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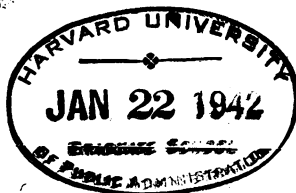
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THIRD ANNUAL MESSAGE

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OF

CHARLES F. WARWICK

Mayor of the City of Philadelphia

WITH

ANNUAL REPORT

OF

THOMAS M. THOMPSON

Director of the Department of Public Works

AND OF THE

Philadelphia Dept. of Public Works

BUREAU OF WATER

FOR THE

YEAR ENDING DECEMBER 31, 1897

BOBOL SOCIETY
CIVIL ENGINEERS

PHILADELPHIA:
DUNLAP PRINTING CO., 1306-8-10 FILBERT STREET
1898.

UNIVERSITY OF PHILADELPHIA

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OFFICE OF THE MAYOR

PHILADELPHIA.

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Secretary :

JOHN K. McCARTHY.]

Chief Clerk :

HARRY C. GILL.

Contract and License Clerk .

JOSEPH F. JONES.

Stenographer and Typewriter :

HENRY W. PEIRSON.

Ass't Stenographer and Typewriter .

HARRY M. FISLER.

Messenger :

WILLIAM G. LEE.

REPORT FOR 1897.

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THIRD ANNUAL MESSAGE

OFFICE OF THE MAYOR, CITY HALL.

Philadelphia, April 4, 1898.

TO 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 herewith transmit to your Honorable Bodies this, my Third Annual Message, upon the financial and general conditions of the Municipality. I also send the Annual Reports of the Directors of the Departments of Public Safety and Public Works, and of the President of the Department of Charities and Correction for the year 1897.

FINANCE.

The Annual Report of the City Controller shows that the total receipts of the City from all sources for the year 1897 were \$32,683,285.98 and the total expenditures \$29,616,999.07, showing an excess of receipts over expenditures of \$3,066,286.91. The receipts include the loans that were negotiated during the year 1897.

The funded debt of the City January 1, 1898, less the City Loans held by the Sinking Fund Commission and including outstanding warrants, was \$39,174,353.75; the funded debt January 1, 1897, less the City Loans held by

the Sinking Fund Commission and including outstanding warrants, was \$35,479,579.93, showing an increase of total debt since January 1, 1897, of \$3,694,773.82.

The additions to the funded debt during 1897 were \$5,054,275.00, made up in the following manner: Of the \$6,000,000 Philadelphia and Reading Railroad Subway Loan of March 15, 1894, there was issued on account \$2,400,000; for the improvement of Delaware avenue there was issued a loan of \$2,000,000; for the Refunding Loan of June 17, 1897, \$650,000 and unclaimed matured loans amounting to \$4,275.00. The amount redeemed during the same period was \$2,204,600, making an increase in the gross funded debt for the year of \$2,849,675. Deducting the City securities held by the Sinking Fund Commission from this gross funded debt leaves a net funded debt of \$37,939,220.22.

The real estate owned by the City as appraised by the Board of Revision of Taxes for the year 1898 amounts to \$53,793,669, showing an increase over the appraisement of January 1, 1897, of \$1,018,775.

It will be seen by the Controller's report that there is an apparent deficit. This, however, is susceptible of explanation. The appearance of even a seeming deficiency is misleading and results, in a measure, in affecting the credit of the City, especially in the minds of those who do not carefully study the details. The apparent deficiency is due to the fact that the personal property taxes for 1897, amounting to \$1,031,608.93 and the amount due for schools, \$1,289,934.16, making a total of \$2,321,543.09, have not all been paid by the officers of the State to the City, as required by law, only \$600,000 having been remitted, leaving a balance due the City and unpaid at the time the Controller made his report of \$1,721,543.09.

The same condition has prevailed for years and it is vicious and unwarranted. In the settlement of the City's

accounts for the year the absence of the latter sum from the City Treasury discloses a deficit amounting to \$828,325.61, whereas had this money been returned to the City by the State, as required by law, there would have been a surplus shown of \$893,217.48. Repeated demands upon the part of the City Treasurer to the State authorities, urging the payment of this money, have been made, but up to this time without avail. From the reports of the State Treasurer it is shown that there is a balance in the banks of deposit of over four millions of dollars. There may be some reason for this delay in payment, but up to this time it has not been shown. The law under which the City pays this money to the State requires that immediately upon payment by the City, the State shall remit the proportionate share to which the municipality is entitled.

In the matter of the loan of \$11,200,000 that was pending for some time before Councils and defeated, it may not be out of place to refresh our memories and take a retrospective view of the past two years. In 1896 an ordinance was passed providing for the creation of a loan of \$8,000,000 for miscellaneous purposes, and subsequently an ordinance for the creation of another loan of \$3,000,000 for the improvement of the water supply. At that time the expenditure of money under the items of these loans was considered of the utmost importance, in so far as the welfare of the City was concerned. There was little, if any opposition to the contemplated improvements, and preparations were at once made by the authorities for the placing of the loans. The question was raised, however, by certain parties who contemplated bidding for the same, as to the right of the City to increase her indebtedness under the law, it being contended that she had reached the limit of her power to borrow. To have attempted at that time to place the loans, with this doubt in the minds of the people would have resulted in either the City receiving too

little in the matter of premiums, or perhaps, no bids at all.

By reason of this condition of affairs, a Bill in Equity was filed by certain citizens in the Court of Common Pleas No. 1, asking that the City be restrained from the creation of these loans. After argument the Court held that the City had not reached the limit of her borrowing capacity and therefore had the right to increase her indebtedness to the amounts named in the ordinances. It was of the utmost importance, however, for the credit of the City, to have this question passed upon by the Supreme Court and an appeal was taken thereto, and in May last that Court handed down an opinion deciding that the question would have to be submitted to a vote of the people before the City's indebtedness could be increased. This necessitated waiting until the election in the following November and at that time, the question having been submitted to a popular vote, the City, by a majority of 17,475 votes, was authorized to increase her indebtedness in accordance with the items enumerated, to the extent of \$11,200,000. From that date up to a short time since, Councils had this Loan Bill under consideration. For upwards of three years the matter received the attention of the people, and authority came from them in November last, virtually directing the enactment of an ordinance authorizing the increase of the indebtedness to the amount of \$11,200,000 for the improvements provided for under the several and distinct items of the bill. In the meantime a measure introduced into Councils and known as the Schuylkill Valley Water Company's bill stood in the way of the passage of an ordinance authorizing said loan.

It has been contended in some directions, that the passage of the bill authorizing the creation of the loan would carry with it an appropriation. It is useless to say that this is not so; the bill simply provided for authority to increase the indebtedness of the City to the amount of \$11,200,00,

and such authority would not have carried with it in any way an appropriation, or power to expend one penny under any of the items enumerated. If this Loan bill had passed, separate bills providing for appropriations under the different items would have been introduced and referred to the proper committees and unless favorably reported by them and acted upon favorably by Councils, the appropriations and expenditures could not have been made.

The most urgent and important item under the said bill was of course, that of \$3,700,000 for the improvement of our water supply ; this matter is referred to, however, under the distinct head of the Bureau of Water. The other items of the so-called Loan bill provided for the improvement of suburban roads, the completion of the Boys' High School and the erection of new school buildings, for building main sewers and the completion of the Aramingo Canal Sewer, for the building of a new almshouse, for the abolition of grade crossings on the line of the Philadelphia and Trenton Railroad, for the equipment and building of the Philadelphia Museums, for the building of an art gallery, for a library site and building, for the extension of Fairmount Park, for the repaving of streets, tramway streets and intersections and underground work incident thereto, for the building of bridges, for the improvement of public parks and squares, for the purchase of ground and the building of fire and police stations, and electrical and underground construction, for grading and repairs to paved streets, curved curbing, resurfacing asphalt streets, repairs to bridges, repairs to sidewalks, repairs to ditches and sluices, and for repaving with an improved pavement small streets, 40 feet or less in width from house-line to house-line and underground work incident thereto.

A careful reading of these items, I am sure, must convince every fair minded and progressive man in this com-

munity, that money expended in these directions would bring great results in so far as the health, safety, comfort, convenience and enlightenment of our people are concerned.

In order that this measure might receive popular support, I called about me a Citizens Advisory Committee composed of experienced, progressive business men representing every interest, and taken from every walk in life. This committee held many meetings, consulted with members of Councils (for the committee was appointed to advise not only with the Executive but the Legislative branches of the City Government), and they have loyally given their time and thought to the consideration of this important bill in its every feature, as affecting the interests and the welfare of the City.

It was contended a short time since, while this bill was pending in Councils, that it contained several objectionable features and that many members who were willing in every way by legislation to assist in the improvement of the water supply, could not vote for the bill in its entirety, and to meet this objection, I submitted a message to Councils calling upon both branches to disregard all factional considerations and acting singly for the welfare of the City, to consider alone that item providing for the improvement of the water supply, but even then the measure was defeated. I now call upon your Honorable Bodies to take up, at the earliest possible moment, the consideration of a loan bill, following in every particular the features of the original bill. There should be no opposition to the improvement and filtration of the water supply, to the improvement of suburban roads, to the completion of the Boys' High School, the erection of new school buildings, the improvement of our sewer system, the abolition of grade crossings, the extension of Fairmount Park, the common pleasure ground of the people, the repaving of our streets, especially the small streets, with im-

proved pavements, the abatement of the Aramingo Canal nuisance, the equipment and building of the Philadelphia Museums, an institution that has already given to our City an international reputation, nor to the building of an Art Gallery and a Free Public Library. These last two are not mere luxuries, as has been intimated in some quarters; they are for the improvement, refinement and education of our people and may be a beginning that will ultimately make our City the art centre of this continent. Public spirited citizens who have devoted their wealth and time to the collection of pictures and works of art stand ready, whenever the opportunities are offered, to present to the City donations of immense value. Such collections will call to our City strangers from all over this continent and also from foreign countries. Even if we are to consider these matters from the most selfish standpoint, an appropriation made in these directions will bring ample financial return.

No city can stand still. She must either advance or lose her position. Philadelphia in the past ten years has progressed marvellously and to halt her now in her career would be most disastrous.

I cannot refrain at this time from calling attention to a gift that has recently been made to the city by a public-spirited citizen of his beautiful residence on North Broad street, to be used as a branch of the Free Library. The gift is to be coupled with a donation of pictures representing the best examples of American art, amounting in value to the sum of \$400,000.

If the city be generous and broad in her liberality in the support of such institutions, she will induce generosity upon the part of her wealthy citizens. These are questions that should rise above all selfish or personal considerations, and I appeal to your Honorable Bodies not to deprive this City

of the opportunity now offered, to secure those improvements that will be of incalculable benefit to our whole people and for all time.

DEPARTMENT OF PUBLIC SAFETY.

The report of the Director of the Department of Public Safety is full of interesting material and worthy of careful consideration, and I cannot speak too highly of the efficiency and loyalty shown by him in the discharge of his duty.

Bureau of Police.

The police force is well disciplined, under most excellent control, and has rendered most efficient service. Your attention is specially called to the fact that in certain sections of our City an increase in the number of patrolmen is required, and in the suburban districts, an increase in the mounted force.

An innovation was made during the past year in the assignment of a member of the force as a Drill Master, and already the value of his services is seen and appreciated.

Better accommodations and conveniences should be afforded the men in the different station houses. It will be seen by the report of the Director that 512 men are forced to occupy "beds in pairs." The station houses should be made as comfortable and as attractive as possible. Attention given to this matter will necessarily improve the *morale* of the force.

During the summer of 1897 11,719 vacant houses were under the care of the Bureau of Police, an increase of 1,253 over the year 1896. Of this number but 34 (12 less than in the year 1896) were entered and robbed of goods valued at \$14,252. Goods to the amount of \$1,388 were recovered. This gives some idea of the faithful services rendered by those men who watch during the period of vacation, when thousands of our citizens are absent from their homes.

Since my last annual report, I am glad to say that the question that had been raised as to the right of the City to appropriate money to the Police and Firemen's Pension Funds has been decided by the Supreme Court to the effect that the Municipality may make such appropriations. The work that these public servants are called upon to perform, often in the face of impending danger, requires courage and heroism, and to provide for their families in case of death and for them personally after a long period of faithful service, appeals not only to our sympathy but it is an imperative duty.

In the matter of Meat Inspection a great deal of valuable work has been done, and consequently much disease prevented. I refer you especially to the Director's report upon this important branch of the service.

Bureau of Fire.

This Bureau is in a most excellent state of discipline, The total number of fires during 1897 was 2,427, being 185 less than during the previous year. The total amount of loss sustained was \$2,680,670, being an increase of \$241,617 over the previous year.

In 1886, after a competitive test between the Rotary and the Piston types of engines, the former was considered the best. A few weeks since, another test was made by the Bureau in the presence of a committee of three citizens, experienced in these matters, and their report favors the use of the Piston rather than the Rotary engine. In view of this fact, I agree with the Director that hereafter the purchase of engines should be made only after a most careful competitive test.

A new danger in case of fire has arisen in this City within a comparatively recent period owing to the erection of very high buildings. Many of these structures are called fire-proof, but experience has shown us that in frequent instan-

ces this is a misnomer, and it is of the utmost importance that special measures for protection should be provided. The suggestion that large mains should be laid from the Delaware river westward to Broad street on Market, Chestnut and Arch streets with a pumping station at the Delaware River, and a similar line of mains from the Schuylkill River eastward to Broad street on the same streets, with a pumping station at the Schuylkill River, for the purpose of giving direct pumpage of great volume and force in case of fire upon those main business thoroughfares, is worthy of careful consideration.

To show the dangers that are undergone and the heroism that is shown in this branch of the service, it is only necessary to state that 260 firemen, while in the performance of their duty, suffered injuries of a more or less serious nature.

Electrical Bureau.

The Electrical Bureau, as I have taken occasion to say heretofore in my previous messages is one of the best equipped and one of the most efficient in this or any other country. The plant is one of which the City has every reason to be proud.

Philadelphia, without question, in so far as I have been able to learn from personal inspection, is the best lighted City on this Continent. We have 7,119 lamps located in our streets which furnish not only illumination but provide safety and security for life and property.

The report of the commission appointed under resolution of your Honorable Bodies to inquire into the subject of an Electric Light Plant, to be owned and operated by the City, referred to in the report of the Director, merits your most careful attention. The report of the experts shows that an overhead system would cost \$1,562,731, and its annual maintenance \$583,664.74; that an underground

system would cost \$3,475,867 and its annual maintenance \$732,210.18.

Bureau of Health.

The Bureau of Health last year lost by death two of its members, Dr. Peter D. Keyser, who died on March 9, 1897, after a faithful and intelligent service covering a period of eight years, and Dr. W. H. Ford, who died on October 18, 1897, after a like faithful and intelligent service covering a period of twenty-six years, and let it be borne in mind that these two officials served without remuneration, save that which comes from the satisfaction of a public duty loyally performed.

The vacancies caused by these deaths were filled by the appointment of James W. Walk, M.D., on April 9, 1897, and George Woodward, M.D., on December 21, 1897.

The members of the Board of Health cannot be too highly commended for the loyal and efficient services they have at all times given.

The general health of the City during 1897 was unusually good. The death rate was 18.72 per 1000, being the lowest record for thirteen years. Diphtheria as shown by the reports prevailed to a greater extent than for several years past. Scarlet fever had a slight increase in percentage over the year 1896. There was not one single case of small-pox in this City during the year, so far as is known, nor has there been a case since October, 1895. Typhoid fever caused 401 deaths, one less than during the previous year, although the number of cases reported was 2,994, an increase of 504. It is generally believed that this increase was directly due to the use of our drinking water in certain localities. Dr. Abbott, Chief of the Division of Bacteriology, in a report made by him as to the cause of this increase in these districts, shows proofs of the connection between the outbreak of typhoid fever in December and the overflow of the intercepting sewer.

Accompanied by several officials I made, a short time since, a personal inspection of the Municipal Hospital, and I desire to urge upon the attention of your Honorable Bodies the absolute necessity of an immediate appropriation for its sanitary improvement, especially of the main building, which, in its present dilapidated condition lacking proper accommodations, is a disgrace to our civilization and a reflection upon our humanity. The heating apparatus is most primitive and the system of ventilation most incomplete. On the upper floors, where the sick are confined, the food is received in and distributed from bath rooms, which are in close proximity to a double row of water closets.

There are no suitable conveniences for the physicians, the nurses and those having the care of the patients, but notwithstanding these unfavorable conditions too much praise cannot be given to those in charge of the institution. The cleanliness and the tidiness shown throughout, spoke in commendation of the care and devotion of those having the hospital in charge.

The buildings should be enlarged and greater accommodations provided at the earliest possible moment. Owing to lack of space the authorities are compelled frequently to have in the same ward patients with scarlet fever as well as those with measles. This should not be allowed to continue.

The Board of Health is now carefully preparing plans providing for the improvement and extension of this hospital, which plans will soon be submitted to your Honorable Bodies for consideration. This hospital unfortunately is looked upon as a pest house and many efforts have been made to remove it from its present locality, and so long as this question of removal is agitated, just so long will there be uncertainty as to what should be done in the matter of permanent improvements. This question should be set at rest and acted upon definitely. It is said by those who know that in-

stitutions of like character are located in the very centre of the large cities of Europe. The science of public sanitation has made such an advance in modern times, that surrounding neighborhoods are comparatively safe and free from contagion. So far as this institution itself is concerned it has never been shown that the health of the immediate neighborhood has in any wise been affected by its presence.

As to that dreaded disease small-pox, it would be wise to erect a separate hospital in some other locality or if ground could be secured in close proximity to the present institution, a building with all modern conveniences ready for any emergency should be constructed.

Bureau of City Property.

The Bureau of City Property should be specially commended for the care given to the public parks. They are the pleasure grounds of the people, the play grounds of the children and they should be made as attractive as possible.

The restoration of Independence Hall is making satisfactory progress, and it is hoped that during the coming summer the work will be completed and that this building so sacred and historic in its associations will appear as it did in 1776, during the period of the American Revolution. Much study has been given to the matter by the officials having the immediate charge of this important work. Plans and pictures of the period of the Revolution that could in any wise throw light upon the matter have been carefully studied and historical information wherever obtainable has been most diligently sought for, in order that the restoration may be as close in appearance to the original structure as possible. Great interest has been shown in this work by many of our public spirited citizens and to all those who have assisted us we return our most generous thanks.

Bureau of Building Inspection.

The work performed by this Bureau is of the most important character and I desire to say that it is most intelligently performed in so far as lies within its power.

The building permits for 1897 numbered 8,312, an increase of 1,092 over the previous year. I call attention to the statement made by the Director that the appropriations made to this Bureau for the year 1897 were \$49,320, and the receipts \$39,339.83. The ordinance under which building permits are granted was enacted a number of years ago, when the conditions were radically different from what they are to-day, and a judicious re-adjustment of the charges would easily make this Bureau self-supporting. An ordinance has been framed and will be introduced early in April with this end in view.

To give some idea of the amount of work done by this Bureau during the year 1897 it is only necessary to state that the Inspectors made 52,394 visits. The condemnations amounted to 996, embracing 1,663 buildings.

The ordinance of April 10, 1894, which authorizes the inspection of elevators, as I said in my last Annual Message, cannot be carried out because the force of Inspectors is totally inadequate. In this connection let me say, that it is estimated that there are about 10,000 elevators already in this City and but three inspectors. Every precaution should be taken in the construction of elevators and in view of the tall office buildings which have been and are now being erected, such precaution is an absolute necessity for the safety of our citizens. The most scientific appliances should be insisted upon, and provision made for frequent and careful inspection.

Bureau of Boiler Inspection.

The total number of boilers inspected by this Bureau during the year 1897 was 3,141, and a reference to the report

of the Director will show that the receipts of the Bureau were \$19,908.60, being \$3,908.60 in excess of the expenses.

DEPARTMENT OF PUBLIC WORKS.

The Director of the Department of Public Works deserves much commendation for his able and conscientious discharge of his public duties. The immense amount of work done by this Department cannot be fully appreciated without a careful study of the Director's report.

Bureau of Gas.

The conduct of this Bureau remained under the control of the Department of Public Works until the City leased the same to the United Gas Improvement Company on November 30, 1897. The operations of the Bureau for 1897 until the lease was entered into, included the finishing of the 3,000,000 cubic feet holder at the Point Breeze Works, and the completion of Retort House No. 1 at the Twenty-fifth Ward Works. The total receipts, as reported for the eleven months to November 30, 1897, were \$3,061,-391.71. The gross profits for the eleven months were \$382,662.12, not taking into account the expenses incident to betterments and the lighting of public street lamps as well as the miscellaneous expenses in the matter of the collection of the charges due the City for the consumption of gas.

In the matter of the lease of the Gas Works, there are some facts that I wish to submit at this time. In the beginning of August of last year a proposition was submitted to me by the United Gas Improvement Company providing for the leasing of the Gas Works from the City. The Company offered to expend in the space of three years \$5,000,000 for permanent improvements to bring the plant up to the requirements of the day, and to pay a large sum of money annually into the Treasury of the City.

The principal features of the offer are so well known to your Honorable Bodies, that it is not worth while to refer to them specifically. When the proposition was made, the Company submitted a number of letters from prominent citizens and officials of other cities in which it was conducting its business, showing that it had given good service and entire satisfaction to the public. The proposition was also endorsed by many of our leading business men and had almost the unanimous support of the newspapers of this City. The opponents of the measure when it was introduced into Councils grew bitter in their opposition and in the heat and excitement incident to the time, statements were made which were not founded in truth.

The bill passed Councils and then came to me for my approval or disapproval. Immediately a Bill in Equity was filed in the Court of Common Pleas No. 4 praying the Court to restrain the execution of the contract. Pending the judicial proceedings the matter was held in abeyance. After argument the Bill was dismissed, the contract signed and the company put in possession of the property. Subsequently the Supreme Court affirmed the decision of the court below.

I believe this lease is in the interest of the community. The Gas Works, under the agreement, can be brought up to present scientific standards and will turn a much larger sum of money into the Treasury of the City, than could have been returned under Municipal management.

In my judgment no Municipality can as successfully conduct a manufacturing business as a private corporation.

The constant succession of administrations every four years, the consequent changes in the heads of departments and the inability to continue because of these changes, a settled definite policy looking to one end, must prove to every thinking man that these conditions greatly interfere

with the successful operation of any manufacturing enterprise. No private business could prosper under such a system.

For years the complaints of the citizens have been constant in relation to the quality of our gas, and the administration has done everything in its power to secure appropriations for the improvement of the works.

In my first annual message I said that the Gas Works were one of the most valuable assets of the City and called attention to the fact that the sum of \$54,589.59 was all that had been expended during the year 1895 for permanent improvements; that to keep the works up to the proper standard, it would be necessary to make greater improvements, not only in the manufacture, but in the distribution of the gas, that these improvements would call for large expenditures of money and I further stated that the gas, when it reached the consumer, was not of the quality that it should be and there was no need to conceal the truth.

In my last annual message I again called the attention of Councils to the fact that it would be necessary to expend large sums of money, not only for the introduction of improved and modern machinery but for the laying of new and larger mains for the proper distribution of gas and to further increase the holder capacity.

Our method of distribution was unsatisfactory and insufficient. I cited as an instance of this, that in one section of the City, three dimensions of main were used, the largest being six inches in diameter, whereas a main of 20 inches in diameter would be required for the proper distribution of gas throughout that locality. Similar conditions existed in several other sections of the City. It was absolutely necessary to secure large appropriations to make the improvements in the matter of distribution as required. These facts were ad-

mitted upon every hand; the question had been most carefully considered from every point of view, but we were unable to secure the necessary amount of money to bring about the changes required. The works could not be kept up to a proper standard under these circumstances and something had to be done. It was as though we had a leaky roof which we were constantly patching and repairing when the necessities of the case required absolutely a new one. In view of these conditions, when the proposition of the United Gas Improvement Company was made I deemed it worthy of consideration. It was endorsed by many leading business men of this community, by almost the entire press of the City, and the offer was made by a corporation with capital, with experience and already in successful operation in many of the cities and towns of the United States. It was officered and controlled by business men of our own City, and so organized that it could at once, in case of lease, take immediate charge of the works. After two months' careful study of the matter I submitted the proposition to Councils. Carefully I watched the progress of the measure through both Chambers and saw nothing to change the opinion I formed at the time of its original submission to Councils.

It was of the utmost importance that the lease should be made with a company so experienced, so organized, so equipped and so capitalized that there would be no delay whatever in the continuing of the work in the manufacture and supply of gas.

To have entered into an agreement with a company that had to be formed, place its stock and organize would have resulted perhaps in disastrous delay. In other words it would have been an experiment with an inexperienced company or corporation that might have involved the whole question not only in delay but in annoyance and expensive litigation.

For reasons best known to those who circulated the reports, it was stated that the Gas Works were to be sold, and the transaction was frequently referred to as a sale of the City property.

In my inaugural address I stated that the works should be put in the highest condition of efficiency, that it would be true business economy to construct in the old city proper new mains and provide new methods of distribution; that I had been informed by those who professed to know that the works had not kept pace with the discoveries and improvements made in the manufacture of gas. I further stated, and I have seen no reason since for a change of opinion, that the works should never pass from the absolute control and ownership of the City. In my first annual message for the year ending December 31, 1895, I again called to the attention of Councils the fact that improvements were urgent, but that the gas works should never pass from the absolute control and ownership of the City, and in my second annual message for the year ending December 31, 1896, I again used the same language. I have always opposed a sale of the Gas Works.

The contract of the City with the United Gas Improvement Company is in no sense of the word a sale, but a lease. The works have not passed from the control and ownership of the City, but have been rented for a term of thirty years with a right reserved in the City, to retake possession of same at the end of ten years. It was to the best interests of the City that something should be done and immediately done at the time the proposition was made. The City, if she so desires, may create a sinking fund with the money received annually from this company under the lease, and if it be to her interest ten years from the date of the said lease to take possession, she will be in a position to do so and receive at that time a plant that will have been brought up to date, and that will have

every improvement known in the manufacture of gas, thus enabling the Municipality to conduct the business upon a profitable basis. The matter is entirely within the discretion of the people. Thirty years is a long period and perhaps prior to that time, gas in large cities will not be used for illuminating purposes.

After a most careful consideration of this matter for four months, I was clearly of the opinion when I signed the ordinance that the action of Councils was the proper solution of the case, and I confidently believe that the future will prove the wisdom of the position taken.

Bureau of Highways.

Philadelphia is as well paved as any City on this continent and ten years ago, no one would have predicted the marvelous progress we have made in the matter of improved pavements. No City on this hemisphere has ever had pavements laid at so little cost to itself. Officials from other cities who have visited us have been pronounced in their praise of the character of our highways. We have in the aggregate 1,000.36 miles of paved and macadam streets, of which 316 miles are occupied by Passenger Railway Companies which are compelled to keep and maintain in order the streets upon which their tracks are laid. We have 176.35 miles of macadam streets, of which 23 miles are turnpikes. In addition to the paved and macadam streets there are 412.64 miles of dirt roads. The work in the direction of improved streets should not be halted. The loan bill contained items amounting to \$2,550,000, which money would have been spent in the further improvement of our highways.

Improved pavements, so-called, are one of the greatest inventions of modern times; they conduce to health and comfort in that they can be easily kept clean and are comparatively noiseless. Every small street in the City at the

earliest possible moment should receive attention, and appropriations should be made looking toward the laying of improved pavements. The work done by the City upon small streets in 1897 covers about 4.55 miles.

Bureau of Street Cleaning.

It gives me pleasure to state that the work of this Bureau has been performed in a very satisfactory manner. The total number of complaints of unclean streets from all sources in 1897 was 2,401, which is 812 less than during the preceding year, and it is to be hoped that with care even this number will be greatly decreased.

The garbage of the City has been collected daily and disposed of satisfactorily and in a sanitary manner. The total number of complaints received during the year amounted to 457, being 754 less than the previous year. It is stated, and without fear of contradiction, that this work is not better done in any City on this continent, and from information received no City has its work done in this regard more economically. The total amount expended last year for street cleaning and the removal of ashes and the removal and destruction of garbage was \$866,402.62, the same character of work in New York costing, according to their reports, \$2,959,085.48, and it must be remembered that the area of our City is more than twice that of New York City as it existed prior to the new charter.

There has been criticism in some quarters in relation to the awarding of the contract for the present year for the removal and destruction of the garbage, but this criticism is founded upon information that is erroneous and upon a misconception of the real facts. The proposals for this work were opened on November 30th, 1897, and among the several bidders for the work in the different districts were the following: The American Product Company, which bid for the First District, \$54,200; Second

District, \$59,700 ; Third District, \$41,800 ; Fourth District, \$93,000 ; Fifth District, \$91,800 ; Case & Peoples, who bid for the First District, \$25,000 ; Second District, \$40,000 ; Third District, \$40,000 ; Fourth District, \$80,000 ; Fifth District, \$84,000 ; and Horatio P. Connell, who bid for the First District, \$32,000 ; Second District, \$39,800 ; Third District, \$27,000 ; Fourth District, \$57,000 ; Fifth District, \$54,000. The bids of Mr. Connell were rejected, because of the fact that he had no plant and gave no evidence that in any reasonable time he would have a plant of sufficient capacity to meet the requirements.

The contract was awarded to the American Product Company, which had the contract for the previous year and had given entire satisfaction. There had been but very few complaints from any quarter, the method of the destruction of the garbage was most efficient, and the management of its business in no wise a nuisance.

The system used by Case & Peoples, the second lowest bidders, had already been tried in this City and had proved most ineffectual. A contract had been awarded for the year 1897 for the removal and destruction of garbage in the Fourth District to The Philadelphia Incinerating Company, which used this same system. No sooner was the plant in operation than it gave rise to complaints from the people living and doing business in the immediate locality. The Women's Health Protective Association, after careful investigation of the plant, made a public protest against its further continuance. At length the nuisance became so great that a public meeting was held in the Mayor's office to urge that some action be taken looking to its early abatement. At that meeting the parties conducting and controlling the plant specially requested that a sub-committee of citizens be appointed to confer with them in relation to a settlement of the matter. An offer was then made by

them that if the plant were allowed to run for a few days longer it would be closed down and the nuisance at once abated. This offer was accepted and the business according to the agreement was stopped and the plant abandoned. So many were the complaints in relation to the plant while it was running, that to satisfy my own mind as to the truth, I personally visited it and although I did not enter the premises I was convinced by reason of the stench emitted that the complaints were in no wise exaggerated.

When Case & Peoples subsequently put in their bid for the present year to do the work under the same system, these facts were again submitted and a protest entered by the Women's Health Protective Association against the awarding of the contract to them. The matter was then carefully considered in every detail, and it was decided that there was but one thing under all the circumstances to be done, if we were to consider the health of the City and the comfort of the people and that was to award the contract to the American Product Company, the next highest bidder. This is one of the cases in which the authorities should exercise their discretion in awarding the contract not merely to the lowest bidder but to the best and most responsible bidder.

Bureau of Surveys.

The work under this Bureau is vast and of great importance and a careful study of the report of the Chief Engineer will be found to be most interesting and instructive. The several contracts for dredging in the Delaware River have proceeded satisfactorily, and it is expected that the work will be completed in the latter part of this year. We will then have a free and uninterrupted channel of 600 feet in width and 26 feet in depth at mean low water from the harbor of Philadelphia to the sea. It has been contended in the past that the obstructions in this river have

greatly interfered with the commercial prosperity of our City. With the removal of these obstructions every opportunity will be given our merchants and enterprising business men to restore our commercial supremacy.

The contracts for improving the channel of the Schuylkill River were proceeded with, unfortunately, very slowly, in a measure due to accidents to the machinery of the contractors, but an improvement has since been shown and the operations, it is expected, will be completed in a few months, although not within the time limit.

The work of widening Delaware avenue and the extension of the City piers is progressing most satisfactorily, and when completed will provide an avenue 150 feet in width between Vine and South streets, and will, in every way, facilitate the commerce and business interests of the City.

It is of the utmost necessity that liberal appropriations for the construction of main and intercepting sewers should be made. This is a class of public improvements that is not sufficiently appreciated by the people, because of the fact that it is hidden from view, but nothing so conduces to the health of a community as a complete system of sewers.

One of the most important pieces of engineering work in the history of the City is the construction of the Pennsylvania avenue Subway and Tunnel, and I am glad to say that during the past year remarkable progress has been made towards completion. The judgment of the Chief Engineer of the Bureau was shown when he originally insisted upon having all the sewers and underground work constructed before beginning upon the subway proper. During the progress of the work there has not been any overflow and at no time has the work been interfered with from that cause. The retaining walls are almost completed, the excavating shovels are at work and before the end of this year such progress will have been made that the people will have an idea of the importance and usefulness of the pro-

ject. From the beginning of the work until the present time, the business of the firms on the line of the improvement has not been interrupted or interfered with. The work incident to the underpinning and stone masonry has been done most successfully and scientifically and yet some of the leading manufacturing interests of the city are located on the line of this work. I cannot speak too highly of the engineering skill of those having in charge this great improvement. By this enterprise seventeen dangerous grade crossings will be abolished and on Broad street, the main thoroughfare running North and South, travel will be uninterrupted, and the Green street entrance to Fairmount Park vastly improved and relieved of many objectionable features. During the summer it is expected that Broad street, from Callowhill to Hamilton street, will be free of all obstructions and open to travel.

Bureau of Water.

The total receipts of this Bureau from all sources during 1897 were \$2,971,357.52 as compared with \$2,879,133.26 for the preceding year, an increase of \$92,224.26. The expenditures during the year for permanent improvements and cost of maintenance were \$1,665,153.21. The excess of receipts over expenditures or the net revenue from this branch of the City's service was \$1,306,204.31.

In 1887 the total pumpage amounted to 32,426,779,765 gallons against 95,667,466,871 gallons in 1897, an increase of 63,240,687,106 gallons. In 1887 the consumption per capita per day was 89 gallons as against 187 gallons in 1897, an increase of 98 gallons per capita per day, or in other words an average daily consumption during 1897 calculated upon an estimated population of 1,385,734, of 187 gallons per capita per day, an increase in ten years of more than 100 per cent.

I think it will be admitted that this is a wasteful and

extravagant use of water. It is a matter that calls for immediate consideration. The waste should be stopped or if it goes on at the present rate, no one can calculate what the result may be ten years from this date. It shows what a bountiful supply we have, but it also must convince every thinking man that such waste should not go on indefinitely. Nothing should be done to restrict the proper use of water in manufacturing industries, but at the same time it behooves us to consider immediately some method which while giving a bounteous supply, will prevent extravagance and wastefulness.

During the past year the relining of the Queen Lane and New Roxborough Reservoirs was completed and they both are now in service.

I am glad to report that a recent careful inspection of the Queen Lane Reservoir, shows that since relining, it is virtually water tight and is now standing the pressure of the maximum quantity without any perceptible diminution, save that which results from evaporation.

The Director of the Department calls special attention to the condition of the Belmont Pumping Station, which he says at this time is critical; that the flue system is in a precarious state and liable to collapse at any minute. If this should occur, all the pumps at this station would be thrown out of service for several weeks and in thirty-six hours, all that section of the City west of the Schuylkill River would be without water. If this occurs, somebody will be held responsible for negligence and the results might prove disastrous, and I cannot too earnestly call upon your Honorable Bodies to provide an appropriation for the improvements and repairs there required. Nothing is more costly than negligence in the making of needed repairs to machinery, and appropriations at this time should be provided for the necessary work in this regard required at Belmont, Queen Lane and Roxborough Pumping Stations.

The improvement of the water supply is a crying need. It is a matter that affects the health of every man, woman and child in this community and should receive immediate attention, for unless something be done to furnish a pure healthful supply water, not alone will the City be affected in so far as its inhabitants are concerned, but the result will be to keep from our midst strangers and visitors who at all times add to the wealth of a community. The fame and reputation of the City depend upon the intelligent settlement of this question. The typhoid fever, prevalent here, a short time since, brought us all to a realizing sense of the danger that confronts us. If the City had the money in hand, a wise solution of the question would be to bring the water from a pure source in large aqueducts to this City, but that would require so vast an expenditure of money that such a plan at present is practically beyond our reach. Fortunately we have at this time a plentiful supply of water, which no doubt will meet the requirements for many years to come provided we do not draw upon it too extravagantly. The only question to be settled is as to its quality. Inasmuch as we cannot bring our supply from a distance, it is a duty incumbent upon us to make pure and healthful by a system of filtration that which we have at hand, and I cannot too strongly nor earnestly appeal to your Honorable Bodies to immediately authorize the creation of a loan, so that an appropriation may be made providing for the construction and maintenance of filtration plants. As soon as the loan is authorized, the City will be ready through her officials, having charge of the matter, to submit, as I have already stated in a special message sent to Councils last February, a comprehensive plan looking towards the accomplishment of this object. All that we need now to make our water wholesome is the construction of filtration plants. Subsidizing reservoirs go far towards the improvement of the

water supply and we have accomplished much in that direction, but we must go a step further. We should unite our efforts to meet this great question intelligently and give relief at the earliest possible moment. Any unnecessary delay is a crime against humanity.

The net profits of the Water Bureau for the year as I have already stated amounted to \$1,306,204.31. The sum which the people have authorized to be used for the improvement of the water supply is \$3,700,000. In my judgment, this money should be used as far as it will go, in the construction of sand filtration beds. We have passed beyond the time of experimentation. There might be some question as to whether or not certain mechanical processes should be used but we have no time now to test them. There is one process known to nature which will filter water from any source and that is natural sand filtration. Wherever practicable, these natural sand filtration beds should be constructed, in close proximity to our reservoirs, but in the case of those reservoirs where by reason of the character of the locality or because of the expense incident to the purchase of land this system is not feasible, then the best mechanical process known, to meet the immediate requirements should be adopted. If this plan be accepted \$3,700,000 will go far towards the solution of this much vexed question.

There is no need of further delay. Our duty is clear and imperative and the authority already given to Councils by the people is broad enough in its scope to give immediate and permanent relief to this community. Water is an absolute necessity. The health of our citizens should be the first consideration, and I firmly believe the plan above suggested will meet the exigencies of the case. The reports that have gone abroad in relation to the condition of our water supply have seriously affected the fame and reputation of the City of Philadelphia, and it becomes

our duty not only as officials, but as citizens to settle this question without further delay.

