north heading from Shaft No. 9. a soft seam, consisting apparently of a mixture of plastic clay and rotten, micaceous rock, was encountered, requiring very careful and constant timbering of the work as the heading advanced. From November 6th to December 26th, 1902, the rate of progress was less than six inches per day; from January 1st to February 5th, 1903, the rate of progress represented less than twelve inches per day; the normal rate of progress throughout the work was slightly over two feet per day.

On February 5, 1902, owing to an accident, Shaft Nc. 4 was so seriously damaged that notwithstanding vigorous efforts were made to reclaim it, it was finally abandoned on the 17th of March, 1902, at a depth of about fifty feet below ground level. The second shaft was then located about 100 feet south of original Shaft No. 4, and driven down to the line of the tunnel without any further trouble at this station.

Owing to the inflow of water, an attempt was made to use an air lock on Shaft No. 2, but after trial of about six weeks this was removed and progress continued to the end of the work in the open shaft and headings.

During the coal strike of 1902 serious difficulty was encountered in securing enough coal to keep the machinery running at all the shafts, and especially between Shafts Nos. 1 and 8 there were times when the supply of fuel was so low as to prevent the working of the usual double shift of men. In due time this trouble was remedied through the kindly aid of the officials of the Pennsylvania Railroad, after which time no delay was due to this cause.

Considering the very large amount of brick required for lining the permanent shafts and tunnel (over 9,700,000) considerable difficulty was experienced in getting brick of a satisfactory quality. Several cargos of brick were offered for use and rejected entirely by reason of the very large percentage found unsuitable upon inspection, and the contractor was therefore directed to procure bricks from manufacturers whose general run of material met the requirements of "sound, straight, hard burned brick, uniform in size and structure, and with true even faces." In fact, it was not possible to get the large quantity of brick required in the lining of the tunnel and permanent shafts from one manufacturer, and to meet the conditions, excepting as to size, and avoid delay, two sizes of brick were used. The first brickwork was placed in Section 4, January 3, 1903.

Estimated Carrying Capacity.

Data upon the actual flowing capacity of large brick lined conduits under pressure is very meagre, but with the loss of head between Shaft No. 1, at Torresdale, and Shaft No. 11, at Lardner's Point, of 8.6 feet, it is assumed that the conduit will have a carrying capacity of 300,000,000 gallons per day of twenty-four hours.

By Kutter's formula, with "n" taken at 0.013, the capacity for the given loss of head will be:

$$V=136.\sqrt{2.645\times.000616}=5.484 \text{ feet.}$$

$$Q=5.484\times87.97=482.427 \text{ cubic feet.}$$

$$G=\frac{482.427}{1.5472}=311.8 \text{ million gallons per day.}$$

By Lampe's formula:

$$V = 167.89\ r^{.694} \times s^{.555} \times 5.455 \text{ feet.}$$
$$Q = 5.455 \times 87.97 = 478.987 \text{ cubic feet.}$$
$$G = \frac{478.987}{1.5472} = 309.6 \text{ million gallons per day.}$$

The capacity, of course, can be increased by lowering the level in the pump wells at Lardner's Point, and raising the loss of head in the conduit.

The cubic contents of the conduit taken to the normal level of ground water, 197.00 T. D., is 9,253,932 gallons, and the time required for water to flow from Shaft No. 1 to Shaft No. 11, when the conduit is delivering 300,000,000 gallons per day will be about forty-four minutes.

Comparison of Conduit and Equivalent System of 48-inch Gravity Cast Iron Pipes.

In order to balance the carrying capacity of the Torresdale Conduit with a system of cast iron gravity pipe with the same loss of head, it would require twelve lines of 48-inch cast iron pipe of an average length of 17,100 feet for each line, or a total length of 38.8 miles.

Experience has shown that a leakage of 8,630 gallons per mile per day of twenty-four hours in a line of 48-inch cast iron pipe, operating under a pressure of fifty pounds per square inch, is allowable under all ordinary conditions. The head required for a flow of 25,000,000 gallons per day through each of the twelve lines of 48-inch pipe mentioned is 10.3 feet; and prorating the leakage on the square roots of the heads, the allowable leakage for 38.8 miles of 48-inch cast iron pipe having the same capacity as the Torresdale Conduit, amounts to 100,000 gallons per day of twenty-four hours.

The cost of the cast iron gravity conduit would have been, at the prices prevailing when the conduit was let by contract, about \$3,278,000.00, or \$1,928,000.00 more than the cost of the structure as built.

The interest charges alone on the difference of cost at $3\frac{1}{2}$ per cent. would have been \$67,474.00, while the annual charge due to the probable loss of 200,000 gallons of filtered water per day at \$5.00 for filtration and low service pumpage, and \$3.84 for interest charges on the Torresdale works, will amount to \$6,453.20.

But, it will be shown that an allowance of 100,000 gallons per day for the leakage of the cast iron pipes is reasonable, and hence of the annual value of water lost one-half only should be charged against the conduit, or \$3,226.60; about one-twentieth of the interest charges on the increased cost of cast iron gravity pipe lines.

Cost of the Work.

Contract price		\$1,274,000 00
Extras authorized by City	\$68,505 33	
Deduct scrap steel sold and work not performed	546 60	
		67,958 73
Total cost		\$1,341,958 73
From which deduct plastering not placed		20,735 54
Difference		\$1,321,223 19

The probable cost of the work to the contractor from records made of materials furnished and work performed was \$1,306,186.62, or \$93.10 per linear foot.

The quantities of materials as per original estimate, prior to making the contract, and as actually performed, is shown in the following table:

Items.	Original Quantities from Plans.	Quantities Actually Performed.	Increase Over Original Estimate.	Additional Quantities not Included in Columns 3—4.
	Cubic Yds.	Cubic Yds.	Cubic Yds.	Cubic Yds.
Excavation—Tunnel	83,670	89,366.09	5,696.9	21.0
Excavation—Shaft	5,632	7,425.00	17,931.0	
Concrete	22,381	24,058.00	1,677.0	3,278.8
Brick masonry	18,802	18,360.45	....	1,145.7
Plastering	14,058			
Cast iron	117,640	128,578.00	pounds. 10,938	
Steel	346,374	353,205.00	pounds. 6,831	
Clay for puddle	....	....	....	94.5
Tar paper, single thickness	....	....	....	sq. feet. 619,000

Of the additional shaft excavation, this was authorized under the provision of the contract which permitted a lowering of the centre line of tunnel if found advisable so to do upon sinking Shaft No. 9, which shaft was first driven to the line of the tunnel.

The clay puddle was used over the arch of the closures for the working shafts to render these watertight while the mortar in the brick was setting. Two thicknesses of 3-ply tar paper not included in the original plans were used over the brick arch where this was laid under wet roof.

Addition to Quantities.

In addition to the above statement of quantities of work performed, there was used, but not incorporated as such in the estimates, the following:

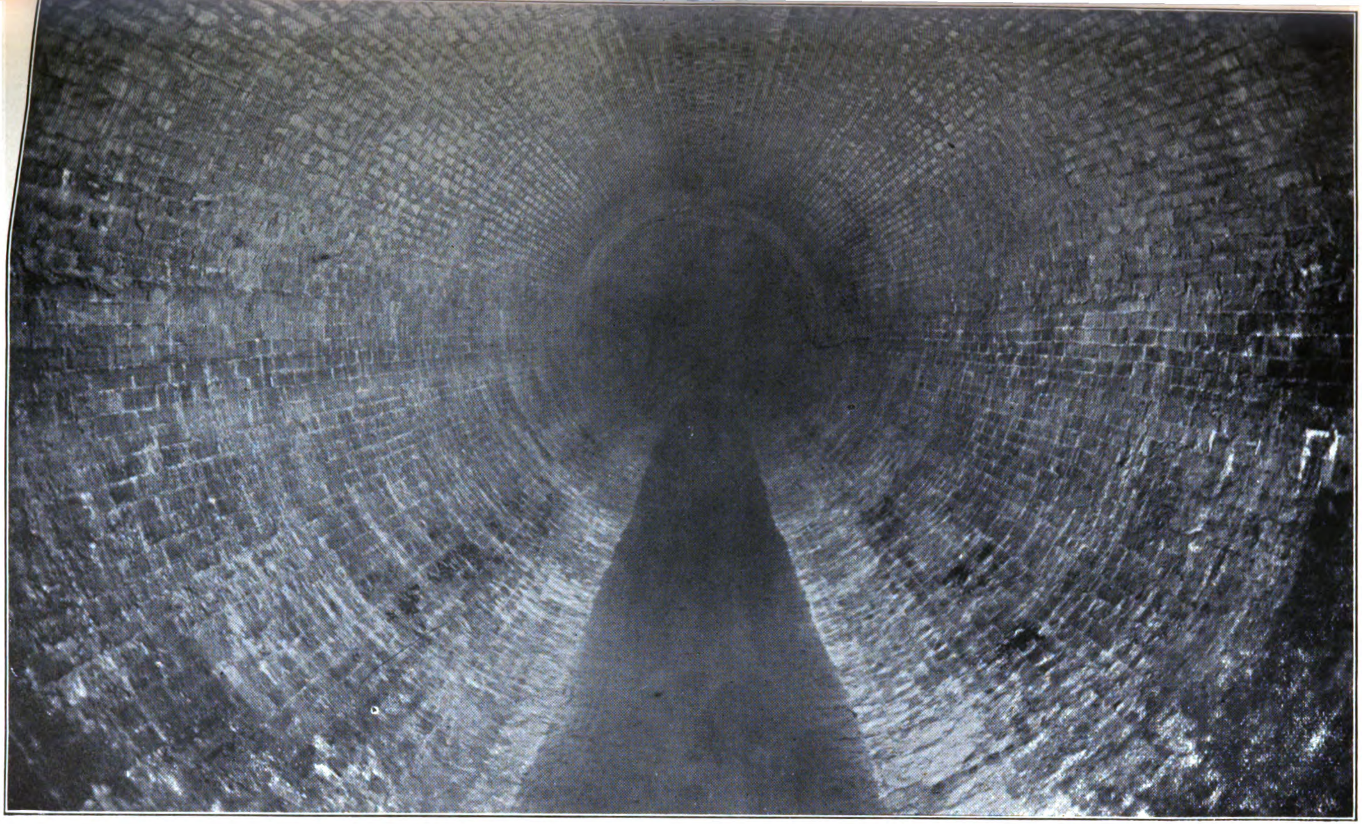

Plate No. 6.—Lining of Tunnel under Shaft No. 5.

34,937	barrels of cement.
9,703,700	bricks.
12,688	cubic yards sand.
16,725	cubic yards ballast.
11,184	linear feet of 6-inch terra cotta pipe.
138,814	feet B. M. timber.

In apportioning the lump sum bid for the several items entering into the construction of the work for the purpose of current estimates, the following unit prices were used:

Excavation in tunnel....................	$7.90	per cubic yard.
Excavation in shafts....................	19.00	per cubic yard.
Concrete	9.00	per cubic yard.
Brickwork	13.00	per cubic yard.
Plastering interior of brick lining.......	1.475	per linear foot.
Castings	.07	per pound.
Steel work	.09	per pound.

Cost of Tunnel Compared to Pipe Line.

Upon the assumption that the cost of the conduit is based on the limit of contract, viz., $1,350,000.00, the cost per linear foot becomes:

$$\frac{1,350,000}{14,030}=\$96.22$$

Relating this to the cost of twelve equivalent lines of 48-inch cast iron pipe aggregating 38.8 miles, viz., 38.8 x 5,280 x $16.00=$3,277,824.00.

Or reduced to the length of the tunnel, the cost per linear foot becomes

$$\frac{3,277,824}{14,030}=\$233.62$$

Examination of the Conduit.

After closing the last two working shafts, Nos. 2 and 7, early in April, 1904, and removing the pumping machinery from Shaft No. 1, daily observations were taken from April 8th to the 18th on the rise of water in the tunnel and end shafts.

After plotting the elevations of water level and corresponding leakage it was found that the leakage was greater than was anticipated at the time of removal of the pumps, and more than could be readily accounted for provided the sump at Shaft No. 1, and all open weepers, had been properly closed.

The contractor's attention was promptly called to the apparent excessive leakage, and after full consideration of the matter it was finally decided to pump out the conduit, make an examination of the interior and correct any defects or oversights of the contractor's work which such examination might reveal.

The Results of Examination.

After considerable delay in making the necessary arrangements for head house, boilers and pump to empty the conduit, the work of pumping out was started August 13, 1904, using for this purpose at first a No. 8 DeLaval steam turbine, having a rated capacity of 1,200 gallons per minute under 125 feet head, and later a No. 9 and a No. 11 Cameron shaft sinking pump. The No. 9 Cameron pump had a capacity of 300 gallons per minute, and the No. 11 Cameron a capacity of 450 gallons per minute.

The pumps were hung on wire cables from hand winches and chain blocks in such manner that they could be lowered as the water level in the shaft was reduced; and as each pump was lowered by stages in this manner, the three lines of pipe reaching from ground level to the pumps were increased by adding sections uniformly ten feet in length.

The discharge of the pumps was carried into a tight wooden sluice way and run into a weir box having a width of five feet, a depth of one foot nine inches below the weir crest, and a length of fourteen feet, and provided with the usual screens to smooth the water before it approached the weir, and with a weir having a notch twenty-one inches wide by nine inches deep. The weir was made of brass plate, with sharp edge, set truly plumb, and at right angles to the axis of the weir box, and with the crest level from end to end. The heads on the weir were read by means of an ordinary hook gauge with vernier reading to one-thousandth of a foot, set in a stilling box outside the weir box, and connected with the latter by means of a perforated iron pipe laid across the bottom about three feet upstream from the weir.

All conditions for accurate measurement of the water pumped from the conduit were carefully observed, the point of the hook gauge being referred to the crest of the weir from day to day by means of a "Y" level and leveling rod.

The same outfit, of course, served not only to measure the rate at which water was being removed from the conduit before it was emptied, but after it was emptied, to gauge the flow, all of which, of course, was removed from Shaft No. 1 and discharged over the weir.

Observations of the head on the weir, of the level of the water in Shaft No. 1, and of the general conduct of the work were made hourly, night and day, throughout the operations from the time the pump was started on the 13th of August, 1904, until December 17th, when the pumps and all other material were removed from Shaft No. 1, and preparations made to close the shaft head, and after this until January 12th, at which time the ground water having reached elevation 193.00 T. D., was rising at such a slow rate as to render further observations undesirable.

The depth and diameter of the shaft rendered all operations for pumping out and repairing the conduit very difficult. After the two Cameron shaft sinking pumps, and the DeLaval steam turbine, with their steam exhaust and discharge pipes, had been hung, the remaining space for lowering men and materials was too small for a cage or even a bucket, and only about large enough to accommodate a boatswain's chair suspended from the hook of the derrick. I cannot compliment too highly the riggers and engineers in charge of the derrick for their careful work for the period of 132 days of active operations, during which time no serious accident to men or machinery occurred.

October 20, 1904, the water was lowered in the conduit until the depth over the invert at Shaft No. 1 was such as to permit of an examination being made from end to end, at which time it was discovered that the sumps at Shaft No. 1 and Shaft No. 2 had not been closed. In addition to the open sumps, considerable water was coming into the conduit through a number of large open joints in the brickwork, and from several particularly wet spots in the arch between Shafts No. 8 and No. 11, but by far the largest proportion of leakage was from the two open sumps as the gaugings later given will show.

Closing Sumps.

The sump at Shaft No. 1 was closed in the following manner:

An opening about eight feet long by five feet wide was cut through the brick invert and concrete cradle for a depth from the center of invert of twenty-four inches. The center of the sump thus formed was further excavated by blasting the rock for a depth of fourteen or fifteen inches to accommodate the suction of the No. 11 Cameron pump, which was arranged to pump the water away from this sump until it was finally closed. Over the bottom of the excavation coarse gravel and boulders were carefully spread by hand and leveled for a foundation for the casting or "sump closer." On the gravel was set, and lined and leveled, a flared cast iron box, measuring six feet six and one-half inches in length, by three feet and one-half inch in width over the lower flange, and five feet ten and one-half inches in length, by two feet six and one-half inches in width over the upper flange, with an anchor flange at midheight having a mean of above dimensions.

The internal dimensions of the box were five feet seven and one-quarter inches long at the bottom, and five feet long at the top, by two feet four and one-half inches wide at the bottom, and one foot eight inches wide at the top. Across the casting at midlength a bridge was cast.

The upper flange was planed and drilled for one inch diameter studs, and the casting was closed by a cover divided at midlength with a sharp "V" shaped groove at the junction of the two plates.

The box was everywhere one and one-quarter inches thick, and the cover one and one-half inches thick.

One section of the cover plate was bored, drilled and tapped in the center for a six-inch union flange, and short six-inch nipple with a flange on the top to accommodate the suction of the Cameron pump.