The furnishing of water is to my mind clearly a municipal function. It is not in any sense of the word a manufacturing industry. It is simply the distribution of that upon which life and health depend, and with authority given by the people themselves to Councils to expend a large sum of money for this purpose, there is no excuse to put this matter off for further consideration. A loan should be authorized and an appropriation should be made, plans should be submitted, and contracts immediately awarded for the doing of the work required. The very moment two or three districts are supplied with wholesome water the question will be settled.

DEPARTMENT OF CHARITIES AND CORRECTION.

The President and Directors of this Department have at all times displayed earnest and loyal devotion to the duties of their office. Though serving without remuneration they have given their constant and unremitting care to the conduct of the Bureaus under their charge.

In my prior messages I have urged that it would be of great advantage to the Almshouse if it could be removed from its present situation. The location of such an institution should be in the suburbs, if possible, in a farming section.

The Hospital should not be interfered with. Both institutions, the Almshouse and the Hospital, would be greatly benefited by their separation.

As I have stated before, it would be a wise measure to provide for the consolidation of all the Poor Districts in this county and place them under the direct control of the Department of Charities and Correction. The Almshouse at all times is crowded and its accommodations over

taxed, while some of the poor houses in the outlying districts have comparatively but very few inmates, and these should be used to relieve the overcrowded condition of the Almshouse proper. A bill was offered in the last Legislature providing for such consolidation, but unfortunately it did not succeed in passage; a like bill should be introduced when the Legislature again meets.

At the time of the destruction by fire of the State Capitol at Harrisburg I appointed a Committee of Citizens to secure if possible the assent of the State authorities to the removal of the Capital from Dauphin to Philadelphia County. Many meetings were held and an effort was made to arouse public sentiment, but unfortunately success was not reached. It would be not only a great advantage to our City but also to legislation to have the seat of the State Government located here.

Several events of great interest have taken place during the past year. The Society of the Cincinnati of the State of Pennsylvania, on May 15, 1897, dedicated the Washington Monument, which stands at the Green street entrance of Fairmount Park. The statue is imposing, artistic and the finest of its kind in the country. The event was considered of such importance that the President and Vice President of the United States and the members of the Cabinet took part in the ceremonies incident to the dedication. The whole affair reflected great credit upon our City.

The opening of the Commercial Museums on June 1, 1897, was an event of national interest. This institution has made rapid growth and its use and importance are appreciated throughout the length and breadth of this land and it has already received recognition and commendation from many foreign visiting Committees. The opening

ceremonies were most impressive; the President of the United States and several members of his Cabinet took an active part in the event.

The statue of Stephen Girard, located on the west side of the City Hall, was dedicated on the 20th of May, 1897. The statue is a tribute to the memory of one who as a merchant and philanthropist did much for the advancement of Philadelphia, and is a worthy recognition of his great and abundant charity.

These statues add greatly to the adornment of our City.

The Eighteenth National Saengerfest was held in this City in June, 1897, and continued for three days; it was one of the most successful of its kind ever held in this country.

Philadelphia is fast becoming a Convention City and visiting delegations have been much impressed with that hospitality that characterizes us as a people.

In conclusion, let me ask the assistance and co-operation of your Honorable Bodies in all those matters that will tend to the advancement of our City's interests. Much can be done to push the City forward and maintain the progress she has made during the past ten years, but great results can only be reached when we earnestly and devotedly unite our efforts for the accomplishment of the common good.

I am, respectfully,

CHAS. F. WARWICK,

Mayor.

ANNUAL REPORT

OF THE

Department of Public Works

FOR THE

Year ending December 31, 1897.

OFFICERS
OF THE
Department of Public Works.

Director,
THOMAS M. THOMPSON.

Assistant Director,
HARRY W. QUICK.

CHIEF CLERK—WILLIS SHEBLE.
CLERK—ERNEST T. HANEFELD.
ASSISTANT CLERK—ANDREW L. TEAMER.
STENOGRAPHER AND CLERK—HARRY A. STOY.
STENOGRAPHER AND TYPEWRITER—JOSEPH MARCUS.
MESSENGER—JOHN P. JUNIOR.
GENERAL INSPECTOR—ROBERT C. HICKS.

Superintendent of City Ice Boats,
H. E. MELVILLE.

Chiefs of Bureaus,
GAS—WILLIAM K. PARK.
HIGHWAYS—WILLIAM H. BROOKS.
LIGHTING—JOHN J. KIRK.
STREET CLEANING—SYLVESTER H. MARTIN.
SURVEYS—GEORGE S. WEBSTER.
WATER—JOHN C. TRAUTWINE, JR.

ELEVENTH ANNUAL REPORT
OF THE
DEPARTMENT OF PUBLIC WORKS

THOMAS M. THOMPSON, Director.

Philadelphia, January 3, 1898.

HON. CHARLES F. WARWICK,
Mayor of Philadelphia.

Dear Sir:—In accordance with Section 1, Article 1, of the Act of Assembly, entitled, “An Act to provide for the better government of cities of the first class in this Commonwealth,” approved June 1st, 1885, I have the honor to present the annual report of the Department of Public Works, for the year ending December 31st, 1897, the same being the eleventh annual report of the Department.

By reason of the financial stress, the amount of work actually executed outside of the work on the Pennsylvania Avenue Subway, has been much less than for several years. No money has been available for the construction of main sewers, bridges, or the repaving of streets with improved pavement, nor for the extension and improvement of the water system.

In the Loan Bill of \$11,200,000 now pending before Councils, \$8,250,000 is set aside for works of various kinds

in this Department, and as the bill is in a position that admits of favorable action, it should be taken up without delay and passed by both branches of Councils.

Appropriations for the year were.....	\$7,691,281 71
Amount brought forward from previous years	2,499,400 24
Additional appropriations and transfers...	5,442,278 99
Total	\$15,632,960 94

The expenditures of the year were.....	\$10,102,022 23
Amount carried forward to 1898.....	4,662,600 27
Amount transferred	173,778 99
Amount merging	694,559 45
Total	\$15,632,960 94

The lease of the Philadelphia Gas Works to The United Gas Improvement Co., which went into effect December 1st, 1897, caused the unexpended balance of the appropriation to the Bureau of Gas, amounting to \$483,688.46, to merge. This amount would have been expended in the operations of this Bureau, had it continued in existence during the month of December.

The work of the Department during the past year has progressed in a satisfactory manner and to the fullest extent within the limit of appropriations.

A more extensive study than is given in this resume of the year's work with details of figures and expenditures, will be found in the elaborate and statistical reports of the Chiefs of the various Bureaus, which are herewith submitted.

City Ice Boats.

The three City Ice Boats received the necessary repairs incident to a winter service, after having been in commission from January 26th to February 27th, 1897.

Between these dates was the only period that ice formed

in sufficient thickness and quantity to require the operation of the boats, and by their efficient service, the channel of the river was kept open, and at no time during the winter season was the navigation of the river obstructed by ice.

\$24,991.41 were expended for repairs and general maintenance, and the boats are in good condition for service.

\$325.68 were received for towage and the sale of old material, and was paid into the City Treasury.

In view of the satisfactory service given by the electric light plant and search light, which was placed on Ice Boat No. 3 during 1896, it was deemed advisable to place similar plants on Boats No. 1 and 2. On April 6th, 1897, proposals for the work were received and the contract awarded to the lowest bidder. The work was completed and plants tested June 28th, 1897. All three boats are now thoroughly equipped with electric lighting and search lights.

On June 18th, 1897, Councils, by ordinance, authorized the Director of the Department of Public Works to place two of the ice boats at the service of the Pennsylvania Naval Militia, and appropriated \$1,700 for the purpose. On June 30th boats Nos. 2 and 3 were placed in commission, and Capt. H. E. Melville, Superintendent of the City Ice Boats, was directed to report to Mr. Francis Shunk Brown, Commander. After a successful cruise, the two boats were returned to their dock at the House of Correction wharf, on July 12th, and placed out of commission.

At the date of this report, January 3rd, 1898, Ice Boats Nos. 1 and 2 are in commission and at work.

The following comparative summary is an abstract of the work done by the City Ice Boats and of the receipts and the expense of maintenance during the years 1894-95, 1895-96, and 1896-97.

	1894 and 1895.		1895 and 1896.		1896 and 1897.	
	No.	Tonnage.	No.	Tonnage.	No.	Tonnage.
Vessels Outward.....			1	190		
Vessels Inward.....	2	1,925			1	648
Vessels Assisted.....					1	2,511
Totals.....	2	1,925	1	190	2	3,159

	1895 and 1896.	1894 and 1895.	1896 and 1897.
Amount received for towage and assistance rendered.....	\$437 08	\$40 00	\$321 28
Amount received for the sale of old material.....		28 12	4 40
Total paid City Treasurer.....	\$437 08	\$68 12	\$325 68

	1895.	1896.	1897.
Total amount of warrants drawn.....	\$33,597 71	\$22,767 49	\$24,991 41
Deduct Cash paid City Treasurer.....	437 08	68 12	325 68
Actual current expenditure.....	\$33,160 63	\$22,699 37	\$24,665 73

Bureau of Gas.

On November 30th, 1897, you advised me that, in pursuance of an ordinance of Councils, "authorizing the execution of a contract with The United Gas Improvement Co., its successors and assigns, by the City of Philadelphia, for the lease to the former of the gas works, street mains, conduits, pipes, services, meters and other property real and personal of the latter, used for and in connection with the manufacture and distribution of gas in the City of Philadelphia, for the operation, maintenance, enlargement, extension and betterment of the same, for the manufacture and distribution of gas in said City by the said United Gas

Improvement Co., its successors and assigns, and for the exclusive supply by said lessee and its assigns, of all gas to be supplied to consumers by or with the consent of said City during the term of the lease, etc.," approved November 12th, 1897, you had executed and delivered on the part of the City, to The United Gas Improvement Co., its successors and assigns, a lease and contract in the words set forth in said ordinance, and instructed me to deliver immediate possession of the leased property to the representatives of The United Gas Improvement Co.

Your instructions were immediately complied with, and on December 1st, 1897, all property collectively known as the Philadelphia Gas Works, was placed in possession of The United Gas Improvement Co., and an itemized receipt taken for the same.

The execution of the contract and agreement with The United Gas Improvement Co. severed the relationship of the employes of the Bureau of Gas with the City; but, in order to better protect the interests of the City during the settlement of accounts and appraisalment of the stock, implements, material, etc., the services of the following named employes were retained until December 31st, 1897: William K. Park, Chief of the Bureau; Alexander J. McCleary, Assistant to Chief and General Storekeeper; Thomas L. George, Comptroller and General Bookkeeper; Rudolph McGirr, Paymaster and Chief Clerk at works; Charles R. Knowles, general clerk at works; and John McCormick, general clerk at main office.

In this connection, I desire to testify to the efficient and valuable service of Mr. William K. Park, Chief of the Bureau of Gas. During his many years of service, both as chief engineer of the Philadelphia Gas Works under the management of the Trustees, and also as Chief of the Bureau of Gas, since its organization in 1887, under the Act of Assembly approved June 1st, 1885, he has proved

himself to be a most capable and faithful official, earnest and ambitious in his desire to serve the City, and highly respected by all his associates. The City, by his retirement, was deprived of the services of an efficient and experienced officer.

The operations, expenses and receipts of the Bureau of Gas herein reported, and referred to in the report of the Chief of the Bureau, are for a period of eleven months ending November 30th, 1897.

There were 316,173 tons of coal carbonized, with an average yield of 4.79 cubic feet of gas to the pound of coal. The average candle power of the gas manufactured during the eleven months was 19.09.

The total output of gas to November 30th, 1897, was 5,564,697,850 cubic feet, which is almost as much as the entire output of the preceding year.

There were laid 38.35 miles of mains and distributing pipes, of which 32 miles were of the smaller sizes from four inches down.

The operations of 1897 included the finishing of the 3,000,000 cubic feet holder at the Point Breeze Works; and the completion of Retort House No. 1, at the Twenty-fifth Ward Works, rebuilt upon the site of the old structure condemned by the Bureau of Building Inspectors.

The receipts, as reported in detail by the Chief of Bureau for the eleven months to November 30th, 1897, are as follows:

For gas services, etc.....	\$2,754,192 73
Coke, tar, etc.....	300,958 02
Miscellaneous	6,241 03
Total	\$3,061,391 78

The gross profits of the eleven months ending November 30th, 1897, were \$382,646.12.

Under the terms of the lease, The United Gas Improvement Co. will collect and pay into the City Treasury all monies outstanding for gas furnished by the Bureau, for which bills will be rendered at the quarterly and monthly periods. At the writing of this report, (January 3d, 1898), it has paid into the City Treasury \$245,159.91, collected during the month of December.

The following tables give the manufacturing and holder capacities, also the comparative statement of the operations of the Bureau of Gas during the years 1895, 1896, and to December 1st, 1897.

Manufacturing Capacity.—The following table gives in detail the capacity of the several works.

Works.	Stacks.	Retorts per Stack	Total Retorts.	Grand Total.	Maximum Capacity per Works. 24 hours.	Total Maximum Capacity 24 hours.
Ninth Ward.....	4	150	600			
	2	194	388			
Experimental Bench.....			3	991	6,600,000	
Twenty-first Ward.....	1	30	30	30	200,000	
Twenty-fifth Ward.....	6	120	720	720	5,500,000	
Twenty-sixth Ward.....	6	144	864	864	8,000,000	20,300,000

The above does not include the plant of the Philadelphia Gas Improvement Company, which has a capacity of 11,000,000 cubic feet per day.

There are at the Ninth Ward Works, in addition to the above, eight (8) retorts used exclusively for vaporizing naphtha, for maintaining clear pipes about the works.

The following table gives in detail the date of construction, the location and capacity of all holders:

Location.	When Erected.	Dimensions.	Capacity.	Total.
Ninth Ward Works.....	1851	Feet. 140 x 70	Cubic feet. 1,000,000	
“ “	1871	140 x 70	1,000,000	
“ “	1844	80 x 60	300,000	
“ “	1847	80 x 60	300,000	2,600,000
Twenty-fifth Ward Works.....	1876	140 x 105	1,500,000	
“ “ “	1876	140 x 70	1,000,000	
“ “ “	1885	140 x 105	1,500,000	
“ “ “	1885	140 x 70	1,000,000	
“ “ “	1889	140 x 70	1,000,000	6,000,000
Point Breeze Works.....	1852	160 x 90	1,800,000	
“ “ “	1897	182 x 115½	3,000,000	4,800,000
Twenty-first Ward Works.....		60 x 38	103,000	
“ “ “	1874	78 x 44	200,000	303,000
Frankford: Frankford avenue and Buckius street.....		50 x 16	31,000	
Frankford: Frankford avenue and Buckius street.....		45 x 16	25,000	
Frankford: Frankford avenue and Buckius street.....	1869	80 x 26	130,000	186,000
Bridesburg: Richmond and Bridge streets.....	1869	60 x 21	59,000	59,000
Ninth and D'iamond streets.....	1869	140 x 105	1,500,000	
“ “ “	1874	140 x 105	1,500,000	3,000,000
Ninth and Miffin streets.....	1874	115 x 62	600,000	
“ “ “	1890	140 x 84	1,577,000	2,177,000
Twenty-fifth and Callowhill sts...	1831	100 x 75	700,000	
“ “ “	1888	80 x 42	203,000	903,000
Germantown: Near Wister Sta- tion, P. & R. R. R.....	1870	100 x 60	500,000	500,000
Total.....				20,528,000

The following table gives in detail the total Output of Gas and its Distribution during the years 1895, 1896, and to December 1, 1897.

Total Output and Distribution of Gas.

	1895.		1896.		*1897.													
	Cubic feet.		Cubic feet.		Cubic feet.													
Stock delivered and not paid for, and on hand January 1.....	644,294,320		655,074,900		787,387,850													
Manufactured and purchased during the year.....	<table border="0"> <tr> <td></td> <td>Manufactured.</td> <td>Purchased.</td> </tr> <tr> <td>1895</td> <td>2,728,065,000</td> <td>1,694,687,000</td> </tr> <tr> <td>1896</td> <td>2,997,065,000</td> <td>1,916,396,000</td> </tr> <tr> <td>1897</td> <td>3,033,153,000</td> <td>1,744,157,000</td> </tr> </table>			Manufactured.	Purchased.	1895	2,728,065,000	1,694,687,000	1896	2,997,065,000	1,916,396,000	1897	3,033,153,000	1,744,157,000	4,422,752,000	4,913,461,000	4,777,310,000	
	Manufactured.	Purchased.																
1895	2,728,065,000	1,694,687,000																
1896	2,997,065,000	1,916,396,000																
1897	3,033,153,000	1,744,157,000																
Total to be accounted for.....	5,067,046,320		5,568,535,900		5,564,697,850													
	1895.		1896.		*1897.													
	Cubic feet.	Per cent.	Cubic feet.	Per cent.	Cubic feet.	Per cent.												
Delivered to private consumers, for which bills have been rendered.....	2,744,496,900	54.16	2,945,395,800	52.90	2,723,360,690	48.94												
Delivered to consumers (bills not rendered) and in holders, December 31.....	655,074,900	12.93	787,387,850	14.14	787,301,850	14.15												
	1895.		1896.		*1897.													
Public lighting, etc.	Cubic feet.	Per cent.	Cubic feet.	Per cent.	Cubic feet.	Per cent.												
Bureau of Police.....	23,261,900	00.46	23,792,800	00.43	22,533,100	00.40												
Bureau of Fire.....	17,553,400	00.35	17,421,100	00.31	16,173,500	00.30												
Bureau of Water.....	3,056,800	00.06	3,026,400	00.05	3,174,200	00.06												
Public Buildings.....	26,895,700	00.53	36,468,500	00.66	19,386,300	00.36												
Almshouse.....	20,113,500	00.40	18,473,900	00.33	13,274,400	00.24												
City Property.....	3,580,300	00.07	3,529,800	00.06	4,371,500	00.08												
Public Squares.....	6,621,299	00.13	6,377,742	00.11	5,520,472	00.10												
Park Commission.....	639,900	00.01	651,000	00.01	514,600	00.01												
Schools.....	15,964,100	00.31	17,972,800	00.33	19,459,900	00.36												
Free Libraries.....			996,000	00.01	2,436,100	00.01												
	117,786,899	02.32	128,710,042	02.30	106,844,072	01.88												
Street lamps.....	520,707,106	10.28	545,321,470	09.80	526,566,855	09.50												
Used at works, offices, stations, etc.....	26,840,200	00.53	29,074,600	00.52	29,678,200	00.53												
Unaccounted for, leakage, etc.....	1,002,140,315	19.78	1,132,646,138	20.34	1,390,946,273	25.00												
Total.....	5,067,046,320	100.00	5,568,535,900	100.00	5,564,697,850	100.00												

* To Dec. 1, 1897.

*Comparative Statement of the Pipe laid during the years
1895, 1896, and to December 1, 1897.*

	1895.	1896.	1897.
	Feet.	Feet.	Feet.
2 inch.....	1,755	922	2,270
3 inch.....	7,580	18,556	11,076
4 inch.....	157,534	158,924	157,312
6 inch.....	37,617	44,671	31,576
8 inch.....	12,904	1,028	24
10 inch.....	368		
12 inch.....	8,960	24	8
16 inch.....			28
20 inch.....	6,378		188
Total.....	*233,046	†224,125	‡202,482

* 1895 equal to 44.13 miles. † 1896 equal to 42.44 miles. ‡ 1897 equal to 38.35 miles.

The following is a summary of the receipts and expenditures for the years 1895, 1896, and to Dec. 1, 1897.

Comparative Statement of Receipts.

Year.	Receipts.	Increase.
1895	\$3,155,956 47	\$12,525 18
1896	3,318,145 08	162,188 61
1897	3,061,391 78	

Comparative Statement of Expenditures.

	1895.	1896.	1897.
Current expenses.....	\$2,985,513 85	\$3,229,155 70	\$2,799,679 80
Extensions	54,589 59	322,947 41	116,304 87
Total	\$3,040,103 44	\$3,552,103 11	\$2,915,984 67

*Comparative Statement of Operations of the Bureau of Gas
during the Years 1895, 1896, and to Dec. 1, 1897.*

	1895. Cubic feet.	1896. Cubic feet.	1897. Cubic feet.
Total output.....	4,423,804,000	4,911,967,000	4,777,896,000
Largest production of gas in any 24 hours...	¶17,478,000	*19,128,000	c18,934,000
Largest consumption in any 24 hours.....	a19,008,000	b20,010,000	d19,440 000

* ¶ On December 13th and 24th.
a b On December 24th and 24th.
c d On Jan. 28th and Nov. 29th.

	Bushels.	Bushels.	Bushels.
Quantity of coke on hand January 1st.....	117,000	23,000	3,000
Made during the year.....	8 256,889	8,563,290	7,838,442
Total.....	8,373,889	8,586,290	7,841,442
Coke sold during the year.....	4,009,378	3,826,933	3,315,478
Breeze sold during the year.....	1,357,480	1,532,395	1,194,290
Used under retorts.....	2,460,836	2,685,382	2,767,906
Used under boilers and lime-kilns.....	428,604	426,710	410,423
In offices, yards and in pipe laying.....	94,591	111,870	136,030
On hand December 1, 1897.....	23,000	3,000	17,315
Total.....	8,373,889	8,586,290	7,841,442

	1895.	1896.	1897.
Number of meters introduced during year...	6 535	6,098	6,196
Total in use.....	160,082	166,780	172,976
Services introduced during the year.....	7,106	7,082	6,230
Total in use.....	204,126	211,208	217,438
Lights added during the year.....	131,457	139,629	130,950
Total in use.....	2,904,026	3,043,655	3,174,605
Total number of consumers.....	161,245	168,614	174,791
Number of public lamps.....	21,621	21,614	21,834

The following table gives the amount of gas consumed in the several Departments of the City during the past three years, and for which the Bureau of Gas receives neither money nor credit:

Quantity of gas burned free in 1895...638,494,005 cubic ft.

Quantity of gas burned free in 1896...674,031,512 cubic ft.

Quantity of gas burned free in *1897...633,410,927 cubic ft.

* Eleven (11) months to Dec. 1, 1897.

Bureau of Highways.

This Bureau has charge of the maintenance and reconstruction of about 1,415 miles of paved and unpaved highways, and includes all the different kinds of construction from the dirt road to the Belgian block street with concrete foundation.

The paved and macadamized streets of the City aggregate 1,002.36 miles, of which 316 miles are occupied by passenger railway companies. 176.35 miles of the above are macadam streets, of which 23 miles are turnpikes. In addition to the paved and macadam streets, there are 412.64 miles of unpaved streets or dirt roads.

The work of this Bureau during the past year has been well and satisfactorily done, but has been limited by the amount appropriated for it. Owing to the small appropriation made for street reconstruction, the Department has not been able to extend the improved pavements as much as would have been desirable. No appropriation was made for this purpose, outside of the amount set aside for repaving small and tramway streets, and for one block of Mifflin Street, between Broad and Fifteenth streets.

During the year there has been laid by the City 19.40 miles of new paving, 4.63 miles of repaving with improved pavement, and 14.77 miles of macadam roads have been built in the suburban district.

The expenditures of the Bureau were \$206,949.77 less

than the preceding year. The appropriations to this Bureau, the amount expended, also a summary of the work done, will be found in the tables accompanying the report, and are also set forth in detail in the report of the Acting Chief of the Bureau.

The appropriation for the maintenance of paved streets is entirely out of proportion to the demands made upon it. With the continued increase of street mileage, the appropriation allowed for the maintenance is totally inadequate, making it impossible to keep the streets in such constant repair, that reconstruction would be required at less frequent intervals.

There were 472,322 square yards of repairs made to streets and 104,675 square yards of repairs over permit ditches during the year. This is far in excess of repairs made during any previous year, yet, notwithstanding the care exercised to repair the streets most in need, a large proportion of cobble and rubble paved streets could not be repaired because of insufficient funds.

The grading of streets continues to be one of the most important branches of work in the Bureau of Highways. 288 contracts were made, and the unusual amount of 2,373,510 cubic yards of grading was done during the year, which is 1,234,731 cubic yards in excess of the amount of work done in 1896. This increase is largely due to the fact that many builders opened and graded streets at their own expense, in order to facilitate the paving of the streets.

The appropriation for the maintenance of unpaved and macadamized public highways was utilized to the best advantage. 30,720 tons of broken stone was distributed over 20 miles of road requiring resurfacing. The roads have received the constant and careful attention of the contractors, and the end of the year just closed finds them in first class order.

One of the greatest difficulties we have to contend with in the maintenance of macadamized highways, is the liability of washouts in the gutters and along the roadway. To obviate this, the Department requested Councils to make an appropriation to provide for placing gutters of granite block, vitrified brick or cobble or rubble stone on macadamized highways, especially where there are steep grades. It is to be regretted that Councils made no provision for this work, for in each case where such gutters were placed, the roadbed would receive a substantial support, and the danger from washouts be removed.

The sprinkling of macadamized roads was continued during the year with equally as good results as during previous years.

Granite curved curbing has been placed at the intersection of all streets paved or repaved to the full extent of the amount appropriated for the purpose. This is such a decided improvement over the old square corners that it is to be regretted that Councils do not provide more liberally for this character of work.

No serious breaks occurred to the sewers of the City during the past year. Systematic and stated inspections were made of all sewers, and wherever repairs were necessary they were promptly made.

The work of repaving small and tramway streets with improved pavement, was continued to the extent of the amount available for the purpose, the work done in 1897 being equal to 4.55 miles. This good work should continue, and Councils should make liberal appropriations for the purpose until every small tramway street in the City is repaved with improved pavement. Viewed from a sanitary standpoint, more good will result from this character of work than for an equal expenditure of money for any other purpose.

The many bridges of the City are, with few exceptions, in good condition. A majority of the larger bridges received special attention and a great many of the minor bridges in the suburban districts of the City received a thorough overhauling during the year, at a total cost of \$82,521.71.

Proposals have been received for reconstructing the North and South approaches of the Penrose Bridge. Contract for the North approach has been awarded, and that for the South approach will be awarded as soon as funds are made available.

There are 332 bridges under the care of the Superintendent of Bridges, and the approximate value of these structures is about \$16,500,000.

On September 30th, 1897, Mr. Thomas L. Hicks resigned as Chief of the Bureau of Highways to assume the position and duties of Postmaster of the City of Philadelphia; and on October 1st, 1897, Mr. William H. Brooks was appointed Acting Chief of the Bureau of Highways, which position he still holds pending an examination to be held by the Civil Service Board, of applicants for the position.

The following tables give comparative statements in detail of the work done during the years 1895, 1896, and 1897, and of the receipts and expenditures of the Bureau of Highways for the same period.

Comparative Statement of Work done.

	1895.	1896.	1897.	
New paving.....	149,515.05	169,832.14	126,864.38	Linear ft.
Macadamizing (new).....	66,813.	47,199.	78,029.	" "
Grading.....	1,114,823.88	1,138,778.93	2,373,510.84	Cubic yds.
New footway paving.....	110,066.50	115,478.27	71,657.01	Square yds.
Repairs to paved streets.....	329,598.14	304,481.97	472,322.35	" "
Footways repaved.....	19,448.24	23,071.67	19,651.25	" "
Ditches repaved.....	109,860.47	113,658.18	104,675.78	" "
Gutter stone laid.....	21,462.50	20,252.	34,731.30	Linear ft.
Crossing stone laid.....	26,437.68	24,090.55	9,330.	" "
Tramway stone laid.....	4,397.41	2,825.	585.	" "
Curbstone reset.....	356,687.	250,411.29	130,374.	" "
Wooden trunks.....	4,972.66	7,263.40	5,225.	" "
Brick and stone drains.....	1,744.50	1,104.	2,098.	" "
Hand railings.....	3,125.90	3,029.90	1,583.50	" "
Broken stone used.....	15,964.68	20,708.75	30,720.	Tons.
Macadamizing (resurfacing).....	42,920.00	81,641.	110,485.	Linear ft.
Curved curb corners.....	28,329.39	23,806.65	19,300.11	" "
Footway, curb and railroad notices served.....	46,025.	28,755.	17,830.	

Summary of Work done in Improved Pavements—New Streets.

	1895.		1896.		1897.	
	Square Yards.	Linear Feet.	Square Yards.	Linear Feet.	Square Yards.	Linear Feet.
Granite blocks.....	90,090.	28,293.	28,244.75	8,384.50	21,231.	7,218.
Sheet asphalt.....	110,342.	28,544.	133,995.77	39,236.87	135,846.74	36,209.
Vitrified bricks.....	131,051.	68,629.	119,011.17	46,484.05	168,852.21	58,983.56
Asphalt blocks.....	1,309.	795.				
Macadamizing.....	146,024.	66,813.	93,773.	47,139.	162,102.72	78,019.
Total.....	478,816.	* 193,074.	375,024.69	† 141,304.42	488,034.67	‡ 180,439.26

Replacing Cobblestone with Improved Pavements—Old Streets.

	1895.		1896.		1897.	
	Square Yards.	Linear Feet.	Square Yards.	Linear Feet.	Square Yards.	Linear Feet.
Granite blocks.....	2,977.	1,525.	70,600.16	18,608.29	12,147.	1,694.
Sheet asphalt.....	2,834.	390.	116,054.18	43,674.90	13,228.92	10,147.
Vitrified bricks.....	6,901.03	3,795.05	17,153.30	5,208.	5,013.70	5,119.
Granolithic.....	15,722.10	16,561.	6,553.44	7,449.96	3,652.69	4,971.12
Slagblock.....	1,812.	983.	1,477.82	785.57	2,688.	2,523.
Total.....	30,246.13	* 23,254.05	211,838.90	† 75,726.72	36,730.31	‡ 24,454.12

* 1895, Total amount of new paving 216,328.65 linear feet, equal 40 miles 5,128.05 linear feet.
 † 1896, Total amount of new paving 217,031.14 linear feet, equal 41 miles .551 linear feet.
 ‡ 1897, Total amount of new paving 204,893.38 linear feet, equal 38 miles 4,253 linear feet.

In addition to the work done by the City in paving and repaving of streets with improved pavement, the following statement shows in detail the work done by the passenger railway companies during the year 1897 :

	Paving Linear Feet.	Repaving Linear Feet.	Total Linear Feet.
Granite blocks.....		1,407.5	1,407.5
Granite blocks (old blocks relaid).....		4,953.	4,953.
Sheet asphalt.....		8,842.5	8,842.5
Remacadamizing	300		300.
Total.....	300	15,203.	15,503.

Equal to 2 miles 4,943 linear feet at an estimated cost of \$35,000.

Comparative Statement of Receipts.

Years.	Receipts.	Increase.	Decrease.
1895.....	\$150,513 24		
1896.....	155,054 06	\$4,540 82	
1897.....	135,439 35		19,614 71

Comparative Statement of Expenditures.

	1895	1896	1897
Current expenses.....	\$415,861 82	\$546,931 82	\$579,195 64
For extensions.....	1,006,796 37	984,787 23	745,573 64
Totals.....	\$1,422,658 19	\$1,531,719 05	\$1,324,769 28

Board of Highway Supervisors.

During the past year there has been less activity by private corporations, owning underground systems, than for several years past, causing a large decrease in the number

of permits issued by this Board and a corresponding decrease in the money receipts.

During the year 1896, 278 permits were issued for electrical conduits, while during the year 1897 there were but 38 permits issued.

The receipts for the year were \$2,380.80, and the expenses \$7,328.28, leaving a deficit of \$4,947.48. At the first glance this would seem to be a loss, but the very fact of the increased force of the Board being less occupied with outside orders, has enabled it to accomplish much work which was left undone in past years, and to make large and valuable additions to the City's plans, which has more than compensated for any decrease in receipts.

I beg to refer to a suggestion made in my report of last year, for the construction of a system of subways within which all pipes, whether for gas, water or wires, either municipal or private, can be placed. Such a system of subways is absolutely essential in a city the size of Philadelphia, and could be made a source of much revenue to the City.

The following is a summary of the transactions of the Board of Highway Supervisors, and of the work of the draughting department for the years 1895, 1896, and 1897.

The following is a statement of the number of permits authorized to be issued for electrical conduits during the year 1897:

Brush Electric Light Co.....	1
Edison Electric Light Co.....	21
Columbia Electric Light Co.....	2
Penna. Heat, Light and Power Co.....	10
Pneumatic Transit Co.....	3
American T. and T. Co.....	1
	—
Total	38

Transactions of the Board of Highway Supervisors.

Permits authorized to be issued.	1895	1896	1897
For vaults.....	18	16	15
For railroad tracks, curves and turnouts.....	192	113	66
For underground pipes.....	37	17	8
For electrical conduits.....	81	278	38
For erecting bridges.....	2		1
For tunnels.....		1	
For miscellaneous.....	2		2
For awnings.....	360	345	283

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

	1895	1896	1897
Plans of iron awnings drawn.....	360	341	271
New street record plans prepared.....	176	43	92
Blue print plans placed on file.....	167	190	186

Receipts and Expenditures.

	1895	1896	1897
Receipts.....	\$10,975 90	\$14,354 36	\$2,380 80
Expenditures.....	4,400 00	5,198 93	7,328 28
Profit to the City.....	\$6,575 90	\$9,155 43	*\$4,947 48

* Deficit.

Bureau of Lighting.

The United Gas Improvement Co., having leased the Philadelphia Gas Works, it is required by the terms of the lease to light and maintain the City's gas lamps. Therefore these lamps, which were formerly under the immediate charge of the Bureau of Lighting, were transferred to the said company on December 1st, 1897. Con-

sequently this report embraces only eleven months of the year for said lamps.

During the year there was an increase of 1984 public lamps; the total number in use on December 31st, 1897, was 41,930, divided as follows:

*Gas lamps now maintained by The United Gas Improvement Co.....	21,834
Gas lamps supplied from Northern Liberty Gas Works	92
Gas lamps supplied by Department of Charities and Correction	239
Gasoline lamps	12,646
Electric lights, under the care of Department of Public Safety (Electrical Bureau).....	7,119
<hr/>	
Total	41,930

* Until Dec. 1, 1897, under the care of the Bureau of Lighting.

Of the above gas lamps, 2,059 of the City's lamps and 111 of those maintained by the Department of Charities and Correction have been discontinued because of their proximity to electric lights erected during the year.

On December 31st, 1897, there were in use 12,646 gasoline lamps. These are lighted and maintained by the Pennsylvania Globe Gas Light Co., under contract with the City, at \$21 per lamp per year, and are located generally in suburban districts, where there are no gas mains or other means of lighting.

The report of the Chief, which is herewith submitted, treats in detail of the operation of this Bureau.

The following comparative statement shows the number of gas and gasoline lamps, and the expenditures of the Bureau of Lighting during the years 1895, 1896 and 1897.

	1895.		1896.		1897.	
	No.	Cost.	No.	Cost.	No.	Cost.
Gas lamps under charge of Bureau of Lighting	21,621	\$202,518 33	21,614	\$202,388 82	21,831	*\$19,981 48
Gasoline lamps.....	11,538	238,728 66	11,604	242,371 86	12,646	256,114 18
Gas lamps supplied by the Northern Liberty Gas Company.....	130	3,268 07	128	2,592 85	92	2,325 47
Gas lamps under charge of Bureau of Correction	239	.....	239	.....	239	.....
Total	33,528	\$444,545 06	33,585,	\$447,48 53	34,811	\$452,371 18

* Cost for 11 months.

Not lighted because of proximity to electric lights—1895, 4,182; 1896, 2,411; 1897, 2,050.

The above table shows an increase of 220 gas lamps and 1,042 gasoline lamps over the number in use in 1896.

Bureau of Street Cleaning.

The work of this branch of the City service has been performed in an eminently satisfactory manner, as is evidenced by the decrease in the number of complaints received during the year, and the generally clean condition of our streets. The total number of complaints from all sources was 2,401, which is 812 less than during the preceding year. The garbage of the city has been collected daily and disposed of in a satisfactory and sanitary manner. The total number of complaints received during the year, of garbage neglected, was 457, an average of less than two per day for the year, and 754 less than the previous year.

Never in the history of the city has this work been better done; and we have every assurance that under the contracts for the year 1898 it will be done equally as well if not better. The equipment provided by the contractors for this very difficult and highly important municipal work is not surpassed by any city in this country.

During the year, there have been cleaned 131,377 miles of streets and 446,232 inlets. There were collected and removed from buildings, 668,358 loads of ashes and other dry refuse, at a cost to the city for the work of \$517,735. There were also collected and disposed of 162,874 loads of kitchen garbage and 9,796 dead animals, at a cost of \$321,310.

The contract price for cleaning streets, collecting and removing ashes, etc., during the year 1898, is \$545,451, an increase of \$24,857 over the contract price of the preceding year; and the contract price for the collection and disposal of garbage during the year 1898 is \$7,500 in excess of the amount it cost in 1897. In both instances the increase in the cost of the work is owing to the rapid growth of the city and the increased work required of the contractors, but I am still of the opinion, as stated in my previous reports, that if legislation could be effected to permit the making of contracts for this work for a period not exceeding five years, the work could be done still better, and at less aggregate cost, than under the present system of one year contracts.

From year to year the public expects a higher standard in the cleanliness of streets, consequently our specifications this year have been drawn in stronger terms than ever, and many more streets will be required to be cleaned daily, than has been done heretofore.

One of the drawbacks to street cleaning, which we have in this city to-day, is the constant and unrestrained violation of the ordinance forbidding the throwing of paper and other waste material into the streets. This could, in a great measure, be prevented by securing the co-operation of the police, and arresting anyone detected in thus violating the law. Still another drawback is, the overfilling of ash receptacles, and the placing of waste paper on top of them, from which it is blown by the first wind, and

scattered over the street surface, thereby causing the streets to present an untidy appearance.

The so called sprinkling of streets by private contract has been very unsatisfactory, there being but little judgment exercised by the contractors in this work, for, in many instances, the streets, instead of being sprinkled, are deluged with water. The remedy for this trouble is to specify by ordinance, or in contract, the size of meshes to be used in the sprinkler for discharging water, so that the streets will be sufficiently sprayed to lay the dust. An ordinance governing this matter, and compelling the contractors to use only such wagons and sprinklers as should be approved by the Department of Public Works, was prepared and sent to Councils during the year, but thus far no definite action has been taken upon it.

It would be a great convenience to all business houses, as well as those who have occasion to drive upon the streets, if Councils would appropriate a sufficient sum to provide for the removal of snow from the streets in the business centre of the city. Allowing it to remain on the streets, it quickly becomes ice through continual thawing and freezing, and forms hillocks of ice which are not only disagreeable but dangerous to those driving; furthermore, while the snow and ice are on the streets they cannot be properly cleaned, and the dirt accumulates, and, after a continuous thaw, the streets present a filthy appearance until such time as they can be cleaned.

The following is a statement in detail of the operations of the Bureau of Street Cleaning during the year 1897, also the totals for the years 1895 and 1896:

Total Work during the Year 1897.

DISTRICTS.	CLEANED.					REMOVED.				Number of Complaints of all kinds.
	Squares.	Inlets.	Crossings.	Market Houses.	Snow from Fire Plugs.	Number of Dead Animals.	NUMBER OF LOADS.			
							Dirt.	Ashes.	Garbage.	
First.....	276,817	104,966	42,050	457	2,260	1,892	39,541	127,314	28,050	331
Second.....	296,918	111,900	45,954	1,209	2,721	1,992	46,446	109,720	31,191	878
Third.....	178,826	42,299	16,400	254	1,050	1,447	13,909	57,228	21,152	228
Fourth.....	364,515	122,248	38,242	.....	329	2,967	99,046	207,656	46,741	537
Fifth.....	175,651	48,973	50,541	.....	418	1,498	18,179	126,440	35,740	424
Sixth.....	21,140	15,843	3,081	.....	1,205	.....	11,155	.....	.....	3
Totals, 1897.....	1,813,770	446,232	196,267	1,920	7,983	9,796	228,276	668,358	162,874	2,401
Totals, 1896.....	1,178,757	476,351	163,152	1,536	10,034	10,315	235,681	625,228	152,729	3,213
Totals, 1895.....	881,664	553,501	397,738	1,546	24,525	10,295	235,866	620,065	136,513	5,028

The total expenses of the Bureau of Street Cleaning for the year 1897 were \$866,402.62.

Bureau of Surveys.

The amount and importance of the work of the Bureau of Surveys can be gathered from the report of the Chief Engineer, of which this report is necessarily a brief extract.

The expenditures of the Bureau of Surveys during the past year were \$2,827,790.27, of which \$2,582,519.61 was expended for permanent improvements. The receipts of the Bureau from all sources were \$145,085.58.

Main Sewers.—As no appropriation was made until late in the year for the construction of main sewers, and as all such sewers previously authorized had been completed, no work of this character was done.

Councils by ordinance, approved November 4th, 1897, authorized the construction of four main sewers, and transferred from other items to the main sewer item a sufficient sum of money to cover the cost of their construction. Proposals for the work of construction were received on November 16, 1897, the work promptly placed under contract and the contractors ordered to proceed with it at once.

It is a source of regret that Councils have not provided more liberally for the construction of main sewers. Building operations in various sections of the city have been very active, improvements have been pushed far beyond the line which, a few years ago, marked the division between the city and farms, but these improvements must be halted, unless adequate means for drainage are provided.

Main sewers are urgently needed in the southern part of the City, in the First and Twenty-sixth Wards; also in the wards west of the Schuylkill river and in the north-eastern section of the City. To build the main sewers listed for construction—all of which are necessary for the health and proper development of the City—will require an appropriation of at least \$2,000,000.

The needs for the following systems were all referred to

in previous reports, and under the personal supervision of the Chief Engineer of Bureau of Surveys, plans for their extension have been prepared, and are only awaiting the necessary legislation in order to enable us to commence work.

Aramingo Canal System. The main stems of this system have been practically completed and are in active service. The outlet of the sewer in Aramingo Canal at Norris Street should be extended from the present terminus to the bulkhead line of the Delaware River. Provision is made for this extension in the proposed loan, and the work will be commenced as soon as the necessary legislation is enacted.

Wingohocking System.—This system should be extended to Mt. Airy, in order to provide proper drainage for this section of the city, which is rapidly improving. The construction of the main branch north of Eighteenth street and Fisher's Lane, is absolutely necessary, as the increase in sewage makes the condition of the East branch of the Wingohocking Creek worse each year. The sewer should also be extended from its present terminus near Eleventh street to Fifth street.

Frankford Intercepting System.—In my previous report I called attention to the importance of providing a proper system of drainage for the district of Frankford. Plans for the drainage of this entire section have been prepared, with a view to giving permanent relief and to provide for efficient disposal of the sewage. The work will be expensive, but the money so used will result in a rapid development and important improvements in this section of the city—consequently, bringing adequate return for the outlay.

Intercepting System.—The extension of the many stems of the intercepting system in territory tributary to it, is more important than ever, and is emphasized by the recent

agitation of the pollution of the water supply taken from the Schuylkill River.

In several sections of the Manayunk district there are numerous streets which discharge their surface drainage into old water courses and thence into the Schuylkill River. This matter has been taken up by the Bureau of Health, and an ordinance to authorize the extension of the intercepting sewers through various streets was prepared by the Bureau of Surveys and sent to Councils over a year ago. The matter is still in the hands of Councils' Committee, awaiting an appropriation.

Plans for the extension of other main intercepting systems have been prepared, and their construction is of an importance that should not be underestimated. They are referred to in detail in the report of the Chief Engineer.

Cohocksink System.—The reconstruction of the Cohocksink Sewer on Randolph street, was continued to a point north of Oxford street, joining a section that had been previously reconstructed. During the past year two breaks occurred in the old Cohocksink Sewer, one on Montgomery avenue, west of Darien street, and another on Eleventh street, south of Diamond street. No serious damage was caused by either break, and prompt repairs were made. Breaks in this old sewer are frequent, and the Department will utilize the money appropriated for repairs to main sewers in 1898, in reconstructing such sections of this sewer as are known to be in poor condition.

Branch Sewers.—During the year 25.20 miles of branch sewers were constructed by the city, and under private contract 6.16 miles. Eight contracts were made for the construction and reconstruction of inlets, not included in sewer contracts, under which 643 inlets were built or rebuilt, 4,664.52 feet of granite curbing placed, and 9,162 feet of lateral sewer connections built.

Bridges.—As stated in my previous report, an appro-

priation of \$400,000 was made in December, 1896, for the construction of the Gray's Ferry Bridge across the Schuylkill River. No other bridges were authorized during 1897.

The city is rapidly growing, and demands are constantly made for better facilities for communicating between built up sections. There are a number of important bridges for which there has been a popular demand for some time; these bridges should be built at once, but in the absence of appropriation the Department has been unable to satisfy the demand, consequently the list of urgent bridges increases yearly.

While the amount set aside in the proposed loan for the construction of bridges will complete several important improvements, it will require an annual appropriation of large sums to meet the requirements of the city's development. Bridges absolutely necessary and which should be constructed at once would require an expenditure of more than \$2,000,000.

During the year Bridge street draw-bridge over Frankford Creek, in the Twenty-third and Twenty-fifth Wards, was completed. This is the only draw-bridge in the City operated by electricity.

Gray's Ferry Bridge over the Schuylkill River in the Twenty-sixth and Twenty-seventh Wards.—Work on this long discussed and much desired structure has been begun under plans approved by the proper authorities. Proposals for the masonry substructure were received July 20th, 1897, and the contract awarded to the Jutte and Foley Co., for the sum of \$235,733.04. The contract was promptly executed, and notice to begin work was issued to take effect August 16th 1897, time for completion as per contract, ten months; limit of contract, \$250,000. At the date of this report (January 3d, 1898) about 33 per cent. of the total work included in the contract for the masonry substructure has been completed. The superstructure will be of

steel, and the bridge and approaches will be 1,910 feet long, extending from near Thirty-sixth street on the East side of the Schuylkill River, to the intersection of Forty-seventh street and Gray's Ferry road, on the west side; and the estimated cost of the whole structure is \$475,000.

Pennsylvania Avenue Subway.—In the history of the abolishment of dangerous grade crossings in our great cities, there has probably been no work of such magnitude, or covering so many engineering difficulties, as that of lowering the tracks of the Philadelphia and Reading Railway on Pennsylvania avenue, in the proposed subway and tunnel.

Immediately upon the passage of the ordinance of Councils authorizing the construction of the work, by which seventeen dangerous grade crossings are to be abolished and the entrance to Fairmount Park relieved of many objectionable features, Mr. George S. Webster, Chief Engineer of Bureau of Surveys, with his assistants, began the preparation of the necessary plans to carry out the work; and within a few months the Department received bids and placed under contract the entire system of sewers required to drain the depression made by lowering the tracks some twenty-five feet below their present level. None of the former sewers were of a sufficient depth to meet the new conditions and entirely new sewers had to be constructed.

The entire sewerage system has been completed, and embraces more than three and a half ($3\frac{1}{2}$) miles of sewers, generally from twenty (20) to forty (40) feet beneath the surface of the street.

At the time the plans for the sewers were prepared, the work of preparing the detail plans for the construction of the subway and tunnel, and making the connections to the various industrial establishments, was begun, and pushed

rapidly. Separate studies were required of each connection, in order to secure a satisfactory and economical arrangement.

After the preparation of all general and detail drawings and specifications, proposals for the greater part of the work were received on May 12th, 1896, contracts awarded, and the work was actively begun in the month of August, 1896, and has been vigorously prosecuted.

Substantial progress has been made on the construction, and the magnitude of the work can best be understood by reference to the following figures:

Total earth and rock excavation.....	438,475 cubic yards.
Total masonry laid.....	111,132 cubic yards.
Temporary track laid.....	7½ miles.
Average number of men employed by contractors.	575

The summary of the work is as follows:

The temporary track system completed on Hamilton and Callowhill streets, and on Pennsylvania avenue, from Tenth to Twenty-fifth streets; temporary tracks on north side of Pennsylvania avenue in progress; temporary freight sheds completed.

The retaining walls are for the most part completed; underpinning, except on Thirteenth street, completed; north tunnel wall completed; south tunnel wall about one-half completed; bridge abutments west of Thirteenth street completed, with three exceptions, two of which are almost finished; core removed between Thirteenth and Fifteenth streets, except under tracks on Pennsylvania avenue, and east half of Broad street.

The report of the Chief Engineer gives detailed and interesting descriptions of the work planned, and of its progress under the contracts already made.

Delaware and Schuylkill rivers:—Contracts Nos. 3 and 4, for improving the channel of the Schuylkill river, and which were in force at the beginning of the year, were

proceeded with, but owing to several delays caused by accidents to machinery of the contractors, the amount of work done was not so great as might have been desired. The contractors have now placed additional machinery upon the site, and it is expected that the work under these two contracts will be completed in the early part of the year 1898.

Work under the several contracts for dredging in the Delaware River has proceeded satisfactorily. Large quantities of materials, consisting of rock, mud and sand have been removed, and it is expected that all the work of dredging now under contract, will be completed in the autumn of 1898.

The completion of this work will give a free and uninterrupted channel six hundred feet wide and twenty-six feet deep at mean low water, from the harbor of Philadelphia to the sea.

Widening of Delaware avenue and extension of City piers—The City appropriated to the Delaware avenue improvement, the sum of \$1,500,000. The Board of Directors of City Trusts, in order to combine with the City in this improvement set aside the sum of \$650,000 for the purpose, and entered into an agreement with the City to pay this sum on City contracts for bulkhead, sewers and other underground structures.

The plans for the work being completed, and approved by the proper authorities, proposals, after public advertisement, were received August 19, 1897, and the contracts promptly awarded as follows: Contract No. 7, consists of the construction of the bulkhead between Vine and South streets. Contract No. 5, embraces the sewers on Delaware avenue, between Market and Vine streets, and on Market street. Contract No. 6, embraces the sewers on Delaware avenue and adjacent streets, between Market and South streets.

Notice to begin work on the bulkhead, was issued to the contractor on September 22d, and on the sewers, on October 6, 1897. The work was promptly started, and is progressing satisfactorily, and when completed, will give to the City an avenue one hundred and fifty feet in width, between Vine and South streets, and will greatly facilitate the commerce and business interests of the City.

Plans were prepared for the widening and extension of the piers at Chestnut street and Arch street. The work was advertised for, and proposals received November 1, 1897, and contracts awarded promptly. For the extension of the pier at Race street, a new application has been made, and it is now in the hands of the Committee of the Board of Port Wardens.

Plans are now being prepared for buildings enclosing the decks of the Arch and Chestnut streets piers, and it is the intention of the Department, to construct a pavilion on the outer end of the upper deck of the Chestnut street pier.

Testing Laboratory: A number of improvements have been added to the laboratory during the past year, and more work was accomplished than during any previous year.

Numerous tests have been made of stone, brick, asphalt and other construction materials, either in the laboratory or under the supervision of this branch of the service. All cement used in the Department is tested for fineness, time of setting, specific gravity, expansion, tensile strength, both neat, and with standard sand.

The importance of the tests made by this branch of the City service has been fully demonstrated, and its usefulness can be greatly extended by the introduction of additional apparatus.

The Board of Surveyors and Regulators, consisting of the Chief Engineer and the thirteen District Surveyors,

held thirty meetings during the year, six of which were road day meetings, at which 182 plans were acted upon. Four hundred and ninety-two references from the Survey Committee were received, acted upon, and reported back to Committee. Thirty-eight plans showing changes in street railways were approved, and 144 revisions of the City plan confirmed.

During the year, the Board has completed the revision and changing of street names. No less than 1,800 names were changed or adjusted, which work was performed by the various ward sub-committees, and finally, after numerous meetings of the full Board, the changes were approved February 23, 1897.

Objections by citizens were made to the change in name of some streets, but nearly all of the objections have been overcome by subsequent ordinances restoring the old names or altering new ones to 125 streets, a small percentage of the total.

District Surveyors—The following is a summary of the receipts and expenditures of the District Surveyors for the year 1897, and in totals for the years 1895 and 1896:

Summary of Receipts and Expenses of District Surveyors.

District.	Surveyors.	Cash Receipts.	Credit for work done for the City.	Total Credit.	EXPENSES.				Balance profit to the City.	Profit to the City in 1896.	Increase.	Decrease.
					Salaries.	Pay of Assistants.	Miscellaneous.	Total.				
1	Thomas Daly	\$5,855 81	\$6,406 75	\$12,262 56	\$3,000 00	\$5,189 29	\$1,827 64	\$10,016 9.	\$2,245 68	\$7,203 41	.....	\$4,957 78
2	Chas. W. Close..	6,201 79	5,794 63	11,996 42	3,000 00	6,300 0.	1,299 79	10,599 79	1,396 63	1,069 57	\$827 06	
3	Wm. C. Cranmer.....	6,010 97	9,573 46	15,584 43	3,000 00	9,169 94	2,014 02	14,184 86	1,399 57	4,339 47	.....	3,439 90
4	Frits Bloch.....	4,164 57	8,541 07	12,705 64	3,000 00	6,189 96	1,610 04	10,800 00	1,905 64	6,076 60	.....	4,170 96
5	Walter Brinton.....	10,988 36	8,959 34	19,947 70	3,000 00	7,555 98	2,344 02	12,900 00	7,047 70	6,916 02	131 68	
6	Joseph Mercer.....	10,266 11	9,669 58	19,935 69	3,000 00	8,339 91	2,600 09	13,910 00	5,995 69	19,859 66	.....	18,863 97
7	Wm. K. Carille.....	5,938 39	6,350 95	11,389 34	3,000 00	4,629 29	1,539 36	9,168 65	2,220 69	3,015 67	.....	794 98
8	C. A. Sundstrom.....	3,322 33	14,242 06	17,564 39	3,000 00	10,699 92	2,499 51	16,199 23	1,365 16	1,704 00	.....	338 84
9	Jos. C. Wagner.....	8,751 98	11,374 72	20,129 70	3,000 00	11,164 00	1,836 00	16,000 0	4,129 70	4,925 68	.....	795 98
10	Ino. H. Webster, Jr.	7,894 97	9,189 47	17,084 41	3,000 00	7,793 25	2,877 03	13,670 28	3,414 16	5,875 31	.....	2,461 15
11	Jos. Johnson.....	16,934 11	10,122 68	27,056 79	3,000 00	9,464 63	2,335 37	14,890 0	12,256 79	3,318 75	3,908 04	
12	J. H. Gillingham.....	10,193 28	13,847 29	24,040 57	3,000 00	9,259 9	1,539 33	13,799 29	10,241 28	7,478 43	2,762 85	
13	H. M. Fuller.....	11,855 31	5,692 64	17,577 95	3,000 00	8,541 62	2,853 5	14,095 12	3,432 83	7,693 75	.....	4,210 92
	Total	\$107,510 98	\$119,764 64	\$227,275 62	\$39,000 00	\$104,297 75	\$26,876 40	\$170,174 15	\$57,101 47	\$85,906 32	\$7,129 63	\$35,034 48
	Total 1896.....	122,339 79	132,830 47	255,670 26	39,000 00	108,633 98	23,029 96	170,663 94	85,006 32	126,926 05	4,894 03	46,813 76
	Total 1895.....	151,081 45	152,693 71	303,775 16	39,000 00	112,816 53	25,032 58	176,849 11	126,926 05	202,327 17	7,236 76	82,837 88

Registry Division.

The following is a comparative summary of the operations of the Registry Division of the Bureau of Surveys during the years 1895, 1896 and 1897:

	1895.	1896.	1897.
Number of certificates registered owners issued.....	13,620	13,770	12,700
Number issued for use of the Law Department.....	498	569	732
Receipts from certificates of registered owners.....	\$3,381 00	\$3,432 50	\$3,173 00
Number of original lots plotted.....	13,103	13,269	14,319
Number of transfers registered.....	26,978	29,026	30,848
Number of plans made for use of City Departments, Bureaus, etc.....	305	494	481
Number of examinations of registry plan books made by the public.....	30,490	35,673	36,737
Number of descriptions of property filed for registry.....	39,680	42,690	43,108
Number of titles perfected.....	2,215	2,560	2,516
Number of certificates of legal opening of streets issued to Bureaus, etc.....	2,794	3,141	2,945
Number of certificates of registered owners in municipal lien cases for Law Department.....	2,854	2,177	2,356

In the matter of renewing worn out registry plan books, good results have been accomplished, but not what the necessities of the case require. Of equal importance with the renewal of plan books, is the renewal of worn out topographical sectional plans of the City. Owing to the inadequacy of the force, no men could be placed upon this work until the month of September—consequently but few plans have been renewed.

The rapidity with which these plans and books are wearing out, is due to the increased use (about fifty per cent. in the past ten years); and as they are wearing out faster than renewal takes place, the public good warrants an increase in the force engaged upon this work.

The following tables give a comparative summary of the operations of the Bureau of Surveys, in the active con-

struction of work; also, the receipts and expenditures during the years 1895, 1896 and 1897:

Comparative Summary of Main, Branch and Private Sewers, and Bridges built during the years 1895, 1896 and 1897.

	1895.		1896.		1897.	
	No.	Linear Feet.	No.	Linear Feet.	No.	Linear Feet.
Bridges	16		6		2	
Intercepting sewer (section).....	5	9,865				
Intercepting sewer connections.....			2	5,990	1	413
Main sewers.....	22	25,012	2	12,671		
Branch sewers.....	328	224,693	294	116,633	200	133,072
Private sewers.....	109	59,181	94	44,611	96	32,576
Subway sewers.....	5	13,886			4	2,328
Delaware avenue sewers.....					1	360
Total.....	485	*332,637	398	†179,905	304	‡168,749

* 1895 equal to 62.97 miles. † 1896 equal to 34.07 miles. ‡ 1897 equal to 31.94 miles.

Comparative Statement of Work upon Bridges during the Years 1895, 1896, 1897.

	1895.	1896.	1897.
Finished.....	16	6	2
Begun	5	1	3
Authorized.....		1	1
Planned.....	8	8	11

Comparative Statement of Receipts.

Year.	Receipts of Bureau.	Receipts of District Surveyors.	Total.	Decrease.
1895.....	\$62,585 17	\$151,081 45	\$213,666 62	
1896.....	58,558 70	122,839 79	181,398 49	\$32,268 13
1897.....	37,574 60	107,510 98	145,085 58	36,312 91

Comparative Statement of Expenditures.

	18 5.	1896.	1897.
Current expenses.....	\$246,404 34	\$245,951 48	\$245,270 66
For extensions.....	1,610,347 65	896,641 45	2,582,519 61
Total.....	\$1,856,751 99	\$1,142,592 93	\$2,827,790 27

Bureau of Water.

The total receipts of the Bureau of Water from all sources in 1897, were \$2,971,357.52, as compared with the preceding year of \$2,879,133.26, an increase of \$92,224.26. The expenditures during the past year both for permanent improvements and cost of maintenance were \$1,665,153.21. The excess of receipts over all expenditures, or the net revenue from this branch of the City service was \$1,306,204.31.

The total number of gallons of water pumped was 95,667,466,871. The average daily pumpage was 262,102,616 gallons, an increase of 22,513,457 gallons daily over that of the previous year.

One of the notable features of the reports of this Bureau, is the increase in the quantity of water pumped. Compared with the report of ten years ago, we have the following:

	Total pumpage gallons.	Capita per day. gallons.
1897.....	95,667,466,871	187
1887.....	32,426,779,765	89
Increase.....	63,240,687,106	98

The average daily consumption during the year 1897, calculated upon an estimated population of 1,385,734, is 187 gallons per capita, per day, an increase over 1887, as shown in the above table, of 98 gallons per capita per day, or an increase of more than 100 per cent. in ten years.

No one will pretend to believe that this represents water actually consumed for either household or manufacturing purposes, but on the contrary we are forced to the belief that it indicates a wasteful and extravagant use of water. As stated in my previous report, the waste of water is a municipal sin; a remedy for this evil can certainly be found, and Councils should give the matter immediate consideration, and by proper legislation, put the Department in a position to keep the use of water within reasonable bounds. Unless some action is taken at an early day to restrict the waste of water, it will be practically impossible to keep up the daily supply in time of greatest consumption.

During the year, the relining of the Queen Lane and new Roxborough Reservoirs was completed, and both these reservoirs are now in service. The appropriation for this work was made prior to 1897.

The other reservoirs of the City have been kept in good repair. The dam at Fairmount received some temporary repairs, but it will very soon require additional repairs of a more extensive and permanent character. Repairs have been made at Fairmount and other pumping stations, as far as the funds available would permit.

The report of Frank L. Hand, General Superintendent (Appendix B), which accompanies the report of the Chief of Bureau of Water, refers in detail to all repairs made, and also enumerates the requirements of the several pumping stations, to place them in proper condition to meet the demands made upon them.

The distribution system has been improved by the laying of 30.6 miles of distributing mains, making an aggregate of 1,242.7 miles of water pipe now in use.

The construction of the Pennsylvania Avenue Subway, necessitated the lowering of several of our large distributing mains, so as to carry them under the Subway.

This work was done without inconvenience to the public and in a most satisfactory manner.

No appropriation was made to the Bureau of Water by Councils during the past year, either for extensions or permanent improvements—consequently but little work, other than a few minor repairs, has been accomplished. The efficiency of this important branch of the municipal service is handicapped by the lack of sufficient appropriations to make the required repairs to the boilers and machinery of the several pumping stations, and to provide additional pumping facilities to meet the increasing demands made upon some of our stations.

At the date of this report—January 3, 1898—Belmont Pumping Station is in a critical condition. The flue system is in a precarious state, and liable to collapse at any moment. Should this occur, all the pumps at this station would be thrown out of service for several weeks, and in thirty-six hours all that section of the City west of the Schuylkill river would be without water.

The boilers at this station are in need of repairs, but as they are all required to run the pumps, their services cannot be dispensed with for a longer time than a day or two, and even for that period, only one can be spared at a time. It is imperative that some action be taken at once to provide for additional boilers, boiler house and stack at this station, as under existing conditions it will be impossible for the Department to meet the increasing demands which will be made upon this overworked station during 1898.

At this writing I have prepared, and will forward to you with the request that you transmit the same to Councils, a communication calling the attention of those bodies to the condition of affairs at Belmont, Queen Lane and Roxborough Pumping Stations, also at Belmont and Roxborough Auxiliary Stations, requesting that they make

sufficient appropriation to cover the cost of some urgent and necessary repairs to the present machinery, and also to provide better facilities at these stations in order to meet the pressing demands made upon them; and it is to be hoped that for the efficiency of the service, they will give the matter immediate attention and make the appropriation asked for.

Of the several schemes presented by private corporations for a future water supply, none seemed to have met with favor except that of the Schuylkill Valley Water Co. The bill of this company is now pending before the upper branch of the municipal legislature.

The City of Philadelphia should always hold absolute control over its water supply, and resist any and every scheme which seeks to put this essential public function in the hands of a private concern.

A plentiful and pure water supply is essential, and the necessity for an intelligent and prompt decision upon this important subject, is imperative. The question of a new source of water supply has received careful consideration, and the Department is prepared, and can, within any reasonable time, present a comprehensive plan for a future supply for the City. But the fact that it would take years of time, and the expenditure of very large sums of money to bring us a new supply, has forced me to the conclusion that filtration, which could be easily and economically introduced at once, is the proper method to adopt under present conditions, for the purification of the water supplied to our citizens.

The Loan Bill now pending before Councils, and which provides \$3,700,000 for the improvement of our water supply, should be taken up at the earliest possible moment, and pressed to passage in both branches of Councils. If this is done, it will place in the hands of the Department,

the means for the betterment of the water supply of our City.

As no appropriations were made during the past year to meet the recommendations suggested in my previous report, for the improvement of this branch of the public service, the conditions remain the same as they were a year ago, except that they are more urgent, owing to the increasing demands made upon the service.

I therefore again renew the recommendations made in my report for 1896, and urge that some action be taken at once to provide for the following:

A new reservoir for West Philadelphia District.

Belmont Pumping Station—Eight new boilers, boiler house and stack. This is imperative for the reasons previously stated in this report.

A new engine house for the No. 4 Worthington pump at this station. At present it has only a temporary covering of boards to protect it from the weather.

New 3,000,000 gallon pump at the Belmont High Service Station. The engine at this station was constructed over thirty years ago, and is required to be run night and day throughout the entire year; owing to its age, it is in a precarious condition, and should it for any reason be thrown out of service, the district supplied by it will be deprived of water.

Queen Lane Pumping Station.—A new 48-inch pumping main from this station to the Queen Lane Reservoir. The four engines at this station are required to deliver water through one 48-inch main to the reservoir. This increases both the pressure on the pumps, and the cost of pumpage, and should this main for any reason be thrown out of service, we would be compelled to supply the district now cared for by this station, by direct pumpage from the Spring Garden Pumping Station, thus crippling our facilities for keeping the East Park Reservoir full.

Coal shed and tunnel.—All the coal used at this station, we are compelled to haul from the Wissahickon Station, on the Philadelphia and Reading Railway, at a cost of 25 cents per ton, and this extra expense to the City, during the year 1897, amounted to \$7,563. This extra cost could be saved annually in the expenditures of this station, if proper facilities were provided for the delivery of coal.

Relocation of the suction mains from the river to the Queen Lane Pumping Station. A recent examination of the pumps at this station, reveals the fact that there are fractures in each of the 12 pump chambers, and the breaking of these parts is due largely to the admission of air into the suction mains, causing severe strain to be brought upon the pumps and the pumping main. I would therefore urge that these pipes be laid at a lower level.

Roxborough Pumping Station.—The section of the City supplied with water from this station, has outgrown the supply, and additional facilities are required to meet the increasing demands for water, to wit, a new 10,000,000 gallon triple expansion pump, eight new boilers, boiler house and stack.

A new 5,000,000 gallon pump at the high service station. The same condition exists at this high service station as at the auxiliary station at Belmont, and provision should be made at once to relieve the overworked engine, and to meet any emergency which may arise.

Spring Garden Pumping Station.—Additional storage capacity for coal should be provided at this station.

Fairmount Pumping Station.—A portion of the roof covering the wheel house at this station is in a deplorable condition, leaking at every rainfall. It should be repaired at once, in order to protect the machinery housed therein.

A new reservoir to connect with the Wentz Farm Reservoir, to aid in furnishing an adequate supply of water to the northeastern section of the City.

Additional large distributing mains should be laid in various parts of the City, in order to meet the increasing demand for water.

All the above, and many minor needs, are absolutely necessary, and it is important that money should be provided for the work.

The following tables give the number and types of engines, the locations and capacities of reservoirs, and a comparative summary of the operations of the Bureau of Water; also, receipts and expenditures for the years 1895, 1896 and 1897:

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

PUMPING STATION.	Designated number of engine or turbine.	TYPE OF ENGINE.	Designed capacity in million gallons per day.	Total.
Spring Garden.	Old Station	Compound Rotary.....	20,000,000	170,000,000
	" "	Simpson's Compound Rotary	10,000,000	
	" "	Marine Compound Rotary...	20,000,000	
	" "	Worthington Duplex.....	10,000,000	
	" "	Gaskill	20,000,000	
	New Station.....	Worthington Duplex.....	15,000,000	
	" "	"	15,000,000	
" "	Holly	30,000,000		
" "	"	30,000,000		
Queen Lane.....	1	Southwark	20,000,000	80,000,000
" "	2	"	20,000,000	
" "	3	"	20,000,000	
" "	4	"	20,000,000	
Belmont.....	1	Worthington Duplex.....	5,000,000	38,000,000
"	2	"	5,000,000	
"	3	"	8,000,000	
"	4	"	20,000,000	
Belmont Auxiliary.....	1	Worthington.....	2,000,000	2 500,000
" "	2	Snow.....	500,000	
Roxborough.....	1	Southwark	12,000,000	24,500,000
"	2	Worthington Duplex.....	5,000,000	
"	3	"	7,500,000	
Roxborough Auxiliary..	1	Worthington.....	5,000,000	5,000,000
Mt. Airy.....	1	Davidson.....	1,000,000	3,000,000
" "	2	"	1,000,000	
" "	3	Knowles	1,000,000	
Chestnut Hill.....	1	Knowles.....	250,000	750,000
" "	2	Worthington Duplex.....	500,000	
Frankford	1	Marine Compound Rotary ..	10,000,000	42,000,000
"	2	Corliss Compound Rotary.....	10,000,000	
"	3	Southwark Rotary.....	22,000,000	
Fairmount.	New House.....	Turbine Wheels.....	2,000,000	33,290,000
	" "	"	5,330,000	
	" "	"	5,330,000	
	" "	"	5,330,000	
	Old	"	5,100,000	
	" "	"	5,100,000	
	" "	"	5,100,000	
Total.....				399,040,000

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

Name of Reservoir.	Location.	Date of Completion.	Height above City Datum.	Capacity in gallons.
Fairmount. {	Reservoir No. 1.....	East Fairmount Park.....	94 feet.	26,350,000
	" " 2.....			
	" " 3.....			
	" " 4, Section 1.....			
	" " 4, " 2.....			
" " 4, " 3.....				
Lehigh..... {	Section 1.....	Sixth and Lehigh avenue.....	114 "	28,910,000
	Section 2.....			
Section 3.....				
Spring Garden.....	Twenty-sixth and Master streets.....	1844	120 "	12,950,000
Corinthian.....	Corinthian avenue and Poplar street.....	1852	120 "	37,341,400
East Park... {	Section 1.....	East Fairmount Park.....	138 "	62,738,000
	Section 2.....			
	Section 3.....			
Queen Lane {	North Basin.....	Thirty-third street and Queen lane.....	238 "	205,620,000
	South Basin.....			
Frankford.....	Oxford Turnpike and Conly street.....	1877	167 "	36,045,000
Belmont.....	West Fairmount Park.....	1870	212 "	39,758,000
Mount Airy ..	Allen's lane and Mower street, Germantown.....	1871	363 "	4,546,000
Roxborough.....	Ridge and Shawmont avenues.....	1866	366 "	1,338,000
New Roxborough {	North Basin.....	Port Royal avenue and Ann street.....	414 "	71,594,000
	South Basin.....			
Manatawua tanks—2.....	Manatawua and Ridge avenues.....	1878	442 "	107,000
Chestnut Hill tank.....	Hartwell avenue and Chestnut Hill Railroad, Chestnut Hill.....	1860	481 "	52,000
Belmont Stand Pipe.....	West Fairmount Park.....	1835	148 "	106,000
Roxborough Stand Pipe.....	Port Royal avenue and Ann street.....	1895	490 "	106,000
Total.....				1,417,860,400

*Comparative Statement of Pumpage for the Years 1895, 1896
and 1897.
Pumpage.*

	1895. Gallons.	1896. Gallons.	1897. Gallons.
Pumped to reservoirs.....	78,775,849,104	87,698,642,529	95,667,466,871
Equal to gallons pumped 100 feet high	132,040,954,195	161,776,711,713	187,371,927,277

NOTE.—The “pumped to reservoir,” etc., includes 1,668,275,750 gallons of repumpage to higher levels at Mt. Airy, Roxborough and Belmont Auxiliary Stations. This deducted from the total pumped, gives 93,999,191,121 gallons as the total consumption.

The cost of pumpage is calculated on the total pumpage, and the consumption per capita on the smaller quantity.

	1895. Gallons.	1896. Gallons.	1897. Gallons.
Pumped by water-power.....	7,587,193,211	8,959,846,128	7,590,276,532
Pumped by steam-power.....	71,188,655,893	78,733,796,401	88,077,190,339
Largest quantity pumped in 24 hours.	258,838,527	286,955,648	319,216,876
Smallest quantity pumped in 24 hours.	133,916,719	72,143,883	261,009,818

Year.	Average daily consumption.	Average consumption in galls. per capita per day, estimating the population at*	Increase of	Increase per capita per day.	Cost per 1,000,000 gallons pumped 100 ft. high.
	Gallons.	Gallons.	Gallons.	Gallons.	
1895	213,202,777	160.3	6,381,670,823	2.2	3.69
1896	235,596,614	172.5	8,409,347,349	12.2	3.43
1897	257,532,030	187	7,770,830,162	13.3	3.16

* 1895—1,329,957 estimated.
1896—1,367,815 estimated.
1897—1,385,734 estimated.

The cost of pumping one million gallons lifted one hundred feet high was \$3.16, or 27 cents less than in the previous year.

About eight per cent. of the total pumpage was by water-power, the turbine wheels using..... 227,703,295,960 gallons.
To pump..... 7,590,276,532 “

*A Comparative Statement of the Total Pipe Laid and of other Work done during the Years 1895,
1896 and 1897.*

YEAR.	PIPE LAID.			*PIPE RELAID. Feet.	FIRE HYDRANTS PLACED IN POSITION.			SUBSTITUTED FOR DEFECTIVE HYDRANTS.			Fire Hydrants in use.	New Water At- tachments.
	FEET.	EQUAL TO.			New Style	Old Style.	Total.	New Style	Old Style.	Total.		
		Miles.	Feet.									
1895.....	209,295	39	3,375	31,063	902	.....	902	379	4	383	10,038	10,410
1896.....	196,839	37	1,479	71,189	732	1	733	384	6	390	10,624	7,860
1897.....	161,810	30	3,410	45,902	566	.....	566	256	4	260	11,101	7,618

Total pipe laid, 1,242 miles, 3,711 linear feet.

* Adds nothing to feet in ground.

*Comparative Statement of Receipts and Expenditures for the
years 1895, 1896, and 1897.*

Receipts.

	1895.	1896.	1897.
Receipts from water rents.....	\$2,367,057 60	\$2,441,583 95	\$2,528,008 69
“ “ fractional rent.....	166,713 87	193,684 38	181,248 87
“ “ water pipes.....	161,285 14	131,602 69	142,217 77
“ “ City Solicitor's office.....	46,994 07	43,806 52	53,517 84
“ “ penalties.....	37,498 56	36,417 98	35,184 08
“ “ delinquent rent.....	28,920 75	19,132 75	19,559 00
“ “ Chief Engineer's office..	11,676 44	4,875 91	3,564 08
“ “ searches.....	5,539 25	5,633 50	5,243 25
“ “ delinquent penalties.....	4,171 49	2,295 58	2,813 94
Total.....	\$2,829,857 17	\$2,879,133 26	\$2,971,357 52

Expenditures.

	1895.	1896.	1897.
Current expenses.....	\$1,509,902 97	\$1,307,696 40	\$1,354,642 90
For extensions.....	387,322 23	517,914 49	310,510 31
Total.....	\$1,897,225 20	\$1,825,610 89	\$1,665,153 21

Director's Office.

The work of the Director's Office, incident to the current business, has been conducted with regularity, and all matters of whatever nature have received prompt attention, and I desire to commend the Chief Clerk, and his assistants, for the careful and satisfactory manner in which the multitudinous duties of the office have been performed.

SUMMARY OF APPROPRIATIONS, EXPENDITURES, RECEIPTS, ETC., OF THE DEPARTMENT OF PUBLIC WORKS,
DURING THE YEAR 1897, AND TOTALS FOR THE YEARS 1895 AND 1896.

Bureaus.	Appropriation for 1897.	Balance available from previous years.	Additional appropriations and transfers.	Total.	Number of Warrants Drawn.	AMOUNT OF WARRANTS DRAWN.			Transfers From.	Balance Available, 1898.	Total.	Amount Merging.	Receipts.	Number of employes Dec. 31, 1897.
						Current Expenses.	Extensions.	Total.						
Director's Office.....	\$27,320 00		\$47 00	\$27,367 00	211	\$24,560 34		\$24,560 34	\$2,500 00		\$27,060 34	\$36 66		9
City Ice Boats.....	32,400 00			32,400 00	190	24,991 41		24,991 41	5,530 00		30,521 41	1,878 59	\$325 68	9
Gas.....	2,983,683 00	\$34,184 43	468,581 99	3,486,454 42	1,314	† 2,812,461 09	\$103,522 88	2,915,983 97	86,781 99		3,002,765 96	483,688 46	† 3,061,391 78	1,720
Highways.....	1,246,155.71	280,815 45	193,700 00	1,720,671 16	3,486	579,195 64	745,573 64	1,324,769 28	71,600 00	\$294,329 06	1,690,698 34	29,972 82	135,439 35	112
Board of Highway Supervisors.....*													2,380 80	10
Lighting.....	471,490 00		3,250 00	474,740 00	260	439,533 78	12,837 35	452,371 13	3,250 00		455,621 13	19,118 87	50 64	2
Street Cleaning.....	871,814 00			871,814 00	474	866,402 62		866,402 62	4,117 00		870,519 62	1,294 88		14
Surveys.....	938,760 00	1,792,125 94	4,406,000 00	7,136,885 94	4,818	245,270 66	2,582,519 61	2,827,790 27		4,298,682 69	7,126,472 96	10,412 98	145,085 58	292
District Surveyors.....†													107,510 98	13
Water.....	1,119,654 00	392,274 42	370,700 00	1,882,628 42	2,794	1,354,642 90	310,510 31	1,665,153 21		69,588 52	1,734,741 73	147,886 69	2,971,357 52	926
Total 1897.....	\$7,691,281 71	\$2,499,400 24	\$5,442,273 99	\$15,632,960 94	13,547	\$6,347,058 44	\$3,754,963 79	\$10,102,022 23	\$173,778 99	\$4,662,600 27	\$14,938,401 49	\$694,559 45	\$6,423,542 33	3,107
Total 1896.....	\$6,568,591 59	\$2,399,549 78	\$3,375,128 91	\$12,343,270 28	12,931	\$6,610,641 36	\$2,734,721 32	\$9,345,362 68	\$447,254 07	\$2,499,400 24	\$12,292,016 99	\$51,253 29	\$6,548,346 00	3,336
Total 1895.....	\$6,870,710 42	\$2,722,630 15	\$2,983,362 78	\$12,576,703 35	13,032	\$6,409,416 46	\$3,072,032 65	\$9,481,449 11	\$478,803 51	\$2,399,549 78	\$12,359,802 40	\$216,900 05	\$6,361,533 19	3,499

* Included in the appropriation and in the expenditures of the Bureau of Highways.