The casting was leveled on the gravel base; the water pumped down to and maintained at the level of the lower flange, and the box concreted in place, leaving, of course, the center open to serve as a sump until the opening was finally closed. After the concrete had set for two weeks, the cover plates were bolted down on white pine gaskets; the "V" opening between the plates caulked with lead, and the pump suction reduced in size and set in the six-inch riser in one of the cover plates. The riser upon removal of the pump was closed with a six-inch flange bolted down on a white pine gasket.

To bring the water freely from the sides of the sump to the center of the casting, short lengths of old four-inch boiler flues were set in place as the gravel was laid.

When the sump was closed it was perfectly water-tight. All the work connected with the placing, concreting and final closing of the casting was performed under the supervision of Mr. John E. Powell, superintendent in charge of repairs.

At the open sump at Shaft No. 2 a different plan was adopted. Here the original plan was to carefully square the opening to the smallest possible dimensions, fill the hole with coarse gravel, set above it on the invert a stout wooden form braced down and made water-tight by caulking around the edges, and pump grout into the opening under fifty or sixty pounds pressure through a two-inch pipe set in the form. In cutting out the hole, the workmen misunderstood orders, and made the sump large enough to receive the form. This mistake or blunder caused at least two weeks additional work, and largely increased the cost and difficulty of closing the sump.

Several expedients were adopted and failed of the purpose, and finally a No. 4 centrifugal pump of 400 gallons capacity per minute was set up near the sump. An alternating current motor was procured and set up on a temporary timber platform, and belted to the pump, and the current to operate the motor carried in from Shaft No. 1, a distance of 1,400 feet. The suction of the pump was then carried to the bottom of the sump, and the discharge set in a sluice box which delivered the water north of a temporary sand bag and clay dam placed north of the sump.

A similar dam was built south of the sump, and the water from south of Shaft No. 2 flumed across the opening under the shaft.

When the pump was put in service, delivering about 350 gallons per minute, the sump and invert of the conduit were laid dry, and operations to permanently close the sump commenced.

In the center of the sump on a coarse gravel foundation, as at Shaft No. 1, a short length of twelve-inch steam pipe with a flange top and bottom was set, with the upper flange about five inches below the line of tunnel invert. In this nipple was set the suction pipe of the centrifugal pump, which was operated constantly day and night to keep the opening dry.

Railroad bars cut about four feet long were placed at right angles and diagonally across the opening above the lower flange of the twelve-inch nipple, and securely anchored at the ends under the old concrete cradle of the conduit. Concrete was then rammed in the dry hole up to the level of the upper flange, around the nipple, and up to the line of the invert around the hole outside the nipple. The nipple after the concrete had set for over a week was closed with a blank flange bolted down on a white pine gasket, and the depression of four or five inches over the cap finished to the line of the invert with a fine cement mortar.

This sump when closed was perfectly watertight.

When the sumps were closed a portion of the water which previously issued from them forced its way through the concrete and brickwork between Shafts Nos. 1 and 3.

In anchoring the sump casting and nipple in place with concrete due consideration was given to the pressures which would come upon these when closed, and the water forced to seek other though less convenient points of efflux.

The work at Shaft No. 2 was also conducted under the supervision of Mr. Powell.

The hydrostatic pressure of the water in the rock at the bottom of the conduit was roughly forty-three pounds per square inch, and the upward pressure on the sump casting at Shaft No. 1, and on the nipple and railroad bars at Shaft No. 2, was estimated as over forty tons in each instance.

The necessity of operating a power pump at Shaft No. 2, so far from the only open shaft at the north end of the conduit, imposed an unusual difficulty, and nothing in all probability could have satisfied the conditions so well as the electric current and motor employed.

Many open weepers and joints in the brick work were found, and all these were carefully closed with poplar plugs and white pine wedges, and where considerable water flowed in spots from the roof or arch, holes were jumpered through the brickwork and concrete, iron pipes driven in, and grout pumped over the arch under pressures up to 100 pounds per square inch.

Grout was used generally in the proportion of four parts of cement to one part of fine sand, although in some cases the sand was omitted.

Upon entering the conduit, considerable dirt, debris, timber and loose brick from the construction work was found lying on the invert. Planks left in the tunnel had become water-logged and impregnated with iron from the rock water and lay on the invert. All this material was removed, slush from the cement mortar used in laying the brickwork carefully washed out, and removed either at Shaft No. 1 or Shaft No. 11, whichever happened to be nearest.

In closing the shafts after the pumps, pipes and other hamper were removed, steel buckle plates one-quarter inch thick, bent to the intrados of the brick arches, were set on the lower flanges of the "I" beams spanning the shafts, and left in place after the brick arches were turned and covered with concrete. This was done to avoid the use of wooden centers, which could not conveniently be removed after the arches were turned.

It is probable that all the real work performed in closing the sumps and weepers, and in plugging open joints in the brick work, and in grouting over the arches, could have been performed by the contractor before he drew the pumps from Shaft No. 1 at a cost of $1,000.00, while the operations performed under unusual difficulties, of installing new pumping machinery, hoisting apparatus, steam and water pipes, electric currents, etc., including all labor of cleaning out the conduit, cost over $22,000.00, illustrating the old adage that "haste makes waste," and the other old adage "that what is not in a man's head is in his heels."

Measuring the Leakage.

Information on the leakage of structures like the Torresdale conduit is very meagre; few such conduits have been built and very little data recorded of the water lost or gained either during or after the construction, and of the structure in service. The inverted siphon of the Second Croton Aqueduct under the Harlem river, the Washington Aqueduct, and the Jersey City Conduit are examples in point; ordinary railway tunnels are not comparable to the Torresdale conduit, because the former are nearly always cut through elevated ridges or knobs much above tide level, are usually self-draining, and not subject to the influence of the water level in nearby streams at higher elevation than the line of the work. Exceptions may be noted in railway tunnels which pass under rivers like the St. Clair tunnel at Detroit; the tunnels under the Chicago river at Chicago and under the Thames in London. The Wachuset aqueduct, which is a similar structure, I am advised by Mr. Frederick P. Stearns, Chief Engineer of the Metropolitan Water Board, Boston, was not tested for watertightness. No evidence of leakage is known to exist, but no data has been recorded to prove absolute watertightness of the structure. No data is to be found in the office of the City Engineer of Chicago, showing either construction or service leakage of the lake tunnels. It is probable that these are practically water-tight because they are driven through a tough impervious clay. In the construction of the Cleveland tunnel compressed air was used, and aside from this the material through which the tunnel is driven was a tough clay, practically impervious, and therefore not comparable with the tunnel driven through such material as was found in the line of the Torresdale conduit.

Gauging in Empty Conduit.

The gauging in the empty conduit was done with a fifteen inch brass weir screwed to the face of a two-inch plank, about seven feet long, cut to the radius of the invert, five feet three and one-half inches. The weir plate was accurately constructed with a sharp edge uniformly fifteen inches long, with a depth of notch of six inches. After this had been carefully set plumb at right angles to the axis of the conduit, with the crest of the weir level, and secured in position by bracing against the arch, and by the use of sand bags placed on the down stream side of the weir, clear of the notch and overfall, the joint between the segment of the plank and the brickwork was made tight with clay so that all water was required to pass through the notch of the weir. The gauging was done by measuring from a stiff arm attached to the top of the weir board and extending about two feet up-stream, carrying at its end a thin vertical strip of wood with small wooden lug at the bottom. The lug was in each case carefully adjusted to the level of the crest of the weir by a straight edge and spirit level, and fixed tightly in position. The depths on the weir were gauged by means of a thin steel rule set on the lug. The accuracy of adjustment of the lug was tested before and after readings were taken, and the depth of the weir was determined by taking the submerged length of the rule from the lug to the level of the water.

Readings of the flow in the tunnel were taken at intervals of fifteen minutes, and until they showed no further increase in the head on the weir. After the regime of water flow was established in this manner, the weir was

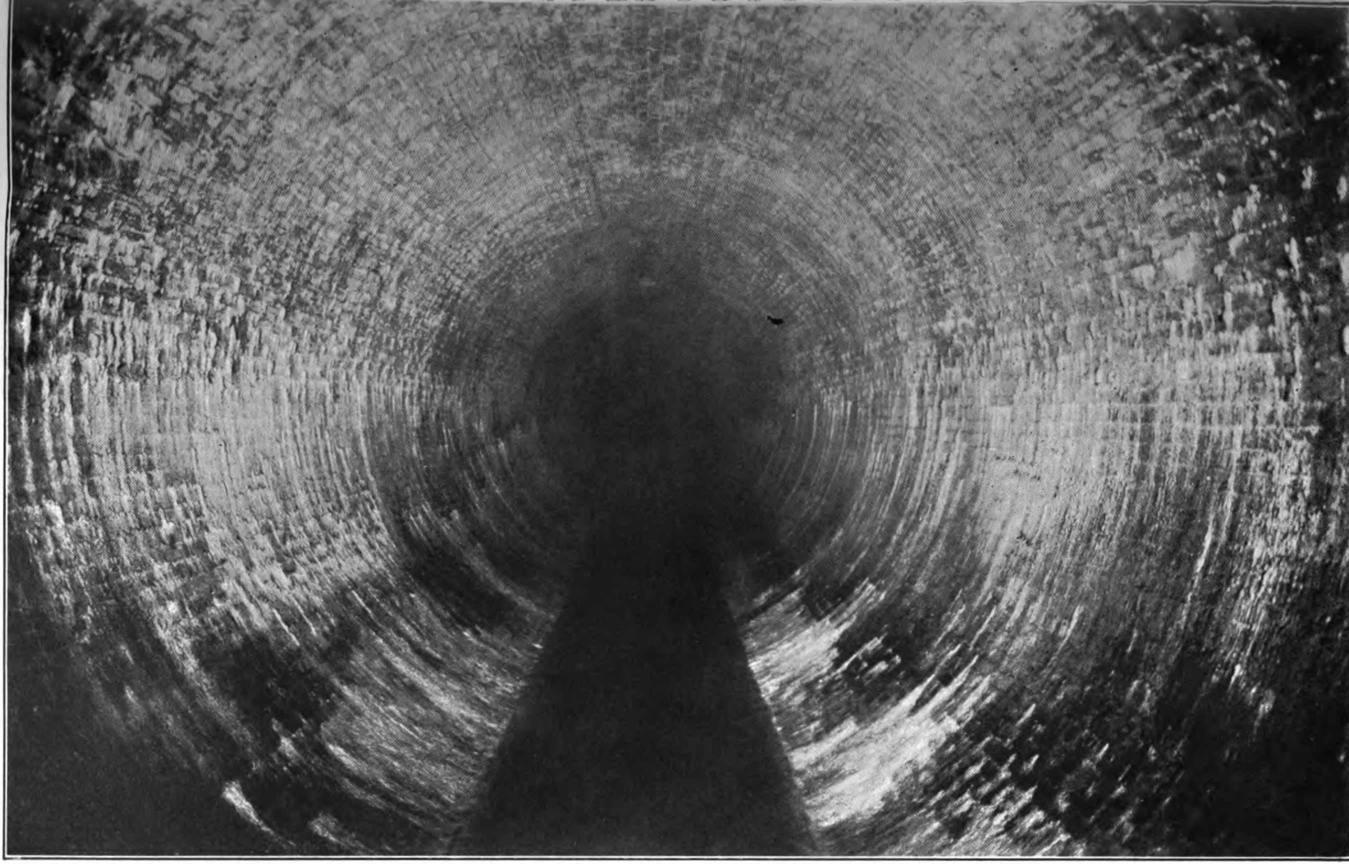

Plate No. 7.—Lining of Tunnel under Shaft No. 6.

then moved to a new station. The heads noted on the weir at different points were converted into volumes of flow after the formula

$$q=c.\ \tfrac{2}{3}\ \sqrt{2g.}\ b.\ h^{\frac{3}{2}}$$

In the following table are given the final gaugings taken before the pumps were removed from Shaft No. 1. The notes from stations south of Shaft No. 2 were taken before all the operations for reduction of the leakage had been completed, but the gaugings at Shaft No. 2 and at the top of Shaft No. 1, took into account all the water flowing at the respective stations, which included for Shaft No. 2 all leakage between that station and Shaft No. 11, and the gauging at Shaft No. 1 of course included all water coming from the conduit. It is thus probable that the leakage south of Shaft No. 2 was less than the table shows, and the leakage from Shaft No. 1 to Shaft No. 2 correspondingly more than 364 gallons per minute.

Station.	Length of Tunnel Embraced in Gauging.	Flow for Station.	Accumulated Flow at Station.
	Linear Ft.	Gallons.	Gallons.
At shaft No. 11	0	9	9
Between shafts 9 and 10	1,557.81	84	93
Between shafts 8 and 9	1,845.00	23	116
Between shafts 7 and 8	1,607.50	81	197
Between shafts 6 and 7	1,587.50	57	254
Between shafts 5 and 6	1,557.00	92	346
Between shafts 4 and 5	1,508.00	84	430
Between shafts 3 and 4	1,442.00	44	474
Between shafts 2 and 3	1,238.00	162	636
From midway between shafts 2 and 3 to and including shaft No. 1	2,016.00	202	838

Of the 838 gallons per minute for the whole conduit, 364, or over 40 per cent., occurs between Shaft No. 1 and midway between Shafts Nos. 2 and 3, a distance of 2,016 linear feet.

For a period of thirteen days—June 1 to 15, inclusive, 1903—at the time when the water from Shaft No. 1 and its connected headings was being pumped separately, i. e., when the water from one section of the work was not allowed to flow to and be pumped from another section, the average leakage was, at

	Gallons Per Minute
Shaft No. 1	350
Shaft No. 2	336
Shaft No. 3	122
Total	808

For a period of thirteen days—June 16-30, inclusive:

Shaft No. 1	294
Shaft No. 2	416
Shaft No. 3	102
Total	812

For a period of fifteen days—July 1-15, inclusive:

Shaft No. 1	248.2
Shaft No. 2	362.8
Shaft No. 3	96.0
Total	707.0

For a period of fourteen days—July 16-31, inclusive:

Shaft No. 1	305
Shaft No. 2	328
Shaft No. 3	95
Total	728

For a period of thirteen days—August 1-15, inclusive:

Shaft No. 1	319
Shaft No. 2	340
Shaft No. 3	94
Total	753

For a period of thirteen days—August 17-31, inclusive:

Shaft No. 1	244
Shaft No. 2	346
Shaft No. 3	96
Total	686

For a period of thirteen days—September 1-15, inclusive:

Shaft No. 1	277
Shaft No. 2	324
Shaft No. 3	98
Total	699

For a period of thirteen days—September 16-30, inclusive:

Shaft No. 1	228
Shaft No. 2	327
Shaft No. 3	89
Total	644

These gaugings were not taken with the precision of those upon which the present leakage of the conduit is based, but are deemed sufficiently accurate for the present purpose, and comparing these leakages with the leakage for the same sections after the operations connected with the examination and repair of the conduit were completed, viz., 408 gallons per minute, will show a reduction of 44 per cent. A part of this reduction, of course, must be credited to the arching of the tunnel and relieving arches under the working shafts, which, however, would apply only to Shafts Nos. 2 and 3.

Upon closing the working shafts prior to April 8, 1904, readings were promptly taken of the elevation of water in the conduit at Shaft No. 1, and later at Shaft No. 11, when it rose to sufficient height to be gauged from the iron staging in the latter shaft with results as follows:

On the 8th of April (the first day of gauging) the elevation of water in Shaft No. 1 was 95.467 T. D., or 6.397 feet above the invert of the arch.

By the 18th of April, during a period of ten days, the water had risen to an elevation 182.15 T. D., at which time it was thought that the rate of inflow was too great to be accounted for upon the supposition that the sump at Shaft No. 1 and all weepers had been closed.

Prior to closing the last three working shafts, viz., Nos. 2, 7 and 9, the flow of water from the sump at Shaft No. 1 was very large, and it was thought that excepting with great care upon the part of the workmen this sump would either not be effectually or neatly closed, and investigations were therefore begun to determine whether the last efforts necessary to reduce the leakage to a minimum had been properly made.

The best gaugings previous to closing the last three working shafts (April, 1904) indicated a probable flow of 922 gallons per minute, divided as follows:

Station.	Distance Between Stations. Linear Ft.	Leakage each Station. Gallons.	Accumulated Leakage. Gallons.
From shafts 9 to 11	2,112.81	42.2	42.2
From shafts S8 to 9	790.00	17.8	60.0
From shafts S7 to N9	1,607.50	20.0	80.0
From shafts S6 to N8	1,593.60	40.0	120.0
From shafts S5 to N7	1,452.50	92.0	212.0
From shafts S3 to N6	2,939.29	74.0	286.0
From shafts 2 to N4	1,952.10	391.0	677.0
From midway between 1-2 to 2	675.68	43.0	720.0
From No. 1 to midway between 1-2	675.69	202.0	922.0

Gaugings between all the shafts, previous to placing the larger portion of the brick lining and concrete backing, determined by the operation of the pumps at each of the respective shafts, gave leakages as follows:

Shaft.	Gallons Per Minute.
1	517.50
2	312 00
3	367.00
4	85.00
5	125.00
6	120.00
7	145.00
8	175.00
9	110.00
10	155.00
11	64.00
	2,175.50

Comparing the last gaugings (December, 1904) with these leakages, which generally represent the unrestrained flow of water through the shattered rock after blasting at the headings and benches, the reduction of the inflow of water amounts to about 61.50 per cent.

Considering Shafts Nos. 1, 2 and 3, the gaugings made during the first three months of 1903, in advance of the lining of the tunnel, show an average leakage of 1196.50 gallons per minute, and compared to the last gaugings taken after the lining was about completed, but before the working shafts were closed (October, 1903) show a reduction of 46 per cent., and compared with the December, 1904, gauging, a reduction of 70 per cent.

Elevation of Ground Water.

While the elevation of ground water has been assumed at 198.00 T. D., or slightly above high tide in the Delaware river along the line of the conduit, the gaugings taken last April, after the conduit was closed, and since the 17th of December, when the repairs on the work were completed and the pumps and machinery removed, indicate that this may be too high, and that the mean level of ground water along the line of the conduit is not coincident with or above high tide. Of course considerable time will be required for the water to attain its normal level, but assuming that it may be 197.00 T. D., then the difference between the maximum elevation of water in Shaft No. 1 and ground water will be ten feet, i. e., the head on the inside of the conduit will be ten feet greater than the water in the drift and rock on the outside of the conduit.

At elevation 190.00 T. D., or seven feet below probable normal elevation of ground water, the known leakage into the conduit since the sumps and open weepers have been closed, and particularly bad spots in the roof grouted under pressure, was at the rate of sixty-five gallons per minute, and reasoning by analogy that when the water in the conduit is at mean elevation, Shafts No. 1 to No. 11, of 202.70 T. D., or 5.7 feet above assumed elevation of ground water, the leakage would be no greater, it would then appear that the daily leakage will not be in excess of 93,600 gallons, or say 100,000 gallons per day, an amount which would readily be allowed for an equivalent system of cast iron pipes operating under the same conditions.

Watertightness.

In preparing the plans and specification the term "watertightness" was frequently used. This was meant watertightness within the limitations of the materials to be used in lining the permanent shafts and tunnel, and no arbitrary leakage was fixed in the specification because it was not possible in advance of driving the headings to make an accurate calculation of the amount of water that would be encountered. It was known from the diamond drill borings along the line of the work that water would be found in the drift and rock at certain depths, and an effort was made to show at what depth water would be found, and to indicate whether the flow was large or otherwise. The diamond drill borings that preceded the preparation of the plans for the work were conducted not so much however to determine the presence of water in the rock as to indicate the character of the rock, and to furnish data upon which to fix the centre line of the tunnel.

Considering the elevation of the centre line of the conduit with reference to sea level or mean tide in the Delaware river, it should be obvious that the rock was bound to contain a considerable volume of water, and that when headings were driven into it a flow would be encountered, the quantity of which however could not be determined in advance. In close grained rock, without fissures, and with little injury to seams in blasting, the flow would naturally be much less than if the rock was porous, heavily fissured and considerably disturbed in carrying on the operations of tunneling. Therefore it was impossible at the time the specification was prepared to indicate any standard for leakage, but the intention was to reduce this to the least possible quantity in a brick lined tunnel and shafts, thoroughly backed with first-class concrete.

Considering that the mean centre line of the tunnel is over 100 feet below ground level, and about 100 feet below mean tide in the Delaware river, it would scarcely be reasonable to assume absolute watertightness for a work so constructed, nor is there any evidence before me, and I have sought it in records of similar works in this country and abroad, that masonry conduits of this description have ever been even approximately water-tight, excepting as in the case of the Cleveland and Chicago lake tunnels, where they are driven through a tough, impervious blue clay, and as I am informed no serious trouble was experienced from ground water during construction.

Considering structures which bear a similarity to the Torresdale Conduit:

The Jersey City Conduit is a structure eight feet six inches internal diameter, lined with concrete. Section 1 has a length of 4,600 feet, of which 1,600 feet is in tunnel through shale and sand stone, and 3,000 feet in open cut. The leakage of this during construction amounted to 134,000 gallons per day of twenty-four hours.

Assuming that it was fairly distributed through the entire length of the work, this would give for the length and diameter of the Torresdale Conduit:

$$\frac{134{,}000 \times 10.58 \times 14{,}000}{8.5 \times 4{,}600} = 507{,}623$$ gallons per day or 352.5 gallons per minute.

Section 4, of the same work, 7,300 feet long, is constructed entirely in tunnel, probably through the same material as was found in the tunnel operations on Section 1. The leakage of this section was at the rate of about 2,000,000 gallons per day of twenty-four hours, and the corresponding leakage for the Torresdale Conduit would be:

$$\frac{2{,}000{,}000 \times 10.58 \times 14{,}000}{8.5 \times 7{,}300} = 4{,}774{,}214$$ gallons per day, of twenty-four hours, or 3315.4 gallons per minute.

The New York Shaft of the Harlem River Conduit has a present leakage of about 300 gallons per minute. This is leakage from the aqueduct shaft to a pump shaft designed for use as a sump, and cannot very well be compared to the Torresdale Conduit, because in one case it is a structure under a head when empty of over 103 feet, while the other is a shaft having a head varying from 0 to the depth of the shaft. If any attempt was made to compare the depth and diameter of the New York shaft with the length and diameter of the conduit, it would then appear that the allowable conduit leakage would be enormous, as shown hereafter, and it would be better to consider the leakage of the New York shaft in service with the probable leakage of the Torresdale Conduit when in service, because the leakage reported for the shaft at the New York end of the Harlem river siphon is service leakage, and not leakage of the empty structure.

Under conditions of service, assuming the elevation of the water in Shaft No. 1 as 207.00 T. D., and the elevation of the water in Shaft No. 11 as 198.00 T. D., then the mean elevation of the hydraulic grade line of the conduit will be 202.50 T. D. Taking normal ground water level at 197.00 T. D., the mean balanced head throughout the length of the conduit would be five and one-half feet. Proportioning the leakages on the square roots of the heads with the conduit in service, and with the conduit empty:

$838 \times \frac{\sqrt{5.5}}{\sqrt{103}} = 193.60$ or say 200 gallons per minute or 288,000 gallons per day, or less than $\frac{1}{10}$ per cent. of the carrying capacity of the conduit.

It has already been shown that the rate of leakage does not vary as the $\sqrt{}$ of the heads, but as some different function of the head, the value of which for lack of time has not been determined. In the absence of an expression which will fit the conditions of rise of water level and leakage into the conduit, such comparisons as will be made with other conduits under pressure will be upon the assumption that the leakage does vary as the square roots of unbalanced heads.

Comparing the New York shaft of the Harlem river siphon (which is twelve feet three inches diameter, 318 feet deep) for water depth and diameter with the length and diameter of the Torresdale Conduit, and assuming losses of water or leakage proportioned to the square roots of the respective water heads, we have the following as the corresponding leakage of the conduit:

Wetted surface of Harlem shaft—

38.48 x 318=12,236.64 square feet.

Wetted surface of conduit—

33.25 x 14,000=465,500 square feet.

Ratio of wetted surfaces—

$$\frac{466,500}{12,236.64}=38.12$$

Ratio of mean square roots of effective water heads—

$$\frac{\sqrt{103.48}}{\sqrt{141.37}}=\frac{10.17}{11.89}=0.855$$

and the corresponding leakage of conduit based on Harlem river shaft should be—

300 x 38.12 x 0.855=9,777.78 gallons per minute, or 14,080,000 gallons per day of twenty-four hours.

The Buffalo Conduit or intake, which conveys the water from a pier at the head of the Niagara river into the pump well of the Buffalo pumping station, is a structure blasted through the Niagara limestone, cut to a section about 8 x 8 feet and unlined. The intake is 1,020 feet long, and during construction leaked at the rate of 1,000,000 gallons per hour, or 24,000,000 gallons per day, equivalent to 16,667 gallons per minute. The tunnel is about sixty-five feet below the surface of the ground, and probably about sixty feet below the level of water in the Niagara river.

Omitting the large flow of water mentioned above, which came from another source than the river, the leakage was said to be very small, not over 500 gallons per minute when the tunnel was empty or pumped out. Of course, when the tunnel was filled there was probably no leakage at all because the pressure of water inside and outside would be quite the same.

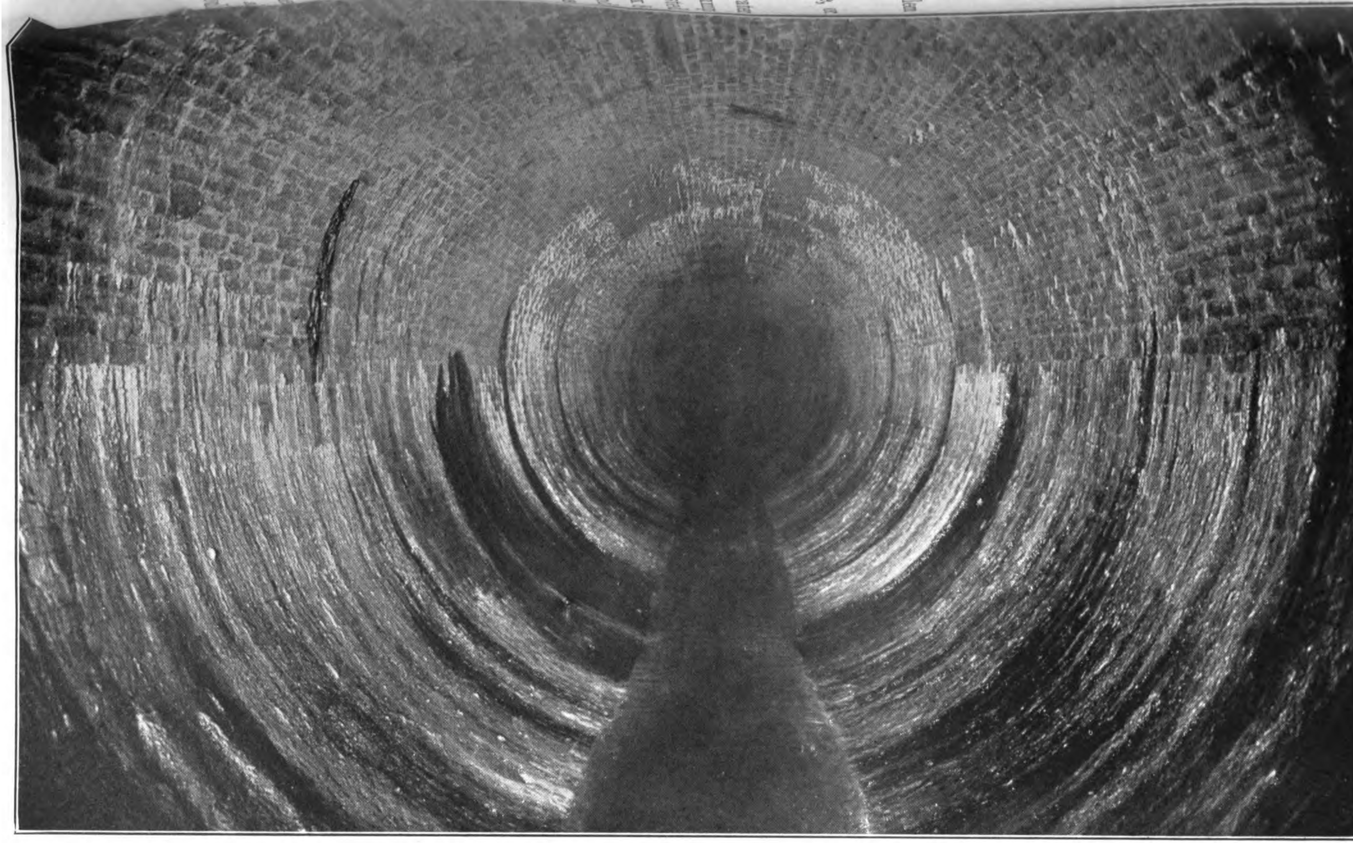

Plate No. 8.—Lining of Tunnel under Shaft No. 7.

Neglecting the difference of sections and effective heads of water, and proportioning leakage on lengths only, and assuming the least recorded leakage, the Buffalo conduit for a length equal to the Torresdale conduit, both considered as empty structures, should have leaked at the rate of 6,863 gallons per minute, or at about eight times the rate of known leakage for the empty Torresdale conduit.

During the year 1903, Atlantic City, New Jersey, laid a wood stave pipe, forty-two inches, 9,807.4 feet long. This was tested for watertightness when completed under ten pounds pressure, and gave a leakage at the rate of seventy-eight gallons per minute.

Comparing this to the Torresdale Conduit, and assuming the leakage to bear some relation to the internal surface of the pipe and conduit, and that it should be proportioned on the square roots of the respective heads, then the leakage for the Torresdale Conduit compared to the Atlantic City wood stave pipe would be 164.25 gallons per minute.

A wood stave pipe should be as tight as a steel riveted pipe, and should represent the minimum leakage for water carrying conduits, and yet it is evident that this leakage under the conditions of test (which I understand are substantially the conditions of service) is greater than the service leakage anticipated for the brick-lined Torresdale Conduit.

An equivalent in carrying capacity of the Torresdale Conduit, as stated heretofore, would be 38.8 miles of 48-inch cast iron pipe. An allowable leakage of 10,000 gallons per mile per day of 48-inch pipe under a pressure of fifty pounds per square inch has been a standard to which the Bureau of Filtration has endeavored to lay the various water pipes about filters and reservoirs and in the distribution systems, and assuming this value to apply to the lines of cast iron water pipe which would have been required to balance in carrying capacity the Torresdale

Conduit, the daily leakage then would be 388,000 gallons per day. The pressure on the empty conduit amounts to about 44.61 pounds per square inch, and proportioning this upon the square roots of the pressures, an allowable daily leakage for the conduit empty compared to cast iron lead jointed pipes, made up in twelve foot lengths, would be:

$$\frac{388{,}000 \times 6.679}{7.071} = 366{,}448 \text{ gallons per day.}$$

The leakage of cast iron pipe is presumed to occur only at the joints, which are spaced about twelve feet apart. In the case of the conduit, however, every brick in the lining is surrounded by a mortar joint, and if the leakage of cast iron pipe is reduced to the leakage per linear foot of joint, and then compared with the leakage per linear foot of mortar joints in the intrados of the invert and arch of the conduit, we will have the following result:

Lineal feet of lead joint per mile of cast iron pipe:

$$\frac{(48+2.5) \times 3.1416 \times 5280}{12 \times 12} = 5817.2 \text{ feet.}$$

Allowing 10,000 gallons leakage per day per mile:

$$\frac{10{,}000}{5817.2} = 1.719 \text{ gallons per linear feet of lead joint.}$$

The mortar joint per linear foot of conduit is 49.873 feet for the circular joints and 159.60 feet for the axial joints, a total of 209.47 linear feet.

Taking the leakage of the conduit empty as 838 gallons per minute, or 1,207,000 gallons per day of twenty-four hours, and proportioning the leakage on the square roots of the pressures, fifty pounds for the cast iron pipe, and forty-three pounds (in round numbers) for the empty conduit, then the leakage per linear foot of joint in the conduit would be:

$$\frac{1,207,000}{209.47 \times 14,000} \times \frac{\sqrt{50}}{\sqrt{43}} = 0.44 \text{ gallons and the ratio of}$$

leakage per linear foot of joint:

$$\frac{1.719}{.44} = \text{about } 4.$$

Considering the two classes of structures: one with joints everywhere throughout its length and circumference and the other with joints occurring only at intervals of twelve feet, this is an interesting if not the correct method of comparison.

The gaugings for the return of ground water to the conduit since December 16, indicate that at elevation 190.00, which is seven or eight feet below normal ground water level, the leakage was practically nil, or from the records less than forty gallons per minute, showing that the theory of flow upon the square roots of the unbalanced heads will not apply.

Moreover, if it be assumed that the leakage upward for an unbalanced head of seven or eight feet would be no greater than the inward leakage for the same difference of heads between the water in the conduit and the water in the rock, the leakage then under conditions of service should be even less than the amount above mentioned. Of course, exactness in this cannot be stated at the present time, nor until the conduit is in service and exact gaugings based upon the displacement of the pumps at Lardner's Point made.