† Included in the appropriation and in the expenditures of the Bureau of Surveys.

‡ Expenses and receipts for eleven months.

The following is a comparative statement of the expenditures of the Director's Office during the years 1895, 1896 and 1897:

Item.		1895.	1896.	1897.
1	Salaries.....	\$17,790 00	\$18,690 00	\$20,195 00
2	Keep of horses.....	487 50	750 00	1,400 00
3	Printing, stationery, etc.....	2,499 74	2,318 38	2,543 81
4	Expenses attending investigation of filtration.....			421 50
	Total.....	\$20,777 24	\$21,758 38	\$24,560 34

Receipts and Expenditures.—The appropriations, expenditures and receipts of the Department for the year 1897, are set out in the following table in details by Bureaus, and also in totals for the years 1895 and 1896:

As the suggestions and recommendations, made a year ago have not been met, either by appropriation or legislative action, they are here repeated.

I would respectfully urge that more liberal appropriations be made, both for maintenance and permanent improvements.

Highways.—An ordinance should be passed requiring all owners of property to have six-inch granite curb set upon all streets hereafter, prior to paving or repaving.

More liberal appropriation for the substitution of granite curved curbing in place of the old fashioned square corners. The importance of larger appropriations for the maintenance of macadam roads; also for repairing and painting bridges.

The necessity of an appropriation for repaving with improved pavement, streets not occupied by passenger railway tracks; also for the repaving of tramway streets.

Street Cleaning.—The importance of an ordinance providing an appropriation for the removal of snow from streets in the business centre of the City.

That legislation be obtained authorizing the Department to award contracts for the cleaning of streets and the collection and disposal of garbage, for a period of three or five years.

Surveys.—The importance of liberal appropriations for the extension of the main and intercepting sewer systems, and for the construction of bridges. Both these works are of paramount importance, and should receive the immediate attention of Councils.

Water.—The necessity of immediate action upon a plan for the future water supply of the City.

Liberal appropriations for the extension and repairs to the several pumping stations and reservoirs.

Laying additional large mains for the improvement of the system of distribution.

Extension of the water supply system to Fox Chase.

All of the suggestions herein stated, are for the improvement of the public service, and their importance require that early action be taken upon them.

Appropriations, 1898.

The following is an abstract from the ordinance making an appropriation to this Department for the year 1898, with a statement of balances available from previous years for work ordered and for which contracts are executed:

Bureaus.	Annual Appropriation for the year 1898.	Balance Available from previous years.	Total.
Director's Office.....	\$24,707 00	.....	\$24,707 00
City Ice Boats.....	32,400 00	.....	32,400 00
Highways.....	1,090,474 62	\$294,329 06	1,384,803 68
Lighting.....	275,980 00	.....	275,980 00
Street Cleaning.....	909,533 00	.....	909,533 00
Surveys.....	621,260 00	4,298,682 69	4,919,942 69
Water.....	1,068,843 40	69,588 52	1,138,431 92
Total.....	\$1,023,198 02	\$4,662,600 27	\$8,685,798 29

In concluding this report, I desire to mention the hearty co-operation of the Chiefs of the several Bureaus, and their fidelity, in the discharge of their responsible duties; and to thank you for the confidence and assistance you have always given me.

Very truly yours,
 THOMAS M. THOMPSON,
Director.

ANNUAL REPORT
OF THE
BUREAU OF WATER
For the Year 1897.

OFFICERS
OF THE
BUREAU OF WATER.

Chief,

JOHN C. TRAUTWINE, JR.

Assistants,

ALLEN J. FULLER,

WILLIAM WHITBY.

Draughtsmen,

John E. Codman,

William Farrell,

Martin Murphy,

John R. Gorman.

Chief Clerk—Job T. Hickman.

Assistant Clerk—James G. Dixon.

Correspondence Clerk—P. deHaven.

Search Clerk—H. J. Johnson.

Assistant Search Clerk—Wm. J. Duffy.

Clerk—Thomas Spence.

Assistant Clerk—K. McNeal.

Assistant Clerk—J. I. Barney.

Time Clerk—W. J. Innes.

Pipe Inspector—Theodore S. S. Baker.

Pipe Clerk—George G. Whitby.

Messenger—Haines Lewis.

Telephone Operators,

Frances Shields,

Calvin Craner.

General Superintendent,

F. L. HAND.

Clerk to General Superintendent—John A. Hayes.

Assistant Clerk to General Superintendent—John B. Wright.

Works—General.

Foreman Machinist—Robert Bromily.
Foreman Carpenter—Henry Guest.
Foreman Bricklayer—Frank A. Mooney.
Foreman Stonemason—Michael Farrell.
Foreman Rigger—James Forrest.
Foreman Painter—Joseph Work.
Foreman Laborer—William Calhoun.
General Storekeeper—S. C. Buchanan.
Electrician—Henry P. Morgan.
Superintendent of Shop—James H. Dean.
Clerk to Superintendent of Shop—Morris P. Getz.

Purveyors.

First District, John H. Holmes.
Clerk—William J. Mackey.
General Foreman—Thos. Preston. *Foreman of Repairs*—W. W. Wellington.
Office, 1120 Wharton street.

Second District, David A. Craig.
Clerk—Charles H. Green.
General Foreman—Michael Young. *Foreman of Repairs*—Edw. Homan.
Office, 918 Cherry street.

Third District, Charles J. Lowry.
Clerk—J. A. Spanagle.
General Foreman—Elias Abrams. *Foreman of Repairs*—William Magee.
Office, Beach street and Susquehanna avenue.

Fourth District, John Montgomery.
Clerk—Arthur B. Cook.
General Foremen—George W. Showaker, James Hutchinson.
Foreman of Repairs—John Richards.
Office, Twenty-sixth and Master streets.

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

Sixth District, George H. Laut.
Clerk—William D. Kinsler.
General Foreman—Samuel Loeb. *Foreman of Repairs*—Jas. W. DeHart.
Office, Town Hall, Germantown.

ANNUAL REPORT
OF THE
BUREAU OF WATER

For the year 1897.

Eleventh Annual Report of the Bureau of Water.
Ninety-sixth Annual Report of Operations Connected with
the City Water Supply.

Philadelphia, January 26, 1898.

THOMAS M. THOMPSON, Esq.,
Director, Dept. of Public Works.

SIR:—The water service of this City is in critical condition.

Between continued starvation on the one hand, and enormously increasing waste on the other, it is made to appear, as stated in your report of 7th October last, that “we are compelled to negotiate with corporations and individuals, to secure for the citizens of Philadelphia a pure and abundant supply of water.”

As a matter of fact the City holds in her own hands the key to the solution of her water problem.

As stated in my report to you of 25th September last:

“The City has, at its doors, an ample supply of water for the freest possible use of all our citizens, for at least a generation or two to come, and our present machinery, with the possible exception of our distribution system, will be ample for handling it for years to come.

"All we need is means for preventing waste, and means for filtering the water.

"Given these, and the present supply is all that can be desired, both as to quality and as to quantity.

"Both of these objects can be secured at a cost not exceeding, perhaps, ten million dollars total, and the needed improvement can be made gradually, defraying the expense out of the surplus earnings of this Bureau, which now amount to about one million dollars* annually.

"To launch out into contracts with private corporations, binding the City to the annual payment of millions of dollars for fifty years, for facilities which the City does not want, would, therefore, appear absolutely inexcusable."

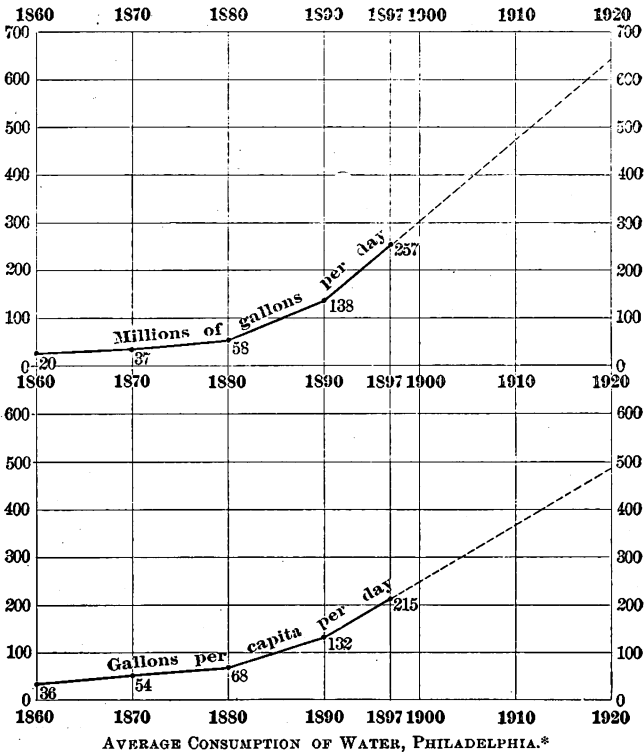
Increase of Consumption.

The following table and diagram show how enormously our consumption of water has increased, amounting, in 1897, to 215 gallons per head per day, more than half of which was wasted.

Year.	Population.†	Daily consumption of water. Gallons.	
		Total.	Per Capita.
1860.....	565,529	20,398,198	36
1870.....	674,022	36,626,255	54
1880.....	847,170	57,693,719	68
1890.....	1,046,964	137,736,703	132
1897.....	1,200,000	257,500,000	215

* The excess of earnings over current expenses, from 1892 to 1896 inclusive, averaged \$1,469,356 per annum. For 1897, it was about \$1,560,000.

† The populations used in the table and diagram for the years 1860, 1870, 1880 and 1890 are those given by the U. S. Census, and that for 1897 is estimated from the census data. The figures thus obtained for the population are lower than those generally used in previous reports and in other portions of this report.



Continued Starvation.

In its efforts to grapple with the rapidly increasing consumption of water, the Bureau, although earning annually, for the City, about a millions dollars net above its expenses, has been and still is handicapped by the refusal of all appropriations for extensions and improvements, except for repair of reservoirs, as witness the following statement:

* To avoid danger of exaggeration, the dotted line showing the estimated increase of consumption between 1897 and 1920 is projected in the same direction as the line between 1890 and 1897, although the rest of the diagram shows that the rate of increase itself increases. The dotted line therefore represents a conservative estimate; and, as pointed out in my report for 1895, such estimates are dangerous. The dotted line must, therefore, be taken with this reservation. It is owing to the insufficiency of such estimates that the increases in our reservoir capacity, advocated some years ago as promising relief from our troubles, have failed to bring that relief.

FOR EXTENSIONS AND IMPROVEMENTS OTHER THAN REPAIRS OF
RESERVOIRS.

Year.	Estimates.	Appropriations.
1896.....	\$2,835,150	\$1,000*
1897.....	3,327,750	0
1898.....	3,863,750	0

As a consequence of this, and of the increasing waste of water, the consumption has again overtaken our pumping capacity; and there will, almost certainly, be a shortage of water at many points during the coming year.

Increasing Waste.

In my first annual report (that for 1895) I said: "I regard the diminution of waste as the first and most pressing duty of this Bureau."

At that time the principal apparent evils resulting from waste of water were the annually recurring fear of water famine, the necessity of pumping almost continuously and without regard to the condition of the river, continual demands for money to build and operate new machinery and new reservoirs for pumping and storing wasted water, and the almost prohibitory cost of any comprehensive scheme for the improvement of the supply.

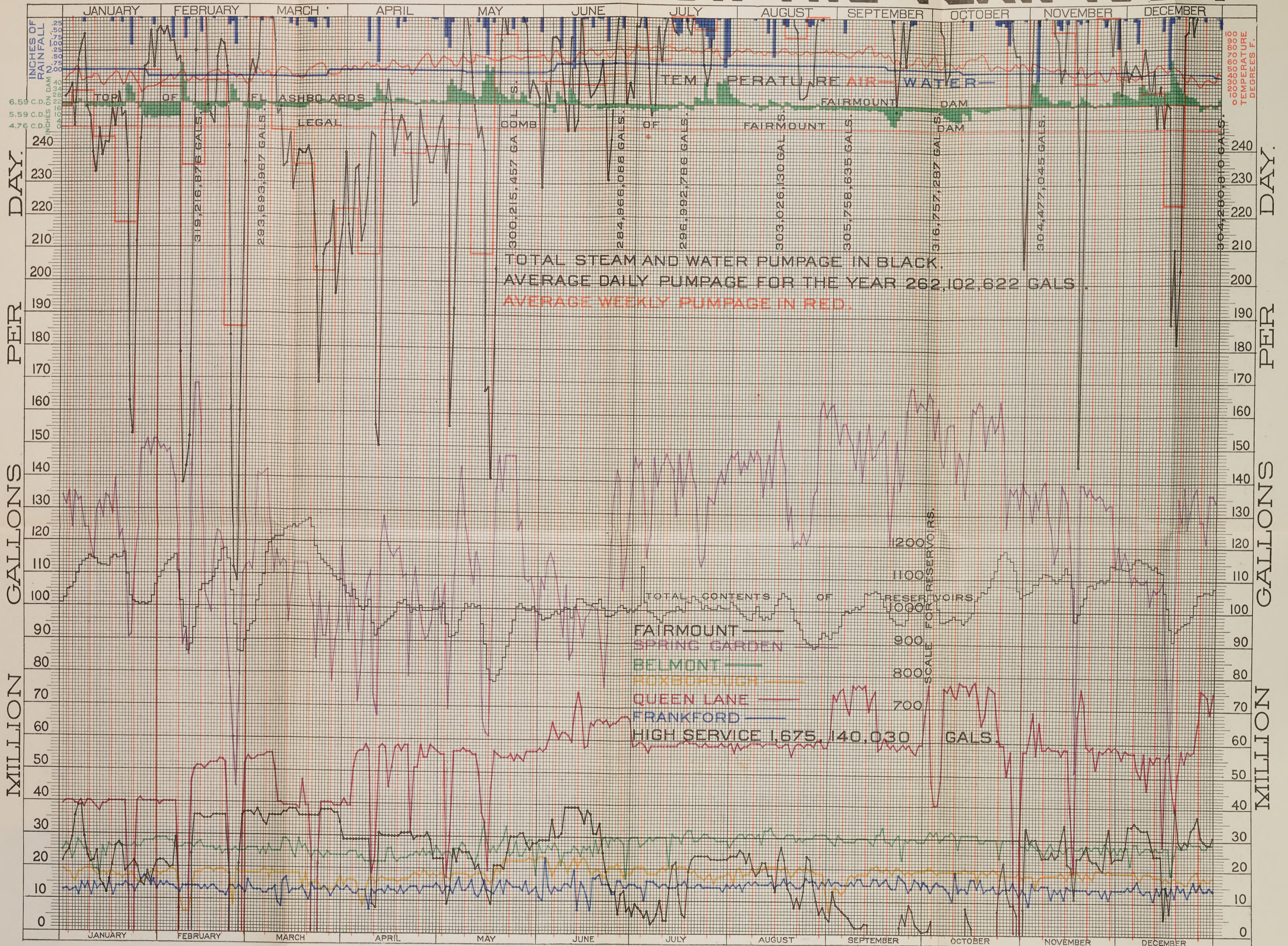
Now, however, by reason of our continued and increased waste of water, the City is threatened with the loss of control of her water works.

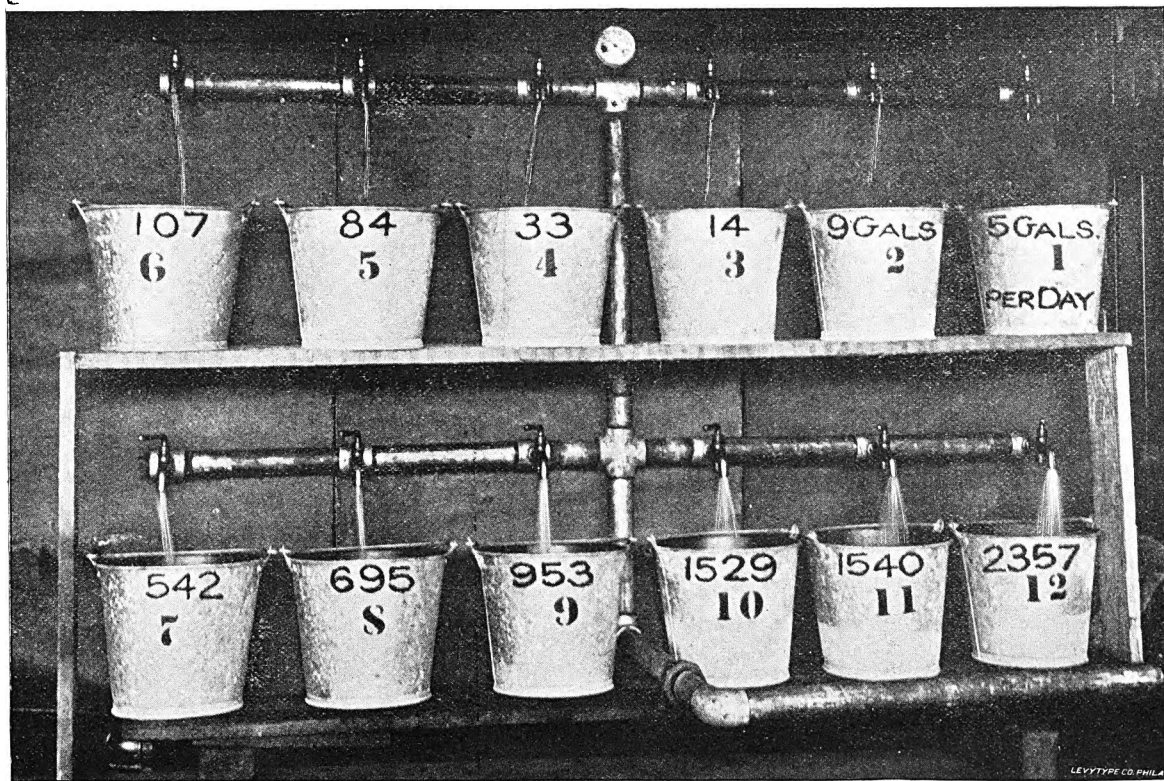
The Remedy.

The remedy is simple. The waste must be stopped by making it to the interest of each consumer to avoid *waste*, at the same time encouraging him to the fullest and freest *use* of water. This can be done by the general introduction of water meters.

* For the purchase of telephones. Owing to fear of infringement of patents, the telephones were not purchased, and the appropriation merged.

PUMPAGE DIAGRAM FOR THE YEAR 1897.





DAILY CONSUMPTION, IN GALLONS, BY STREAMS OF DIFFERENT SIZES.

LEVYTYPE CO. PHILA.

Meters will injure those, and those only, who are now taking more than they pay for, shifting the burden upon the community.

Householders can take all the water they want for the most liberal domestic use and for every luxury except waste, and yet reduce their bills below the present schedule charges,* which necessarily saddle the careful and conscientious with the wastefulness of the careless and unprincipled.

The general introduction of meters would, therefore, undoubtedly reduce the revenues, as well as the expenses, of the Bureau of Water, but this, even if it resulted in a decrease of net earnings, would be a matter of small moment when compared with the City's loss of the control of her water supply.

In my report for 1895, I, said:

"The aim of the Bureau should be, not to show a profit upon its transactions, but to furnish plenty of good water at the lowest possible cost to the community.

"Acting upon this view, the introduction of meters should be governed, not by a desire to increase the City's revenue from water furnished, but, first, to decrease the City's expenditure by cutting off a waste which, under

* See accompanying table, showing the results obtained from meters placed, experimentally, upon twenty residences in different parts of the city. Four of these residences averaged 149 gallons per head per day; and one took as much as 181 gallons. The remaining sixteen averaged only 33 gallons per head per day, but they paid for the wastefulness of their fellow-citizens.

~ The photograph shows the rates at which hydrants waste water. The one leaking 60 drops per minute lost about 5 gallons per day. That running full head lost 2,357 gallons per day.

The temptation to undue restriction in the use of water is removed by the minimum charge. Nothing is saved by reducing one's consumption below the point corresponding to the minimum charge,

It is a mistake to suppose that water wasted contributes to the cleanliness of the city or of its sewers. To exert any cleansing effect upon the sewers, the water must be carried into and through them at much higher velocities than that of the water which is now allowed to waste through them.

“the present circumstances, appears little short of criminal, and thus enabling the Bureau to furnish to all a plentiful supply with the means now at hand, and second, to substitute a just, scientific, common-sense method of doing business in place of that which we have inherited from the earliest water-works practice, a method which would be ludicrous by reason of its clumsiness, were it not for the serious injustice which it involves.”

It is often urged that meters would work hardship to manufacturers, whom the City should seek to encourage. The present meter rate of 30 cents per 1,000 cubic feet, or 4 cents per 1,000 gallons, is just about what it costs the City to furnish the water; but, if it is considered advisable to give water to any or to all manufacturers at less than cost, the City can do this as well with meters as without them.

It is safe to say that the general introduction of meters would, without in the slightest curtailing anyone's free use of water, reduce our consumption one half, solely by cutting off utterly unprofitable and defenceless waste. It would thus practically double the capacity of our present works, giving plenty of water for all.

It would cut in two the cost of the installation and operation of filter plants or that of bringing water from a distance. Even without the introduction of any means for purifying the water, it would at once improve the quality of that furnished through our mains; for we could then more safely cease pumping during seasons of muddy or coal-polluted water, and give the water in the reservoirs a longer time for subsidence.

The minimum flow of the Schuylkill would once more exceed our maximum draft upon it, our annual conflict with the Schuylkill Navigation Company would be avoided, and the spectre of the City's acquisition of that Company's properties would be once more suppressed.

CONSUMPTION OF WATER BY PRIVATE RESIDENCES AS OBSERVED BY METERS.

LOCATION.	Date set, 1897.	Days run.	Persons supplied.	GALLONS PER DAY.		ANNUAL COST OF WATER.				APPLIANCES.						
				Total.	Per head.	By Schedule.	BY METER.*			Hydrants.	Baths.	W. Closets.	Basins.	W. Paves.	Pantry Sinks.	W. Tubs.
							Actual.	Minimum Charge.	4c. per 1,000 gallons.							
4104 Girard avenue.....	September 8.....	112	10	1,493	149	\$20 00	\$21 80	\$5 00	\$21 80	1	2	3	2	1	1	
707 North Forty-second street.....	September 13.....	107	8	1,132	142	13 00	16 53	5 00	16 53	1	1	2		1		
709 North Forty-second street.....	September 13.....	107	7	1,005	144	13 00	14 67	5 00	14 67	1	1	2		1		
713 North Forty-second street.....	September 13.....	107	3	543	181	13 00	7 93	5 00	7 93	1	1			1		
First four. {	Total.....	423	28	4,173		\$59 00	\$60 93	\$20 00	\$60 93	4	5	7	2	4	1	
	Average.....	106				\$14 75	\$15 23	\$5 00	\$15 23							
1111 Walnut street.....	September 16.....	104	18	832	46	\$40 00	\$20 00	\$20 00	\$12 15	1	5	6	2	1		
202 South Twelfth street.....	August 23.....	135	12	354	30	12 00	13 00	13 00	5 25	1	1		1	1		
38 North Eleventh street.....	September 3.....	117	7	62	9	13 00	13 00	13 00	90	1	1	1	1	1		
413 North Thirty-third street.....	May 20.....	223	6	97	16	15 00	5 00	5 00	1 44	1	2	2	2			
107 North Thirty-fifth street.....	May 20.....	223	7 ⁹	120	17	16 00	5 00	5 00	1 75	1	1	1	2	1		2
4102 Girard avenue.....	September 8.....	112	6	296	49	20 00	5 00	5 00	4 27	1	2	3	2	1	1	
1126 North Forty-first street.....	September 9.....	111	6	354	60	16 00	5 26	5 00	5 26	1	1	2	2	1	1	
1128 North Forty-first street.....	September 9.....	111	5	276	56	16 00	5 00	5 00	4 05	1	1	2	2	1	1	
724 North Forty-second street.....	September 10.....	110	6	156	26	13 00	5 00	5 00	2 30	1	1	2		1		
726 North Forty-second street.....	September 10.....	110	7	165	24	13 00	5 00	5 00	2 40	1	1	2		1		
728 North Forty-second street.....	September 10.....	110	8	216	27	13 00	5 00	5 00	3 17	1	1	2		1		
730 North Forty-second street.....	September 10.....	110	4	35	9	13 00	5 00	5 00	51	1	1	2		1		
715 North Forty-second street.....	September 13.....	107	4	104	26	13 00	5 00	5 00	1 53	1	1			1		
1609 Allegheny avenue.....	June 30.....	182	5	157	32	13 00	5 00	5 00	2 30	1	1	1	1	1		
2223 Venango street.....	August 19.....	132	6	194	33	15 00	5 00	5 00	2 85	1	1	2	2	1		
4514 Chester avenue.....	May 20.....	223	6	319	54	17 00	13 00	13 00	4 71	1	1	2	1	1	1	2
Last Sixteen. {	Total.....	2,220	113	3,737		\$269 00	\$119 26	\$119 00	\$54 94	16	22	30	18	15	4	4
	Average.....	139				\$16 84	\$7 45	\$7 44	\$3 43							

* Where water rents are charged by meter, the minimum rate is one-half of the schedule rate on the ferrule through which the supply is taken from the City main, except in the case of 1/2-inch ferrules, where the minimum charge (\$5 per annum), by meter is the same as the schedule rate. If the quantity registered by the meter, when charged at 30 cents per 1,000 cubic feet (about 4 cents per 1,000 gallons), amounts to more than the minimum rate, the bill is made according to the reading of the meter.

Finally, the improvement and development of the supply would be brought well within the City's own means.

In my report for 1896 I submitted, as Appendix L, an ordinance providing for and regulating the use of water meters. The main provisions of this ordinance were:

(1.) The metering of all manufacturing establishments and other large consumers.

(2.) The metering of residences upon application of the owners.

(3.) The metering of residences without the consent of the owners in cases of waste.

The passage of this ordinance, with the necessary appropriations, would solve the water problem.

What To Do.

In brief, the situation imperatively demands:

1st. Restriction of waste.

2d. Purification of the water.

3d. Increase of our pumpage from the Delaware within or near the City limits.

I give waste-restriction the first place because it belongs there. No competent manufacturer would apply costly processes of improvement to needlessly wasted material.

Under the loan bill recently authorized by Councils and approved by the people, \$3,700,000 are subject to appropriation by Councils, "for extension, filtration and improvement of the water supply," with the provision that one million dollars of this amount "shall be applied to increase and improve the water supply of that portion of the City of Philadelphia lying west of the Schuylkill river." This nearly covers the amount (\$3,863,750) of our estimate for extensions and improvements for 1898, (Appendix G) which includes one million dollars for the improvement of the West Philadelphia supply. The difference, and the cost of a filter plant on the Delaware

side, will be covered by less than half the Bureau's estimated net earnings in 1898.

What To Do First.

For the immediate future I urge the improvement of the West Philadelphia supply, the filtration of all the water now pumped from the Delaware, and the other extensions and improvements mentioned in our estimate.

West Philadelphia.

To bring the improvement of the West Philadelphia supply within reasonable limits of cost, it is necessary to meter the supplies of that district. If this is done, and if the boiler capacity of the station is made equal to the capacity of the pumps, the present pumping station, the present mains, and, I believe, the present reservoir, will be found ample for the needs of the district, and the filtration of the reduced quantity of water demanded will be brought within the means provided in the loan bill.

Before this plan was matured, a new reservoir appeared as a necessity, and provision for it was made in our estimates; but in view of the present greatly preferable plan, the construction of a new reservoir involves merely an expenditure of money without adequate return, and must indefinitely postpone any material improvement in the quality of the water furnished to West Philadelphia; for such a reservoir as can be built for any reasonable proportion of the funds available will make little or no appreciable improvement in the water furnished.

Besides, it would be two or three years before a new reservoir could be put in service.

In a letter of December 17, 1897, to Mr. J. Warner Goheen, Chairman of Committee of West Philadelphia Councilmen, I suggested the laying of a main, to connect the Queen Lane and Belmont Pumping Stations, not as

a regular means of supply from either district to the other, but as a measure to be used only in case of emergency.

Filtration of Delaware Supply.

Our pumpage from the Delaware is but about fifteen million gallons per day. For this capacity a "sand" filter plant could probably be constructed for \$300,000 or less.

As our policy should be to increase our pumpage from the Delaware, in order to relieve the drain upon the Schuylkill, the question of metering the Delaware supply might be held in abeyance until the result of metering that of West Philadelphia has demonstrated to the public the benefits of the system; for a filtering plant, of proper capacity for the present Delaware pumpage, would be of about the right size for a metered supply to twice the present population.

Report on Filtration.

On August 30th I submitted, at your request, a report on filtration, embracing descriptions of the more important systems, with accounts of many existing plants. The conclusions reached may be summed up as follows:

"I believe it to be absolutely necessary for each municipality to work out its own salvation, with fear and trembling, in this matter. Visits to existing plants, study of their results and examination of the filtered waters yielded by them, are most useful in increasing our general information on the subject, but they cannot take the place of actual experiment, on a working scale, and under our own conditions. A method which may do very well for one city or for one portion of our works, may be found extremely expensive in operation, if not, indeed, absolutely unsuitable, in another. Samples of other waters, passed through a given filter, throw but little light upon what we might expect as the result of passing the Schuylkill or Delaware water through the same filter here.

“And, indeed, the behavior of a filter, as respects its “chemical or bacteriological efficiency, is but a portion of “what we have to determine before we can make a proper “selection. Economy of operation, under our conditions, “the necessity of providing settling basins, and the general “suitability of a system to our own existing work and to “the several and widely different members of them—these, “and many other points, must be very carefully consid- “ered and digested before we can properly design a sys- “tem of filtration for our water supply.

“The proper plan of procedure is, as you have always “urged, to begin with some one district. Let Councils “grant to this Bureau, say for the year 1898, its own “surplus earnings for that year, or about one million dol- “lars, to be expended, upon your plans and in accordance “with your judgment, for the improvement of the supply “of West Philadelphia, or of some other district, if one “can be found in more urgent need of improvement. The “experience gained by such an experiment (for whatever “we first do in the matter of filtration will of necessity “be an experiment, no matter upon how grand and costly “a scale) will be of the utmost value to us in designing “and constructing the works for the improvement of the “supply in the remaining districts.”

Proposed Changes of System.

The propositions which have been prominently before Councils during 1897, looking to changes in our system of water supply, may be briefly summarized and grouped, as follows:

A. From the Delaware River.

Philadelphia Water Supply Co.—Company to take water from the Delaware above Trenton, filter it, bring it to the City through two conduits, and deliver it to the City reservoirs and distributing mains.

Palmyra Filtrated Water Co.—Company to make an excavation on the New Jersey shore of the Delaware river, opposite our Frankford pumping station, to collect water in it from the river, and bring it across the river in a submerged main to the pumping station.

B. From the Schuylkill.

Schuylkill Valley Water Co.—Company to construct dams in the Schuylkill below Reading, filter the impounded water, bring it through a conduit and deliver it to the City's pumping stations. Company to construct, also, a filter and a new reservoir for the Delaware supply.

Aqueduct from above Norristown. City to build impounding dams and bring the water through a conduit to the reservoirs.

Schuylkill Navigation Co.—City to acquire control of the properties and franchises of the company.

The several ordinances respecting the Schuylkill Navigation differ chiefly in the method of compensation to the company.

(a.) The company's proposition:

City to remit so much of the company's Pennsylvania avenue Subway obligations as shall be agreed upon with the Mayor; the Mayor to surrender all bonds and securities.

(b.) Earnings of Bureau, for ten years, to be appropriated to Bureau, to be expended as follows:

75 per cent. for maintenance, operation, extension and improvement.

10½ per cent. for construction of filters.

14½ per cent. to Schuylkill Navigation Co.

(c.) Philadelphia Water and Filter Co. City to pay company \$375,000 per annum, for fifty years, maintaining, operating, and (if desired) modifying the works of the Navigation Co. during that time, at the end of which the works become the property of the City.

C. From Other Sources.

Artesian Wells. Messrs. John J. Schadt and Wm. II. Taylor, Jr., to submit a plan for furnishing an adequate supply of pure water from a source "within the City's limits or with a radius of two miles from the City limits." I understand that Messrs. Schadt and Taylor contemplate a supply from artesian wells.

D. Purification of Existing Supplies.

Philadelphia Sanitation Co. Company to erect here filtration plants, similar to that erected by it for the purification of sewage, at Reading, Pa.

(a.) City to purchase the plants outright.

(b.) Company to operate the works for fifty years, on royalty, after which the works become the property of the City.

Electric Rectifying and Refining Co. Company to purify the water by the Pridham electrozone process.

In my report of September 25, already quoted, and published by you as an appendix to your report of October 7th on Water Supply and Filtration, I have discussed, at some length, several of these propositions.

As a whole, they are mischievous, as diverting effort from the one thing needful.

The propositions of the Philadelphia Sanitation Co. and of the Electric Rectifying and Refining Co., looking to the purification of the present supplies, should be unhesitatingly condemned because they commit the City to the wholesale adoption of untried and almost unknown methods.

The remaining propositions involve a change in the source of supply. Most of them involve heavy expenditures for which there is no occasion.

The proposition of the Philadelphia Water Supply Co.,

while leaving to the City the task of distributing the water, relieves it (for a consideration) of the cost of pumpage, but all the others, while they exact from the City heavy payments (amounting, in some cases, to more than half the gross income of the Bureau), yet leave the City charged with the cost of pumping and distributing the water, as at present. These operations would have to proceed at the City's expense, practically as if no change had been made.

Philadelphia Water Supply Co.

With the exception of a sketch indicating the proposed lines of the company's conduits through the City, and a plan, prepared by outside parties for a filter plant and, I believe, since abandoned, no plans of this company's proposed works have been submitted.

The scheme is not only unnecessary, but also enormously expensive, costing the City, during the fifty years of the lease, probably between one and two hundred million dollars, after which the City must either purchase the works or renew the lease for another fifty years, "and so on thereafter at the end of each period." As pointed out in my report of September 25th, the ordinance abounds in provisions unfavorable to the City.

Palmyra Filtrated Water Company.

If, as this company is understood to claim, its proposed excavation on the New Jersey bank of the Delaware will be filled, not with river water, as provided in the company's ordinance, but with subsoil water from the interior of New Jersey, if this water is found to flow in sufficient quantity and to be sufficiently superior to what we can obtain by filtering the Delaware water, and if there are no legal difficulties in the way, negotiations might properly be made for the supply of a moderate fixed quantity at a proper rate and for a limited time; the construction

of the works to be at the company's risk, and any increase in the amount taken to be optional with the City.

Schuylkill Valley Water Co.

This scheme is equally unnecessary with that of the Philadelphia Water Supply Co., and scarcely less costly, except that at the end of fifty years the works (which then will be of but little if any value) become City property without further payment.

In my report of September 25th I called your attention to many mischievous provisions in the ordinance submitted by this company; and in my report of December 29th, after a careful study of some of the plans submitted, I mentioned the following objections to the scheme from an engineering standpoint.

The damages involved in the flooding of the adjacent country by the proposed dams would probably be found prohibitory by the company; but, even if the dams were built, the 18,000 million gallons storage provided would be insufficient to sustain the proposed draft of 400 million gallons per day (a draft which, at our present rate of increase, will be reached by 1915); while the cross-sections of the proposed pools are so shallow that, even during normal years, the drawing down of their levels in summer would leave them in most objectionable condition, wide stretches of previously submerged country being exposed to the sun or covered with but a few inches of water.

The defects of the proposed storage system would alone suffice to condemn the scheme, even if the City required anything of the sort.

Schuylkill Navigation Company.

If, as I have urged, we turn to the near-by Delaware for further extensions of our pumpage system, and especially if we properly restrict the wasting of water, we have no

need of the properties and franchises of the Navigation Company; for the present minimum flow of the Schuylkill is ample for our needs and luxuries, barring the luxury of waste.

If, however, we are to go on wasting water as at present, these properties and franchises will be, in one sense, of still less value, owing to their inadequacy. By 1915 we shall be requiring 400 million gallons per day from the Schuylkill; and, if the 18,000 million gallons storage, proposed by the Schuylkill Valley Water Co., is insufficient for such a draft, how hopelessly inadequate will be the 4,000 or 5,000 million gallons storage capacity of the Navigation Company's pools.

The navigation is practically defunct. The railway company, lessee, has already abandoned the Susquehanna navigation and it is safe to say that, were it not for the possibility of negotiations with the City, the Schuylkill navigation would speedily follow suit. Even if the system were offered to the City free of charge, I seriously doubt whether the advantages accruing would offset the expense of keeping it in order.

Aqueduct from above Norristown.

This proposition aims to keep the control of the water supply within the City's hands; but it involves a large expense without compensating advantages. I know of no sites in the vicinity of Norristown, for impounding dams from which a sufficient supply of water could be brought by gravity into our existing reservoirs.

Artesian Wells.

A number of small towns in the vicinity of the City are now supplied by artesian wells, and it may be of advantage to resort to such wells for the supply of some

of our far outlying districts, but I know of no good reason why the City itself should not sink and control them.

Pollution.