The probabilities are that the leakage with the conduit in service will be so small that the most accurate system of gaugings for the water flowing into shaft No. 1, and for the water flowing out of shaft No. 11, would not indicate a difference, *i. e.*, the relation of forty gallons a minute to 300,000,000 gallons a day, or 208,333 gallons per minute, is such that the best known methods of gauging would not show a loss of 2/100 of one per cent. of the flowing capacity between the two ends of the conduit. Even if the loss was as high as 200 gallons per minute, as figured on the basis of the square roots of heads, it would only be five times this quantity, or 1/10 of one per cent. of the flowing capacity of the conduit, an amount entirely too small to be indicated with any method of gauging the flow of the conduit which could be conveniently applied.

Proposed Steel Tube Lining.

It has been suggested that the conduit might have been lined with a steel tube instead of bricks laid in cement mortar. In such case probably the steel would have been made up in segments with circular and radial angle iron flanges bolted together on the inside, and the two finished internally with a ring of fine concrete or mixture of cement and sand, say 4½ inches radial thickness.

Such construction would have increased the cost of the work by quite 100 per cent., and the annual interest charge at 3½ per cent. on $1,274,000.00 would have been $44,590.00, or (assuming it to have been possible to make such construction absolutely water-tight) about seven times the annual value of the filtered water lost by leakage of the brick lined conduit.

Refuse from Contract No. 29 Found in Shaft No. 11.

Notwithstanding strict orders were given to the contractor for Contract No. 29, Lardner's Point Pumping Station No. 2, that no waste materials from his operations while making connection between shaft No. 11 and valve chambers Nos. 2 and 3, should be allowed to go into Shaft No. 11, upon emptying the conduit over thirteen cubic yards of waste material from this contract was found at the foot of the shaft, measuring about two feet in depth over the center of the invert, and tapering to nothing about fifty feet northward in the conduit. Excepting the conduit had been emptied no one would ever have suspected the presence of this material, which consisted of sand, cement, gravel and similar wastes. The effect of this was to reduce the sectional area of the conduit quite 11.55 square feet, or thirteen per cent. of its least sectional area.

Had this material been allowed to remain in the conduit, its carrying capacity would have been seriously reduced, and instead of charging it to the true cause, viz., that of waste material going into it through operations under another contract, it would probably have been charged to the roughness of the interior or to the insufficiency of the formulas employed for the flow of water through large conduits.

This condition, of course, was a revelation when the first inspection trip was made through the conduit after it was pumped out.

A hole was cut in Shaft No. 11, a derrick and hand winch set up, and the material removed by means of a dumping bucket by hand labor, and the conduit left in a perfectly clean condition.

It is probable that if there had been no question as to the proper completion of the work by the contractor for the Torresdale Conduit (Contract No. 14), and it was known that this material lay at the bottom of Shaft No. 11, that excepting it could have been removed by the aid of a diver, or by some method of pumping out the material under water, it would have been profitable to have pumped out the conduit solely for the purpose of removing the refuse which came into it from Contract No. 29.

Supposed Disintegration of Cement.

During the past summer, while the conduit was being pumped out for the purpose of examination and correction of any omissions or defects which the emptying of the conduit might reveal, it was suggested by a well-known chemist in this City that there was some evidence of serious disintegration of the mortar in the brickwork and the concrete. After the conduit was emptied, careful examination was repeatedly made from end to end by myself and several assistants detailed for the purpose, to detect any evidence of disintegration of the mortar in the joints of the brickwork, and no evidence of injury or impairment from any cause was discovered. While considerable lime was removed with the water from the conduit during the process of pumping out, this, after the first few weeks pumping steadily diminished until the water attained about the alkalinity or lime content found by analyses of the water from the shafts and headings previous to the placing of the brick lining and concrete backing. The total amount of lime removed with the water amounted to about 50,000 pounds, and this should be balanced against the lime in 35,000 barrels of Portland cement used in the construction of the work. The cement, under the terms of the contract, weighed about 380 pounds to the barrel, of which say 62 per cent. by weight was lime, or 8,246,000 pounds; and of the lime from all known sources, not of course including the lime found by test in the rock water previous to lining the conduit, about 0.60 per cent. may have come from the mortar in the joints of the brickwork, and in the concrete. No external evidence of this loss, however, was found upon examination of the lining.

I am informed by manufacturers of cement that there is a probable one per cent. to one and one-half per cent. excess of lime in the mixture, *i. e.,* the amount of lime is usually slightly more than is really required to make a perfect cement. The influence of this upon either the strength or hardening properties of cement is not noticeable, and if it be assumed that there is a slight excess of lime, it would be possible to lose even a larger percentage than was shown by the estimate of lime lost in pumping out the conduit without impairing the quality of either the concrete or the mortar in the brickwork.

Under the conditions of service it is not thought that the slight outward leakage of filtered Delaware river water will have any serious effect on the lime in the cement and this opinion is based upon long observation of the influence of water low in lime content like that of Loch Katrine, on the cement plastering and mortar in the joints of the masonry of the first Glasgow Aqueduct.

Analyses of Water Flowing into the Shafts and Headings.

During the construction of the work samples of water were collected monthly from the shafts and headings, and analyzed for mineral content and bacteria. The rock water, as would naturally be supposed, excepting for the considerable amount of iron it carried, was unobjectionable from a sanitary point of view. The bulk of the leakage into the conduit when empty occurred north of shaft No. 4, or within the first 3,500 feet of tunnel length, at which point under conditions of service the pressure of water in the conduit will be greater than the pressure of water in the ground and rock, and the leakage will be of filtered water into the rock and not of rock water into the conduit. The leakage, therefore, does not represent any possible menace to the quality of the water supplied from the Torresdale filters, but does represent a loss of filtered water, the value of which has been previously noted.

Under conditions of service, with the conduit delivering 300,000,000 gallons per day of twenty-four hours, the lowest elevation which it is expected the hydraulic grade line will take in shaft No. 11, is 198.00 T. D., or about the maximum elevation heretofore noted of ground water along the line of the work. Of course, when the flow is less than 300,000,000 gallons per day, the hydraulic grade line at Shaft No. 11 will be correspondingly higher, and it would only be at such times as the flow is increased to more than 300,000,000 gallons per day, or for some other reason the hydraulic grade line might be lowered throughout the length of the conduit, that the elevation of the water in Shaft No. 11 would be below that of the ground water, when a small amount of ground water may find its way into the conduit south of Shaft No. 10. Should this occur no uneasiness need be felt as to its influence on the very large volume of filtered water flowing through the conduit, and indeed it is doubtful if careful technical tests would show any change in the character of the water at Lardner's Point by reason of the small admixture of water from the rock surrounding the conduit.

LARDNER'S POINT PUMPING STATIONS.

The work at this point embraced the following contracts:

Lardner's Point Pumping Station No 2—Contract No. 29.

Mr. George C. Dietrich, Contractor.

S. M. Swaab, Assistant Engineer in charge.

This contract consists of an engine house, boiler house, connections to boiler house, the Delaware river connection, valve chambers Nos. 1, 2 and 3, connections to Shaft No. 11 of the Torresdale Conduit, valve chamber at the river end of the Delaware river, and all the aqueducts required to convey water from Shaft No. 11 of the Torresdale Conduit to the pump-house of the stations already under construction, and an additional station which will presently be required, and for the conduct of water from the Delaware river to the pump well until such time as water may be supplied from the Torresdale filters. Subsequent contracts, like Contract No. 68, and the contract when made for Lardner's Point Pumping Station No. 4, will embrace only the engine houses, boiler houses, pump wells, and short connections to valve chamber No. 3, from which chamber filtered water will be distributed to the pump wells of the three new houses under construction or contemplated as part of the Improvement, Extension and Filtration of the Water Supply.

This contract with the exception of some minor details has been completed for the past six months, but great difficulty has been experienced to prevail upon the contractor to finish his work. While the amount of work to be performed during the latter part of 1904 has not been large in value or difficult of construction, it has only been by the utmost urging that progress has been made toward completion of the work. At the present time very little remains to be done, and it is thought that by the end of January, 1905, the work will have been so far advanced as to admit of final settlement with the contractor and payment of the balance due.

It is unfortunate that so much delay has been occasioned in the completion of the work under this contract, because the machinery constructed by the Holly Manufacturing Company under Contract No. 11 has been ready to go into the house since July, 1903, and after answering for all necessary delay in time of completion by reason of extra work, there has been upwards of a year's delay due to the dilatory manner in which the contractor has forwarded his work.

Certain features embraced in the original contract have been omitted as part of the work at the present time, because of the inconvenience of performing the work until such time as the placing of the machinery in the engine and boiler houses has been completed, or by reason of the probability that if certain features were finished at the present time they would suffer serious injury before all the machinery had been properly set up and started.

In view of this the finishing of the floor in the engine room, the placing of the curb and granolithic pavement in front of the engine and boiler houses and the completion of the grading, seeding and sodding about the premises have been omitted. These are all items which can better be completed after all the machinery has been placed in position, and at a time when the work can be performed without prospect of injury by subsequent operations in either the engine or boiler houses. The work on the contract is 98 per cent. completed.

The financial statement with reference to this contract is as follows:

Limit of contract	$565,000 00
Face of estimates	548,637 95
Amount paid	466,342 26

Lardner's Point Pumping Station No. 3—Contract No. 68.

Ryan & Kelley, Contractors.

S. M. Swaab, Assistant Engineer in charge.

This contract consists of an engine house, boiler house, connections to boiler house, pump well and connection to valve chamber No. 3, constructed under Contract No. 29.

At the present time all the excavation, puddle and concrete under foundation walls and foundations for engines and the pump well have been completed. The foundations for both chimneys have been completed, the brickwork in the boiler house has been completed, the structural steel for the superstructure and for the steel floor system of the engine house is now being placed, the roof purlins are in

Plate No. 9.—Lining of Tunnel under Shaft No. 8.

place; annex to the boiler house, roof ceiled and ready for tiling; gullet walls in boiler house partially built, and all concrete piers for railway tracks completed; the north chimney completed, south chimney partially built, smoke tunnels from boiler house to base of both chimneys completed.

This contract is 55.92 per cent. completed, and the remainder of the work can probably be performed in less than ninety days of good operating weather in the early part of 1905.

The financial statement with reference to this contract is as follows:

Limit of contract	$350,000 00
Face of estimates	183,133 74
Amount paid	155,663 68

Lardner's Point Pumping Machinery—Contract No. 11.

The Holly Manufacturing Company, Contractors.

Harry M. Hillegas, Assistant Engineer in charge.

This contract embraces the first three 20,000,000 gallon high duty high service triple expansion pumping engines and the complement of twelve 200 H. P. marine fire box boilers and electric traveling crane.

This contract is 55 per cent. finished. Two of the engines have already been run in service, and only the usual adjustments, placing of lagging on steam cylinders and non-conducting covering on steam pipes and general touching up on a contract of this nature remains to complete the work.

The machinery was constructed for and proportioned in cylinder sizes to deliver into the New Oak Lane Reservoir constructed under Contract No. 27, but by some changes of adjustment and the addition of a Westinghouse pump and air receiver, arrangements have been made to admit of this machinery temporarily pumping to the Wentz Farm Reservoir to assist in maintaining the supply from the Delaware river until such time as filtered water is supplied from the Torresdale filters through the Torresdale Conduit.

The financial statement with reference to this contract is as follows:

Limit of contract	$360,000 00
Face of estimates	194,422 93
Amount paid	165,784 49

Lardner's Point Pumping Machinery—Contract No. 67.

The Holly Manufacturing Company, Contractors.

Harry M. Hillegas, Assistant Engineer in charge.

This contract embraces the second set of three 20,000,000 gallon high duty high service triple expansion pumping engines, and the complement of twelve 200 H. P. marine fire box boilers.

The water ends of the engines embraced in this contract have now been completed and are in place, and with diligence upon the part of the contractor it is believed that this work can easily be finished by the 1st of July, 1905.

The financial statement with reference to this contract is as follows:

Limit of contract	$440,000 00
Face of estimates	
Amount paid	

Electric Traveling Crane for Lardner's Point Pumping Station No. 3—Contract No. 48.

Alfred Box Company, Contractors.

S. M. Swaab, Assistant Engineer in charge.

This contract embraced an electric traveling crane of thirty tons capacity for the engine room of the Lardner's Point Pumping Station No. 3. The work is now in process of construction, and the crane will be erected directly the work on Contract No. 68 has proceeded far enough to admit of it.

The financial statement with reference to this contract is as follows:

Limit of contract	$6,500 00
Face of estimates	
Amount paid	

Coal Handling Machinery and Pockets for Lardner's Point Pumping Stations Nos. 2-3—Contract No. 31.

The specification for this contract is prepared and ready for letting. Some slight changes will be required in the plans, and it is anticipated that the contract will be offered for bids within the next thirty days, and will embrace a wharf, a hoisting tower at the Delaware river for the handling of coal from barges, an elevated tramway from the hoisting tower to the coal pockets, a bucket and hopper elevator at the easterly end of the coal pockets for receiving coal from the Pennsylvania Railroad, a set of coal pockets with a capacity of 5,000 tons of coal, a system of cable cars for the transfer of coal from the hoisting tower or bucket elevator to the pockets, automatic dumping cars, a system of railway tracks from the set of coal pockets to boiler houses Nos. 2 and 3, and charging cars to convey the coal from the pockets to the boiler houses.

Scales will be provided at the wharf hoisting tower for the weighing of coal upon reception from barges and railway cars, and also in the line of the surface railway for the weighing of coal as it is run in the charging cars from the pockets to the boiler houses.

This contract is intended to embrace all that relates to the handling, storage and distribution of coal for the two new pumping stations, Nos. 2 and 3.

When the contract has been completed there will be no more contract work to be performed at the Lardner's Point Pumping Stations until the time arrives for the transfer of the pumping machinery from the Spring Garden and Queen Lane Pumping Stations to Lardner's Point Pumping Station No. 3, when a contract will be made for the necessary changes required in the two 30,000,000 gallon Holly engines at the Spring Garden Pumping Station, and four 20,000,000 gallon pumping engines at the Queen Lane Pumping Station, to adapt them to the new Lardner's Point service, and to rectify certain recognized defects in the original construction of the machinery.

ELECTRIC LIGHTING SYSTEM.

Electric Light Equipment for the Upper and Lower Roxborough Filters—Contract No. 44.

Pennsylvania Equipment Company, Contractors.

H. M. Hillegas, Assistant Engineer in charge.

This contract embraced two sets of driving engines and electrical generators erected in the Annex to the Roxborough Auxiliary Pumping Station, Shawmont avenue and Eva street, to furnish light to the Upper and Lower Roxborough Filters; the Lower Roxborough Preliminary Filter Station, and to the Roxborough Auxiliary Pumping Station.

While the contract was substantially completed as early as August, 1902, considerable delay was occasioned by reason of the failure of the machinery to comply with the contract requirements for economy and efficiency. The trouble seemed to be entirely in the driving engines, and during the past year the manufacturer of the engines, The Watertown Engine Company, sent an expert mechanic to the Roxborough station and successfully corrected the defects in the machinery, and tests made January 13, October 7, October 10 and October 17, demonstrated full compliance with the requirements of the contract.

The machinery has at all times been satisfactory in furnishing the current required for the lighting of the Upper and Lower Roxborough Stations, and it is a matter of congratulation that notwithstanding the terms of the contract were in some respects difficult of performance on the part of the engine builder, after repeated tests to determine the cause of the early failure of the machinery the defects were thoroughly remedied, and upon the final test all the contract requirements were successfully met.

In the following tables are included the results of test of each engine for full load, half load, and 25 per cent. overload:

Unit No. 1.

	Full Load. Oct. 7, 1904.	Half Load. Oct. 10, 1904.	25 Per Cent. Overload. Aug. 17, 1904.
Volts	248.70	248.70	250.00
Amperes	146.46	75.01	188.50
Kilowatts	36.427	18.655	47.125
Rise of temperature allowed by cont.	40.00° C.	....	55.00° C.
Rise of temperature in field by test	40.30° C.	....	48.30° C.
Per cent. overload required by contract	....	....	25.00
Per cent. overload by test	....	....	25.67
Electrical H. P.	48.830	25.007	63.17
Steam pressure at throttle required	100.00	100.00	100.00
Steam pressure at throttle by test	96.12	99.88	96.75
Weight of steam per hour allowed by contract	1,980.00 lbs.	1,140.00 lbs.	....
Weight of steam by test	1,895.40 lbs.	1,086.40 lbs.	
Temperature of calorimeter	271.30° F.	283.60° F.	
Manometer in inches	0.91	1.03	
Per cent. moisture entrained	1.10	0.50	
Indicated horse power	61.80	37.634	79.170
Steam per I. H. P.	30.670 lbs	28.868 lbs.	
R. P. M.	274.39	275.78	275.00
Steam per K. W. per hr. by contract	52.80 lbs.	60.80 lbs.	
Steam per K. W. per hr. by test	52.033 lbs.	58.236 lbs.	
I. H. P. per K. W.	1.697	2.017	1.680
Combined efficiency	79.01 %	66.446 %	79.79 %
Duration of test	10 hours.	10 hours.	2 hours.