In spite of the intercepting sewer, much pollution enters the Schuylkill and the Delaware through surface drainage and otherwise. As reported in my letters of October 5th and November 20th, the canal at Manayunk, flowing, as it does, between banks lined with cotton, woolen and paper mills, and dwellings of the poorer class inhabited by Hungarian and other foreign laboring people of most uncleanly habits, is a notable source of offence of this kind; and measures should at once be taken to secure a thorough and effective police control of this neighborhood, as well as of all others contributing to the pollution of the stream.

Beyond the city limits, the aid of the State Board of Health should be invoked.

On the afternoon of November 16th, through an over-flushing of the intercepting sewer, near the mouth of the Wissahickon, a large body of sewage was discharged into the creek, whence it flowed into the Schuylkill, passing the intake of our Queen Lane Pumping Station, a few hundred yards below.

Immediately upon learning this fact, about 4 P. M., I stopped the pumps at Queen Lane, and later, those at Spring Garden and Fairmount stations; and these all remained idle until the next afternoon, when Mr. Eastwick, Assistant Chemist of the Board of Health, reported that a sample of water, taken at Spring Garden station early in the morning, and afterward analysed, showed no worse than the river water frequently does after floods.

In the meantime, Mr. Edwin F. Smith, Superintendent Reading Railway Co., had, at my request, let down a large and Engineer of the Canal Division, Philadelphia and

body of water from Flat Rock pool, for the purpose of flushing out the Fairmount pool.

Early in the morning of the 17th, and hours before pumpage was resumed, the river presented its normal appearance.

The records of the Bureau of Health show a large increase in the number of cases of typhoid fever in the district supplied from the Queen Lane station, beginning a week or two after this overflow; but the number afterward decreased, and during the present month, with no repetition of the accident, it has again increased, and to much higher figures than before.

To prevent similar accident in future, I respectfully urged, in my letter of November 18th, the closing of the outlets in the intercepting sewer, through which such overflows may otherwise take place.

In November last, the residents of Germantown complained of a strong taste and odor in the water furnished them. Many of the reports represented the taste and odor as resembling those of carbolic acid. As the water came from the new Roxborough reservoir, which had just been relined with asphalt, it was at first thought that the lining might account for the trouble; but samples of water taken directly from the relined basin were tried and found free from marked taste or odor. There was no possible connection between this trouble and the overflushing of the intercepting sewer at Wissahickon on November 16th, for the water complained of was drawn from the pool above that into which the overflow took place.

All our efforts, aided by the officials of the Bureau of Health and by Mr. George C. Whipple, Director of the Mount Prospect Biological Laboratory, Brooklyn, who kindly spent a day, with Dr. Pease, Assistant Bacteriologist, Bureau of Health, in investigating the matter, failed to determine definitely the cause of this trouble.

Analyses.

Although the Bureau of Water has no chemical or bacteriological laboratory or force of its own, it has, during 1897, carried on several lines of investigation with the aid of the Bureau of Health, drawing freely upon the valuable services of Dr. Herbert D. Pease, First Assistant under Dr. A. C. Abbott, Chief of the Bacteriological Division, and Mr. J. H. Eastwick, Assistant to Mr. W. C. Robinson, Jr., Chemist. Mr. Eastwick has devoted all of his time to analyses of water.

The principal work inaugurated was that of a series of semi-weekly chemical and bacteriological examinations of samples of the Schuylkill water, taken at the Spring Garden pumping station, where more than half of the City's entire supply is taken. The object is to determine how the character of the water is affected, from time to time, by seasonal and other changes. The results are plotted, together with the rainfall and the depths of water in the river.

Among the special investigations made was a series of analyses to determine the relative purity of the Wissahickon, near its mouth, and of the Schuylkill at Queen Lane pumping station. At the same time stream gaugings are being made by employees of the Bureau; the object being to ascertain whether it is worth while to lay a main from the Wissahickon to the Queen Lane pumping station for its partial supply, as suggested by Mr. Jacob J. Seeds, member of Common Council from the Twenty-second Ward.

Mr. Eastwick has also made three series of examinations of waters taken from the Schuylkill at points above Reading, in order to study the changes which there take place by reason of the commingling of the acid waters from the anthracite mining regions with the calcareous waters of Maiden creek and of the limestone belt.

With a laboratory, properly manned and equipped, many other useful and important lines of investigation could be carried on; such as investigations of the Delaware water, the relative purity of the water of both rivers at different points (to aid in the proper location of intakes), the location of points of contamination and the character of the impurities sent into the streams, the effect of sedimentation in our reservoirs, etc., etc.

It is greatly to be hoped, therefore, that at least the facilities thus far granted may remain at our disposal.

Pumping Stations.

The report of the General Superintendent, Appendix B, forcibly shows how starvation affects our pumping stations. Everywhere the record is one of faithful and intelligent effort and eternal vigilance, on the part of the Superintendent and of the engineers at the stations, in order to get the best possible results in spite of insufficiency of means.

At Fairmount one of the two wheelhouses has been, for years,* in a condition so disgraceful that for decency's sake, we have been obliged to keep it closed to the public, and the engines are rusting from the rain which percolates through the roof; while the forebay (which, unfortunately, we cannot hide) is equally an eye-sore. During the year it attracted the attention of the health authorities.

At Spring Garden (where more water is pumped than at all the other stations combined) the forebay is in scarcely more presentable condition than at Fairmount; and our largest and best engines are wasting coal for want of proper boiler capacity.

At Belmont we are forced to pump without intermis-

* In his report for 1889 Mr. John L. Ogden, then Chief of the Bureau, said: "The roof over the mound-dam wheel-house leaks badly."

sion, whatever may be the state of the river; and yet the boiler service is altogether insufficient and in pitiable condition, liable to collapse that will throw the entire system out of service and deprive the district of water; and the largest, newest and best engine is protected only by a rude house of boards, erected over it in 1894-5 by employees of the Bureau in default of means to provide a proper house, for which plans were prepared in our drafting room years ago.

At Queen Lane (our newest and finest station) the four large new engines have all been fractured, and further damage to them is hourly threatened by want of means to re-lay the suction mains, which bring the water from the river to the pumps. From the pumps all the water goes to the reservoir through a single main, seriously increasing the pressure upon both main and pumps and endangering the whole system; and, the station being still unprovided with proper means for storing and handling coal (although designs for a coal-handling system were designed years ago), the coal used has to be hauled by carts, adding over \$7,000 per year to the cost of pumpage.

At Roxborough the boilers are in scarcely less deplorable condition than those at Belmont, while the engines are in much worse condition. At this station it is all we can do to keep pace with the consumption; so that, while the relining of the new reservoir was completed months ago, we have not yet been able to fill it.

Belmont and Roxborough high-service stations are provided, each, with an old engine, which had formerly done duty elsewhere and which must be kept going night and day, year in and year out, with no chance for repairs. An accident to this single engine would throw the system out of service and deprive the district of water.

This state of affairs at our pumping stations has, for

the greater part, prevailed during the last three years, in spite of repeated appeals for the means necessary to remedy it.

Reservoirs.

The relining of Queen Lane Reservoir with asphalt, by the Vulcanite Paving Co., was completed as follows:

South Basin, September 9, 1896.

North Basin, August 16, 1897.

Both basins have since been continually in service, except for short intervals when one or the other has been shut off for the purpose of measuring the height of the water surface. Each basin has, since its relining, held its intended depth of 30 feet; but, at that depth, evidences of leakage appeared, and the depth was reduced. Except on Queen street near Thirty-third, and in an adjoining meadow (both of which have since been drained by employees of this Bureau) the leakage caused no inconvenience. From our observations of the water surface it appears that with a depth of 20 feet the daily loss in depth is about one-half inch, at which rate it would require about two years for the reservoir to empty itself. With a depth of 15 feet the daily loss is about one-third inch. Since the relining, the basins have commonly held between 20 and 25 feet.

The method of relining was that suggested by the contractors in response to your invitation for such suggestions; and the contractors are under bond to the City, in the sum of 25 per cent. of the cost of relining, to "maintain the work in good order, and the basin free from leakage under a head of 30 feet, to the satisfaction of the Director, for five years following its acceptance by the Director, making all repairs and additions which may be necessary for such maintenance."

With the exception of a beginning made in the latter part of 1896, the new reservoir at Roxborough has been

entirely relined with asphalt during 1897; the north basin having been finished by the Alcatraz Paving Company of Pennsylvania, September 25th; and the south basin by the Vulcanite Paving Company, November 6.

There has since been as much as about 16 feet in the north and 22 feet in the south basin, and thus far there has been no external evidence of leakage, even in places which, hitherto, have always been wet when there were 10 feet of water in the reservoir.

Here, as at Queen Lane Reservoir, the contractors suggested the method of relining, and they are under bonds for the satisfactory behavior of the work.

Distribution.

The report of Mr. Fuller, Assistant in Charge of Distribution, Appendix C, is a no less eloquent sermon upon the text of starvation and waste, than that of Mr. Hand, General Superintendent.

Mythree annual estimates for new pumping and supply mains, and the amounts appropriated, have been as follows:

	Estimate.	Amount Appropriated.
For 1896.....	\$1,819,150	0
For 1 97.....	2,029,050	0
For 1898.....	1,935,050	0

As a result of this, in connection with waste of water, we learn, from Mr. Fuller's report, of growing insufficiency of supply in important sections of the city, of the throwing of Fairmount reservoir out of service and of the inability of the Queen Lane system to perform the functions for which it was intended.

In spite of the expenditure of \$3,500,000* in the addition of 194 million gallons per day to our pumpage capacity, 530 million gallons to the capacity of our reser-

* All appropriated prior to 1895.

voirs, and 15 miles of large mains (additions sufficient, in themselves, for the supply of all our legitimate needs and luxuries), our supply is scarcely in better condition than before.

Estimate of Cost of Works.

At my request, Mr. John E. Codman, who is still rated as Draughtsman, has prepared an estimate of the first cost of our existing works with modern machinery, buildings, etc. From the detailed estimate, given in his report, Appendix F, it appears that the total amount is approximately thirty-four million dollars, of this about twenty-four million represent mains under ground, while four million are invested in pumping stations and six million in reservoirs.

Assistants.

As in my two preceding reports, I gladly bear testimony to the fidelity and efficiency of my immediate assistants, and to the high character of the employees of the Bureau in general.

Certain increases of salary have already been repeatedly recommended, and many of them are such that the city, in justice to herself, cannot afford to refuse them.

Again, I have to thank you, and the Chairman and members of the Water Committee of Councils, for aid and encouragement in the work.

I remain, sir,

Very respectfully yours,

JOHN C. TRAUTWINE, JR.,

Chief of Bureau.

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 Assistant in Charge of Hydrographic Work.
- F. Report of Chief Draughtsman.

RECEIPTS FROM OPERATIONS OF THE BUREAU OF WATER.
As Reported by the Receiver of Taxes.

1897.	WATER RENTS.			PENALTIES. e		FRONTAGE CHARGES. f		g Fees for Searches.	Charge for Ferrules on New Connections.	h Miscellaneous.	Totals.	
	BY SCHEDULE.			d By Meter, Current and Delinquent.	Current.	Delinquent.	Paid to Receiver of Taxes.					Collected by City Solicitor.
	On Existing Connections.		c On New Connections.									
	Current. a	Delinquent. b										
January.....		\$2,757 25	3 335 71	\$21,711 74		\$318 24	\$12,344 72	\$416 25	\$224 00	\$692 48	\$41,790 39	
February.....	\$192,028 49	1,601 00	4,339 00	9,245 40		233 11	5,781 53	396 50	140 00	10	213,765 13	
March.....	206,143 65	1,592 00	7,989 61	2,556 93		236 42	10, 37 57	556 75	554 00	67 57	229,734 50	
April.....	319,314 70	811 00	8,752 80	15,733 98		120 16	9,213 12	494 25	437 00	493 35	355,370 36	
May.....	1,458,942 15	2,945 50	6,775 73	9,730 55		432 24	7,543 17	467 75	521 00	387 48	1,487,745 57	
June.....	44,710 30	1,594 09	4,615 50	1,399 83	2,039 16	239 12	14,012 78	502 00	362 00	\$20 14	69,794 83	
July.....	27,513 20	4,442 51	3,693 50	18,586 44	1,354 36	664 55	13,492 28	373 75	133 00	559 37	70,772 95	
August.....	95,278 00	1,130 00	2,874 75	7,971 65	4,512 08	169 51	9,757 47	337 50	381 00	19 22	122,431 18	
September.....	37,426 20	539 75	3,202 12	1,556 97	5,462 52	79 77	10,315 59	399 25	362 00	317 94	59,633 11	
October.....	71,294 95	437 03	2,843 30	26,420 33	10,609 86	73 05	13,318 31	445 00	414 00	142 35	126,048 65	
November.....	47,442 25	918 00	2,364 35	6,067 18	6,798 80	137 71	23,283 03	411 75	589 00	148 88	86,161 00	
December.....	29,914 80	741 00	3,320 74	1,198 23	4,407 30	110 06	13,118 10	451 50	895 00	415 20	108,089 80	
Totals for 1897.....	\$2,528,004 69	\$19,559 00	\$54,017 11	\$122,179 76	\$35,184 08	\$2,813 94	\$142,217 77	\$5,243 25	\$5,052 00	\$3,564 08	\$2,971,357 52	
Totals for 1896.....	2,441,633 95	19,132 75	54,346 73	131,247 65	36,417 93	2,295 58	131,622 69	5,633 60	7,590 00	4,875 91	2,879,133 26	
Increase.....	\$86,324 74	\$426 25				\$518 36	\$10,615 08	\$9,711 32			\$92,224 26	
Decrease.....			\$329 62	\$9,067 89	\$1,233 90			\$390 25	\$2,538 00	\$1,311 83		

NOTES.

a "Current."—Water rents by schedule rates for the year 1897, from January 1 to December 31, inclusive. These are due in advance, but the books are not open for payment until the first Monday in February. Hence such rents do not appear under January. Certain institutions, classed by Councils as "Charitable," are charged only 15 per cent. of the schedule and meter rates.

b "Delinquent."—Water rents by schedule rates for the years prior to 1897.

c "On new connections."—Schedule rents on new connections cover, in most cases, only a fraction of the year, and the consumer is charged for that fraction only. Thus, for a connection made on December 11, or 20 days before the expiration of the year, the rent charged would be but $\frac{3}{10}$ of the schedule rate for the entire year. Hence, these rents on new connections were formerly called "fractional rents."

d "By Meter."—The meter rate is 30 cents per 1,000 cubic feet, or say 4 cents per 1,000 gallons. See "Charitable," at end of note a. The minimum meter charge for any given ferrule is one-half the minimum schedule charge on a ferrule of the same size, except in the case of $\frac{1}{2}$ -inch ferrules, for which the minimum meter charge (\$5 per annum) is the same as the schedule rate. Bills for meter rents are rendered quarterly, except in cases where the amount, at the end of each quarter, is less than the proportionate fraction of the annual minimum meter charge. Unpaid meter rents are reported by the Receiver of Taxes twice in each year, and the delinquents are thereupon notified that unless payment is made within five days the water will be shut off.

e "Penalties."—On June 1st, 5 per cent. penalty is charged on unpaid schedule rents, and on September 1st an additional penalty of 10 per cent. is charged on rents still unpaid. If these penalties are paid on or before December 31st, they are classed as "current." If paid after that date they are classed as "delinquent." Hence, those here appearing as "delinquent" were charged in the preceding year.

f "Frontage Charges."—In order to reimburse the City for the cost of laying service mains (mains to which attachments for the supply of properties may be made) in any street, the owners of property fronting upon such street are assessed at the rate of one dollar per foot front on each side. For four months following date of serving of notice these frontage charges are payable to the Receiver of Taxes. Upon the expiration of the four months the bills are sent to the City Solicitor for lien and collection.

g "Fees for Searches."—Fees (25 cents each) for certificates issued relative to municipal claims for pipe frontage and water rents.

h "Miscellaneous."—Under this heading, until April, 1895, inclusive, were included payments to the City in reimbursement for the cost of repairing streets after the laying of water pipe. This, in 1895, amounted to \$1,111.

Since April, 1895, such payments have been included, by the Receiver of Taxes, in the receipts from the operations of the Bureau of Highways.

APPENDIX A.

REPORT OF CHIEF CLERK.

BUREAU OF WATER.

Philadelphia, January 29, 1898.

MR. JOHN C. TRAUTWINE, JR.,
Chief of Bureau.

DEAR SIR :—I have the honor to transmit herewith tables showing the appropriations and expenditures; receipts from the operations of the Bureau; receipts, estimates, requirements and amounts rendered available by appropriation, etc.; comparison of requirements and appropriations; and the detailed expenditures of the Bureau for the year 1897.

Yours respectfully,

J. T. HICKMAN,
Chief Clerk.

List of Miscellaneous Receipts for the year 1897.

Jan.	5	Robert Higgins.....	Redriving ferrule.....	\$8 40
	5	Robert Higgins.....	Shutting off water.....	2 75
	11	Robert Higgins.....	Shutting off water.....	6 00
	11	Doyle & Doak.....	Shifting 6-inch pipe.....	209 95
	18	Joseph B. Atkinson.....	Redriving ferrule.....	2 00
	18	Joseph B. Atkinson.....	Redriving ferrule.....	3 10
	18	Joseph B. Atkinson.....	Redriving ferrule.....	5 75
	18	Joseph B. Atkinson.....	Redriving ferrule.....	9 58
	18	Joseph B. Atkinson.....	Repairing fire hydrant.....	16 97
	29	Franklin Engineering Co.....	Raising pipe.....	421 28
	29	Phila. & Reading Railroad Co.....	Repairing standpipe.....	11 50
Mar.	11	Baltimore & Ohio Railroad Co.....	Recalcing joints.....	6 63
	13	J. Muhr & Bro.....	Repairing fire hydrant.....	1 28
	16	Philadelphia Tattersall.....	Sale of horse.....	38 70
	17	Bureau of Water.....	Overdrawn warrant.....	30
	20	Union Traction Co.....	Putting in 6-inch stop.....	19 41
	27	B. E. Dudley.....	Laying 6-inch pipe.....	1 25
Apr.	13	Wetherill & Bro.....	Repairing pipe.....	9 88
	21	J. W. Harris.....	Rent of farm No. 2.....	200 00
	21	W. Root.....	Rent of farm No. 3.....	100 00
	21	H. M. Harris.....	Rent of farm No. 1.....	150 00
	27	Joseph Perna & Co.....	Shoring up pipe.....	25 14
	28	Theodore Cooper.....	Repairing mains.....	8 33
May	3	John Hevener.....	Rent of farm No. 3.....	78 50
	7	Edward Perry & Co.....	Repairing fire hydrant.....	13 12
	8	Bureau of Water.....	Overdrawn warrant.....	4 11
	10	Franklin Sugar Refinery.....	Raising pipe.....	15 22
	12	E. Webb & Son.....	Repairing fire hydrant.....	1 29
	18	Jos. & J. Madden.....	Repairing mains.....	242 40
	22	Burnham, Williams & Co.....	Renewing stop.....	30 92
	25	Geo. W. Ruch & Co.....	Repairing main.....	1 92
June	18	Union Traction Co.....	Repairing fire hydrant.....	20 14
	23	H. M. Harris.....	Rent of Farm No. 1.....	100 00
	29	Henry Snyder.....	Rent of Saloon.....	200 00
July	8	H. Hathaway & Co.....	Laying 6-inch pipe.....	307 32
	16	Board of City Trusts.....	Laying 6-inch pipe.....	121 06
	19	John M. Harris.....	Rent of Farm No. 2.....	100 00

Miscellaneous Receipts for the year 1897—Continued.

	23	Allison Mfg. Co.....	Recalcing joint.....	4 40
	26	Wallace & Jones.....	Shutting off water.....	4 35
	26	Wallace & Jones.....	Repairing fire hydrant.....	5 24
	29	D. P. S. Nichols.....	Sale of horse.....	17 00
Aug.	20	Allison Mfg. Co.....	Repairing leak in meter.....	4 25
	25	Robert Higgins.....	Repairing 6-inch pipe.....	8 03
	25	Robert Higgins.....	Redriving ferrule.....	1 00
	31	M. & J. B. McHugh.....	Drawing and redriving ferrule.....	5 94
Sept.	14	Joseph B. Atkinson.....	Redriving ferrule.....	1 75
	17	J. H. Loughheim & Co.....	Redriving ferrule.....	3 00
	17	J. H. Loughheim & Co.....	Repairing main.....	10 52
	21	Union Traction Co.....	Changing location of stop.....	38 13
	21	Union Traction Co.....	Renewing stop.....	20 29
	21	Union Traction Co.....	Changing location of stop.....	16 70
	21	Union Traction Co.....	Renewing stop box.....	5 75
	21	Union Traction Co.....	Changing location of stop.....	24 20
	21	Union Traction Co.....	Changing location of stop.....	28 23
	22	Frederick Starke.....	Repairing main.....	17 90
	22	Frederick Starke.....	Shutting off water.....	21 13
	22	Frederick Starke.....	Replacing pipe.....	125 65
	24	A. H. & F. H. Lippincott.....	Repairing service pipe.....	4 63
Oct.	8	John W. Evans.....	Curb stop frame and cover.....	1 60
	9	Quaker City Croquet Club.....	Rent of ground.....	10 00
	11	Daniel McMahon.....	Shut-off.....	3 00
	14	Burrau of Water.....	Overdrawn warrants.....	73 72
	15	Gray's Ferry Abattoir.....	Repairing private pipe.....	10 38
	21	Union Traction Co.....	Changing location of stop.....	23 85
	23	D. P. S. Nichols.....	Sale of horse.....	23 40
Nov.	3	John Hevener.....	Rent of Farm No. 3.....	78 50
	6	Rush & Deeham.....	Repairing main.....	10 92
	22	Union Traction Co.....	Moving stop.....	23 49
	24	Edison Electric Light Co.....	Repairing main.....	35 97
Dec.	2	Bureau of Water.....	Overdrawn warrant.....	30
	17	Harrison Bros. & Co.....	Fire connection.....	200 19
	22	Edison Electric Light Co.....	Repairing main.....	14 71
	31	Henry Snyder.....	Rent of saloon.....	200 00
		Total.....		\$3,564 03

Detailed Expenditures of the Bureau for 1897.

General Appropriation.	Amount appropriat'd.	Amount expended.	Amount merging.	Amount not merging
An Ordinance to make an appropriation to the Bureau of Water, approved Dec. 31, 1896..	\$1,119,654 00			
Balance from books of 1896.....	392,274 42			
Increased by additional appropriations.....	370,700 00			
Net appropriation.....	\$1,882,628 42			
Item 1.—Salaries.....	\$303,354 00			
Diminished by transfer...	6,500 00			
Net appropriation to item.....	296,854 00			
For Salary of 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.....	4,700 00	4,700 00		
General superintend't..	3,500 00	3,500 00		
Clerks to general superintendent.....	2,000 00	2,000 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.....	2,750 00	2,750 00		
Chief Inspector.....	1,200 00	1,200 00		
Inspectors.....	19,000 00	18,750 01		
Permit clerks.....	2,300 00	2,300 00		
Purveyors.....	9,200 00	9,200 00		
Clerks to purveyors.....	4,800 00	4,795 70		
Assistant clerks to purveyors.....	4,500 00	4,043 08		
Hydrant inspectors.....	7,050 00	5,640 00		
General foremen.....	6,634 00	6,129 16		
Foreman of repairs.....	3,900 00	3,900 00		
Superintendent of Shop	1,500 00	1,500 00		
Clerk to superintendent of shop.....	900 00	900 00		
Watchman (offices and yards).....	6,075 00	6,015 72		
Storekeepers.....	1,400 00	1,400 00		
Foreman machinist.....	1,500 00	1,500 00		
Foreman bricklayer.....	1,100 00	1,100 00		
Foreman carpenter.....	1,000 00	1,000 00		
Foreman stonemason...	900 00	875 00		
Foreman painter.....	900 00	900 00		
Foreman rigger.....	900 00	900 00		
Foreman laborer.....	840 00	840 00		
Janitor main office.....	720 00	720 00		
Lineman.....	1,000 00	1,000 00		
Telephone operators.....	1,100 00	1,100 00		
Electrician.....	1,200 00	1,200 00		
General storekeeper.....	1,000 00	1,000 00		
Yard keeper, Fourth District.....	915 00	915 00		
SALARIES AT PUMPING STATIONS.				
Fairmount, engineers, oilers, &c.....	14,310 00	14,283 27		
Spring Garden, engineers, oilers, &c..	79,300 00	78,109 31		
Belmont, engineers, oilers, &c.....	19,800 00			
Belmont Auxiliary, engineers, oilers, &c.....	4,750 00	24,178 46		

Detailed Expenditures of the Bureau for 1897.

General Appropriation.	Amount appropriat'd	Amount expended.	Amount merging.	Amount not merging
Item 1.—Continued.				
Queen Lane, engineers, oilers, &c.....	\$27,600 00	\$25,154 51		
Roxborough, engineers, oilers, &c.....	17,270 00	} 21,816 68		
Roxborough Auxiliary, engineers, oilers, &c.....	4,750 00			
Mt Airy, engineers, oilers, &c.....	3,070 00	3,070 00		
Chestnut Hill, engineers, oilers, &c.....	1,500 00	1,500 00		
Frankford, engineers, oilers, &c.....	16,700 00	16,523 00		
Total.....		\$296,198 90	\$655 10	
Item 2.—For general supplies includ-				
ing fuel, oil, and small stores.....	\$200,000 00			
Increased by additional appropriation	195,000 00			
Net appropriation to item.....		\$395,000 00		
Deficiencies of 1896:				
Coke.....	\$19 60			
Hauling coal.....	31 80			
Paints.....	84 51			
Coal.....	25,871 38			
Chandlery.....		\$26,007 29	3,048 17	
COAL FOR SHOP AND OFFICES.				
4 tons bituminous at \$3.09.....	\$12 36			
5 tons stove at \$5.23.....	26 15			
7 tons stove at \$5.53.....	38 71			
9 tons stove at \$5.20.....	46 80			
47.11 tons bituminous at \$3.13.	147 55			
42.01 tons stove at \$4.79.....	201 55			
29 tons pea at \$2.77.....	822 69			
		1,295 81		
COAL FOR STATIONS.				
83.17 tons pea, Chestnut Hill, at \$2.94.....	\$246 74			
125 tons egg, Fairmount, at \$4.59.....	573 75			
992.13 tons buck, Mt. Airy, at \$2.17.....	2,154 06			
8,040.11 tons buck, Frank- ford, at \$2.05.....	16,483 13			
15,556 06 tons pea, Spring Garden, at \$2.70.....	42,002 03			
22,932.06 tons pea, Belmont, at \$2.66.....	60,999 93			
24,113.18 tons pea, Roxbor- ough, at \$2.70.....	65,107 55			
27,630.14 tons pea, Queen Lane, at \$2.95.....	81,510 57			
41,346.03 tons buck, Spring Garden, at \$1.98.....	82,855 39			
		351,933 15		
Coke.....		377 80		
Grease.....		10 16		
Hauling coal, 1,528 tons at 30c	\$458 40			
Less hauled by the Bureau..	19 50			
		438 90		
Lubricant, 7,980 pounds, at 10c.....		798 00		

Detailed Expenditures of the Bureau for 1897.

General Appropriation.	Amount appropriat'd	Amount expended	Amount merging.	Amount not merging
Item 2—Continued.				
OIL.				
5½ gallons paraffine, at 10c...	\$5 20			
5½ gallons Arctic, at 12½c	6 56			
15½ gallons black, at 7c.....	10 57			
320 gallons gasoline, at 10c..	32 00			
450 gallons common, at 7½c	33 75			
815½ gallons electric at 14c	44 17			
106 gallons lard, at 42c.....	44 52			
534 gals. cylinder, at 17.48c.	93 35			
805½ gals. engine, at 16.98c.	136 78			
2,165½ gals. cylinder, at 19½c.....	427 67			
4,060 gals. headlight, at 8c...	324 80			
2,213 gals. cylinder, at 19c...	420 49			
2,991½ gals. cylinder, at 17c	508 54			
4,353 gals. engine, at 16c.....	697 28			
4,599 gals. engine, at 16½c..	753 87			
5,536 gals. engine, at 16½c..	914 25			
5,94½ gals. cylinder, at 20c...	1,189 00			
		\$5,667 80		
Oil cups.....		102 00		
Paints.....		649 67		
Tallow.....		45 02		
Turpentine.....		43 12		
Wood.....		38 40		
Total.....		\$390,455 29	\$1,544 71	
Item 3.—For repairs to machinery, including the conveyance of work- men incident thereto..... \$50,000 00				
Increased by additional ap- propriation.....	34,000 00			
Net appropriation to item.....	\$84,000 00			
Deficiencies of 1896:				
Belting.....	\$11 89			
Gauge glasses.....	44 40			
Gum goods.....	300 30			
Hardware.....	13 50			
Packing.....	72 00			
Repairs to boilers.....	656 95			
Repairs to engines.....	60 00			
Repairs to pipe covering...	46 40			
		\$1,215 44		
Air chambers, Roxborough.....		1,939 00		
Brass Fittings.....		1,659 40		
Chandlery.....		500 00		
Condensers, Belmont and Roxb' h aux.		980 00		
Donkey pump.....		146 25		
Fire brick.....		540 60		
Freight.....		1 89		
Forging.....		32 00		
Grates:				
Queen Lane.....	\$478 22			
Mt. Airy.....	710 51			
Belmont.....	1,614 02			
		2,802 75		
Gum goods.....		849 98		
Hardware.....		314 21		
Iron Fittings.....		1,531 94		
Packing.....		4,181 00		
Paints.....		12 37		

Detailed Expenditures of the Bureau for 1897.

General Appropriation,	Amount appropriat'd.	Amount expended.	Amount merging.	Amount not merging
Item 3.—Continued.				
Repairs to boilers:				
Fairmount.....	\$3 00			
Mt. Airy.....	12 00			
City shop.....	218 51			
Roxborough.....	1,199 18			
Frankford.....	1,272 33			
Belmont.....	1,682 11			
Queen Lane.....	3,431 18			
Spring Garden.....	6,921 42			
		\$14,739 68		
Repairs to engines:				
Frankford.....	\$58 86			
Roxborough.....	98 00			
Spring Garden.....	300 17			
		467 03		
Repairs to hoisting engine.....				
		96 46		
Repairs to pipe covering:				
Queen Lane.....	\$273 12			
Frankford.....	257 77			
Belmont.....	551 96			
Spring Garden.....	1,195 42			
		2,278 27		
Repairs to Jack.....				
		11 05		
Shop castings, 36,764 lbs. at 1.36.....				
		500 00		
Solution.....				
		332 52		
Transportation.....				
		2,358 00		
Valves.....				
		824 13		
Water columns.....				
		43 74		
Wages:				
Bricklayers.....	\$7,443 62			
Carpenters.....	1,590 50			
Laborers.....	9,759 47			
Machinists.....	19,967 96			
Stonemasons.....	4,300 00			
		43,061 55		
Total.....		\$81,399 26	\$211 74	\$2,009 00
Item 4.—For maintenance and re-				
pairs to buildings, grounds and				
reservoirs..... \$75,000 00				
Increased by additional				
appropriation..... 50,000 00				
Net appropriation to item..... \$125,000 00				
Deficiencies of 1896:				
Bricks.....	\$6 60			
Electric supplies.....	2,132 56			
Iron.....	34 78			
Light.....	18 10			
Lumber.....	39 79			
Paper hanging.....	7 55			
		\$2,239 18		
Brass fittings.....				
		366 79		
Bricks.....				
		785 00		
Brushes.....				
		32 88		
Carts.....				
		165 00		
Cement.....				
		936 00		
Chandlery.....				
		808 12		
Cleaning wells.....				
		11 00		
Coal.....				
		16 25		
Device for watering horses.....				
		210 00		

Detailed Expenditures of the Bureau for 1897.

General Appropriation.	Amount appropriat'd.	Amount expended.	Amount merging.	Amount notmerging
Item 4.—Continued.				
Disinfectant (rental).....		\$153 00		
Electrical supplies.....		4,962 64		
Forage.....		1,602 55		
Furnishing light.....		204 83		
Granite.....		105 06		
Gum goods.....		930 12		
Hardware.....		1,502 80		
Hauling.....		298 00		
Horses, two at \$112.....		224 00		
Horse shoeing.....		210 68		
Ice.....		400 00		
Iron (bar).....		192 80		
Iron fittings.....		498 37		
Lamps.....		25 80		
Lime.....		57 50		
Lumber.....		3,459 84		
Paints.....		130 35		
Paper hanging.....		68 00		
Plants.....		152 42		
Professional services, V. S.....		24 00		
Repairs to harness..... \$49 50				
Repairs to jack..... 18 80				
Repairs to roofs..... 2,793 20				
Repairs to siding..... 171 39				
Repairs to wagons..... 109 30				
		3,142 19		
Sand.....		126 47		
Stone.....		205 16		
Tin.....		276 28		
Telegraph poles.....		60 00		
Terra cotta pipe.....		141 74		
Range.....		48 00		
Relining north basin Queen Lane Reservoir — 4,202 square yards floor at \$1.15..... \$4,832 30				
less 20 per cent..... 966 46				
		3,865 84		
Wagon.....		175 00		
Wages:				
Bricklayers..... \$1,168 62				
Carpenters..... 5,991 00				
Engineers' Corps..... 10,811 50				
Helpers..... 12,141 24				
Horses and carts..... 5,479 50				
Laborers..... 47,982 82				
Painters..... 5,161 00				
Stonemasons..... 2,951 50				
		\$91,387 18		
Total.....		\$120,195 84	\$8,887 70	\$966 46
Item 5. For repairs and improvement of the distribution, including the purchase of material in connection therewith and expenses incidental thereto..... \$100,000 00				
Increased by additional appropriation..... 40,000 00				
		\$140,000 00		
Diminished by transfer... 7,000 00				
Net appropriation to item.....		\$133,000 00		

Detailed Expenditures of the Bureau for 1897.

General appropriation.	Amount appropriat'd	Amount expended.	Amount merging.	Amount not merging
Item 5—Continued.				
Deficiencies of 1896:				
Bricks.....	\$8 88			
Cement.....	135 00			
Gum goods.....	1 00			
Iron castings.....	59 80			
Paper hanging.....	12 16			
		216 84		
Brass fittings.....		569 00		
Bicycle.....		62 50		
Bricks.....		142 35		
Cement.....		387 20		
Chandlery.....		534 84		
Coal.....		85 45		
Fittings for tapping machines.....		3,129 51		
Forage.....		1,448 15		
Gum goods.....		844 18		
Hardware.....		1,177 53		
Iron (bar).....		66 99		
Iron fittings.....		500 00		
Iron pipe:				
1,480 6 in., 54,358 lbs. at .84c.....	\$4,587 82			
17 12 in., 15,851 lbs. at .839c.....	132 99			
127 16 in., 168,092 lbs. at .839c.....	1,410 29			
		6,131 10		
Iron special castings:				
37,433 lbs. at 1.87c.....	\$700 00			
146,342 lbs. at 1.54c.....	2,253 68			
		2,953 68		
Lead (pig), 43,041 lbs. at 3.48½.....		1,500 00		
Lumber.....		2,908 27		
Plastering and painting.....		86 00		
Plumbing.....		49 36		
Repairs to pavement.....		95 40		
Sand and stone.....		480 84		
Shop castings, 63,100 lbs. at .99.....		634 58		
Supporting tracks.....		186 95		
Transportation.....		1,061 00		
Tolls.....		2 26		
Wagons.....		461 25		
Wages:				
Improvement.....	\$12,774 75			
First District.....	1,298 72			
Second District.....	9,478 24			
Third District.....	28,210 85			
Fourth District.....	21,375 89			
Fifth District.....	9,845 32			
Sixth District.....	14,037 82			
		105,016 59		
Total.....		\$130,731 82	\$2,268 18	
Item 6. For supplies, including fuel and labor at the City Construction and Repair Shop.....				
	\$50,000 00			
Increased by additional appropriation.....	20,000 00			
	\$70,000 00			
Diminished by transfer....	4,500 00			
Net appropriation to item.....	\$65,500 00			

Detailed Expenditures of the Bureau for 1897.

General Appropriation.	Amount appropri'd.	Amount expended.	Amount merging.	Amount not merging
Item 6.—Continued.				
Babbitt metal, 600 lbs. at .08 c.....		\$48 00		
Block tin, 1,000 lbs. at .14 $\frac{1}{4}$ c.....		148 75		
Brass castings, etc.:				
785 lbs. expansion metal, at 24 $\frac{1}{2}$ c.....	\$192 33			
11,125 lbs. lead coating, at .03 $\frac{15}{16}$ c.....	383 77			
11,650 $\frac{1}{2}$ lbs. red metal at 11 $\frac{1}{16}$ c.....	1,293 19			
8,794 $\frac{1}{2}$ lbs. ajax metal at 21 $\frac{1}{16}$ c.....	1,857 84			
25,593 lbs. yellow metal at 8 $\frac{1}{4}$ c.....	2,111 43			
	\$5,838 56			
Cr.				
9,275 lbs. scrap brass at 6 $\frac{1}{16}$ c..	\$568 09			
11,990 lbs. turnings at 4 c.....	479 60			
	\$1,047 69	4,790 87		
Brass fittings.....		118 58		
Corporation cocks:				
50 one-inch at 76 $\frac{1}{2}$ c.....	\$38 25			
1,000 half-inch at 32 $\frac{1}{16}$ c...	329 30		367 55	
Chandlery.....		500 00		
Gum goods.....		551 07		
Hauling ashes.....		5 00		
Hardware, bolts and nuts.....		1,983 10		
Horse shoeing.....		20 25		
Iron (bar).....		1,682 69		
Lead (pig) 43,041 lbs. at 3.48 $\frac{1}{2}$ c.....		1,500 00		
Lime.....		20 00		
Listing.....		12 00		
Lumber.....		2,298 59		
Paints.....		28 60		
Plug valves, 91 small at \$1.29.....		117 39		
Shop castings:				
14,320 lbs. at .99.....	\$143 75			
58,474 lbs. at 1.30 c.....	759 98			
165,623 lbs. at 1.40 c.....	2,318 68			
129,065 lbs. at 2 $\frac{1}{4}$ c.....	2,902 65			
255,139 lbs. at 1 $\frac{1}{2}$ c.....	3,527 12			
435,390 lbs. at 1.36 c.....	5,921 30			
		15,572 88		
85 hours machine work at 60 c.....		51 00		
Stone.....		19 20		
Transportation.....		40 00		
Wages.....		34,707 09		
Total.....		\$64,592 61	\$907 89	

Detailed Expenditures of the Bureau for 1897.

General appropriation.	Amount appropria'd.	Amount expended.	Amount merging.	Amount not merging
Item 7.—For general, incidental and contingent expenses, including keep of horse for Chief of Bureau, General Superintendent and Assistant, each \$400.....	\$16,30 00			
Increased by additional appropriation.....	2,000 00			
Net appropriation to item.....	\$18,300 00			
Deficiencies of 1896:				
Testing gauge.....	\$1 50			
Stationery.....	1,800 85			
		\$1,802 35		
Advertising.....		199 30		
Care of clocks.....		15 00		
Carriage hire.....		35 75		
Chairs and repairs.....		71 00		
Engineer supplies.....		232 73		
Ground rent, 918 Cherry street.....		26 66		
Ice.....		90 14		
Incidentals.....		649 08		
Incidentals, Hydrographic Corps.....		159 95		
Insurance, fire.....		242 00		
Keep of horse.....		500 00		
Maps.....		278 40		
Meals.....		5 00		
Messenger and telegraph service.....		29 81		
Photographic supplies.....		116 29		
Services of expert testing engine.....		256 15		
Serving morning papers.....		27 04		
Stationery.....		8,116 05		
Subscriptions (periodicals).....		26 45		
Telephone (calls).....		14 94		
Telephone supplies.....		85 00		
Text books.....		238 32		
Transportation.....		233 20		
Typewriter supplies.....		97 50		
Washing towels.....		102 00		
Wages:				
Hydrographic Corps.....	\$1,560 00			
Improvement roll.....	573 00			
		2,133 00		
Writing duplicates.....		2,200 99		
		\$18,283 19	\$16 81	
Item 8. For the purchase of material and cost of labor in connection with the laying of service mains and expenses incident thereto..	\$210,000 00			
Increased by additional appropriation.....	50,000 00			
	\$260,000 00			
Diminished by transfer.....	10,000 00			
Net appropriation to item.....	\$250,000 00			
Deficiencies of 1896:				
Explosive caps.....	\$3 60			
Forage.....	11 84			
Gum goods.....	89 36			
Hardware.....	6 12			
Harness and repairs.....	104 64			
Horse-shoeing.....	24 00			
Iron (bar).....	6 89			
Lumber.....	160 20			
Professional services, V. S.....	8 01			
Shop castings.....	43 80			
Special castings.....	67 04			
		\$525 49		

Detailed Expenditures of the Bureau for 1897.

General Appropriation.	Amount appropriat'd.	Amount expended.	Amount merging.	Amount not merging.
<i>Item 8—Continued.</i>				
Brass fittings.....		\$915 41		
Bricks.....		491 65		
Cement.....		493 00		
Chandlery.....		598 07		
Clay.....		112 18		
Corporation cocks:				
7,330 ½-in., at 32.93.....	\$2,423 65			
500 ½-in., at 37.50.....	187 50			
100 ¾-in., at 50 cts.....	50 00			
100 1-in., at 76.50.....	76 50			
25 1½-in., at \$1.20.....	30 00			
50 1½-in., at \$1.33 ⅔ cts.....	69 75			
100 2-in., at \$2.10.....	210 00			
		3,047 40		
Device for watering horses.....		150 00		
Disinfectant.....		21 00		
Dynamite.....		164 26		
Forage.....		1,274 81		
Gum goods.....		1,804 88		
Hardware.....		1,591 73		
Harness and repairs.....		337 10		
Hauling.....		3,933 86		
Horses, two at \$112.....		224 00		
Horse-shoeing.....		698 99		
Ice.....		353 00		
Iron (bar).....		413 87		
Iron pipe:				
13,953 6-in., 5,088,488 lbs., at 3.04 cts.....	\$42,946 83			
499 8-in., 243,267 lbs., at 8.44 cts.....	2,053 17			
800 10-in., 540,401 lbs., at 8.33 cts.....	4,533 96			
2,538 12-in., 2,362,278 lbs., at 8.13 cts.....	19,349 67			
873 16-in., 1,154,772 lbs., at 8.33 cts.....	9,688 54			
200 20-inch, 362,210 lbs., at 8.33 cts.....	3,039 10			
		81,611 27		
Iron special castings:				
128,572 lbs., at 1.87c.....	\$2,404 31			
474,723 lbs., at 1.54c.....	7,310 73			
		9,715 04		
Lead (pig) 254,192 lbs., at 3.48½.....		8,858 59		
Lead pipe, 9,070 lbs., at .4½c.....		385 50		
Lumber.....		2,318 65		
Machine work, 260 hours, at 60c.....		156 00		
Packing.....		617 69		
Paints.....		27 3		
Pasture for horse.....		4 50		
Plans.....		40 00		
Plug valves:				
141, at \$1 29.....	\$181 89			
250, at \$1 75.....	437 50			
750, at 75c.....	562 50			
		1,181 89		
Professional services V. S.....		241 60		
Repairs to stoves.....	\$9 50			
Repairs to wagons.....	902 71			
		912 21		
Rent of office, Fifth District.....		68 75		
Rent of shop, Fifth District.....		50 60		
Shop castings:				
21,580 lbs. at 2¼c.....	\$487 12			
103,401 lbs. at 1¼c.....	1,531 03			
281,701 lbs. at 10c.....	2,788 84			
		4,826 99		

Detailed Expenditures of the Bureau for 1897.

General Appropriation.	Amount appropriated.	Amount expended.	Amount merging.	Amount not merging.
<i>Item 8—Continued.</i>				
Spars.....		\$18 00		
Stop Valves:				
Two 8-in. x 6 in., 4-way at \$75.....	\$150 00			
Seventy-five 6 in. 3-way at \$41.....	3,300 00			
		3,450 00		
Stable supplies.....		76 05		
Tapping machines.....		3,984 00		
Traveling expenses (Pipe inspectors).....		1,233 54		
Venturi meter, 48-inch.....		2,650 00		
Wagons.....		457 50		
Wages:				
Improvement.....	\$5,657 00			
First District.....	8,778 86			
Second District.....	15,279 39			
Third District.....	29,142 61			
Fourth District.....	19,518 24			
Fifth District.....	4,725 85			
Sixth District.....	18,900 33			
		102,002 28		
Total.....		\$242,018 05	\$7,981 95	
<i>Item 9.</i>				
For service pipes and meters.....	\$10,000 00			
Corporation cocks:				
1,000— $\frac{1}{2}$ in. at 32.93c.....	\$329 30			
100— $\frac{3}{4}$ in. at 37.50c.....	37 50			
10— $\frac{1}{2}$ in. at 50c.....	50 00			
100—1 in. at 76.50c.....	76 50			
		\$493 30		
Curb stops, 1,395 $\frac{5}{8}$ in. at .34c.....		474 30		
Lead pipe:				
12,106 lbs. at 4 $\frac{1}{4}$ c.....	\$514 50			
41,600 lbs. at .0360c.....	1,497 60			
		2,012 10		
Parts of meters.....		177 25		
Water meters:				
5 $\frac{3}{4}$ in., at \$15.....	\$75 00			
30 $\frac{3}{4}$ in., at \$12.....	360 00			
10 $\frac{1}{2}$ in., at \$8.....	80 00			
5 1 in., at \$20.....	100 00			
10 1 in., at \$16.....	160 00			
5 1 $\frac{1}{2}$ in., at \$37.13.....	185 65			
10 1 $\frac{1}{2}$ in., at \$30.....	300 00			
10 2 in., at \$45.....	450 00			
10 2 in., at \$50.....	500 00			
5 3 in., at \$85.....	425 00			
5 3 in., at \$90.....	450 00			
10 4 in., at \$175.....	1,750 00			
2 6 in., at \$400.....	800 00			
	\$5,635 66			
Less hauling.....	15 50			
		5,620 15		
Total.....		\$8,777 10	\$1,222 90	

Detailed Expenditures of the Bureau for 1897.

General Appropriation.	Amount appropriat'd.	Amount expended.	Amount merging.	Amount not merging
Item 10. Emergencies.....	\$5,000 00			
Repairs to engines.....		\$1,912 84		
Repairs to damage from bursted pipe.....		78 00		
Total.....		\$1,990 84	\$4,009 16	
Item 11. For repairing and improving reservoirs..... \$100,000 00				
Balance from books of 1896.. 185,830 35				
Increased by additional appropriation 7,700 00				
Net appropriation to item.....	\$293,530 35			
Deficiency of 1896:				
Asphalt work.....		\$200 00		
Analyses.....		70 00		
Bricks.....		442 50		
Cerion paint.....		26 25		
Cement.....		4,320 00		
Crushed stone.....		923 06		
Coping stone 92 ft. 3 in. 2 ft. at \$2.95..... \$272 87				
1,452 ft. 9 in. 3 ft. at \$3.35... 4,67 21				
	\$5,140 08			
Less 20 per cent..... 1,028 01				
		4,112 07		
Relining north basin Queen Lane Reservoir:				
69,585 sq. yds. floor at \$1.15.. \$80,022 75				
Less 20 per cent..... 16,004 55				
		64,018 20		
Relining south basin Upper Roxborough Reservoir:				
52,494.27 sq. yds., at \$1.28½.....				
		67,455 14		
Relining south basin Upper Roxbor- ough Reservoir:				
16,186 sq. yds. slope at \$1.45..... \$23,469 70				
38,753 sq. yds. floor at \$1.20..... 46,503 60				
		69,973 30		
Retaining wall Queen Lane Reser- voir:				
157 cu. yds. excavation at 22c..... 34 54				
636 cu. yds. masonry, at \$4.97 3,160 92				
45,638 sq. yds. sodding, at 13c 5,542 94				
14,062 cu. yds. earth filling, at 57c..... 8,015 34				
	\$16,753 74			
Less 20 per cent..... 3,350 73				
		13,403 01		
Retained per cent. on Contract for Retaining Wall, Queen Lane Reservoir..... \$14,236 42				
Less retained for future payment..... 1,500 00				
		12,736 42		
Sand and lime.....		2,479 23		
Services of driver.....		230 00		

Detailed Expenditures of the Bureau for 1897.

General Appropriation.	Amount appropriat'd.	Amount expended.	Amount merging.	Amount not merging
Wages:				
Bricklayers.....	\$2,125 48			
Horses and carts.....	1,004 00			
Laborers.....	6,707 05			
Stonemasons.....	1,455 00			
		\$10,291 53		
Total.....		\$250,680 81	\$461 78	\$42,387 86
Item 12.—Extensions:				
Balance from 1896.....	\$83,712 30			
Retained per cent. on Contract for Engines, Queen Lane Reservoir.....		\$59,829 60	\$37 50	\$23,845 20
Item 13.—For the construction and completion of Queen Lane Reser- voir:				
Balance from 1896.....	122,731 77		122,731 77	

RECAPITULATION.

Balance from books of 1896.....	\$392,274 42			
Special appropriation.....	370,700 00			
		\$762,974 42		
Annual appropriation.....		1,119,654 00		
			\$1,882,628 42	
Expended for deficiencies.....	32,006 59			
Expended for maintenance.....	1,322,636 31			
Expended for extensions.....	310,510 31			
		1,665,153 21		
Amount merging.....	147,886 69			
Amount not merging.....	69,588 52			
		217,475 21		
			1,882,628 42	

The following table shows the receipts from the operations of this Bureau during several recent years, together with the estimates of requirements, the amounts rendered available by appropriations, etc., and the amounts expended :

YEAR.	Receipts.	Estimates.	Available Appropriations.	Expended.
1890	\$2,381,037 70	\$1,658,653 00	\$1,371,028 00	\$938,364 29
1891	2,500,762 78	2,000,000 00	1,880,633 48	1,530,294 04
1892	2,634,456 02	1,500,000 00	2,476,628 37	1,372,457 31
1893	2,374,275 24	2,871,800 00	3,813,973 92	2,593,390 81
1894	2,759,630 59	4,230,564 00	3,888,326 05	2,912,356 04
1895	2,829,837 17	4,335,366 00	2,616,077 32	1,897,225 20
1896	2,379,133 26	4,385,604 00	2,231,671 15	1,825,610 83
1897	2,971,357 52	4,948,379 00	1,882,628 42	1,665,153 21
1898 .....	.....	5,443,379 00	.....	.....

Appropriation for 1898.....\$1,068,843 40
 Balance from 1896..... 69,538 52

Requirements and Appropriations.

The following table makes comparison between the requirements of this Bureau for the year 1898 and the amounts appropriated :

Statement Showing the Estimates of the Bureau for the year 1898 and the Amounts Appropriated.

Item.		Estimates.	Appropriations.
1	Salaries	\$322,529 00	\$303,354 00
2	General supplies	350,000 00	350,000 00
3	Repairs to machinery.....	100,900 00	81,000 00
4	Repairs to buildings, grounds, and reservoirs...	125,000 00	125,000 00
5	Repairs to distribution.....	200,000 00	135,900 00
6	Material and labor at City shop	80,000 00	66,500 00
7	General incidental and contingent expenses....	17,000 00	18,300 00
8	Service Mains.....	300,000 00	233,000 00
9	Service pipes and meters	100,000 00	10,000 00
10	Emergencies	25,000 00	5,000 00
11	Extensions and improvements	\$3,863,750 00	.....

APPENDIX B.

REPORT

OF THE

GENERAL SUPERINTENDENT

OF

Work during 1897, on Buildings, Grounds and Reservoirs,
and on Boilers and Machinery at the Pumping Stations.

OFFICE OF THE GENERAL SUPERINTENDENT.

BUREAU OF WATER.

Philadelphia, January 3, 1898.

MR. JOHN C. TRAUTWINE, JR.,
Chief of Bureau of Water.

DEAR SIR :—I have the honor to submit the following report of work performed under my direction during the year 1897:

The engines and boilers at the several pumping stations have been, with few exceptions, kept running to their full capacities.

The repairs to the Fairmount, Queen Lane, and new Roxborough reservoirs, respectively, have been completed, and the several other reservoirs have all been kept in good condition.

The following table shows the pumpage—annual, maximum, average daily, and daily per capita—as compared with that for the year 1896:

Comparison of Pumpage for 1896 and 1897.

	1896. Gallons.	1897. Gallons.	Increase. Gallons.
Annual pumpage:			
From rivers.....	86,228,360,959	93,999,191,121	7,770,830,162
High service.....	1,465,281,570	1,668,275,750	202,994,180
Total.....	87,693,642,529	95,667,466,871	7,973,824,342
Maximum daily pumpage:			
From rivers.....	282,661,868	314,851,516	32,189,648
High service.....	4,993,780	4,365,360	71,580
Total.....	286,955,648	319,216,876	32,261,228
Average daily pumpage:			
From rivers.....	235,593,614	257,532,031	21,938,417
High service.....	4,003,502	4,570,618	567,116
Total.....	239,600,116	262,102,649	22,502,533
Average daily pumpage:			
From rivers, per capita.....	172.2	195.8	13.6

*Cost of raising 1,000,000 Gallons 100 Feet during 1896
and 1897.*

Station.	1896	1897	Increase.	Decrease.
Fairmount	\$1 29	\$1 66	\$0 37	
Spring Garden.....	3 58	3 44		\$0 14
Belmont	3 63	3 84	21	
Belmont High Service.....	41 38	24 69		16 69
Queen Lane.....	2 88	2 12		76
Roxborough.....	3 13	3 37	24	
Roxborough High Service.....	8 31	7 05		1 26
Mt. Airy High Service.....	10 66	11 96	1 30	
Chestnut Hill High Service.....	109 22	432 73	323 56	
Frankford.....	4 26	4 24		02
Average	\$3 43	\$3 16		\$0 27

*Volume and Cost of Pumpage, etc., for the years 1886 to
1897, inclusive.*

Years.	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.	Estimated Population.
1886	26,658,966,569	46,255,361,203	\$4 13	80	975,000
1887	32,426,779,765	51,289,948,331	3 99	89	995,000
1888	37,068,760,428	59,483,831,199	4 49	100	1,020,000
1889	42,518,919,781	69,034,118,434	3 87	110	1,050,000
1890	51,698,508,099	84,501,451,686	3 05	131	* 1,046,000
1891	55,665,648,000	93,490,106,725	2 99	140	1,071,672
1892	59,787,584,178	102,443,373,631	2 68	143	† 1,142,650
1893	6,352,736,978	110,590,708,479	3 22	150	1,190,498
1894	72,073,724,238	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

* United States census.

† City census.

‡ Including repumpage or high service.

DAILY PUMPAGE

Table showing the Nominal, Maximum, Minimum and Average Daily Pumpage for 1896 and 1897.

NAME OF STATION.	NOMINAL.		MAXIMUM.		MINIMUM.		AVERAGE.	
	1896	1897	1896	1897	1896	1897	1896	1897
Fairmount.....	33,290,000	33,290,000	41,963,052	39,994,701	850,850	784,664	24,490,454	20,795,278
Spring Garden.....	170,030,000	170,060,000	170,998,740	168,563,170	29,830,000	45,524,300	127,587,557	124,332,590
Belmont.....	38,000,000	38,000,000	32,886,592	33,191,583	10,872,340	15,255,935	25,797,572	27,307,458
Queen Lane.....	80,000,600	80,000,000	42,119,150	78,292,150	1,644,000	11,695,680	26,343,698	63,222,063
Roxborough.....	24,500,000	24,507,000	23,418,140	23,062,430	6,288,770	5,799,700	17,441,755	17,853,806
Total from Schuylkill.....	345,790,000	345,790,000	311,385,654	343,104,031	49,455,960	79,060,249	221,651,035	213,511,200
Increase.....				31,718,380				
Frankford.....	35,000,000	42,000,000	21,661,923	23,362,138	3,921,730	7,032,780	13,923,625	14,607,471
Total from Delaware.....	35,000,000	42,000,000	21,661,923	23,362,138	3,920,730	7,032,780	13,923,625	14,007,474
Increase.....				1,700,215		3,112,050		83,849
Total from Delaware and Schuylkill.....	380,790,000	387,790,000	333,047,577	366,466,172	53,376,690	86,093,029	235,574,661	257,518,674
Increase.....		7,000,000		33,418,595		32,716,339		21,944,013

Nominal, Maximum, Minimum and Average Daily Pumpage for 1896 and 1897—Continued.

NAME OF STATION.	NOMINAL.		MAXIMUM.		MINIMUM.		AVERAGE.	
	1896	1897	1896	1897	1896	1897	1896	1897
Belmont High Service.....	2,500,000	2,500,000	576,720	1,153,440	106,800	202,920	268,418	445,911
Roxborough High Service.....	5,000,000	5,000,000	2,566,080	4,980,690	356,400	2,212,650	2,163,626	3,114,330
Mt. Airy High Service.....	3,000,000	3,000,000	2,220,000	1,965,000	995,000	641,250	1,574,462	1,010,317
Chestnut Hill High Service.....	750,000	750,000	885,600	378,840	63,960	36,900	52,549	13,354
Total High Service.....	11,250,000	11,250,000	6,248,400	8,477,970	1,522,160	3,093,720	4,014,493	4,583,942
Total daily.....	392,040,000	390,040,000	339,295,977	374,944,142	54,893,790	89,186,749	239,589,159	262,102,616
Increase.....		7,000,000		35,648,165		34,287,959		22,513,457

The following is a summary of the work done at the several stations and reservoirs:

Fairmount

During the summer, while the wheels were out of service on account of the low condition of the water in the Schuylkill river, all the wheels and pumps at Fairmount received attention and the necessary repairs.

Nos. 1 and 3 wheels have done but little service during the year on account of the reservoir being thrown out of service. These wheels pump only into the Fairmount reservoir, and, in consequence, have run only on twenty-nine (29) days during 1897.

The remaining wheels at this station pump into Corinthian reservoir, and I would recommend that Nos. 1 and 3 be similarly connected, as they are now idle while water is running over the dam.

Work on the unfinished section of the basin was started as soon as the weather permitted, and the walls of No. 1 section were torn down to the line where solid masonry was reached and were then built up from that line with Conshohocken stone, pointed, and finished with a cement concrete coping around the entire section. The low division banks were covered with cement concrete, and stop-houses of brick were built over all the stops in the several sections. The outside and the division banks were graded with gravel and then rolled. The dam received some temporary repairs, but it will soon require others, of a more extensive and permanent character. The wheel houses and grounds at this station have been kept in fair condition, considering the means available, with the exception of the house on the Mound dam, which is in the same deplorable state, leaking at every rain and keeping the machinery and building in so unsightly a condition that we are obliged to keep the house closed to the public.

Forebay.

As stated in my report for 1895, the forebay at Fairmount and the entrance to it from the river have always been subject to shoaling, on account of the progressive diminution in the velocity of the water as it passes the entrances of the flumes to the several wheels, and by reason of two corners in which the water loses its velocity and deposits its sediment. It is proposed, if the necessary means are provided, to construct walls reducing these channels to such dimensions as will obviate this difficulty in the future.

Spring Garden Pumping Station.

The engines and boilers at this station have been kept in good running order and have required but very little repairs other than those incident to the general wear of hard-worked machinery. The two 30-million gallon engines at this station have been run to a disadvantage, owing to the insufficient boiler capacity for steam at high pressure. These engines were designed to be run with steam at a pressure of 150 pounds. Only six of the boilers at this station were constructed for steam at that pressure. With the quality of coal used by the Bureau they are inadequate to supply steam for both engines at the pressure required to run them to the best advantage. In consequence of this, when both engines are running at the same time it is necessary to use a lower pressure of steam. As the engines are both supplied through one steam pipe, should either of them be out of service, the one in working condition is run with higher steam pressure, and with very good results.

The boilers at this station, forty-four (44) in number, have been kept in good condition.

Belmont Pumping Station.

The boilers at this station have been run to their full capacity. They are greatly in need of repairs, but as they are all required to run the pumps which supply the rapidly growing demands of West Philadelphia, their services cannot be dispensed with for a longer period than a day or two at the most, and even for that period only one at a time can be spared.

The flue to which all the boilers (with the exception of the three to the iron stack) are connected, is in a very dangerous condition and liable to collapse at any moment. The top of the flue has fallen in, and it is at present covered with iron plates which are suspended from the roof of the boiler house, and these plates, in turn, are covered with a layer of bricks. Should the remaining portion of the flue collapse, all of the pumps at this station would be thrown out of service for weeks, while, at the expiration of thirty-six (36) hours, all of the district west of the Schuylkill would be without water. I therefore earnestly recommend that some action be taken at once toward the introduction of additional boilers, boiler-house and stack at this station. I cannot urge this too strongly, as, under existing conditions, it will be utterly impossible for us to keep up with the demands upon Belmont station during 1898 should the increase in consumption in West Philadelphia be in proportion to that during 1897. I have called attention in my last two reports to the condition of this overworked station, and I would respectfully bring to your notice again the necessity of giving it immediate relief.

The largest and most important engine at the Belmont pumping station is still running under the conditions stated in my report of last year, viz: protected only by a cover of rough boards. No means have been provided for the building of a house around it.

Queen Lane Pumping Station.

The engines at this station are running under unfavorable conditions, owing to the admission of air into the suction mains. This causes them to thump heavily at times and to bring undue strains upon both the engines and the pumps.

Many of the pedestal bolts on the main shafts, as well as one of the pump chambers, have broken. The latter was replaced with a new one. An examination of the pump chambers was subsequently made, and this revealed the fact that they were all cracked in a manner identical with the first one reported above. The breaking of these parts is, in my judgment, due largely to the admission of air into the suction mains and the pounding of the engines. I am of opinion that the major part of the air admitted finds its way through the joints in the pipes. I am led to this belief by the improvement in the working of the engines after the recaulking of the joints. Means were adopted to extract the air from the suction mains by connecting the air chambers on them to the condensers. This method, while partly effective, destroyed the vacuum in the condensers. An independent air pump was then installed and connected to the same pipes. This is now in use and working quite satisfactorily, but it fails to overcome the difficulty. I not only recommend, but strongly urge that these pipes be relaid at lower level, or that a conduit be constructed into a pump well at or near the engine house, and by this means overcome trouble and expense, and improve the running of the engines.

Much work in connection with the improvement of the buildings and grounds has been done in and around this station, but I regret to have to state that our facilities for supplying it with coal leave much to be desired. We are still compelled to have the coal hauled from Wissa-

hickon, on the Reading Railroad, as stated in my report of last year, at a cost, this year, of twenty-five (25) cents per ton.

During the year 1897 there were 26,934 tons of coal consumed at the Queen Lane pumping station. Multiplying this amount by the cost (25 cents) per ton, for hauling it from Wissahickon, we have the sum of \$6,733.50, and, adding to this amount the cost for handling the coal at the works, \$829.50, we have a total of \$7,563, which represents the amount which could be saved in the expenditures at this plant if proper facilities were provided for the delivery of coal. I therefore respectfully urge that some means be adopted looking to an improvement in this particular, and of such a nature as to do away entirely, if possible, with this extra expenditure for the hauling of coal.

The pumps at this station are all required to deliver through one 48-inch main to the reservoir. This not only increases the pressure on the pumps, but the cost of pumpage as well. Should the 48-inch main which receives the deliveries from these pumps be, for any reason, thrown out of service, the entire works would be forced to remain idle. The necessity for the laying of the second main, at the earliest possible moment, is therefore apparent.

Roxborough Pumping Station.

This station, so far as boiler power is concerned, is in much the same condition as the Belmont pumping station. The boilers have all been run, during 1897, to their full capacity. They are all greatly in need of repairs, but their services can be dispensed with only for the length of time required to have them cleaned.

No. 1 engine at this station is also much in need of repairs, and of an extensive character. Two new pump chambers, to replace the present broken ones, have been

in readiness for several months, and every effort has been made to fill the new reservoir, so as to have a supply of water in reserve while the repairs to No. 1 engine are in progress, the two smaller engines being entirely unequal to meet the demands of the district supplied by this station. It is for this reason that the greatest care is necessary in the management of No. 1 engine, so as to keep it, in its impaired condition, in running order.

As I stated in my report of last year, engines Nos. 2 and 3 are required to force water into the new reservoir, and the pressure necessary to accomplish this is much greater than that for which the engines were designed.

I therefore repeat the recommendation in my report for 1896, and urge that some action be taken at once looking to the introduction of additional pumps and boilers at this station. The district furnished with water by these works has out-grown the supply, and additional facilities will be required during the year 1898 to meet the increasing demands upon them.

Frankford Pumping Station.

The engines and boilers at this station are in good condition. This is accounted for by the fact that there is a reserve in both engine and boiler capacities, which enables us to drop them out of service when repairs are required to be made.

The 15-million gallon compound vertical engine, known as No. 3, built for this station by the Southwark Foundry and Machine Company, was completed and reported ready for the duty test required by the specification. This engine was contracted for as a 15-million gallon engine, but the contractors, upon being granted permission to make certain alterations, subsequently guaranteed for the engine a capacity of 22-million gallons. The experts appointed Prof. H. W. Spangler, by the City, and Mr. Edward T.

Child, by the Southwark Foundry and Machine Company, decided, therefore, to make two tests, instead of one as at first proposed, one for 15-million gallons capacity, as contracted for, the other for 22-million gallons capacity, as subsequently guaranteed. The test for 22-million gallons capacity was made first. It was begun at noon on June 16th and continued until 7.58 P. M., when a lead joint blew out of the pipe connecting the force main with No. 2 engine, necessitating the stoppage of the test. The slow speed test (15 million gallons) was begun at 6.45 P. M., June 18th, and terminated at 4.45 A. M. on the following day. An account of the tests will be found in a report made by the experts to Mr. Thomas M. Thompson, Director of the Department of Public Works. The engine was put in service immediately after the report of the experts, and it has since given satisfaction in every particular.

Roxborough and Belmont High-Service Stations.

Both of these stations are in the same condition as stated in my reports for 1895 and 1896. As there is but one pumping engine at each station, that engine is required to run night and day, throughout the entire year. If, for any cause, it should be thrown out of service, the district supplied by it would be without water, and for this reason I again urge that provision be made at once to relieve the engines and pumps in question.

Queen Lane Reservoir.

During the year 1897 the following improvements, begun during 1896, were completed:

Asphalt concrete floor lining in north basin.

Reconstruction of outer slopes and retaining wall.

Other work carried on during the year was as follows:

Coping placed on retaining walls.

Alterations in parapet walls at steps at west end of division embankment, and building retaining wall at steps at east end of division embankment.

Repairing asphalt walk on top embankment.

Observations on leakage, evaporation and rainfall taken.

Asphalt Concrete Floor Lining. North Basin.

During the latter part of April the north basin was emptied, and, on April 26th, the Vulcanite Paving Company began cleaning the floor, preparatory to laying asphalt concrete. As this work requires a perfectly dry surface, the contractors were not allowed to begin laying asphalt concrete until May 20th.

About 40,000 square yards of the asphalt concrete laid last year, and which did not conform to the specification regarding its solidity, were taken up, reworked and relaid. This work was not completed until August 16th, on which day water was turned in from the south basin.

Reconstruction of Outer Slopes and Building of Retaining Walls.

Mr. Michael McManus, contractor for the reconstruction of the outer slopes and the building of retaining walls, resumed operations on April 19th. The Vulcanite Paving Company's asphalt plant, having been built on the line of the retaining wall on Thirty-first street near the steps, interfered with the progress of Mr. McManus's work, and he was, therefore, unable to complete this part of it until October 1st.

During the summer the outer slopes were graded and sodded, in accordance with the provision of the specification.

Coping for Retaining Walls.

The first delivery of coping for the retaining walls was made on April 19th, by the contractor, Mr. Michael Mc-

Manus. Very slow progress has been made with this work, there having been 1,545 lineal feet laid, which is less than half the quantity required to complete the work.

Alterations in Parapet Walls.

During the latter part of November the parapet walls at the steps at the west end of the division embankment were altered by the masons of the Bureau. Some of these walls were built unnecessarily high and afforded seclusion for committing nuisances. The alterations consisted in decreasing the height of these walls.

At the east end of the division embankment a wall was built and repairs to steps made by the masons of the Bureau of Water.

Repairing the Asphalt Walk on Top of the Embankment.

On the south and west sides of the south basin the Neuchatel asphalt walk was considerably damaged by the heavy hauling during the repairs to reservoir. During November the Vulcanite Paving Company repaired the top of the western embankment. The walk on top of the southwest bank remains in a very bad condition.

Leakage.

On March 21st the south basin, for the first time, was filled to the intended maximum depth, 30 feet. The gauge-board in the north basin registered 21 feet 2 inches. On March 22d, the day following, the first indications of leakage appeared since the relining of the reservoir with asphalt. These indications were as follows:

1. Water flowing through retaining wall on Thirty-first street south of Bowman.
2. Increase in flow of stream crossing Abbotsford avenue west of Thirty-first street.
3. Four inches of water standing in pipe ditch in Thirty-second street and Abbotsford avenue.

4. Springs appeared in pipe ditch south of reservoir and in ditch on Thirty-first street.

5. The meadow northwest of reservoir very wet, and stream flowing from same much increased in flow.

6. Water coming out of ground in Queen street east of Thirty-third street.

The south basin was then drawn down about one-third, and the north basin gradually emptied to allow the completion of the asphalt concrete floor lining. Under this head the above-described evidences of leakage gradually disappeared, except the stream running through wall on Thirty-first street, which continued to flow until July 24th.

On October 26th the depths of water in the north and south basins were 30 feet, and 27 feet 8 inches, respectively. The north basin was shut off from distribution and the pumpage turned into the south basin. Hook-gauge readings were taken in the north basin to ascertain the fall in the water surface. The few readings taken at 30 feet head indicated a loss of about 3 inches per day. On October 27th all the evidences of leakage, as heretofore described, reappeared. The stream flowed from the meadow northwest of reservoir at the rate of 150,000 gallons per day, which is about double its average flow with the reservoir empty.

On October 29th the north basin was put on distribution, and by November 1st the depth decreased to 20 feet 4 inches, when it was again shut off and hook-gauge readings taken. Under this head the north basin lost about one-half inch per day. During this test, which lasted until November 11th, the south basin was kept on distribution, and its depth ranged from 18 feet to 25 feet. On November 2d, the water discontinued running through the wall on Thirty-first street. The streams south and west of reservoir decreased in flow.

On November 11th the north basin was drawn down to 15 feet 4 inches, when another series of hook-gauge readings was begun. This test continued until December 13th. Under 15 feet head the north basin lost about one-third inch per day. The evidences of leakage slowly disappeared, except in the meadow northwest of reservoir. This continued wet, and it was considered advisable to drain it by a series of 6-inch terra cotta drain pipe, aggregating 1,350 lineal feet. This work was completed November 29th. Since then the condition of the meadow has been normal.

On November 4th a pool of water, about 10 feet wide, extending about 30 feet along the foot of slope on Thirty-first street north of Bowman street, was observed. It was suspected, at first, that this water came from the north basin, when evidence was found which negatived such a theory, and its existence was attributed to the recent heavy rains, falling on the outer slopes and collecting at the foot, forming these pools.

A test of the south basin was started December 20th, but few or no results were obtained, and the test was postponed on account of the ice, which prevented ascertaining, accurately, the amount of evaporation. On December 28th the south basin was put on distribution, and the customary method of pumping into the north basin and distributing from the south basin was resumed.

Observations on Evaporation and Rainfall.

Observations on evaporation from water surface and rainfall were taken to determine the correction for the hook-gauge readings. The observations were taken daily, from April 16th to December 26th.

Monthly reports of these observations have been made by the Assistant in Charge of Hydrographic Work.

New Roxborough Reservoir.

The relining of the north basin consisted of a coating of asphalt concrete, $1\frac{1}{2}$ inches thick, on both floor and slopes.

As in all our other asphalt work in the relining of reservoirs, a priming coat of asphalt dissolved in benzine was first spread over the original surface and allowed to dry thoroughly.

On the floor, the asphalt concrete was underlaid by a coat of melted asphalt, which, however, was omitted on the slopes, lest it should tend to cause a slipping of the lining there.

As a further safe-guard against slipping or creeping of the slope lining, the asphalt concrete there used was made somewhat poorer in asphalt, and was given, besides, an admixture of limestone dust.

The result was an asphalt concrete that showed not the slightest tendency to slip or creep under continued exposure to the hottest summer sunshine.

Over the entire surface of both floor and slopes was spread a layer of melted asphalt. Here, also, the slope treatment was made poorer than that on the floor, as a precaution against flow under a hot sun, and the lining thus prepared has behaved admirably in this respect.

The relining of the south basin is similar to that employed at the Queen Lane reservoir, the floor being given two inches of asphalt concrete, with a top coating of melted asphalt, while the slopes received two coats of melted asphalt with burlap between them, the burlap being anchored at the top of the bank and the entire slope work being covered with hard vitrified bricks laid flat and dry.

On April 8th the north basin was emptied to allow the Alcatraz Paving Company of Pennsylvania to complete the asphalt concrete lining begun last year.

On April 24th the said company began laying asphalt concrete, but, owing to the damp condition of the floor, work was suspended until May 18th.

The frequent rains during the summer months prevented the contractors from making rapid progress, and this work, therefore, was not completed until September 25th.

For a period of several months after the north basin was emptied, water continued running into the basin through the brick lining at the northwest corner, and along the foot of the west slope, from midway between the north and the south outlet pipes, to the northwest corner. Many theories have been advanced as to the source of the water which finds its way into the basin at this point, and as to the reason for its continuance for so long a period after the basin was emptied, but none satisfactorily explains either.

As the entire embankment at this place is built above the natural surface of the ground, it seems improbable that the water is traceable to springs in the embankment, and its location with relation to the south basin makes it unreasonable to attribute its source to that basin.

Before the asphalt concrete was laid over the bricks in the northwest corner, a drain was constructed to carry off the water coming from the embankment.

The brick lining was removed and an excavation, about 8 feet by 11 feet, was made in the embankment. A bed of porous concrete, 10 feet long, 7 feet wide and 2 feet thick, was laid over several brick drains, all emptying into a 2-inch pipe which connects with the 12-inch reservoir drain pipe.

A stop was put on the 12-inch reservoir drain pipe between the end of the pipe inside the basin and the connection with the 2-inch pipe. This stop is intended to relieve the 12-inch pipe, which runs under the embank-

ment at the northwest corner, of the reservoir pressure, and to prevent water from the basin getting into the above-described drain.

About 75 square yards of the brick lining along the foot of the west slope were removed. The wet clay was replaced with dry, well-rammed clay, over which bricks were laid to conform with the adjoining slopes. This work was done by employees of the Bureau of Water. After these bricks became dry this slope was covered with asphalt concrete.

On May 26th a break was discovered in the south outlet pipe, in the embankment, about 10 feet from the inside surface of the basin. This break was repaired before water was turned in the north basin.

None of the outlet pipes in this reservoir are equipped with stops or gates by the aid of which the water can be shut off from the inside of the basins. The break referred to demonstrated the advisability of providing some means by which the water could be shut off from inside the reservoir in case of a break occurring in the pipe under the embankment, thus preventing immeasurable damage which would probably result from such a break.

As a permanent equipment could not be built before the completion of the lining of the north basin, a temporary covering, made of 2-inch plank was bolted over the ends of the outlet pipes. The north outlet pipe is used for a pumping main, and a door, which will act as a check-valve, was put in the plank covering, which is bolted over the end of this pipe. These temporary gates still remain in place.

On September 6th the south basin was emptied, to allow the contractors to begin the repairs thereon, and the district formerly supplied from this basin was put on direct pumpage until the completion of the relining of the north basin.

After the water was drawn off a depression was found in the brick lining on the slope of the east embankment. This depression extended 60 feet north from about midway between the north and south corners, and was about 12 feet above the floor of the basin.

After 107 square yards of the brick lining were removed, two holes, about one inch in diameter, were found running through the clay into the embankment. These holes were filled with cement grout, and the original grade was restored by filling the depression with clay, over which the brick lining was relaid.

The brick slope lining was extended over the cement concrete steps at the east end of the division embankment. The steps were brought to a uniform grade by filling the triangular space at each step with cement concrete.

This work was done by employees of this Bureau.

On September 9th the Vulcanite Paving Company, contractors for relining the south basin with asphalt, began cleaning the floor preparatory to laying asphalt concrete. A deposit of mud, which had been accumulating since 1893, covered the entire floor. It measured about 3 inches in thickness immediately after the water was drawn off, and, when dry, $1\frac{1}{2}$ inches. This mud was deposited, by the contractors, on the outer slope of the west embankment.