Unit No. 1.

	Full Load. Oct. 17, 1904.	Half Load. Oct. 18, 1904.	25 Per Cent. Overload. Jan. 13, 1904.
Volts	250.05	249.92	250.06
Amperes	149.91	75.01	186.75
Kilowatts	37.488	18.747	46.699
Rise of temperature allowed by cont.	40.00° C.	....	55.00° C.
Rise of temperature in field by test	39.30° C.	....	41.00° C.
Per cent. overload required by contract	....	....	25.00
Per cent. overload by test	....	....	24.53
Electrical H. P.	50.252	25.130	62.60
Steam pressure at throttle required	100.00 lbs.	100 00 lbs	100 00 lbs.
Steam pressure at throttle by test	100.40 lbs.	100.29 lbs.	100.63 lbs.
Weight of steam per hour allowed by contract	1,980.00 lbs.	1,140.00 lbs	
Weight of steam by test	1,893.30 lbs.	1,074.00 lbs.	
Temperature of calorimeter	279.00° F.	281.20° F.	
Manometer in inches	.98	.94	
Per cent. moisture entrained	.80	.70	
Indicated horse power	63.748	36.362	67.857
Steam per I. H. P.	29.70	29.536	....
R. P. M.	276.00	275.78	277.00
Steam per K. W. per hr. by contract	52.80 lbs	60.80 lbs.	
Steam per K. W. per hr. by test	50.50 lbs	57.289 lbs.	
I. H. P. per K. W.	1.70	1.94	1.453
Combined efficiency	78.829 %	69.110 %	92.25 %
Duration of test	10 hours.	10 hours.	2 hours.

As the economy guarantees were limited to the full and half loads, the 25 per cent. overload tests of January 13th and August 17, 1904, are included with the tests for full load and half load of each set of machinery.

The financial statement with reference to this contract is as follows:

Limit of contract	$15,500 00
Face of estimates	15,360 48
Amount paid	14,577 48

Electrical Generators, Driving Engines and Main Switchboard for the Lardner's Point Pumping Station No. 2—Contract No. 45.

J. F. Buchanan & Company, Contractors.

Harry M. Hillegas, Assistant Engineer in charge.

This contract embraces three sets of driving engines and electrical generators, main switchboard and wiring from the generators to main switchboard.

At the time of awarding this contract there were some features of the generator not quite in harmony with the requirements of the specification, and as a precaution against introducing machinery which might not be in all respects satisfactory the contractor was ordered to construct, erect and subject to test, one engine and generator before setting up the remaining two, for the purpose of determining compliance with the essential requirements of the contract.

The first engine and generator has been erected on its foundation, connected to the steam pipe and is ready for test. Directly these tests have been made to determine compliance with the economy and efficiency terms of the contract, if it should be found that the machinery as furnished by the contractor, is in all respects satisfactory from a practical point of view, he will be ordered to proceed with the erection of the other two sets of machinery, otherwise this set will be used until such time as he can furnish generators of the type described in the specification for the contract.

The driving engines and generators were built by the Ridgway Dynamo and Engine Company, Ridgway, Pennsylvania. Each engine and its generator is mounted on a continuous cast iron base plate. The steam cylinders are 10 inches diameter, 12 inches stroke, and operate at 250

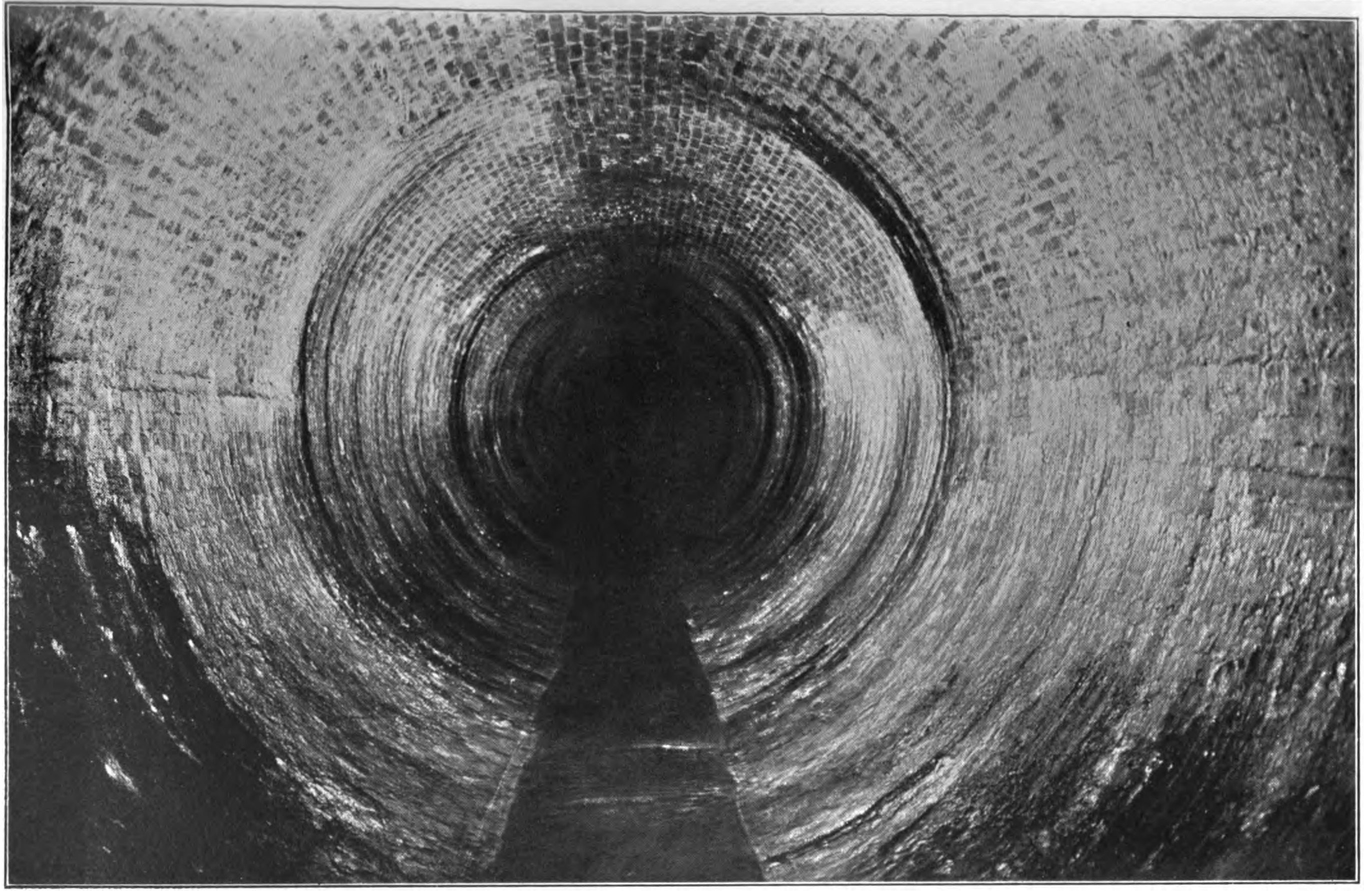

Plate No. 10.—Lining of Tunnel under Shaft No. 9.

revolutions per minute. Steam at 150 pounds gauge pressure will be furnished at the throttle valves of the engines.

The electric generators are of the constant potential compound wound ten-pole type, and direct connected to the shafts of the driving engines. Each generator is guaranteed to economically and without excessive heat deliver 200 amperes at 250 volts, measured at the main switchboard. The field frames are of channel section of cast steel, and insulated from the subbase to withstand a 300-volt alternating current for a period of ten seconds.

The condition of service for this machinery, viz., lighting Lardner's Point Pumping Stations Nos. 2 and 3, the coal handling outfit and pockets, and furnishing power for the operation of the cranes in the engine rooms of Pumping Stations Nos. 2 and 3, requires the use of a generator of first class design and construction, well ventilated and with adequate compensation for armature reaction.

The main switchboard of blue Vermont marble is set off from the east wall of the dynamo room, and is equipped with the usual complement of circuit breakers and instruments to measure and control the current, and the special circuits leading from the room.

In operation one set of machinery is deemed of ample capacity to light the two stations, and if at such times as all the lights may be turned on, power is required to operate the crane, the second set of machinery would be put in service temporarily for this purpose, and if at the same time it should be required to operate the coal handling machinery which will be constructed to operate by electric current, then the third set of machinery will be put in service. Ordinarily it will rarely occur that more than two of the generators will run at the same time, leaving the third generator in reserve. If in the future, however, it should be found necessary to operate the three sets of machinery, a foundation has been provided for a fourth engine and generator, which when purchased and erected will provide one set of machinery always in reserve. It is thought that the fourth engine and generator will not be needed for some time to come, and in Contract No. 45 provision was made for the purchase of only three sets of machinery.

The financial statement with reference to this contract is as follows:

Limit of contract	$9,000 00
Face of estimates	
Amount paid	

Electric Lighting System for the Belmont Filters. Contract No. 46.

Pennsylvania Equipment Company, Contractors.

H. M. Hillegas, Assistant Engineer in charge.

This contract embraces two sets of driving engines and electrical generators for the lighting of the Belmont Filters, the Belmont Pre-Filters and the gate houses at the sedimentation and clear water basins.

This machinery was put in service about the first of August, 1904, and upon test demonstrated full compliance with the requirements of the contract. As this machinery, like that furnished under Contract No. 44, for Roxborough, was installed under rather severe conditions for engines of such small capacity, and very successfully complied with the contractor's guarantee, I have included the following table of operations as interesting data.

CONTRACT No. 46.—RESULTS OF DYNAMO TESTS.

10 x 10-inch Watertown Engines and M. P. 6-37½-275 Fort Wayne Generators.

Contract Conditions—Volts, 250 ; Amperes, 150 ; Kilowatts, 37.5 ; Revs. 275.

		UNIT No. 1.				UNIT No. 2.			
		Half Load.	Full Load.	Overload.		Half Load.	Full Load.	Overload.	
				25 pr. ct.	50 pr. ct.			25 pr. ct.	50 pr. ct.
		Dec. 1, '04.	Nov. 30, '04.	Nov. 30, '04.	Nov. 30, '04.	Nov. 28, '04.	Nov. 25, '04.	Nov. 25, '04.	Nov. 25, '04.
Generator.	Volts	249.95	249.88	250.00	246.0	250.00	250.06	249.56	243.0
	Amperes	74.85	149.95	187.62	228.0	75.01	149.99	187.56	233.0
	Kilowatts	18.728	37.464	46.908	56.088	18.754	37.505	46.807	56.619
	Rise of temperature of field allowed by contract	....	40.0° c.	55.0° c.	....	....	40.0° c.	55.0° c.	....
	Rise of temperature of field by test	31.0° c	38.65° c.	54.0° c.	....	24.0°	36.9° c.	50.5° c.	....
	Overload required by contract	....	....	9.375	18.750	....	....	9.375	18.750
	Overload by test	....	....	9.408	18.588	....	....	9.307	19.119
	Per cent. overload required by contract	....	....	25.0	50.0	....	....	25.0	50.0
	Per cent. overload by test	....	....	25.09	49.57	....	....	24.82	50.98
	Electrical horse power	25.105	50.230	62.881	75.185	25.140	50.275	62.744	75.897

Contract No. 46.—Results of Dynamo Tests—Continued.

		Unit No. 1.				Unit No. 2.			
		Half Load.	Full Load.	Overload.		Half Load.	Full Load.	Overload.	
				25 pr. ct.	50 pr. ct.			25 pr. ct.	50 pr. ct.
		Dec. 1, '04.	Nov. 30, '04.	Nov. 30, '04.	Nov. 30, '04	Nov. 28, '04	Nov. 25, '04.	Nov. 25, '04.	Nov. 25, '04.
Engine.	Steam pressure at throttle required...	125.00	125.00	125.00	125.00	125.00	125.00	125.00	125.00
	Steam pressure at throttle by test......	122.79	122.78	123 88	124.00	123.43	124.06	121.25	121.00
	Weight of steam per hour allowed by contract..............................	1,140.0	1,980.0	....	....	1,140.0	1,980.0	....	....
	Total weight of water to boiler per hour	1,062.4	1,855.4	....	....	1,077.3	1,889.8	....	....
	Total weight of water from separator per hour..............................	14.0	14.7	....	....	14.1	16.8	....	....
	Per cent. moisture, determined by separator..................................	1.32	.79	....	....	1.309	.89	....	....
	Weight of steam to engine per hour, by test..................................	1,048.4	1,840.7	....	....	1,063.2	1,873.0	....	....
	Weight of steam to engine per hour, corrected for initial pressure..........	1,039.07	1,824.28	....	....	1,056.50	1,865.94	....	....
	Weight of dry steam required per hour under contract conditions............	1,040.29	1,826.03	....	....	1,056.28	1,865.70	....	....
	Indicated horse power, by test..........	34.121	63.006	79.072	89.061	38.661	67.786	85.022	100.04
	Steam per indicated horse power per hour....................................	30.453	28.954	....	....	27.327	27.527	....	....
	Friction horse power.....................	5.805	5.805	5.805	5.805	7.723	7.723	7.723	7.723
	Revolutions per minute.................	274.97	276.24	271.75	264.0	276.17	274.09	274.50	276.0

Contract No. 46.—Results of Dynamo Tests—Continued.

		UNIT No. 1.				UNIT No. 2.			
		HALF LOAD.	FULL LOAD.	OVERLOAD. 25 pr. ct.	OVERLOAD. 50 pr. ct.	HALF LOAD.	FULL LOAD.	OVERLOAD. 25 pr. ct.	OVERLOAD. 50 pr. ct.
		Dec. 1, '04.	Nov. 30, '04.	Nov. 30, '04.	Nov. 30, '04.	Nov. 28, '04.	Nov. 25 '04.	Nov. 25, '04.	Nov. 25, '04.
EFFICIENCY.	Steam per kilowatt per hour by contract	60.80	52.80	....	....	60.80	52.80	....	....
	Steam per kilowatt per hour by test	55.482	48.694	....	....	56.335	49.752	....	....
	Indicated horse power per kilowatt	1.822	1.682	1.686	1.588	2.061	1.807	1.816	1.767
	Engine efficiency	82.987	90.787	92.659	93.482	80.024	88.607	90.916	92.280
	Generator efficiency	88.660	87.810	85.824	90.306	81.259	83.704	81.171	82.213
	Combined efficiency	73.659	79.73	79.522	84.420	65.03	74.167	73.797	75.867
	Duration of test	10 hours.	10 hours.	2 hours.	Momentary.	10 hours.	10 hours.	2 hours.	Momentary.

The financial statement with reference to this contract is as follows:

Limit of contract	$20,000 00
Face of estimates	16,203 97
Amount paid	13,773 37

Lardner's Point Pipe Distribution System—Contract No. 28.

Mr. Daniel J. McNichol, Contractor.

Seth M. Van Loan, Assistant Engineer in charge.

Progress on this contract was continued during the year and all possible work performed within the limits of the original appropriation of Councils by Ordinance of June 30, 1902. The contract has been supplemented by authority of the Director of Public Works for $400,000.00, making a total limit at the present time of $1,700,000.00.

The material and labor to be paid for by estimates drawn against the extension of the contract is now in progress, and it is thought that the entire work within the limits of the Ordinance of Councils and the authorization of the Director of the Department of Public Works will be completed within the next four months.

All the valve chambers, which constitute the more complicated and troublesome features of the contract, have now been constructed or are in process of construction, and the extension of the contract will complete the laying of straight pipe on Tacony street as far as Wakeling street. An additional amount of $282,000.00 will be required before the three lines of 60-inch pipe, including accessories, can be completed to the intersection of Torresdale and Kensington avenues.

No special advantage would occur from completing 48-inch Pipe Line "T," or constructing 48-inch Pipe Line "S," under the original Contract No. 28, if it should be

Plate No. 11.—Lining of Tunnel under Shaft No. 10.

deemed advisable not so to do, in which event the completion of line "T" and work on line "S" could be embraced in Contract No. 70, which provides for the extension from the three lines of 60-inch pipe by nine lines of 48-inch cast iron pipe from valve chambers Nos. 5, 6 and 7, at Torresdale and Frankford avenues, and valve chambers Nos. 8, 9 and 10, at Torresdale and Kensington avenues, into the Queen Lane and East Park Distribution Districts.

Valve chambers Nos. 1, 2, 3 and 4 are completed.

The placing of the 60-inch pipe and restoration of the streets has been completed from Lardner's Point Pumping Station No. 2, on Robbins street, to Wakeling and Tacony streets. The connecting pipes from Lardner's Point Pumping Stations Nos. 2 and 3 have been laid as far as was possible with the operations going on under Contract No. 68, and are ready for service; in fact, such pumping as has already been done at Lardner's Point Pumping Station No. 2, with the machinery furnished under Contract No. 11, has been through these lines of pipe from the pumping station to Robbins street and Tacony road, at which point the water is diverted into the old line of 48-inch rising pipe leading to Wentz Farm Reservoir.