The asphalt plant for the south basin was located at the foot of the outer slope of the west embankment, near the division embankment.

The brick and asphalt lining of the south basin was completed November 6th, on which day water was turned in from the north basin.

On July 23d a horizontal crack, $\frac{1}{2}$ inch in greatest width and 45 feet long, developed in the newly-laid asphalt concrete lining on the east bank near its north end; but this fracture was found to be due to a swelling of the clay

beneath it, which bulged the brick lining, and with it, of course, the asphalt concrete. The clay and the brick lining were reconstructed by employees of this Bureau, and the asphalt concrete was relaid by the contractors.

During the cold weather of the current month, four vertical cracks have developed in the slope lining of the division bank, which receives less sunshine than any of the others, and one, each, in the east and west banks. In each case these cracks start at the top of the bank and diminish in width as they extend downward toward the water surface. At the most, they are scarcely wider than the thickness of a sheet of writing paper, and in no case do they seem to extend below the surface of the water.

A stop was put on the 12-inch drain pipe inside the south basin, as a precaution against serious damage in case of a break in the pipe under this embankment.

About 100 new fence posts were put in the fence around the north basin, and as many of the old ones, having been rendered unfit for use by decay, were rejected.

The Neuchatel asphalt walk on top of the embankments has settled, in many places, from one to three inches. These depressions occur near the inside edge, about on a line with the fence. After every rain, water collected in these depressions, and, following down around the fence posts, ran off into the embankment.

In order to protect the embankment from damage resulting from the defective walk, the asphalt was cut away a few inches around each post. The remaining space was filled with Neuchatel asphalt so as to form a mound, from one to two inches high and sloping away in all directions from the posts.

The grading of Lare street by the Bureau of Surveys made it necessary to reconstruct the foundation and build an extension to the retaining wall on the east side of the reservoir and adjacent to the street above named.

The contract for this work was awarded to Mr. Michael McManus, who began operations on August , and completed all the masonry on December 7th. Before the contract is completed, however, the coping must be placed on the extended portion of the wall.

The maximum depths reached in the north and south basins, since the reservoir was lined with asphalt, are 16 feet and 22 feet 4 inches, respectively. Under these heads no evidence of leakage appeared.

Respectfully submitted,

F. L. HAND,
General Superintendent.

Jonval Turbines—Double-acting
horizontal plunge pumps.
Total capacity, 33,290,000 gallons
per day.

FAIRMOUNT PUMPING STATION.

Capacity, No. 1—2,000,000 gallons
per day.
Capacity, Nos. 3, 4 and 5—5,330,000
gallons per day.
Capacity, Nos. 7, 8 and 9—5,100,000
gallons per day.

1897	Running Time of each Turbine in Hours.							Gallons Pumped by each Turbine.							Total Pumpage for each Month.	Average Pumpage per Day.	OIL.	
	No. 1	No. 3	No. 4	No. 5	No. 7	No. 8	No. 9	No. 1.	No. 3.	No. 4.	No. 5.	No. 7.	No. 8.	No. 9.			Castor.	Engine.
January.....	8	665	639	290	271	409	209	872,320	179,844,442	171,233,676	78,358,973	65,968,350	105,305,420	51,604,175	653,187,356	21,070,559	1	160
February ...		501	501	421	389	488	371		131,666,745	128,866,096	109,652,497	89,497,500	119,618,695	91,268,950	670,570,483	23,948,958	4	141
March.....		735	744	744	744	720	747		196,399,560	196,267,247	195,346,806	175,880,360	182,747,975	185,227,675	1,181,869,623	36,511,923		194
April.....			680	685	681	685	629			177,862,879	181,326,194	155,503,900	169,433,475	156,486,431	840,612,879	28,020,429	3	189
May.....	11	12	592	629	623	619	523	1,212,800	3,098,842	157,699,541	163,703,362	148,909,425	133,367,983	54,618,850	662,610,803	21,374,542		160
June.....	245	347	474	532	478	684	661	21,967,822	123,095,283	127,906,601	112,385,608	106,794,675	161,897,050	157,939,655	812,186,694	27,072,889	15	182
July.....	3	6		562	423	465	400	269,568	1,391,759		148,514,273	94,200,021	112,457,800	97,358,571	454,191,992	14,651,354		126
August.....	43	136		492	446	676	565	3,405,596	35,637,851		127,974,776	100,194,028	150,699,775	129,223,250	547,135,276	17,649,525	6	142
September ..				163	73	157	11				42,444,951	16,669,504	37,290,525	1,812,800	98,217,780	3,273,926		61
October.....	6	96	83	11	102	98	39	645,736	25,146,205	22,219,739	3,251,433	22,550,150	22,526,775	6,430,200	102,770,238	3,315,168		51
November..	154	207	675		676	685	671	15,229,397	56,504,004	158,855,966		173,855,425	167,125,025	171,926,700	743,496,517	24,783,217		195
December..	274	280	673	304	680	683	686	28,271,972	77,178,850	177,972,748	89,622,185	154,518,185	173,404,879	172,458,072	873,426,891	28,175,061		188
Total Averages }	741	2,985	5,061	4,833	5,586	6,369	5,522	71,875,211	829,963,541	1,318,884,493	1,252,781,058	1,304,541,523	1,535,875,377	1,276,355,329	7,590,276,532	20,795,278	29	1,789

Total Capacity—2,500,000
gallons per day.

BELMONT AUXILIARY STATION.

No. 1.—Worthington Duplex—Capacity,
2,000,000 gallons per day.
No. 2.—Snow—Capacity, 500,000 gallons
per day.

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1897	Running Time of each Engine in Hours.		Gallons Pumped by each Engine.		Total Pumpage per Month.	Average Pumpage per Day.	Coal.		Percentage of Ashes.	Oil.		Mean Water Pressure.	
	No. 1.	No. 2.	No. 1.	No. 2.	Gallons.	Gallons.	Tons.	Lbs.		Cylinder.	Engine.	No. 1.	No. 2.
							Qts.	Qts.					
January.....	158		6,760,410		6,760,440	218,078	32	1,526	.25	31	15	62	.....
February.....	144		6,222,360		6,222,360	222,227	29	245	.25	28	7	61	.....
March.....	165		7,049,480		7,049,480	227,412	33	690	.25	31	7	61	.....
April.....	232		9,954,720		9,951,720	318,224	35	1,490	.25	30	7	66	.....
May.....	323		15,282,555		15,282,555	492,985	43	1,470	.25	31	7	58	.....
June.....	413		19,964,595		19,964,595	665,486	51	435	.25	30	7	59	.....
July.....	448		21,540,115		21,540,115	694,812	47	885	.25	31	7	60	.....
August.....	413		19,847,780		19,847,780	640,250	44	2,105	.25	31	7	61	.....
September.....	481		23,176,835		23,176,835	772,561	52	1,265	.25	30	7	57	.....
October.....	350		16,559,440		16,559,440	543,852	42	535	.25	31	7	61	.....
November.....	180		8,915,130		8,915,130	297,171	40	635	.25	30	7	60	.....
December.....	189		7,185,020		7,185,020	296,290	42	2,010	.25	31	8	60	.....
Totals and average.....	3,496		162,758,470		162,758,470	415,911	495	2,171	.25	365	93	61

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Total Capacity, 24,500,000 gallons per day.

ROXBOROUGH PUMPING STATION.

No. 1—Vertical Compound.—Capacity, 12,000,000 gallons per day.
 No. 2—Worthington Duplex.—Capacity, 5,000,000 gallons per day.
 No. 3—Worthington Duplex.—Capacity, 7,500,000 gallons per day.

1897.	Running Time of each Engine in Hours.			Gallons Pumped by each Engine.			Total Pumpage of each Month.	Average Pumpage per Day.	Coal.		Percentage of Ashes.	Oils.		Mean Water Pressure and Mean Suction Lift in Pounds per Square Inch.			Gallons Raised 100 feet per Pound of Coal.
												Cylinder.	Engine.				
	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.....	711	693	54	364,995,800	156,521,100	15,973,570	537,492,470	17,338,466	1,834	1,410	.25	372	775	160	160	160	492.8
February.....	559	663	54	278,822,420	153,689,250	17,389,410	452,901,080	16,175,028	1,617	1,080	.25	356	696	160	160	160	471.0
March.....	712	540	31	373,042,200	127,381,000	10,003,740	510,423,940	16,465,385	1,712	80	.25	505	942	160	155	160	501.5
April.....	632	589	111	306,646,420	132,112,800	36,772,100	475,531,320	15,251,044	1,512	1,720	.25	561	893	160	145	160	520.2
May.....	700	691	291	333,096,060	168,574,800	90,310,450	592,481,310	19,112,300	1,842	520	.25	632	1,007	160	145	160	571.6
June.....	680	566	432	327,554,840	137,166,150	131,363,860	593,189,850	19,972,995	1,879	1,560	.25	637	988	160	145	160	536.2
July.....	727	252	447	365,059,680	63,068,050	143,406,120	571,533,850	18,436,575	1,794	1,920	.25	867	1,129	160	145	145	535.6
August.....	680	314	572	308,397,100	78,349,150	189,886,110	576,631,360	18,610,011	1,819	1,360	.25	895	957	155	145	155	457.8
September.....	600	320	417	208,211,750	170,973,800	140,092,190	518,377,740	17,219,768	1,670	2,040	.25	747	776	160	145	155	521.8
October.....	706	80	706	343,408,320	19,107,150	216,707,970	579,223,440	18,684,627	2,006	1,600	.25	789	911	160	145	155	485.5
November.....	558	261	526	323,826,120	62,590,150	159,020,010	545,436,280	18,181,209	1,971	240	.25	707	811	160	145	145	465.4
December.....	697	341	491	328,827,200	80,838,850	147,747,610	557,413,660	17,918,086	2,038	40	.25	729	842	160	145	155	459.6
Totals & averages.	8,062	5,313	4,162	3,861,987,910	1,352,471,250	1,321,180,170	6,516,639,330	17,833,806	21,700	160	.25	7,872	10,827	160	148	155	505.2

Total Capacity, 90,000,000 gallons per day.

NEW SPRING GARDEN STATION.

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

1897.	Running Time of each Engine in Hours.				Gallons Pumped by each Engine.				Total Pumpage of each Month.	Average Pumpage per Day.	Coal.		Percentage of Ashes.	Oils.		Mean Water Pressure and Mean Suction Lift in Pounds per Square Inch.				Gallons Raised 100 feet per Pounds of Coal.		
	No. 2.	No. 3.	No. 9.	No. 10.	No. 2.	No. 3.	No. 9.	No. 10.			Gallons.	Gallons.		Tons.	Lbs.	Qts.	Qts.	No. 2.	No. 3.		No. 9.	No. 10.
January.....	717	693	708	275	816,585,000	809,165,700	510,907,500	172,590,020	2,309,248,220	74,491,878	2,713	1,120	.25	1,545	744	52	52	68	70	572.5		
February.....	654	433	358	458	749,562,500	480,430,900	253,285,652	257,823,140	1,741,102,192	68,182,221	2,224	.....	.25	857	544	54	55	70	70	526.6
March.....	716	607	.....	550	831,117,030	681,216,500	.....	330,382,645	1,842,716,145	59,442,456	2,107	280	.25	1,124	658	52	50	.....	67	588.3
April.....	636	490	144	720	708,635,400	564,695,950	90,180,430	427,587,270	1,791,099,050	59,703,301	2,025	634	.25	1,110	603	52	52	72	72	594.9		
May.....	576	610	442	669	651,372,750	708,762,500	486,966,020	416,328,640	2,258,429,910	72,852,577	2,506	820	.25	1,144	619	52	52	61	61	606.2		
June.....	479	359	671	672	546,884,500	399,295,850	416,116,810	398,312,055	1,760,603,215	5,886,973	2,220	1,200	.25	1,021	485	52	56	55	55	533.3		
July.....	705	676	735	711	808,088,000	790,849,500	481,850,950	427,078,340	2,507,816,790	80,897,315	3,226	260	.25	1,328	712	52	52	66	67	522.0		
August.....	556	665	744	744	630,840,000	787,243,800	472,940,555	433,072,950	2,324,067,305	74,971,880	3,024	240	.25	1,244	687	55	55	63	68	517.0		
September.....	604	684	707	710	392,598,850	809,598,200	459,898,490	535,847,560	2,197,943,100	73,264,770	3,022	1,770	.25	1,208	682	56	56	67	68	487.7		
October.....	483	726	743	741	523,700,100	843,486,000	481,119,230	451,272,190	2,299,577,570	74,179,921	3,020	200	.25	1,232	688	56	56	56	56	527.0		
November.....	.....	633	700	706	.....	722,158,500	443,383,610	424,015,380	1,589,557,490	52,985,249	2,45	1,800	.25	901	620	.....	55	55	52	435.4
December.....	462	228	677	709	521,163,500	267,088,500	535,476,730	426,496,730	1,750,225,460	56,458,886	1,915	400	.25	960	496	58	52	56	56	610.9		
Totals and averages.....	6,588	6,304	6,629	7,665	7,180,497,600	7,858,991,900	4,632,126,027	4,700,806,920	24,372,422,447	66,773,760	30,460	2,004	.25	13,674	7,538	54	54	63	63	539.8		

Total Capacity 80,000,000 gallons per day.

CLD SPRING GARDEN STATION.

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

1897.	Running Time of each Engine in Hours.					Gallons Pumped by each Engine.					Total Pumpage of each Month. Gallons.	Average Pumpage per Day. Gallons.	Coal.		Percentage of Ashes.	OILS.		Mean Water Pressure and Mean Suction Lift in Pounds per sq. inch.					Gallons Raised 100 feet per pound of coal.		
	No. 5.	No. 6.	No. 7.	No. 8.	No. 11.	No. 5.	No. 6.	No. 7.	No. 8.	No. 11.			Gallons.	Gallons.		Tons.	Lbs.	Cylinder. Qts.	Engine. Qts.	No. 5.	No. 6.	No. 7.		No. 8.	No. 11.
January.....	542	460	744	650	514	308,816,550	193,620,000	554,141,200	327,471,200	293,580,000	1,677,628,950	54,117,062	2,713	1,120	.25	1,022	650	50	50	50	74	50	411.0		
February.....	557	282	405	502	416	456,487,550	128,280,000	304,520,700	262,375,200	349,376,000	1,500,989,450	53,606,766	2,224	.....	.25	557	476	50	50	50	54	50	454.0
March.....	193	187	449	552	667	92,428,800	78,855,000	330,099,300	277,868,500	564,859,200	1,344,110,800	43,358,412	2,167	280	.25	634	419	50	50	50	63	50	429.1		
April.....	132	134	658	97	594	56,856,150	56,700,330	499,242,000	49,014,000	481,544,000	1,143,356,540	38,111,884	1,791	832	.25	440	317	50	50	50	66	50	429.3		
May.....	323	.....	714	428	668	145,952,500	.....	559,999,000	260,911,300	280,983,410	1,247,846,210	40,253,103	1,983	2,080	.25	628	525	50	.....	50	72	50	423.5
June.....	372	56	516	654	646	182,179,295	24,005,000	386,016,300	330,348,800	526,870,000	1,449,419,395	48,313,979	1,801	260	.25	585	443	63	50	63	63	63	541.3		
July.....	522	.....	724	742	739	238,210,000	.....	542,536,100	374,220,000	598,464,000	1,753,430,100	56,562,261	2,628	1,280	.25	826	620	52	.....	52	83	52	448.7
August.....	608	244	736	744	743	421,735,450	102,690,000	563,246,300	374,976,000	602,392,000	2,065,039,750	66,614,185	2,746	160	.25	918	704	55	53	55	67	53	506.8		
September.....	708	356	720	715	712	550,249,000	346,690,150	545,716,000	359,228,100	565,320,000	2,367,203,250	78,906,775	2,204	1,740	.25	935	692	50	50	55	80	53	722.3		
October.....	739	577	738	737	722	638,610,300	241,178,600	560,194,450	370,346,800	580,542,000	2,390,872,150	77,124,908	2,580	800	.25	970	723	53	53	53	85	53	625.0		
November.....	706	581	639	657	606	626,774,500	243,305,000	527,307,300	326,029,200	535,752,000	2,259,168,000	75,305,600	2,466	2,160	.25	890	680	50	50	82	67	50	610.6		
December.....	700	400	727	686	299	620,145,800	69,558,000	546,609,500	344,755,200	228,840,000	1,809,908,500	58,384,145	1,839	640	.25	636	438	53	53	53	70	50	662.0		
Totals and averages	6,102	3,277	7,830	7,164	7,386	4,338,445,895	1,484,832,140	5,919,628,150	3,657,544,300	5,668,522,610	21,008,973,095	57,558,830	27,082	152	.25	9,041	6,687	52	51	55	70	52	521.9		

Total Capacity, 5,000,000
gallons per day.

ROXBOROUGH AUXILIARY STATION.

No. 1—Worthington Duplex.
—Capacity, 5,000,000 gal-
lons per day.

1897.	Running Time of Engine in Hours	Gallons Pumped by Engine.	Total Pumpage of each Month.	Average Pumpage per Day.	Coal.		Percentage of Ashes.	Oils.		Mean Water Pressure.
					Tons.	Lbs.		Cylinder.	Engine.	
								Qts.	Qts.		No. 1.
January	743	78,441,560	79,441,560	2,562,630	110	430	.25	124	8	56
February	670	71,840,240	71,840,240	2,565,722	98	2,142	.25	116	7	56
March	744	97,796,360	97,796,369	3,154,721	141	1,810	.25	124	7	56
April	720	99,542,810	99,512,810	3,318,093	151	530	.25	120	8	56
May	744	114,759,760	114,759,760	3,701,927	169	640	.25	124	7	56
June	720	111,835,010	111,835,010	3,727,833	171	448	.25	120	7	56
July	741	79,529,460	79,529,460	2,565,466	132	130	.25	124	4	56
August	721	81,610,840	81,610,840	2,632,607	130	1,260	.25	124	7	56
September	719	115,339,770	115,339,770	3,844,659	157	1,540	.25	120	7	56
October	744	102,957,860	102,957,860	3,321,221	146	440	.25	124	7	56
November	720	84,689,580	84,689,580	2,822,986	132	980	.25	120	7	56
December	744	97,387,220	97,387,220	3,141,523	152	1,940	.25	124	4	56
Totals and averages	8,730	1,136,740,470	1,136,740,470	3,114,330	1,694	1,090	.25	1,164	83	56

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

MOUNT AIRY PUMPING STATION.

No. 1—Davidson Rotary. Capacity, 1,000,000 gallons per day.
 No. 2—Davidson Rotary. Capacity, 1,000,000 gallons per day.
 No. 3—Knowles. Capacity, 1,000,000 gallons per day.

1897.	Running time of each engine in hours.			Gallons Pumped by each Engine.			Total Pumpage each Month.	Average Pumpage per Day.	COAL.		Percentage of Ashes.	OILS.		Mean Water Pressure and Mean Suction Lift in pounds per sq. inch.			Gallons raised 100 feet per pound of coal.
	No. 1.	No. 2.	No. 3.	No. 1.	No. 2.	No. 3.	Gallons.	Gallons.	Tons.	Lbs.		Qts.	Qts.	No. 1.	No. 2.	No. 3.	
January.....	744	313	.....	33,356,250	13,581,250	.....	46,937,500	1,514,112	122	720	.25	31	31	60	60	.....	237.2
February.....	672	252	.....	29,413,500	10,680,000	.....	40,093,500	1,431,910	108	580	.25	28	28	60	60	.....	229.1
March.....	15	.....	.....	641,250	.....	.....	641,250	20,685	17	920	.25	1	1	60	.....	.....	22.7
April.....	.....	.....	.....	.....	.....	.....	.....	.....	13	880	.25	.....	.....	.....	.....	.....	.....
May.....	.....	.....	.....	.....	.....	.....	.....	.....	13	1,830	.25	.....	.....	.....	.....	.....	.....
June.....	.....	.....	.....	.....	.....	.....	.....	.....	13	880	.25	.....	.....	.....	.....	.....	.....
July.....	704	378	.....	33,594,250	17,373,250	.....	51,467,500	1,982,822	74	1,034	.25	60	58	60	60	.....	273.8
August.....	744	363	.....	36,925,000	17,118,810	.....	54,043,810	1,743,348	135	1,600	.25	62	62	60	60	.....	246.8
September.....	720	334	.....	35,670,000	15,371,250	.....	51,041,250	1,701,375	150	300	.25	60	60	60	60	.....	242.6
October.....	744	280	.....	35,115,000	12,897,500	.....	48,012,500	1,543,790	128	2,080	.25	62	62	60	60	.....	230.4
November.....	720	189	.....	33,031,500	8,355,500	.....	41,387,000	1,397,566	106	60	.25	60	52	60	60	.....	243.2
December.....	744	12	.....	34,612,500	5,000	.....	35,152,500	1,133,951	96	460	.25	62	31	60	60	.....	226.0
Totals and averages.	5,807	2,121	.....	272,359,250	96,417,560	.....	368,776,810	1,010,347	960	191	.25	426	385	60	60	.....	237.6

Total capacity 38,000,000 gallons per day,

BELMONT PUMPING STATION.

No. 1.—Worthington Duplex, Capacity 5,000,000 gallons per day.
 No. 2.—Worthington Duplex, Capacity 5,000,000 gallons per day.
 No. 3.—Worthington Duplex, Capacity 8,000,000 gallons per day.
 No. 4.—Worthington Duplex, Capacity 20,000,000 gallons per day.

1897.	Running Time of each Engine in hours.				Gallons pumped by each Engine.				Total Pumpage of each Month.	Average Pumpage per Day.	Coal.		Percentage of ashes.	OILS.		Mean Water Pressure and Mean Suction Lift in Pounds per Sq. Inch.				Gallons raised 100 feet per Pound of Coal.
	No. 1.	No. 2.	No. 3.	No. 4.	No. 1.	No. 2.	No. 3.	No. 4.			Gallons.	Gallons.		Tons.	Lbs.	Cylinder.	Engine.	No. 1.	No. 2.		No. 3.	No. 4.
									Qts.	Qts.			No. 1.							No. 2.			No. 3.	No. 4.
January	32	351	312	709	8,333,700	90,799,408	115,924,270	577,697,040	792,754,418	25,572,723	1,881	1,211	.25	484	122	88	88	88	90	419.2
February	29	126	536	650	6,941,400	36,378,888	167,654,475	533,510,748	744,485,511	26,588,768	1,760	292	.25	448	112	88	88	88	90	420.8
March	86	251	452	650	22,748,300	74,922,144	170,135,300	517,287,000	786,092,744	25,357,830	1,875	1,310	.25	512	124	88	88	88	90	416.9
April	248	349	445	476	64,224,300	96,425,834	168,525,930	379,320,670	708,496,734	23,616,557	2,092	1,398	.25	480	120	88	88	88	90	336.9
May	129	299	632	584	33,474,300	72,252,336	236,402,025	461,864,220	803,992,881	25,935,254	1,781	1,200	.25	500	128	88	88	88	90	449.0
June	50	115	583	662	12,275,400	29,216,304	219,550,150	532,841,100	793,882,854	26,462,761	1,608	770	.25	840	240	88	88	88	90	491.1
July	50	170	595	722	200,920,100	222,530,377	333,518,030	153,354,870	910,323,377	29,365,270	1,714	1,260	.25	768	215	88	88	88	90	526.7
August	20	244	685	742	5,307,300	63,021,469	259,329,010	616,158,020	943,815,799	30,445,670	1,746	50	.25	806	127	88	88	88	90	537.8
September	58	209	667	664	214,085,900	55,095,490	251,378,755	362,367,450	882,917,595	29,430,586	1,791	50	.25	780	120	88	88	88	90	488.7
October	320	446	294	732	82,058,500	113,678,388	112,673,486	623,767,880	931,178,254	30,038,008	2,064	1,234	.25	849	124	88	88	88	90	448.8
November	56	248	387	706	14,756,600	54,848,209	42,995,371	706,749,511	819,349,691	27,311,656	1,989	1,105	.25	840	120	88	88	88	90	410.0
December	133	44	566	715	33,560,000	11,575,090	202,108,500	602,688,800	849,932,390	27,417,173	2,086	2,120	.25	840	124	88	88	88	90	405.2
Total and averages	1,211	2,852	6,154	8,012	698,685,800	920,743,937	2,280,195,202	6,067,597,309	9,967,222,248	27,307,458	22,392	800	.25	8,175	1,676	88	88	88	90	442.9

Total Capacity, 750,000 gallons per day.

CHESTNUT HILL STATION.

No. 2.—Knowles.—Capacity, 250,000 gallons per day.

No. 3.—Worthington Duplex.—Capacity, 500,000 gallons per day.

1897.	Running time of each engine in hours.		Gallons pumped by each engine.		Total pumpage of each month.	Average pumpage per day.	COAL.		Percentage of ashes.	OILS.		Mean water pressure and mean suction lift in pounds per sq. in.		Gallons raised 100 feet per pound of coal.
	No. 2.	No. 3.	No. 2.	No. 3.	Gallons.	Gallons.	COAL.			Cylinder.	Engine.	No. 2.	No. 3.	
							Tons.	Lbs.							Qts.	Qts.
January	7	.....	3 0,120	.....	300,120	9,681	11	905	.25	2	.....	53	.....	13.8
February	5	.....	206,640	.....	206,640	7,380	11	524	.25	1	.....	53	.....	9.6
March .....		.....		.....			10	2,169	.25		.....		.....
April .....		.....		.....			8	1,910	.25		.....		.....
May .....		.....		.....			8	1,520	.25		.....		.....
June .....		.....		.....			7	241	.25		.....		.....
July	3	.....	103,320	.....	103,320	3,332	7	1,980	.25	2	.....	50	.....	6.8
August	13	.....	495,360	.....	495,360	15,979	7	879	.25	2	.....	50	.....	35.2
September	4	.....	314,880	.....	314,880	10,496	7	1,333	.25	1	.....	50	.....	21.8
October	31	.....	1,092,240	.....	1,092,240	35,233	11	278	.25	5	.....	50	.....	51.6
November	63	.....	2,243,540	.....	2,243,540	74,784	13	1,114	.25	9	.....	50	.....	87.4
December	5	.....	118,080	.....	118,080	3,809	9	309	.25	1	.....	50	.....	6.9
Totals and averages..	131	.....	4,871,180	.....	4,871,180	13,354	114	1,962	.25	23	.....	51	.....	22.3

Total Capacity 42,000,000 gallons per day.

FRANKFORD PUMPING STATION.

No. 1—Marine Compound Rotary. Capacity 10,000,000 gallons per day.
 No. 2—Corliss Compound Rotary. Capacity 10,000,000 gallons per day.
 No. 3—Vertical Compound Rotary. Capacity 22,000,000 gallons per day.

1897.	Running Time of each Engine in Hours.			Gallons Pumped by each Engine.			Total Pumpage of each Month.	Average Pumpage per Day.	Coal.		Percentage of Ashes.	OILS.		Mean Water Pressure and Mean Suction Lift in Pounds per sq. inch.			Gallons Raised 100 feet per pound of coal.
	No. 1.	No. 2.	No. 3.	No. 1.	No. 2.	No. 3.	Gallons.	Gallons.	Tons.	Lbs.		Cylinder.	Engine.	No. 1	No. 2	No. 3	
January	668	389	55	241,104,294	146,951,196	37,241,248	425,296,738	13,719,249	677	155	.25	469	773	68	70	70	486.9
February	650	351	.....	238,663,566	136,605,840	.....	375,269,406	13,402,478	589	804	.25	408	616	66	70	.....	497.8
March.....	740	344	.....	271,760,160	129,922,680	.....	401,682,840	12,957,510	632	470	.25	1,022	660	68	70	.....	495.2
April.....	665	337	27	242,144,132	126,898,690	19,283,075	388,325,897	12,944,196	701	1,420	.25	639	735	67	70	70	481.4
May.....	646	262	100	230,792,370	93,992,020	82,233,675	421,020,065	13,581,292	711	826	.25	524	751	68	70	72	461.2
June.....	345	202	340	131,228,370	57,625,053	236,900,330	425,153,953	14,171,798	660	544	.25	559	818	74	77	71	502.3
July.....	.....	.....	732	.....	.....	445,422,570	445,422,570	14,368,470	590	960	.25	588	902	.....	.....	66	588.0
August.....	480	453	198	172,551,360	174,885,048	122,521,304	469,957,712	15,095,410	684	300	.25	675	916	70	71	65	585.4
September.....	660	642	.....	223,233,930	245,672,140	.....	468,911,070	15,630,369	704	760	.25	542	809	69	71	.....	518.9
October.....	367	249	408	133,761,414	76,438,825	235,514,846	445,715,085	14,377,905	685	1,872	.25	463	685	75	76	69	506.5
November.....	51	27	638	19,330,312	9,759,390	377,633,520	406,723,222	13,557,440	580	1,156	.25	391	594	73	73	70	546.1
December.....	512	333	216	181,931,302	128,065,579	129,232,820	439,249,701	14,169,245	684	1,000	.25	343	626	72	75	70	499.9
Totals and averages }	5,784	3,539	2,711	2,095,526,210	1,331,816,461	1,685,355,588	5,112,728,259	14,007,474	7,901	1,307	.25	6,673	8,895	70	72	69	510.3

Total Capacity, 80,000,000 gallons per day.

QUEEN LANE PUMPING STATION.

No. 1—Vertical Triple Expansion, Capacity, 20,000,000 gallons per day.
 No. 2—Vertical Triple Expansion, Capacity, 20,000,000 gallons per day.
 No. 3—Vertical Triple Expansion, Capacity, 20,000,000 gallons per day.
 No. 4—Vertical Triple Expansion, Capacity, 20,000,000 gallons per day.

1897.	Running Time of each Engine in Hours.				Gallons Pumped by each Engine.				Total Pumpage of each Month.	Average Pumpage per Day.	Coal.		Percentage of Ashes.	OILS.		Mean Water Pressure and Suction Lift in Pounds per Square Inch.				Gallons Raised 100 Feet per Pound of Coal.		
	No. 1.	No. 2.	No. 3.	No. 4.	No. 1.	No. 2.	No. 3.	No. 4.			Gallons.	Gallons.		Tons.	Lbs.	Cylinder.	Engine.	No. 1.	No. 2.		No. 3.	No. 4.
January	117	400	521	339	93,286,410	330,325,670	435,106,020	281,067,050	1,139,785,150	36,767,262	1,607	320	.25	633	1,914	100	100	100	100	871.3		
February	251	482	486	86	187,374,540	363,273,480	369,282,930	63,168,200	983,099,150	35,110,683	1,564	640	.25	465	1,770	106	104	104	105	772.1		
March	479	404	378	376	375,319,350	315,127,050	297,675,800	307,588,000	1,296,210,200	41,813,232	1,839	1,440	.25	807	2,313	102	103	103	101	865.6		
April	558	569	422	347	445,275,550	455,860,350	339,774,700	278,381,550	1,519,292,150	50,643,071	2,153	1,180	.25	638	2,949	106	105	106	105	866.6		
May	635	414	589	373	487,333,100	317,498,150	458,251,100	288,986,000	1,552,068,350	50,066,720	2,089	640	.25	572	2,008	106	105	105	106	912.6		
June	495	545	677	689	388,159,500	430,118,850	536,838,000	549,027,500	1,904,143,950	63,471,465	2,595	800	.25	666	2,015	109	109	108	108	901.1		
July	596	642	417	562	485,918,300	524,242,350	339,191,750	458,545,850	1,807,898,250	58,319,298	2,344	1,440	.25	687	1,668	106	106	106	106	947.3		
August	702	689	222	604	573,419,750	563,588,200	178,841,200	495,638,500	1,811,487,650	58,435,085	2,380	1,400	.25	642	1,618	106	106	106	106	934.8		
September	697	684	694	372	568,081,500	555,145,250	555,365,400	291,123,080	1,969,720,230	65,657,341	2,698	1,480	.25	657	1,796	105	105	104	109	890.0		
October	655	620	559	564	528,879,750	500,813,800	444,817,050	460,392,950	1,934,903,550	62,416,243	2,618	1,280	.25	755	1,689	104	104	108	108	907.8		
November	480	647	495	537	386,508,950	520,332,000	394,742,300	438,771,400	1,740,354,650	58,011,821	2,507	220	.25	634	1,522	106	106	108	108	854.3		
December	716	681	689	126	569,168,800	551,680,300	543,739,450	100,503,200	1,767,091,750	57,002,959	2,539	1,440	.25	628	1,491	106	106	106	109	855.1		
Totals and averages	6,391	6,777	6,149	4,975	5,089,225,550	5,428,005,450	4,895,625,700	4,013,198,330	19,426,055,030	53,222,068	26,933	1,080	.25	7,784	23,253	105	105	105	106	886.0		

CURRENT EXPENSES AND WORK OF THE PUMPING STATIONS FOR THE YEAR 1897.

STATIONS.	Pay of Employees at the Stations.	COAL.			LUBRICATING OILS AND GREASE.		LIGHTING OILS.		Repairs to Boilers and Machinery.	Small Stores.	Total Expenses.	Total Gallons Pumped.	Lift in Feet, including Suction and Friction.	Gallons Pumped 100 Feet High, Suction and Friction included.	Cost of Raising One Million Gallons One Hundred Feet.	Percentage of Work Done at Each Station.	Height of Surface of Basin Above Pumps in Feet.
		Tons.	Price per Ton.	Cost.	Gallons. Lbs.	Cost.	Oil.	Electricity.									
Fairmount.....	\$8,276 60				454	\$121 00	21 00		\$3,936 15	\$240 00	\$12,594 75	7,590,276,532	100.0	7,590,276,532	\$1 66	4.05	{ 90.00 115.00 120.00
Spring Garden.....	68,475 97	57,543	{ Buck...\$1 98 Pea 2 70 }	\$126,566 10	{ Kg.1,200 9,235 }	1,863 31	33 00	\$1,390 25	36,119 86	985 40	235,433 89	45,381,395,542	150.7	68,407,730,992	3 44	36.51	{ 102 00 *179.00 215.00
Belmont.....	18,161 79	22,392	Pea 2 66	59,562 72	2,463	449 23	21 30	442 35	6,329 61	236 35	85,203 35	9,967,222,248	222.9	22,215,683,927	3 84	11.86	198.08
Belmont Auxiliary.....	3,400 00	496	Pea 2 91	1,443 36	114	23 35	2 30		715 00	72 00	5 656 01	162,758,470	140.9	229,326,684	24 69	.12	†160.00
Queen Lane.....	22,862 84	26,933	Pea 2 95	79,452 35	{ Kg.7,500 7,759 }	2,070 43	31 25	798 28	6,995 72	1,197 35	113,408 22	19,426,055,080	275.2	53,456,956,712	2 12	28.53	231.00
Roxborough.....	15,450 01	21,700	Pea 2 70	58,590 00	4,659	814 02	18 35	439 15	7,129 73	246 95	82,688 21	6,516,639,330	376.8	24,556,903,459	3 37	13.10	{ 319.00 366.00
Roxborough Auxiliary.....	3,400 00	1,695	Pea 3 00	5,085 00	387	73 15	14 85		1,709 75	69 00	10,351 75	1,136,740,470	129.3	1,469,805,427	7 05	78.	†140.00
Mount Airy.....	3,070 00	960	Buck... 2 17	2,083 20	203	37 60	10 20		855 36	53 65	6,110 01	368,776,810	138.6	511,124,658	11 96	.27	‡128.00
Chestnut Hill.....	1,500 00	115	Pea 2 94	338 10	6	1 20	8 35		293 11	23 15	2,163 91	4,874,180	117.8	5,741,784	432 78	.03	128.00
Frankford.....	13,556 33	7,902	Buck... 2 05	16,199 10	3,889	674 95	13 45	351 90	6,815 73	258 30	37,869 76	5,112,728,259	174.6	8,928,377,102	4 24	4.75	108 53
Totals and averages.....	\$158,153 54	139,736	\$2 49	\$349,319 93	{ 29,169 Kg.8,700 }	\$6,128 24	\$174 05	\$3,421 93	\$70,900 02	\$3,382 15	\$591,479 56	95,667,466,871	182.7	187,371,927,277	\$3 16	100.00	.....

* Spring Garden to Queen Lane.

† Repumpage from Belmont.

‡ Repumpage from Roxborough.

‡ Repumpage from Mt. Airy.

APPENDIX C.

REPORT

OF

Assistant in Charge of Distribution.

BUREAU OF WATER.

Philadelphia, January 26, 1898.

MR. JOHN C. TRAUTWINE, JR.,
Chief of Bureau of Water.

DEAR SIR:—The following report on the Distribution System for the year 1897 is respectfully submitted.

Notwithstanding the necessity for the additional pumping and supply mains enumerated in your report of last year, none have been laid, and, as yet, no appropriations are available for this purpose.

The failure to provide these mains made it necessary to extend the limits of the Queen Lane distribution to localities not originally intended to be parts of this system, and while the extensions have somewhat improved the supply of the territory added to the Queen Lane system, the increased consumption has also had the effect of virtually reducing the whole to direct pumpage, a method of supply that the Queen Lane system was constructed for the express purpose of discontinuing.

So great was the draught upon this system that it was even necessary at times to assist the pumpage at the Queen

Lane works by pumping direct into the mains at the Spring Garden works in order to maintain the water in the reservoir at the normal height.

By extending the Queen Lane supply as mentioned, and with the aid of the additional pumpage at the Spring Garden works, the pressures throughout the City, between the Delaware and Schuylkill rivers, were maintained about equal to those of last year. The greatest improvement was in the old direct pumpage district, which is now supplied from the Queen Lane reservoir.

There is, however, a serious deficiency in the supply of several localities, particularly in the Thirteenth and Fourteenth Wards—the old City proper, the lower part of the Twenty-fifth and Thirty-third Wards, and also south of South street, where the consumption has considerably increased, and, owing to a corresponding loss of head, the Fairmount reservoir is no longer able to supply this section except from Saturday noon until early Monday morning. During the balance of the week the supply is taken from the Corinthian Reservoir, and the Fairmount Reservoir is out of service. The West Philadelphia supply has also been unsatisfactory.

At this time it is proper to state that we are about at the end of our resources for drawing water from one section to supply another, and, in the future any material improvement to, and even maintenance of, the present unsatisfactory supply, must be provided for by additional expenditures for the construction of new works or, by a far better method—the restriction of the waste of water.