In order to provide for the filling and test of the Oak Lane Basins, Contract No. 27, 4,721 feet of 48-inch pipe, line "T," was laid in Fifth street, from Tabor road to Medary avenue, where it connects with the rising mains laid under Contract No. 27, as part of the Oak Lane Basins, and it is through this line of pipe that water is now being pumped from time to time for the leakage tests of the basins.

From time to time during progress of the work the hydrostatic test of 200 pounds per square inch as required by the terms of the specification was applied to the pipes, special castings and stop valves, and, with the exception of ruptures of the bodies of several of the 48-inch stop valves in chambers Nos. 1 and 2, the pipe and special castings, and the workmanship on the joints, have successfully met this test, and from the indications doubtless would be capable of taking a higher test than that applied without rupture of the materials or workmanship at the joints.

Considerable trouble, however, has been experienced in the breaking of the cast iron bodies of the 48-inch flange stop valves placed in the chambers. This trouble has chiefly been experienced in chamber No. 1, and in order to remedy the trouble with the valves in chambers Nos. 1 2, 5, 6, 7, 8, 9 and 10, where eccentric or torsional stresses may be developed in the bodies of the valves, it was decided to substitute cast steel castings for the iron bodies originally furnished with the valves. This the Eddy Valve Company, sub-contractors for the valves, has undertaken to do at its own cost, and the fairness with which this contractor has made what seemed to the Bureau his evident obligation to the City cannot be too highly commended. While the contract stipulated cast iron bodies for the stop valves, it also provided for the manner in which it should be placed in the chambers and connected up with the special castings forming part of the pipe system, and that they should be required to take the 200 pounds hydrostatic test applied to the entire pipe system, including the valves from time to time as the work progressed. The valves having failed under this test, the sub-contractor very promptly offered to substitute for the cast iron bodies, cast steel bodies, which it is believed will thoroughly remedy the trouble heretofore experienced. This difficulty it is thought could only occur in end chambers like chambers Nos. 1 and 2 on Robbins street and the combination chambers at Kensington and Frankford avenues, where angular stresses on the valve bodies can be developed under the test pressure applied to the pipe system, and produce fractures such as were experienced in chamber No. 1. In chambers Nos. 3 and 4, and in portions of chambers Nos. 5, 6, 7, 8, 9 and 10, such stresses cannot very well be developed, and it is thought that the cast iron valve body is entirely able to meet the direct stress which may be applied either upon contract test, or with the pipe system in service.

This work was begun in 1903, and in the early part of 1904, before the lines of pipe in Robbins street were covered with backfill it was deemed advisable to place under the lines of 60-inch pipe throughout the system from side to side of the trench a concrete floor 9 inches thick, provided with cheeks opposite each line of pipe to prevent moving of the pipe laterally in the event of rupture in service. The chief object, however, of the concrete floor was to guard against the probable washing out of the earth support under the other lines of pipe should either line be ruptured in service, and notwithstanding the considerable cost of this concrete in the bottom of the trench it was deemed wise to so re-enforce or protect this system of large mains that an accident could not by any chance impair the integrity of the unruptured lines. Under the circumstances should a piece of pipe in either line break, the back fill over and round that line, and perhaps to some extent over the other lines would be washed out, but no disturbance of the uninjured lines could occur by reason of this. If the bottom of the trench, however, consisted only of the natural materials found upon excavation, it is probable that a rupture of one line of pipe would not cnly wash out its own backfill, but cut away the foundation from under the other lines of pipes, and might in extreme case render them all unserviceable until the usual repairs were made. It is not thought, however, that this can possibly occur with the concrete floor in the trench, and that the worst possible condition may be the rupture of a single line.

Upon the other hand, considering that every piece of pipe and special casting, excepting easy bends and breeches pipes, that went into this work has been tested at the foundry to from 300 to 350 pounds per square inch, it is not thought that any serious accident will ever occur with the system in service.

In addition to the unusual precautions observed in drawing the specification for the materials entering into the contract, on each line of pipe, in each valve chamber, a 4-inch Crosby relief valve, set to blow at 125 pounds pressure, has been placed. This is a few pounds in excess of the pressure required to overcome the head due to an elevation of 210 feet above City datum (the flow line of Oak Lane Reservoir), plus friction in the lines of pipe, and should pump shocks or rams occur in the lines of pipe, one or more of the twenty relief valves will open before the pressure will be high enough to injure any part of the pipe system.

It is intended in laying the three 48-inch lines of pipe from valve chamber No. 6, and six 48-inch lines of pipe from valve chambers Nos. 9 and 10, to place check valves upon these lines, which upon any accident to either of the 60-inch lines will close until such time as the damaged line of pipe can be temporarily cut out of service for repair, and meanwhile the supply of water for a period of two or three hours will be maintained from the stored water in Oak Lane Reservoir.

Some of the more important special castings entering into this work are made of cast steel, and subjected to a foundry test of 450 to 500 pounds per square inch (the capacity of the testing outfit at the point of manufacture, the Seaboard Steel Casting Company, Chester), and it is scarcely thought possible, excepting extraordinary settlement should occur in some of the lines of pipe or chambers, that any stresses could develop in the lines of pipe that would bring about a rupture of the pipe or special castings.

The breeches pipe used in the 42-inch and 48-inch lines of pipe laid from the pumping station at Lardner's Point to the four lines of pipe originating in chamber No. 1, in Robbins street, are all provided with Tobin bronze through bolts to guard against corrosion during years of service.

If occasion should require entrance into the pipe, manholes have been provided in each valve chamber through which a man can enter the pipe and remove incrustations which may have formed, scrape the pipe, and restore it from time to time to substantially its original condition as to smoothness and full sectional area. It is not thought, however, that with the filtered water from the Delaware river rapid tuberculation of the pipes will occur. The experience with the original line of 30-inch rising main from Lardner's Point Pumping Station No. 1, to Wentz Farm Reservoir, laid in 1874, conducting unfiltered Delaware river water, indicates that the incrustations develop at a very slow rate with the Delaware river water, and it is thought that with all suspended matter removed this would be even slower with filtered than with unfiltered water.

The concrete sewer chambers at Tacony and Lardners street, Tacony and Wakeling streets, and Tacony and Sanger streets, are completed and in service.

This contract, referring to the original limit of \$1,300,000.00, is now 92.93 per cent. completed; extension of contract, \$400,000.00; total fund provided, \$1,700,000.00.

The financial statement with reference to this contract is as follows:

Limit of contract	\$1,700,000 00
Face of estimates	1,208,246 54
Amount paid	1,180,660 43

Oak Lane Reservoir—Contract No. 27.

R. A. Malone & Company, Contractors.

D. Jones Lucas, Assistant Engineer in charge.

The work upon this contract was finished so far as construction features are concerned during the past year, and all that remains at the present time to complete the contract for acceptance and payment is the test for watertightness of the two divisions of the reservoir. These tests are in progress at the present time, but owing to the limited capacity of the pumping machinery at the Wentz Farm High Service Pumping Station, it is only during such times as the demand for water will admit, that water can be pumped through the improvised connections with the reservoir for the purpose of making the tests. It is not thought that the test for watertightness will reveal a serious leakage, but as the test is a contract condition it cannot be waived without relieving the contractor of a material obligation.

The financial statement with reference to this contract is as follows:

Limit of contract	$560,000 00
Face of estimates	557,699 33
Amount paid	446,159 46

Contracts Required to Complete the Work.

With the exception of the completion of Contract No. 28, Lardner's Point Pipe Distribution System, and extension of the lines of 48-inch pipe from Torresdale and Frankford avenues and from Torresdale and Kensington avenues, into the Queen Lane and East Park Districts (Contract No. 70), there will remain to complete the works at Torresdale only the following contracts:

Contract No. 36. Low Service Pumping Station.

Contract No. 35. Low Service Pumping Machinery.

Contract No. 41. Sand Washer and Preliminary Filter Pumps.

Contract No. 47. Electric Light System.

Contract No. 52. Coal Handling Machinery and Pockets.

Contract No. 56. Queen Lane Contingent of Sand, Gravel and Lateral Collectors.

Contract No. 58. Spur from the Pennsylvania Railroad.

Contract No. 61. Shelter Houses to be erected on the courts.

The completion of the contracts mentioned will then finish all work started and essential as part of the Improvement, Extension and Filtration of the Water Supply, as provided by Ordinance of January 12, 1900.

The nature of these contracts is fully described in my report for the year 1903.

Capacity of Plain Sand Filters.

For convenience of reference 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:

	Gallons.
Belmont (without preliminary filters)	33,500,000
Belmont (with preliminary filters)	65,000,000
Belmont Preliminary Filters (first installation)—Contract No. 39	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

LOWER ROXBOROUGH.

Cost of Cleaning Filters.

About one and one-half day's subsidence and preliminary filtration.

This station consists of five filters of 0.53 acre area each.

In the following table are given the averages for the cost of scraping, removing and washing sand for the year 1904:

Number of runs	26
Average cubic yards of sand scraped per run	120.
Average million gallons filtered per run	123.7
Average million gallons filtered per acre, per run	233.4
Average cubic yards of sand scraped per million gallons of water filtered	0.97
Average cost to scrape	$0.21

Average cost to remove	0.27
Average cost to wash	0.20
Total cost per cubic yard of sand	$0.68
Average gallons of water used per cubic yard of sand to remove	1,766
Average gallons of water used per cubic yard of sand to wash	2,501
Average cost per million gallons to scrape, remove and wash	$0.663
Cost per million gallons of water to scrape, transport, wash and restore sand	$1.13

UPPER ROXBOROUGH.

Cost of Cleaning Filters.

About twelve days' subsidence; no preliminary filtration.

This station consists of eight filters of 0.71 acre area each.

In the following table are given the averages for the cost of scraping, removing and washing sand for the year 1904:

Number of runs	43
Average cubic yards of sand scraped per run	117.75
Average million gallons filtered, per run	78.337
Average million gallons filtered per acre, per run	108.93
Average cubic yards of sand scraped per million gallons of water filtered	1.503
Average cost to scrape	$0.26
Average cost to remove	0.30
Average cost to wash	0.15
Total cost per cubic yard of sand	$0.71
Average gallons of water used per cubic yard of sand to remove	1,874
Average gallons of water used per cubic yard of sand to wash	1,443
Average cost per million gallons to scrape, remove and wash	$0.993
Cost per million gallons of water to scrape, transport, wash and restore sand	1.85

BELMONT FILTERS.

Cost of Cleaning.

About two days' sedimentation; no preliminary filtration.

This station consists of eighteen filters of 0.73 acre area each.

In the following table are given the averages for the cost of scraping, removing and washing sand for the year 1904:

Number of runs	66
Average cubic yards of sand scraped per run	124.1
Average million gallons filtered per run	76.555
Average million gallons filtered per acre per run	104.87
Average cubic yards of sand scraped per million gallons of water filtered	1.621
Average cost to scrape	$0.27
Average cost to remove	0.28
Average cost to wash	0.12
Total cost per cubic yard of sand	$0.67
Average gallons of water used per cubic yard of sand to remove	1,881
Average gallons of water used per cubic yard of sand to wash	1,718
Average cost per million gallons to scrape, remove and wash	$1.036
Assuming that the cost of restoring the sand will be 50c. per cubic yard at Belmont (without preliminary filtration), then the	
Cost per million gallons of water to scrape, transport, wash and restore sand will be	$1.89

In the following table I have shown the number of filters in which the sand has been restored during the past year; the number of cubic yards of sand replaced; the total cost of replacing and finally the cost per cubic yard for each filter. The table gives all the filters in which the sand was restored at each station during the past year. No sand has been restored to the Belmont filters, and will not be until about May or June of the coming year.

Lower Roxborough Filters.

Date—1904.	Filter No.	Cubic Yards. Replaced.	Total Cost of Replacing.	Cost per Cubic Yard.
4-27 to 5- 7	5	750	$317.54	$0 42
6-15 to 6-28	3	855	523.93	61
11- 2 to 11-11	2	1,122.7	519.12	46
11-28 to 12- 8	1	1,137	543.76	48
Totals and average	....	3,864.7	$1,904.35	$0 49

Upper Roxborough Filters.

9- 6 to 11-11	1	1,320	$773 00	$0 59
10-11 to 10-19	7	1,001.4	475 11	47
10-19 to 11- 2	8	1,502	732 75	49
11-18 to 11-28	4	847	487 59	57
11-11 to 11-18	2	847	381 07	45
Totals and average	....	5,517.4	$2,849 52	$0 52

SPRING GARDEN TESTING STATION

Dr. George E. Thomas, Chemist in charge.

The work of the chemical laboratory has been devoted to the collection and daily examination of samples of water from the Upper and Lower Roxborough and Belmont Filters, the analyses of asphalt and asphaltic mixtures, and such other analyses as have been required during the past year.

The same routine was followed during 1904 as governed the examination of water samples during the previous year, excepting that during the past year we have abandoned the usual determinations for free and albuminoid ammonia, and substituted the Kjeldahl test for total nitrogen.

During the year over 1,400 samples of water were collected for chemical analyses, in which the sediment was observed and turbidity determined, and in round numbers 5,000 tests were made for the determination of nitrogen, chlorine, oxygen consumed, etc.

During the months of August, September and October, samples of water were taken daily from Shaft No. 1 of the Torresdale Conduit to determine the lime content which during the operations of pumping out the conduit was in excess of the known lime content of the water as analyzed during the time the conduit was under construction. It was assumed in these investigations that the excess of lime above that normally present in water flowing through the fissures in the rock was obtained from the cement used in the manufacture of the concrete and mortar of the brick lining of the conduit. This matter is discussed in the report on Contract No. 14.

The work of the bacteriological laboratory was principally devoted to the usual determination of the bacterial content of water samples representing the raw water in the Schuylkill river, the subsided water from the Lower and Upper Roxborough and Belmont sedimentation reservoirs, from the Lower Roxborough preliminary filters, from the Lower and Upper Roxborough and Belmont Filters, and finally from the clear water basins at each of the three stations, and a regular semi-weekly determination of the presence of the Bacillus Coli Communis in the water from the Schuylkill river and the other points of collection noted.

In this connection it is interesting to note the results of the tests for the Bacillus Coli Communis in the water flowing from the Lawrence city filters, Lawrence, Massachusetts, and of that shown by a series of tests made upon an experimental mechanical filter by the Massachusetts State Board of Health during the year 1903.

With the Lawrence city filter, and the experimental mechanical filter, using sulphate of alumina as a coagulant,

Plate No. 12.—Lining of Tunnel at foot of Shaft No. 11.

the tests for the presence of B. Coli Communis in the filtered water were not only frequently positive, but resulted in easily determining definite numbers of this sewage bacterium, while a positive test for the presence of the B. Coli Communis in the effluent of the Philadelphia filters occurred so rarely as to assume the practical exclusion of this organism from the filtered water.

To sanitarians as a rule the complete exclusion of the sewage organisms in a polluted water is more significant than the percentage reduction in numbers of bacteria in the applied water, because if after the water has passed through a filter it still contains sewage organism it is an index that the filters are not performing their work at all times properly, and that the fundamental proposition of filtration is not being accomplished, and although it may be more difficult to impress the layman with the significance of determining the presence or non-presence of sewage bacteria in the polluted water than it is to impress him with the percentage reduction of numbers in the applied water, it is more significant with any system of filtration to show that it is competent to completely exclude sewage organisms from the water than it is to show its capability of high bacterial reduction.

The most delicate test along this line with which we are now familiar is the determination of the presence or absence in the filtered water of the B. Coli Communis. This organism, as is well known, bears in many respects close resemblance to the typhoid fever organism, and in fact it is thought by many able investigators to be the progenitor of the typhoid fever organism, the proof of the existence of the latter outside of the human body being so rare as to raise a serious doubt whether it really exists as such for any considerable length of time excepting in the human system.

While this thought originally advanced abroad by Prof.

Malvoz and Ray Lancaster, and was subsequently made the subject of personal investigations prior to the origin of the Philadelphia works, it had but little weight among the investigators of water quality in this country, it is interesting to note that at the present time there is a much larger number of water analysts leaning to the belief that under conditions found only in the human system there may be a conversion of the Bacillus Coli Communis into what we term the bacillus typhosis, as we find the latter in wastes from the human system during typhoid fever, or in certain of the organs of typhoid fever subjects.

Probably the inability to positively demonstrate the presence of the typhoid organism in a water of known pollution fathers the belief that it does not have any independent existence outside the human system, nevertheless there is much testimony available to-day to raise a serious doubt of there being another known nidus than that found in the body.

It is probable that when the operation of filters is so far advanced as to demonstrate what is generally true with reference to the work of the Philadelphia filters, that the reduction of bacterial content as a rule bears a close relation to the reduction of turbidity, i. e., when the turbidity is very low, it is rare indeed that the bacterial content is high, that this part of the test may be abandoned and more elaborate tests for the determination of the B. Coli Communis and other sewage bacteria in water be substituted as a final test of the efficiency of operation of filters.

It is generally recognized that if there were no bacteria of a disease-producing nature in a water supply, the so-called non-pathogenic organisms would be harmless, even if taken in the large numbers frequently found in raw water as used for domestic supply, but the presence of a very small number of pathogenic organisms has caused the expenditure in this country and abroad of many millions of dollars for works of water purification, having always for their sole object the removal from a polluted water the organisms concerned in producing disease.

The presence of the Bacillus Coli Communis in samples of raw and filtered water was determined in quantities ranging from 10 to 50 cubic centimeters, in all samples from the effluent of filters and from the clear water basins.

In addition to the tests of the raw and filtered water for the Belmont Filters, tests have been made from a number of selected stations in West Philadelphia to determine the condition of the water in the filtered water district and in the district receiving a mixture of filtered and unfiltered water.

The results of this examination with reference to the filtered water district, not subject to the contamination of unfiltered water from George's Hill Reservoir, are very satisfactory, and show that there is no bacteriological deterioration of the water in passing from the filters to the consumers.

During the year 22,534 samples of water were examined for numbers of bacteria; 2,223 one cubic centimeter inoculations, and 793 bulk inoculations were tested for the presence of the Bacillus Coli Communis.

The cost of maintaining the Testing Station for the past year was $14,315.15.

PRELIMINARY FILTER No. 12 AND LOWER ROXBOROUGH PRELIMINARY FILTERS.

During the period of time embraced between August 20th and December 31st, a preliminary filter identical in construction with the preliminary filters embraced in Contract No. 39, Belmont and Torresdale, has been in daily service, treating unsubsided Schuylkill river water at the rate of 80,000,000 gallons per acre per day. As a check upon the performance of this filter, comparisons have been made weekly with the Lower Roxborough Preliminary Filters furnished under Contract No. 37. The results of the performance for twenty weeks are given in the following table:

Station.	Rate Mil. Gals. per Acre. per Day.	Turbidity. Parts per Million by Silica Standard.		Percentage. Reduction.
		Applied.	Effluent.	
Pre-Filter No. 12	80	27.6	8.42	69.5
Lower Roxborough Pre-Filters	57	31.0	9.55	54.5

It will be observed that No. 12 was working with unsubsided Schuylkill water at the rate of 80,000,000 gallons per acre per day, while the Lower Roxborough Preliminary Filters were working with Schuylkill water having over one day's subsidence in the Lower Roxborough Reservoir, and at the rate of 57,000,000 gallons per acre per day.

During the period of time embraced in the statement of results the sand bed of preliminary filter No. 12 has been washed from time to time by a reverse current of unfiltered and unsubsided water, the only water available for the purpose, while the sponge and slag beds at Lower Roxborough were always washed with filtered water.

In actual practice at Belmont and Torresdale, preliminary filtered water will be used for washing, and the unfortunate condition prevailing at the Spring Garden Testing Station, which compels the use of raw water from the river for washing the sand bed will be avoided. The use of raw water to wash the sand bed not only is a means of introducing suspended matter into the filter from below, but has an influence of clogging the wash pipes, a condition which will be overcome when the filters are constructed at Belmont and Torresdale. The pre-filtered water will be free from all large particles of suspended matter, which would be calculated to clog the narrow slits in wash pipes, and such finer suspended matter as may remain in the water will not have a marked effect in clogging the sand bed.

During the twenty weeks of operation at the rate of 80,000,000 gallons per acre per day (which rate will be maintained during the next year until after the season of highly turbid water, and longer if found advisable), the sand has not been removed from the filter for washing, but it is anticipated that this will become necessary during the month of January.

The average duration of runs between washings has been 22.31 hours.

In the operation of the type of pre-filters adopted for the Belmont and Torresdale Stations, it is not expected that the periodical washings by reverse current will remove entirely the mud and other suspended matter from the sand bed, but that occasionally the whole body of sand will require removal from the filter by means of a waste ejector, washed and delivered into the empty filter of the series.

Each filter of the Belmont and Torresdale systems will contain when finished 74.2 cubic yards of sand, and with two ejectors working at the same time this amount of sand can be removed from the filter, washed and delivered ready for service into the empty filter of the series in five hours. Thus when it is required to wash completely the sand in any filter it can be accomplished without losing the service of the filter, or rather of its equivalent for more than five hours. Each such washing of sand will restore it to its original condition and in the light of our experience during the past four years with the water from the Schuylkill river, such complete washing of the sand bed will occur from five to six times per year, all of which washings as a rule will occur between November 1st and May 1st.

INFLUENCE OF FILTERED WATER FROM THE ROXBOROUGH AND BELMONT FILTERS ON THE TYPHOID FEVER CASE RATES.

Beginning with January 8th, and continuing through the year a compilation of the statistics from the records of the Bureau of Health, was made from week to week, with a view to showing as well as might be under present conditions the difference between the typhoid fever rates of Wards Twenty-one and Twenty-two, receiving filtered water from the Roxborough Filters, and the typhoid fever rates for the remainder of the City.

Upon the suggestion of Dr. Abbott, President of the Board of Health, that there might be conditions that would make the typhoid fever rates worse in Wards Twenty-eight and Thirty-eight than elsewhere, these were also compared with Wards Twenty-one and Twenty-two, and West Philadelphia as a whole was treated as another division of the City that might be independently considered, and finally Wards Twenty-three, Twenty-five, Thirty-three and Thirty-five, which receive only unfiltered Delaware water at the present time were considered as a fourth district for purpose of comparison.

The net results of the filtered water from the Roxborough Filters when compared with the remainder of the City, show a reduction of the typhoid fever case rates of 59.6 per cent.; when compared with Wards Twenty-eight and Thirty-eight 54.7 per cent.; when compared with West Philadelphia, 78.2 per cent., and when compared with the Delaware river wards, 65.2 per cent.

In view of the fact that this table represents the entire year without interruption, and that the averages for the fifty-two weeks are the figures given above, they should be most convincing to the people of Philadelphia, who have sought relief from typhoid fever in the filtration of the water supply.

1904 Week Ending.	Typhoid cases, City of Philadelphia, Population 1,293,697.		Typhoid cases, Wards 21, 22, Population 97,000.		Typhoid cas exclu'ng Wa Population	
	No. of cases.	Cases per 100,000.	No. of cases.	Cases per 100,000.	No. of cases.	C
January 8	155	11.98	4	4.12	151	
January 15	89	6.88	1	1.003	88	
January 22	88	6.80	2	2.006	86	
January 29	126	9.74	3	3.093	123	
February 5	88	6.88	6	6.18	82	
February 12	103	7.96	2	2.006	101	
February 19	142	10.97	4	4.12	138	
February 26	148	11.44	4	4.12	144	
March 4	195	15.07	6	6.18	189	
March 11	142	10.97	5	5.15	137	
March 18	141	10.90	3	3.093	138	
March 25	148	11.44	2	2.006	146	
April 1	321	24.81	5	5.15	316	
April 8	389	30.06	6	6.18		
April 15	359	27.74	6	6.18		
April 22	352	27.20	11	11.34		
April 29	298	23.03	4			
May 6	277	21.41	14			
May 13	295	22.80	10			
May 20	182	14.06				
May 27	120	9.27				
June 3	102	7.8				
June 10	78					
June 17	72					
June 24	75					
July 1						
July 8						
July 15						
July 22						
July 29						
August 5						

It should be borne in mind that a comparison at the present time cannot show the best results of filtered water because of the fact that the citizens of wards receiving filtered water are to some extent exposed to infection through the use of water in districts where the supply is not yet filtered, i. e., whatever results would be shown under present conditions should be improved upon when the entire water supply is filtered, or when any citizen of Philadelphia moving throughout the city would be bound to drink only filtered water which, of course, is not the case at the present time.

In order to emphasize the influence of filtered water on the typhoid fever rates more forcefully than could be done by comparing Wards Twenty-one and Twenty-two with the four other districts mentioned, a district was isolated in West Philadelphia, bounded by Belmont avenue and Ogden street, Thirty-eighth street, Cleveland avenue and the Schuylkill river. The territory thus embraced by the census of 1900 contains 46,805 people, while the remainder of West Philadelphia contains 101,566, or little less than one-third of the total population of West Philadelphia lives in what is termed the filtered water district.

In this district nothing but filtered water can be obtained, special connection having been made at Belmont and Montgomery avenues with the 20-inch line of pipe proceeding south on Belmont avenue for the supply of water to this district, in such manner that the district is receiving only filtered water, while the remainder of West Philadelphia receives a mixture of filtered and unfiltered water.

Considering the filtered water district from the 10th of June to the end of the year, the total number of typhoid fever cases reported to the Bureau of Health were 20, while in the unfiltered or mixed water districts the total number of typhoid fever cases were 295. Roughly assuming that one-third of the population of West Philadelphia lives in the filtered water district, then there would be 20 cases of typhoid fever in the filtered water district to 142 cases in the mixed water district, or seven times as many cases of typhoid fever in the mixed water district as in the filtered water district.

The net result of this investigation for the year shows, as between the filtered water district and the mixed water district, a reduction of typhoid fever case rates of 86 per cent., and this more nearly represents in my judgment the probable reduction in the typhoid fever rates when all the water is filtered than the comparison made between Wards Twenty-one and Twenty-two and the other districts mentioned, for the reason that the filtered water district of West Philadelphia is supplied exclusively with filtered water, whereas there is a portion of Ward Twenty-one and probably at times a portion of Ward Twenty-two that does not receive filtered water, i. e., with the varied consumption from day to day it is probable that the area embraced in the filtered water district and the population served are not constant as they are in West Philadelphia, but vary from time to time.

Undoubtedly the argument that is persuading the people of Philadelphia, and will persuade in the future the people of other cities, to incur a large outlay for the improvement of the water supply, is based upon the reduction of the typhoid fever rates and the rates of other diseases, the cause of which is known or supposed to be in a polluted water supply.

The statistics with reference to the bacterial reduction of water are not as forceful to the layman as they are to those who are familiar with the biology of water, but statistics with reference to the reduction of typhoid fever rates will have their influence upon the least intelligent layman, because these every one can feel and appreciate at their full value.

I submit herewith blue print tables showing the relation of typhoid fever in the filtered water districts of Wards Twenty-one and Twenty-two, and in the isolated districts of West Philadelphia, as shown by the sketch map, to the City proper, to Wards Twenty-eight and Thirty-eight, to West Philadelphia, and to the four wards receiving exclusively unfiltered Delaware river water.

The last four columns in the general table contain the percentage reduction in the typhoid fever rates between Wards Twenty-one and Twenty-two and the other four districts named, and referring to the West Philadelphia table, the last column shows the percentage reduction in typhoid fever rates between the exclusively filtered water district of that section of the City and the remainder of West Philadelphia.

CHANGES IN STAFF.

During the year the following changes have occurred in the staff:

H. W. Underwood, Assistant Engineer in charge of operation of the Roxborough Filters, resigned April 25, 1904, to take service with the city of Pittsburg as an assistant engineer in the Bureau of Filtration of that city.

W. R. Copeland, Bacteriologist in charge of the Testing Station, resigned on June 25, 1904, to take service with the city of Columbus, Ohio.

Chester H. Wells, Assistant Engineer in charge of Experimental Filter No. 12 at the Testing Station, resigned September 24, 1904, to take service with the State Board of Health of New Jersey.

Charles H. Paul, Assistant Engineer in charge of construction and operation of the Belmont Filters, and in charge of operation of the Roxborough Filters, resigned October 15, 1904, to take service with the United States Geological Survey.

J. William Lee, Stenographer and Chief Clerk, resigned May 21, 1904, to engage in private business.

Howard L. Klotz, Stenographer, resigned May 31, 1904.

Chester F. Drake, 2d Assistant Engineer, resigned August 1, 1904, to take service with a private water company at Pittsburg, Pa.

Fred Schaffhauser, 2d Assistant Engineer, resigned February 29, 1904, to renew his previous connection with the Bureau of Water, this City.

Thomas C. Atwood, 2d Assistant Engineer, resigned May 21, 1904, to take service with the Bureau of Filtration, Pittsburgh, Pa.

C. M. Dugan, Jr., Assistant Chemist Spring Garden Testing Station, resigned September 10, 1904, to engage in private business.

PROMOTIONS.

Dr. George E. Thomas, Chief Chemist, on June 26, 1904, was placed in charge of operations at the Testing Station, vice W. R. Copeland, resigned.

Mr. J. A. Vogleson, formerly First Assistant Engineer Contract No. 25, Torresdale Filters, on October 1st was assigned to the duties previously discharged by Charles H. Paul, in charge of the operation of the Belmont and Lower and Upper Roxborough Filters.

APPOINTMENTS.

Miss M. E. Vaughan, on June 1, was appointed Chief Clerk vice J. William Lee, resigned.

Miss A. C. Codey, on August 1, 1904, was appointed Assistant Stenographer, vice Howard L. Klotz, resigned.

Mr. Francis D. West was appointed Assistant Chemist at the Spring Garden Testing Laboratory, September 23, 1904, vice Mr. C. M. Dugan, Jr., resigned.

In concluding this report I desire to thank you and the officials of your office for the uniform courtesy and assistance given during the past year, and the members of the staff in the Bureau of Filtration for their untiring devotion to the work in my charge.

The operations of the Upper and Lower Roxborough and Belmont Filters have been sufficient to remove from the realm of doubt the value of plain sand filtration for the Schuylkill river water, and to establish the effect of filtered water on the typhoid fever rates of the City, and to this result each member of the staff has contributed his share of the work.

Respectfully submitted,

JOHN W. HILL,
Chief Engineer.

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

Contract No.	Description of Contract	Contractor.	Date of Letting.	Date of Award.	Date of Contract.	Limit of Contract.	Payment.	Date of Final Payment.
1	A Testing Station..............	Thomas Parker.....	Feb. 27, 1900..	Feb. 27, 1900..	Mar. 6, 1900...	$9,000 00	$11,653 54	July 13, 1900.
1 Sup.	Extension to Testing Station.	Thomas Parker.....	....	Apr. 24, 1900..	May 7, 1900...	5,000 00		
2	Ice Refrigerating Machine....	Newb'g Ice Machine & Eng. Co..........	July 20, 1900..	July 25, 1900..	Aug. 20, 1900..	800 00	800 00	Nov. 19, 1900.
3	Filtering Sand and Gravel for Testing Station..............	Norcross & Edmunds............	July 20, 1900..	July 23, 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 20, 1900..	July 27, 1900..	674 50	649 50	Oct. 31, 1900.
5	Test Borings...................	Flaghouse & Beeson	Aug. 7, 1900...	Aug. 8, 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..	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..	Apr. 19, 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 Award	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.		Feb. 20, 1901..				
9A	Cast Iron Stop Boxes..........	J. Alfred Clark.....	Feb. 11, 1901..	Feb. 28, 1901..	May 14, 1901..	$2,100 00	$1,563 80	Dec. 21, 1901.
9B	Stop Valves.....................	Eddy Valve Co......	Feb. 11, 1901..	Mar. 18, 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..	Mar. 18, 1901..	May 8, 1901...	7,500 00	7,488 14	Dec. 20, 1901.
10	Lower Roxborough Filters...	Daniel J. McNichol.	Feb. 11, 1901..	Feb. 20, 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...	May 24, 1901..	June 6, 1901...	360,000 00	165,784 49	Not completed.
12	Upper Roxborough Filters...	Daniel J. McNichol.	Apr. 17, 1901..	Apr. 19, 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..	Apr. 18, 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 Award	Date of Contract.	Limit of Contract.	Payment.	Date of Final Payment.
14	Torresdale conduit...........	D. J. McNichol	May 28, 1901..	Aug. 28, 1901..	Oct. 4, 1901....	$1,350,000 00	$1,245,153 48	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..	June 26, 1901..	Aug. 7, 1901...	2,000,000 00	1,969,136 18	Oct. 10, 1904.
17	Extension of Distribution System......................	Daniel J. McNichol.	April 17, 1901.	Apr. 29, 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. 14, 1901..	Aug. 22, 1901..	23,500 00	21,332 09	March 29, 1904.
19	Belmont Rising Mains, Upper Roxborough Connection Pipes and Extension of Distribution Pipe System...	Daniel J. McNichol.	Dec. 18, 1901..	Dec. 23, 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..	Feb. 17, 1902..	Mar. 1, 1902...	10,800 00	10,490 00	Jan. 25, 1904.

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 Award.	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..	Sept. 27, 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..	Oct. 28, 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.	July 7, 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..	Dec. 23, 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..	Dec 23, 1901..	Jan. 18, 1902..	5,000,000 00	4,717,167 05	Not completed.
26	Torresdale Testing Station....	Patrick Gormly....	July 29, 1901..	Aug, 2, 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 Award.	Date of Contract.	Limit of Contract.	Payment.	Date of Final Payment.
27	Oak Lane Reservoir..........	R. A. Malone & Co..	Dec. 18, 1901..	Dec. 23, 1901...	Mar. 14, 1902..	$550,000 00	$446,159 46	Not completed
28	Lardner's Point Distribution.	Daniel J. McNichol.	Feb. 16, 1903..	Feb. 18, 1903...	Mar. 4, 1903...	1,300,000 00	1,180,660 43	Not completed.
29	Lardner's Point Pumping Station, No. 2...............	Geo. C. Deitrich.....	Sept. 17, 1902.	July 18, 1902..	Oct. 4. 1902 ...	565,000 00	466,342 26	Not completed.
30	Lardner's Point Pumping Station, No. 2...............	....	Feb. 26, 1902..	Readvertised as Contract No. 29.				
32	Addition to Testing Station at Sp. Garden Pump'g Station	....	Sept. 25, 1901 .	No Award Made.				
33	Sand Washers for Upper Roxborough Filters.............	E. M. Nichols.......	Mar. 24, 1903 .	Mar. 27, 1903..	Apr. 4, 1903...	4,000 00	3,849 00	Sept. 4, 1903.
34	Torresdale Intake............	D. J. McNichol......	Aug. 2, 1904...	Aug. 3, 1904...	Aug. 8, 1904 ..	180,000 00	....	No payments made.
37	Preliminary Filters, Lower Roxborough................	Maignen Filt't'n Co.	Sept. 23, 1902.	Oct. 3, 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 Award.	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..	Feb. 18, 1903..	Mar. 4, 1903..	$50,000 00	$47,076 48	April 8, 1904.
38	Prelim'y Filters for Belmont.	....	Feb 18, 1904..	No award.				
39	Prelim'ry Filters for Belmont and Torresdale..............	D. J. McNichol......	Nov. 1, 1904..	Nov. 15, 1904..	Nov. 22, 1904..	1,580,000 00	13,262 40	Not completed.
40A	Low Service Drainage for the Belmont Filters.............	Camden Iron Wks..	June 30, 1903..	July 13, 1903..	July 27, 1903..	7,000 00	7,298 44	Dec. 30, 1904.
40B	Sand Washer Pumps and Boilers for Belmont Filters.	I. P. Morris Co......	June 30, 1903..	July 13, 1903..	July 24, 1903..	29,000 00	16,543 12	Not completed.
42	Administration Building and Pumping Station at Belmont Filters.................	H. B. Shoemaker & Co..................	June 30, 1903..	July 30, 1903..	July 17, 1903..	55,000 00	51,488 36	Sept. 24, 1904.
44	Electric Lighting System for the Upper and Lower Roxborough Filters..............	Pa. Equipment Co..	Mar. 24, 1903..	Mar. 30, 1903..	Apr. 22, 1903..	15,500 00	14,577 48	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 Award.	Date of Contract.	Limit of Contract.	Payment.	Date of Final Payment.
45	Electrical Generators, Driving Engines, etc., for Lardner's Point Pumping Station, No. 2....................	J. F. Buchanan & Co	Feb. 18, 1904..	Apr. 20, 1904..	Aug. 5, 1904...	$9,000 00	....	No payments made.
46	Electric Lighting System for the Belmont Filters.........	Pa. Equipment Co..	June 30, 1903.	July 2, 1903...	July 21, 1903..	20,000 00	$13,773 37	Not completed.
48	Electric Traveling Crane for Lardner's Point Pumping Station, No. 3...............	Alfred Box Co...	Aug. 2, 1904... Nov. 1, 1904...	Nov. 10, 1904..	No award. Nov. 17, 1904..	6,500 00	....	No payments made.
49	Filtering Materials and Underdrains for the Belmont Filters.......................	Daniel J. McNichol.	Feb. 16, 1903..	Feb. 18, 1903...	March 4, 1903.	365,000 00	349,736 91	Sept. 28, 1904.
50	Filtering Materials and Underdrains for the Torresdale Filters.......................	Daniel J. McNichol	Feb. 16, 1903..	Feb. 18, 1903...	March 4, 1903.	500,000 00	167,620 00	Not completed.
54	Queen Lane Conting'nt—Torresdale Filters...............	Daniel J. McNichol.	Feb. 18, 1904..	Mar. 29, 1904..	July 28, 1904..	570,000 00	467,873 45	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 Award.	Date of Contract.	Limit of Contract.	Payment.	Date of Final Payment.
59	Sand Washers and Ejector Pipes for Torresdale Filters..........................	E. M. Nichols........	Aug. 11, 1904..	Apr. 12, 1904...	Sept. 8, 1904..	$37,000 00	$21,397 77	Not completed.
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 2, 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 2, 1903...	July 16, 1903..	2,700 00	2,700 00	Aug. 4, 1904.
66	Pipe Line "U"—Extension of the Roxborough Distribution System..................	J. H. Louchheim....	Sept. 4, 1903.. Feb. 18, 1904..	Apr. 7, 1904...	No award made. Aug. 3, 1904.	110,000 00	85,474 83	Not completed.
67	Pumping Machinery for Lardner's Point Pumping Station, No. 2...............	Holly M'f'g. Co....	Feb. 18 1904..	Apr. 18, 1904..	Aug. 18, 1904..	440,000 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 Award.	Date of Contract.	Limit of Contract.	Payment.	Date of Final Payment.
68	Lardner's Point Pumping Station No. 3...............	Ryan & Kelly.......	Feb. 18, 1904..	Apr. 18, 1904..	Aug. 17, 1904..	$350,000 00	$155,663 68	Not completed.
73	Washers, boxes and piping for Foundation Bolts of Engines at Lardner's Point Pumping Station No. 3...	J. Alfred Clarke.....	Aug. 15, 1904..	Aug. 19, 1904..	Aug. 29, 1904..	2,050 00	2,048 25	Nov. 17, 1904.
74	Removal of Laboratories from Spring Garden Testing Station to Belmont Filters......................		Aug. 15, 1904.. Sept. 6, 1904...		No Award...	Work done	by Water	Bureau.
75	Furnishing Electric Ducts for Torresdale Filters......	Standard Vitrified Conduit Co.........	Aug. 15, 1904..	Aug. 22, 1904..	Sept. 2, 1904..	1,000 00	924 75	Oct. 10, 1904.
76	Furnishing and placing Ventilator Screens for Torresdale Filters..........	De Witt Wire Cloth Co..................	Aug. 15, 1904...	Aug. 16, 1904..	Aug. 30, 1904..	7,750 00	7,619 96	Dec. 22, 1904.

Item.	Description.	Quantity.	Lower Roxborough.	Upper Roxborough.	To C
1	Excavation........................	Cubic yards.	66,257	134,157	
2	Embankment...........	Cubic yards.	22,000	59,500	....
3	Puddle.............................	Cubic yards.	8,750	17,060	....
4	Concrete..........................	Cubic yards.	12,974	24,336	
5	Brick masonry.....................	Cubic yards.	111	302	
6	Rubble masonry..................	Cubic yards.	....	....	....
7	Cast iron pipe.....................	Tons.	220	1,005	....
8	Special castings..................	Tons.	50	170	....
9	Stop valves, 4-inch to 72-inch.....	Each.	55	{ 1 sluice, 63 valves. }	...
10	Cast iron fixtures, etc............	Pounds.	43,021	52,860	
11	Miscellaneous steel...............	Pounds.	70,040	131,512	
12	Filter drains.......................	Linear feet.	6,885	15,875	....
13	Filter gravel........................	Cubic yards.	4,298	9,490	....
14	Filter sand.........................	Cubic yards.	13,247	26,367	....
15	Granolithic pavement...........	Square yards.	4.742	10,200	....
	Remarks......................	....	....	....	....

CONTRACT PRICES.

Bureau of Filtration.

Ordinances January 12, 1900.

Where unit prices are given for items in lump sum contracts they are held to apply only for extra work not covered by the original plans for the contract.

Contract No. 34.

TORRESDALE INTAKE.

Daniel J. McNichol, Contractor.

Awarded August 3, 1904.

Intake complete	$159,000 00	lump sum
Additional excavation below high water	3 50	per cu. yd.
Additional excavation above high water	1 00	per cu. yd.
Additional concrete	12 00	per cu. yd.
Additional rubble masonry	6 00	per cu. yd.
Additional common brick masonry	14 00	per cu. yd.
Additional granite work	3 00	per cu. ft.
Additional steel bars in concrete	09	per pound.
Additional structural wrought iron and steel	06	per pound.
Additional cast iron fixtures	06	per pound.
Additional Y. P. piles	50	per lin. ft.
Additional pile shoes	1 00	each.
Additional Y. P. lumber	40 00	per M. ft. B. M.

Contract No. 39.

PRELIMINARY FILTERS AT BELMONT.

Daniel J. McNichol, Contractor.

Awarded November 15, 1904.

Preliminary filters and house, complete	$218,000 00	lump sum.
Additional excavation for pipe trenches	2 75	per cu. yd.
Additional excavation other than for pipe trenches	75	per cu. yd.

Additional rolled embankment	50	per cu. yd.
Additional puddle	4 75	per cu. yd.
Additional concrete	11 00	per cu. yd.
Additional steel bars in concrete....	04	per pound.
Additional common brick masonry..	20 00	per cu. yd.
Additional hub and spigot C. I. pipe.	38 00	per ton.
Additional hub and Spigot C. I. special castings	80 00	per ton.
Additional flange special castings...	150 00	per ton.
Additional C. I. fixtures	04	per pound.
Additional W. I. bolts, nuts, bars and pipe supports	06	per pound.
Additional structural steel	06	per pound.
Additional filter gravel	3 50	per cu. yd.
Additional filter sand	2 75	per cu. yd.
Additional Y. P. timber	60 00	per M. ft. B. M.

Contract No. 39.

PRELIMINARY FILTERS AT TORRESDALE.

Daniel J. McNichol, Contractor.

Awarded November 15, 1904.

Preliminary filters and houses complete	$1,334,000 00	lump sum.
Additional excavation for pipe trenches	2 75	per cu. yd.
Additional excavation other than for pipe trenches	75	per cu. yd.
Additional rolled embankment	50	per cu. yd.
Additional puddle	4 75	per cu. yd.
Additional concrete	11 00	per cu. yd.
Additional steel bars in concrete....	04	per pound.
Additional common brick masonry..	20 00	per cu. yd.
Additional hub and spigot C. I. pipe	38 00	per ton.
Additional hub and spigot C. I. special castings	80 00	per ton.
Additional flange special castings...	150 00	per ton.
Additional C. I. fixtures	04	per pound.
Additional W. I. bolts, nuts, bars and pipe supports	06	per pound.
Additional structural steel	06	per pound.
Additional filter gravel	3 50	per cu. yd.
Additional filter sand	2 75	per cu. yd.
Additional Y. P. timber	60 00	per M. ft. B. M.

Contract No. 45.

ELECTRIC GENERATORS, DRIVING ENGINES, ETC., FOR LARDNER'S POINT PUMPING STATION, No. 2.

J. F. Buchanan & Co., Contractors.

Awarded April 20, 1904.

For three (3) driving engines, three (3) electrical generators, and one (1) main switch board, including all pipes, valves, electrical instruments and connections and all appurtenances	$8,700 00 lump sum.

Contract No. 48.

ELECTRIC TRAVELING CRANE FOR LARDNER'S POINT PUMPING STATION No. 3.

Alfred Box Co., Contractors.

Awarded November 10, 1904.

For electric traveling crane, complete	$6,500 00 lump sum.

Contract No. 54.

QUEEN LANE CONTINGENT OF FILTERS AT TORRESDALE.

Daniel J. McNichol, Contractor.

Awarded March 29, 1904.

For the entire work of constructing ten (10) filters, complete, with all appurtenances	$547,989 00 lump sum.
Additional excavation for pipe trenches	2 50 per cu. yd.
Additional excavation other than for pipe trenches	40 per cu. yd.
Additional rolled embankment	50 per cu. yd.
Additional puddle	4 75 per cu. yd.
Additional concrete	9 50 per cu. yd.
Additional 3-inch mesh—expanded metal No. 10.....................	10 per sq. ft.
Additional brick masonry	18 00 per cu.yd.
Additional C. I. pipe	36 25 per ton.
Additional special castings	75 00 per ton.

Additional flange pipe and specials..	$95 50 per ton.
Additional wrought iron or steel...	15 per pound.
Additional C. I. fixtures	12 per pound.
Additional T. C. pipe 12 inches and less	1 10 per lin. ft.
Additional granolithic pavement....	2 35 per sq. yd.
Additional straight curbing.........	1 40 per lin. ft.
Additional curved curbing...........	2.10 per lin. ft.
Additional sodding	1 50 per sq. yd.
Additional Y. P. timber	60 00 per M. ft. B. M.
Additional piles	50 per lin. ft.
Additional pile shoes and spikes.....	12 per pound.

Contract No. 59.

SAND WASHERS AND EJECTOR PIPES FOR TORRESDALE FILTERS.

E. M. Nichols, Contractor.

Awarded April 12, 1904.

For furnishing, delivering and erecting seventeen (17) double sand washers, complete	$13,095 00 lump sum.
For furnishing, delivering and erecting system of ejector pipes and meters, complete	$20,015 00 lump sum.

Contract No. 66.

CAST IRON WATER PIPE, SPECIAL CASTINGS, TRENCHING AND PIPE LAYING.

J. H. Louchheim, Contractor.

Awarded April 7, 1904.

Furnishing, delivering and laying 24-inch C. I. water pipe (Class B)...	$33 00 per ton.
Furnishing, delivering and laying 20-inch C. I. water pipe (Class B)...	34 00 per ton.
Furnishing, delivering and laying 16-inch C. I. water pipe (Class B)...	32 50 per ton.
Furnishing, delivering and laying hub and spigot special castings, all sizes and classes	90 00 per ton.

Furnishing, delivering and laying 24-inch geared hub end stop valves.	$225 00	each.
Furnishing, delivering and laying 20-inch hub end stop valves........	130 00	each.
Furnishing, delivering and laying 16-inch hub end stop valves........	75 00	each.
Furnishing, delivering and laying 12-inch hub end stop valves.........	45 00	each.
Furnishing, delivering and laying 8-inch hub end stop valves........	25 00	each.
Furnishing, delivering and laying grey iron castings for stop box frames and covers	03	per pound.
Earth excavation in trenches, including all appurtenances	90	per cu. yd.
Rock excavation in trenches, including all appurtenances	2 30	per cu. yd.
Hard burnt brick in Portland cement mortar, in place	16 00	per cu. yd.
Portland cement concrete, in place..	7 00	per cu. yd.
Rubble masonry in Portland cement mortar in place	5 00	per cu. yd.
Hemlock timber in pipe trenches....	30 00	per M. ft. B. M.
Wrought iron straps, bars and bolts, in place	10	per pound.

Contract No. 67.

PUMPING MACHINERY FOR LARDNER'S POINT PUMPING STATION No. 2.

Holly Manufacturing Co., Contractors.

Awarded April 18, 1904.

Three pumping engines and twelve marine fire box boilers, furnished, delivered, erected and completed, ready for continuous service	$427,769 00	lump sum.

Contract No. 68.

LARDNER'S POINT PUMPING STATION No. 3.

Ryan & Kelley, Contractors.

Awarded April 18, 1904.

Constructing the foundations and superstructures for engine house and boiler house No. 3, complete, with engine and boiler foundations, chimneys, smoke tunnels, pump well, sewers, pipes, and all other appurtenances	$307,236 00	lump sum.
Additional excavation	1 50	per cu. yd.
Additional concrete	9 50	per cu. yd.
Additional puddle	6 00	per cu. yd.
Additional rubble masonry	6 00	per cu. yd.
Additional common brick masonry..	15 00	per cu. yd.
Additional fire brick lining..........	55 00	per M.
Additional cut granite work	4 50	per cu. ft.
Additional granolithic pavement....	2.50	per sq. yd.
Additional cut steel bars in concrete	05	per pound.
Additional wrought iron or steel....	10	per pound.
Additional hub and spigot C. I. water pipe	40 00	per ton.
Additional hub and spigot special castings	90 00	per ton.
Additional C. I. fixtures	10	per pound.
Additional vitrified T. C. pipe 12 inch diameter and over	50	per lin. ft.
Additional Y. P. piles	75	per lin. ft.
Additional pile shoes, including spikes, complete	1 25	each.
Additional Y. P. lumber	60 00	per M. ft. B. M.
Additional sodding	25	per sq. yd.