The absurdity of permitting the abnormal waste of water, as is evidenced by the great increase in the consumption during the past four years, must be apparent to every one who compares the amount expended for improvements with the slight benefit obtained.

The records of this Bureau show that since the com-

mencement of the construction of the Queen Lane System, in 1893, to December 31, 1896, there have been expended about \$3,500,000 for extensions to the pumpage, storage and pipe systems.

These improvements include an addition of 194 million gallons per day to the pumping capacity of the works, 530 million gallons to the capacity of the reservoirs and also the addition of 15 miles of large mains, including 11.24 miles of the 48-inch size. These additions alone should be sufficient to supply all the water required for the City, and such would undoubtedly be the case if the supply was limited to generous instead of extravagant proportions.

During the four years referred to the population has increased about 191,700, for which, judging from the experience in other cities where the consumption is properly regulated, 11,500,000 gallons would be an ample daily supply, the actual increase was 80,000,000 gallons, or 58.44 gallons per capita for the total population of the City, indicating that in four years the waste has increased about 69,000,000 gallons per day, or more water than was pumped during the past year at the newly constructed Queen Lane works.

The greater part of the 69,000,000 gallons wasted is traceable to localities where the pressure on the mains has been somewhat increased, principally the Queen Lane system, and most of the balance, to additional openings and fixtures from which the water is permitted to flow at all times, and for no useful purpose.

After the addition of all the great improvements that have been made during the past four years it is significant that there should be so little increase in the pressure on the mains, and that the improvement of the quality of the water during times of freshet in the river should be so slight that evidently from the facts stated no satis-

factory improvement in the supply can be obtained by the construction of works after the Queen Lane pattern without first checking the waste of water, and, if this were done, but one-seventh* of the expenditures for improvements would give better results than can be obtained with the amount necessary under existing conditions.

Experience shows that here, as well as elsewhere, the cheapest, most reasonable and most effective method of prevention of water waste is by means of the meter, and when it is considered that during the next four years an expenditure of at least \$4,000,000 will be required for new pumps, reservoirs and mains, to maintain the present standard of supply, and that about one-third of this amount, if expended for meters, would accomplish far better results, there should be no hesitancy about the immediate adoption of this method of regulating the supply to consumers.

Consumption.

During the past year the average daily consumption was 257,532,030 gallons, for an estimated population of 1,382,632, or 186.3 gallons per capita per day, but during the months of July, August, September and October the consumption increased to 279,498,277 gallons, or 202.2 gallons per capita per day, and it is during this period of greatest consumption that it is difficult to supply the needful quantity for domestic use and for the extinguishing of fires.

The West Philadelphia supply has been unsatisfactory in quantity and exceedingly objectionable in quality during periods of freshet in the river, and, owing to the breaking down of No. 4 engine, and to the lack of steam power

* During the last four years, as already stated, the population has increased by about 191,700. At 60 gallons per head per day (which is ample) this would have involved an increase of 11,520,000 gallons per day in the consumption. Our actual increase has been 80.8 million gallons per day, or a little more than seven times what it should have been

at the Belmont works, it was necessary, on several occasions, to pump direct into the mains of this district. Under these conditions it was important to economize as much as possible, and with this object in view the City Hall was, for a short time, changed from the Belmont to the East Park supply.

The consumption in West Philadelphia averaged 27,307,458 gallons per day, or 197.6 gallons per capita per day for an estimated population of 138,174, but, during the months of July, August, September and October, the average daily consumption was 29,817,900 gallons, or an estimated daily consumption of 215.8 gallons per capita.

By means of a meter placed on the supply pipe at the Belmont reservoir the quantity of water required to supply the City Hall was ascertained to be 427,000 gallons per day.

Through the same meter and suitable connections to the West Fairmount Park mains the daily consumption for the West Park was found to average 127,000 gallons, the T. A. B. fountain* 45,000 gallons per hour and the Centennial Lake fountain* 6,000 gallons per hour. From these quantities it was estimated that the daily consumption, during the summer months, for the City Hall, West Fairmount Park, and the fountains, averaged about 810,000 gallons per day.

At Chestnut Hill a limited area was supplied through a 12-inch Venturi meter and the consumption averaged 359,000 gallons per day, or about 160 gallons per capita.

The Twenty-first Ward and that part of the Thirty-eighth Ward above Queen Lane were also supplied in a similar manner through a 20-inch Venturi meter, the average daily consumption being 2,527,200 gallons and the per capita consumption 85.6 gallons.

* These fountains run during only a portion of the day, and during only certain seasons.

The Chestnut Hill district is a suburban or residential section, while the Manayunk district is a populous manufacturing centre, and the latter, though well supplied with City water, is deficient in underground drainage, without which there is usually considerably less waste of water, for the reason that excessive surface drainage is a nuisance to which the community will not submit, and neighbourly considerations are very effective to check such waste, which would receive no attention if flowing unseen through the drain pipes to the sewers.

The average supply for the Twenty-first, Twenty-second and part of the Thirty-seventh and Thirty-eighth Wards, supplied from the Shawmont Pumping Works, was 17,785,400 gallons, or 175.7 gallons per capita per day, the population being estimated at 101,200, and, during the months of greatest consumption, 18,252,618 gallons per day, or 180.3 gallons per capita.

Other sections of the City, comprising the greater portion of the area between the Delaware and Schuylkill rivers, are supplied by pumpage, and from the several reservoirs, in such a manner that it is impossible to determine the quantity consumed in each section, but the average daily supply for the whole area (excluding the Shawmont supply mentioned above) was 212,238,172 gallons, or 185.7 gallons per capita, and during the months of greatest consumption 231,427,775 gallons per day, or 202.4 gallons per capita.

Meters.

In my report for 1896 I stated that "the destruction of our meter records by fire, in 1892, when valuable data relative to tests, and to the merits of meters, were lost, necessitates a repetition of most of our work in this direction. Accordingly, a series of tests of mechanical meters have been begun. They are unfinished as yet,

“but will be continued and completed during the present “year.”

This work has been completed and as far as experimental tests may be of value, complete data have been obtained with perhaps the exception of that relating to the relative durability of the meters, to fully determine which would require either a much longer time for experiment than it is convenient to give, or the operation of the meters at a greater velocity than our facilities for testing them will admit of.

The results obtained, however, are sufficient to demonstrate in a great measure the relative merits of the meters, but it must be remembered that while such tests are of value, and are, in fact, necessary in order to reach a determination of the relative merits, experience and good judgment are equally necessary. A table of tests, with the percentage of merit for each meter, is submitted showing the result obtained with the meters actually tested.

Referring to this table, the tests for accuracy, A-a, were made as nearly as possible under the conditions which the meters would be placed in service. The outlet pipe was provided with a valve to regulate the quantity discharged into a tank resting upon platform scales.

Each percentage of error A-a, is the average of three trials of 100 cubic feet, each under like conditions, to ascertain the difference in the quantity registered by the meter and that actually discharged into the tank and measured by weight.

The average error for each meter, B-b, is the difference between the sum of the respective + and — errors, A-a, divided by their number.

The average velocity C' is obtained by the sum of the velocities C divided by their number. The friction D' as indicated by the piezometer is similarly obtained.

Column E shows the total discharge for each meter during the test for durability and Column F the average discharge per day.

From the data enumerated the percentages G. H. I and J are obtained, and the average of these gives the rating for each meter as shown in Column K.

After the completion of the test of the meters each one was examined to ascertain its condition and the results of these examinations are classified upon Table I, as follows:

Slight wear—Surface merely polished.

Worn—Perceptible wear, not serious.

Badly worn—Worn sufficiently to be objectionable.

Fig. 1.—Arrangement of Venturi and Mechanical Meters at Chestnut Hill.

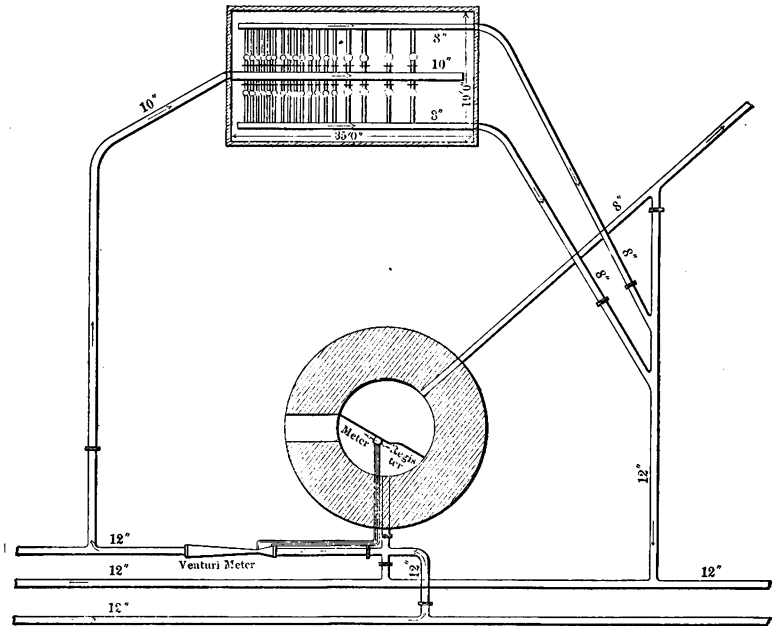
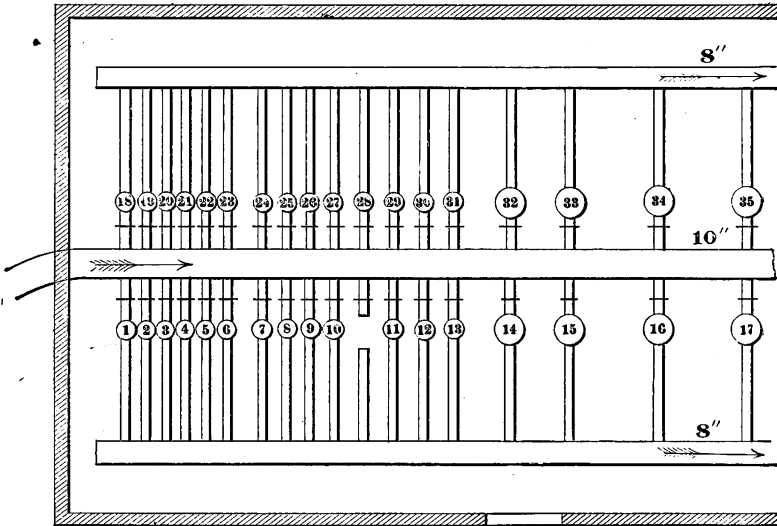
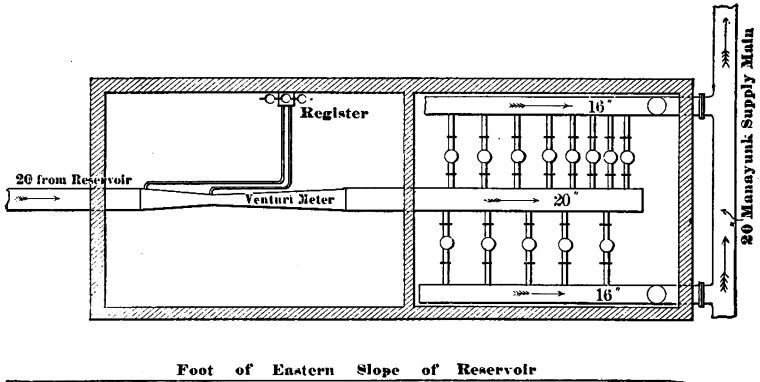


Fig. 2.—Relative position of Mechanical Meters at Chestnut Hill.



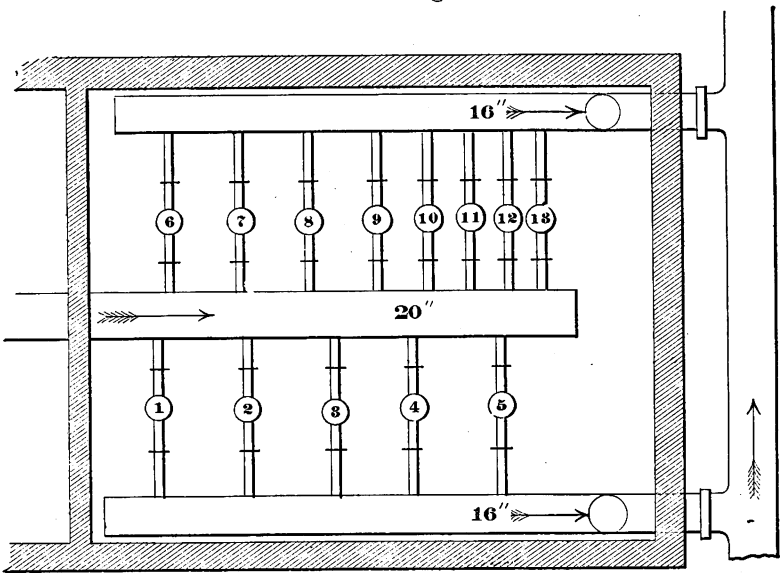
No.	Size.	Meter.	No.	Size.	Meter.
1.....	$\frac{1}{2}$ inch.....	Nash.	19.....	$\frac{3}{4}$ inch.....	Crown.
2.....	$\frac{1}{2}$ inch.....	Union.	20.....	$\frac{3}{4}$ inch.....	Trident.
3.....	$\frac{3}{4}$ inch.....	Union.	21.....	$\frac{3}{4}$ inch.....	Thomson.
4.....	$\frac{3}{4}$ inch.....	Nash.	22.....	1 inch.....	Union.
5.....	$\frac{3}{4}$ inch.....	Hersey.	23.....	1 inch.....	Nash.
6.....	1 inch.....	Crown.	24.....	1 inch.....	Trident.
7.....	1 inch.....	Hersey.	25.....	$1\frac{1}{2}$ inch.....	Crown.
8.....	1 inch.....	Thomson.	26.....	$1\frac{1}{2}$ inch.....	Union.
9.....	$1\frac{1}{2}$ inch.....	Nash.	27.....	$1\frac{1}{2}$ inch.....	Hersey.
10.....	$1\frac{1}{2}$ inch.....	Thomson.	28.....	2 inch.....	Thomson.
11.....	2 inch.....	Trident.	29.....	2 inch.....	Nash.
12.....	2 inch.....	Union.	30.....	2 inch.....	Hersey.
13.....	3 inch.....	Nash.	31.....	2 inch.....	Crown.
14.....	$\frac{1}{2}$ inch.....	Empire.	32.....	3 inch.....	Union.
15.....	$\frac{3}{4}$ inch.....	Empire.	33.....	3 inch.....	Crown.
16.....	1 inch.....	Empire.	34.....	3 inch.....	Hersey.
17.....	2 inch.....	Lambert.	35.....	3 inch.....	Lambert.
18.....	$\frac{1}{2}$ inch.....	Crown.			

Fig. 3.—Arrangement of Venturi and Mechanical Meters at Roxborough.



Foot of Eastern Slope of Reservoir

Fig. 4.—Relative Position of Mechanical Meters at Roxborough.



No.	Size.	Make.	No.	Size.	Make.
1.....	6 inch.....	Crown.	8.....	4 inch.....	Union.
2.....	6 inch.....	Nash.	9.....	4 inch.....	Thomson.
3.....	6 inch.....	Thomson.	10.....	4 inch.....	Nash.
4.....	6 inch.....	Hersey.	11.....	4 inch.....	Gem.
5.....	6 inch.....	Gem.	12.....	3 inch.....	Gem.
6.....	4 inch.....	Crown.	13.....	2 inch.....	Gem.
7.....	4 inch.....	Hersey.			

Figures 1 to 4 show the order in which the meters were placed for the durability test, the average discharge for each group being, respectively, 475,000 and 2,531,000 gallons per day.

A 12-inch Venturi meter was placed on the main supplying group No. 1 at Chestnut Hill, and the difference registered by the Venturi and mechanical meters at the start was 3 per cent. in favor of the Venturi meter, and at the end of the test the Venturi registered 3.4 per cent. more than the mechanical meters.

A 20-inch Venturi meter was also placed on the pipe supplying group No. 3 at the Roxborough reservoir, but considerable variation in the discharge was observed between the Venturi and mechanical meters and it was discovered that this difference was due to a vacuum in the drum containing the actuating device of the Venturi meter, which caused less water to be registered than actually passed through the meter. The vacuum was caused by the great draught upon the main supplying the meter and, owing to the difficulty experienced in this respect, the meter and register have been reset at a lower grade, and it is believed that the conditions are now favorable for obtaining a correct registration of the water passing through it during the coming year.

48-Inch Venturi Meter.

On June 10, 1897, the 48-inch Venturi meter was moved from the Wentz Farm reservoir to the Frankford works and placed on No. 3 pumping main, close to the engine house.

This meter was used June 16-19, in connection with a weir at Wentz Farm reservoir, for measuring the discharge during the duty test of No. 3 engine.

The results obtained and certified to in the official report of the experts are as follows:

HIGH SPEED TEST.

Venturi meter.....	24,156,000 gallons per 24 hours.
Weir.....	23,048,000 gallons per 24 hours.
Apparent loss between meter and weir.....	4.6 per cent.

SLOW SPEED TEST.

Venturi meter.....	15,990,000 gallons per 24 hours.
Weir.....	14,276,000 gallons per 24 hours.
Apparent loss between meter and weir.....	10.7 per cent.

There was evidently leakage through the stop on the connection attached to the pumping main above the meter that did not go to the weir and the quantity of water pumped as indicated by the Venturi meter was therefore used in estimating the duty of the engine.

Later an additional 48-inch Venturi meter was purchased and placed upon the same main at the Wentz Farm reservoir, the distance between the two meters being 4.24 miles. This tandem arrangement enabled us to check one meter with the other, and to ascertain whether there was any material leakage of the main.

The first test under these conditions was made October 26, 1897, and showed 4.16 per cent. greater discharge through the meter at the Frankford Works than through the one at Wentz Farm reservoir. Investigation showed that part of the pumpage passed through a leaky 36-inch stop into the 30-inch main. To prevent this leakage as much as possible No. 1 engine was run to equalize the pressure on both mains.

The difference in the discharge as indicated by the average head shown by the mercury gauge at each meter was then found to be .68 of one per cent., which is a close approximation for measuring the discharge of large pipes, but is of little value for detecting minor leaks.

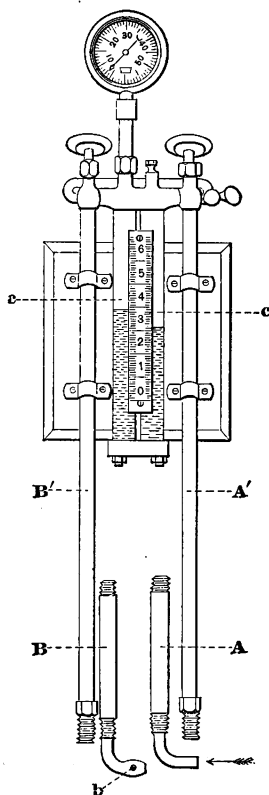
The experience obtained during the past year with this class of meters confirms the estimate previously found of their value, and the adoption of such meters is earnestly recommended for supply mains. We may then determine

the consumption in each district as well as approximately the quantity wasted, and with this information we may perhaps detect waste of which we now have no knowledge, and may, in many cases prevent it.

Pitot Meters.

During the past year a number of experiments have been made with the Pitot Meter, with a view to using this comparatively simple device for the measurement of the discharge of our supply and pumping mains, but until recently the results obtained were very unsatisfactory

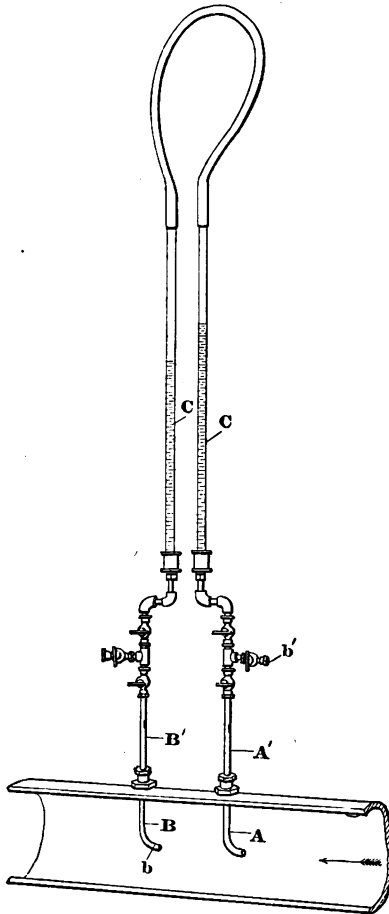
Fig. 5.



This meter is shown in Fig. 5 in which A B are two tubes partly placed within the pipe with the lower ends facing the current. A is an open tube and the lower end receives the force due to the velocity of the water in the pipe plus the pressure on the main. B is closed at the lower end, but is provided with openings in the side b, into which the water is forced in proportion to the pressure on the main. The pressures on the water in the tubes A B are unequal in proportion to the velocity of the water in the main and are transmitted through the respective tubes A' and B' to the mercury in glass tubes CC, which are joined together at the lower end, thus forming a U tube. The greater pressure on one side causes the mercury to rise on the other, and the difference in the respective heights of the mercury columns is proportionate to the head necessary to produce the velocity in the pipe. It is, however, difficult to measure accurately small differences in the height of the two columns of mercury, and, owing to the greater specific gravity of mercury, any error in measurement is multiplied 12.6 times.

The substitution of water for mercury in the U tube makes it necessary to interpose a body of air between the water in the pipes A B and the water in the U tube, in which case the pressure from the main is transmitted to the air confined in the tubes A' B' and from the air to the water in the U tube, C. C. This arrangement failed to give satisfaction for the reason that it was difficult to keep the instrument air tight, and also owing to the fact that any inequality in the quantity of air confined in the tubes A' B' affected the accuracy of the instrument to such an extent that it is even possible to reverse the height of the water columns in the U tube.

These defects were sufficient to condemn the instrument for measuring low velocities, but another form of construction, Fig. 6, gave very satisfactory results.

Fig. 6.

This meter is constructed with the Pitot tubes A B partly within the pipe, as in Fig. 5, and a continuation above consisting of valves, branches, turns and sockets to hold the glass tubes CC, which are connected at the top (in this case) by a piece of rubber hose.

In this instrument the water rises within the tubes A' B' and the glass tubes CC until the compression of the air confined above is sufficient to balance the pressure on the main. In this meter the air in compression is common to the pressures in both tubes and moves in unison with the variations in the height of the water columns. It is therefore immaterial how much air is confined in the meter provided there is sufficient to keep the tops of the water column low enough to be visible in the glass tubes. If there is not sufficient air for this purpose it must be pumped into the meter through the branch b until the desired height of the water is obtained.

A number of tests were made with this device and the following results were obtained.

PITOT METER ON SIX-INCH PIPE—AIR OVER WATER IN GLASS TUBES.

A.	B.	C.	D.	
Mean velocity in feet per second. Discharge measured by weight.	Velocity in feet per second measured by Pitot meter. $V = \sqrt{2gH}$	Constant. $= \frac{A}{B}$	Mean constant. = 0.773. Mean velocity by Pitot meter = 0.773 × B.	Per cent. of error between A and D.
0.781	0.936	0.781	.724	0.09
1.170	1.484	0.788	1.147	1.10
1.553	2.005	0.775	1.550	0.20
2.247	2.942	0.764	2.274	1.19
1.500	1.925	0.779	1.488	0.80
2.191	2,806	0.781	2.169	1 00
2.605	3.449	0.758	2.666	2.34
3.364	4.465	0.754	3.451	2.59

The results as shown above are very satisfactory for velocities of about two feet or less per second and equally good results can be obtained for greater velocities than two feet by using mercury in Pitot meter, Fig. 5.

A number of tests were made with the same meter on a 4-inch pipe, the discharge ranging from 0.77 to 6.16 feet per second. The average constant obtained was 0.777 as against 0.773 for 6-inch pipe. There are, however, minor imperfections in the construction of this meter, the correction of which it is believed will give results fully within a limit of 2 per cent. of accuracy.

To avoid these defects a meter was constructed of a different form but on lines embodying the principal features of the Pitot meter. This meter was constructed for measuring the discharge of a 48-inch main and part of the device is shown in Figs. 7 and 8.

Fig. 7.

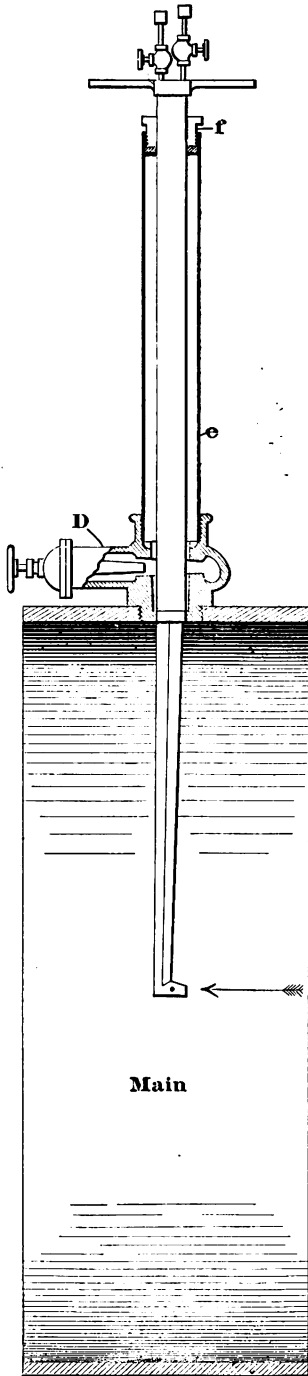
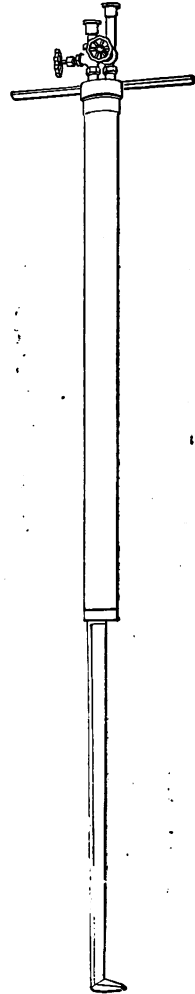


Fig. 8.



To apply this meter it is first necessary to insert a valve D into the main, which may be done while the main is under pressure, with the tapping machine commonly used for this purpose; a tube e about 3 feet long, provided with a stuffing box f at the upper end is then attached to the valve, and within this tube, as far as the closed valve will permit it to go, is placed the Pitot device shown in Fig. 8. The gland of the stuffing box is then tightened, after doing which the valve D may be opened, thus leaving a passage for the Pitot meter to descend into the pipe. A removal of the meter may be effected by a reversal of this proceeding, leaving only the closed valve attached to the main.

When the meter is in position the velocity, plus the static pressure, and the static pressure alone, are conveyed through separate tubes to a measuring device at the top, similar to that described in Fig. 6.

Only a few experiments were made with this meter and the "constants" obtained varied considerably.

Examination showed, however, that the device was faulty in construction as well as in design. These defects are now being remedied, when, I have no doubt, the meter will give results fully as satisfactory as those obtained on the 4 and 6-inch pipe.

Pennsylvania Avenue Subway.

The construction of the Pennsylvania Avenue Subway, west of Thirteenth street, necessitates the alteration of all service and supply mains crossing the line of the work. These alterations were commenced early in the year and have progressed as follows:

The 20 and 30-inch mains in Broad street were relaid in deep trenches across Pennsylvania avenue below the level of the proposed new track surface, and, passing through archways constructed in the north and south

abutments of the bridge, they ascend to the level of the original line to which they were connected and the water turned on July 11, 1897.

A 12-inch main in Broad street was also changed in order to clear the proposed construction of the west half of the Broad street bridge, upon the completion of which, or as soon as the excavation to sub-grade is finished, this pipe will be depressed below the new track level.

Six-inch service pipes crossing the line of the Subway at Fifteenth, Seventeenth, Eighteenth, Nineteenth and Twentieth streets were cut off, and their use abandoned, until the progress of the subway construction will permit the relaying of them without interfering with the building of the Subway.

At Twenty-first street and Pennsylvania avenue one 6-inch, one 20-inch, one 22-inch and one 48-inch main were required to be relaid at sub-grade previous to the excavation of the new roadway in Pennsylvania avenue, and for this purpose two tunnels were constructed between the bridge abutments, parallel with the line of Twenty-first street, 167 feet in length and 36 to 41 feet below the present track surface.

In the east tunnel a 6-inch and a 48-inch main have been laid with ends extending through arches in the bridge abutments at the north and south sides of the Subway. These pipes ascend to the level of the original line and are now ready to be connected, when that part of the old pipes immediately over the Subway will be removed.

In the west tunnel a 20 and a 24-inch main has been laid in a similar manner and will soon be ready to connect to the old mains at the north and south ends.

A 22-inch main in Pennsylvania avenue, between Twenty-first and Green streets was partly removed, and in place of this removed portion a 24-inch main was laid north-east of the Subway with temporary connections to old 22-

inch main east of Twenty-second street and at Gold street. This pipe will eventually be continued west to Green street and east to the 24-inch main in the Twenty-first street tunnel, when the balance of 22-inch main in Pennsylvania avenue will be removed.

The 22-inch main referred to was laid with pipes imported from England, in 1819-20. Each section of the pipe is 9 feet long over all and was cast horizontally, with three concentric rings on the outer surface of the barrel, about two feet apart and projecting $\frac{1}{4}$ inch beyond the body of the pipe.

The bells are $5\frac{1}{2}$ inches deep, with wrought iron band on the outer end, $1\frac{1}{2} \times \frac{3}{8}$ inches in cross section; the lead ring being $\frac{1}{2}$ inch thick.

In consequence of casting these pipes horizontally the barrels vary in thickness, but, notwithstanding their long service and the fact that they were uncoated, unless they may have been whitewashed on the interior surface, no appreciable reduction of the original thickness of the castings could be detected.

The corrosion on the interior surface was found to displace about 4.2 per cent. of the original area, the displacement being ascertained by weighing the water in a section of pipe and carefully measuring its depth, from which data the diameter for the ascertained depth was obtained, and by carefully calibrating the interior diameters of the pipe the difference between the area of the cross section of the water column and that of the pipe, is, as stated, 4.2 per cent.

Broken Mains.

The supply of West Philadelphia is wholly dependent upon one 20-inch main for the high pressure district, and one 20-inch and one 36-inch main for the low pressure district.

On Saturday, March 27, at 4.15 P. M., the latter main was badly broken, at Fifty-second street and Wyalusing avenue, by blasting during the construction of a sewer.

Owing to the difficulty in finding the employees of this Bureau (Saturday afternoon being a half-holiday) it was nearly two hours after the break occurred before the water was turned off, and by that time the gauge indicated that the reservoir had been drained by the broken main to the extent of two feet. In some parts of the district no water could be obtained after the shut off was made, and the supply throughout was not sufficient for fire-protection.

Fortunately the main broke near a large open space that was lower than the surrounding streets and the water within this space escaped through the open end of a large main sewer, thus preventing any damage to the surrounding property.

To make the repairs it was necessary to put in a new section of pipe and this work was completed on the following day, when the water was turned on at 6.30 P. M.

A new 30-inch main for the supply of West Philadelphia was included in your estimate of last year for "extensions and improvements," and the breaking of the main above referred to shows the necessity for laying the proposed main immediately.

On September 30th, at 1.30 A. M. a similar break occurred in the Queen Lane 30-inch supply main at Twenty-third and Parrish streets, but, in this instance, no reason can be assigned for the breaking of the pipe. The water was shut off at 2.22 A. M.; by 2.20 P. M. the broken pipe was replaced with a new one and the water turned on.

Considerable damage to the street paving and sidewalks was caused by this break, and a number of cellars were flooded.

District Yards and Meter Shops.

In relation to these matters I would respectfully call your attention to the following extract from my report of last year :

“A suitable meter shop is urgently needed. At present
 “the office and repair shop for this branch of the service
 “is at 918 Cherry street, which is also the headquarters
 “for the Second Purveyor’s District. The apparatus for
 “testing the meters is at Spring Garden Pumping Station,
 “three miles distant, and various materials are stored at
 “the South street yard, equally inaccessible from the office.
 “This condition of affairs is annoying as well as expensive,
 “and I would earnestly recommend that a meter shop be
 “constructed at Fairmount, on the site of the one destroyed
 “by fire, May 23, 1892, as this location is the most central,
 “and the conveniences for obtaining water and the con-
 “ditions necessary for properly testing meters are better
 “than elsewhere.

“In this connection it may be further said that the work
 “pertaining to the Second Purveyor’s District is greatly
 “hindered by the overcrowded condition of the yard, etc.,
 “and not only should the meter force, now quartered there,
 “be withdrawn, but an addition should be made to the
 “property now occupied. Such an addition could now be
 “made to good advantage by the purchase of properties
 “Nos. 922 and 924 Cherry street, which have been offered
 “for sale to the Bureau. A yard entrance and exit could
 “then be provided, and the confusion and delay consequent
 “upon the massing of wagons in the present limited quar-
 “ters could thus be avoided. It is especially urgent that
 “the storage facilities of this district should be increased,
 “inasmuch as we shall soon be deprived of the South street
 “yard, the ground having been donated by the City to the
 “University of Pennsylvania.”

Notice will, no doubt, be soon received for this Bureau to vacate the premises, and a new storage yard is immediately required.

Storage yards are needed also in the Third, Fourth, Fifth and Sixth Districts, and they should be provided immediately, while suitable sites are yet available for the purpose.

Mains.

The following is a statement of mains laid, relaid, taken up, etc.:

NEW WORK.

Service mains laid.....	135,112 feet.
Supply mains laid.....	15,062 "
Pumping mains laid.....	220 "
Connections, etc.....	11,416 "
Total.....	161,810 "

Comparison of Conditions Relating to the Distribution.

1896-1897 Mains.

		1896.	1897.	Increase.	Decrease.
New Work.	Service mains, 3-in. to 16-in.....	158,945	135,112	.....	23,834
	Supply mains, 12-in. to 48-in.....	20,395	15,062	.....	5,333
	Pumping mains, 20-in. to 48-in.....	1,151	220	.....	931
	Connections and miscellaneous work	16,797	11,416	.....	5,381
	Totals in feet.....	196,889	161,810	.....	35,079
Repairs.	Relaid, 4-in. to 48-in.....	71,189	45,902	.....	25,287
	Miscellaneous repairs, 4-in. to 48-in...	5,864	3,223	.....	2,641
	Taken up, 2-in. to 48 in.....	60,586	34,612	.....	25,974
	Lowered, raised, shifted, 4-in. to 30-in	6,759	6,483	.....	326
	Totals in feet.....	144,398	90,170	.....	54,228
Pipe cut off and abandoned, 3-in. to 16-in.		14,172	10,121	.....	4,051

Pipe laid by Property Owners under Ordinance of Councils, dated June 19, 1890.

	1896.	1897.	Increase.	Decrease.
Six-inch pipe.....	7,842	1,796	.....	6,046

Work Performed in Connection with Construction of Electric Railway.

	1896.	1897.		
Pipe laid.....	5,998			
Fire hydrants.....	11			
Service connections..	84			

Meters.

	1896.	1897.	Increase.	Decrease.
Meters in use.....	1,330	1,386	56	

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

	1896.	1897.	Increase.	Decrease.
Dwellings with water.....	211,722	219,508	7,786	
Dwellings without water.....	12,559	12,588	29	
Water-closets.....	170,039	187,664	17,625	
Baths.....	145,843	154,668	8,828	
Wash-paves.....	81,098	84,966	3,868	
Basins and sinks.....	78,681	81,226	2,545	
Urinals.....	4,686	4,769	83	

REPAIRS.

Mains relaid.....	45,902 feet.
Repairs and connections.....	3,223 "
	49,125 feet.
Old pipes taken up.....	34,612 "
Pipes lowered, raised and shifted.....	6,433 "
	41,045 "
Total.....	90,170

ABANDONED.

Three-inch.....	2,989 feet.
Four-inch.....	6,329 "
Six-inch.....	199 "
Twenty-two inch.....	207 "
Thirty-inch.....	397 "
	<hr/>
Total.....	10,121 "

The total quantity of pipe handled for all purposes throughout the year was 251,980 feet, weighing 11,891,355 pounds.

The total quantity of new pipe laid was 161, 810 feet or 30.64 miles, making, in addition to that previously laid, 1,242.7 miles now in use.

FIRE HYDRANTS.

New style fire hydrants in new locations.....	566
Old style fire hydrants in new locations.....	0
New style fire hydrants in place of old style.....	256
Old style fire hydrants in place of others of the old style.....	4
	<hr/>
Total.....	826
New style fire hydrants taken out.....	36
Old style fire hydrants taken out.....	53
	<hr/>
Total.....	89

The total number of new style fire hydrants added to the distribution system was 477, and the total number in use December 31, 1897, was 11,101, of which 1,050 are of the old style and 10,051 or 90.6 per cent. are of the new pattern.

Drills for Attachments.

The following new attachments were made to the mains:

½-inch.....	6,911; area of openings.....	1,457 square inches.
⅝-inch.....	266; area of openings.....	82 square inches.
¾-inch.....	123; area of openings.....	54 square inches.
1-inch.....	214; area of openings.....	168 square inches.
1¼-inch.....	4; area of openings.....	6 square inches.
1½-inch.....	38; area of openings.....	67 square inches.
2-inch.....	47; area of openings.....	148 square inches.
3-inch.....	3; area of openings.....	21 square inches.
4-inch.....	8; area of openings.....	101 square inches.
6-inch.....	4; area of openings.....	113 square inches.
<hr/>		
Total.....	7,618; area of openings.....	2,217 square inches.

The following attachments, including the ferrules, service pipes and curb stops were put in from the street mains to the curbs, by employees of this Bureau, in order to provide for possible future service without breaking of street pavements:

½-inch.....	1,510
⅝-inch.....	6
1-inch.....	2
<hr/>	
Total.....	1,518

Meters.

During the past year one hundred and seventeen (117) meters have been set in new locations. One hundred and thirty-two (132) meters that were defective, or where a different size or style was required, have been renewed, and fifty-two (52) were removed, where the use of water by meter was discontinued.

The total number of meters in use December 31, 1897, was one thousand three hundred and eighty-six (1,386),

an addition to the number in use during the previous year. of fifty-six (56).

Tabulations of the work performed and expenditures made are herewith submitted, also report of Captain Theodore S. S. Baker, Chief Pipe Inspector, relative to the inspection of pipe and other castings.

Respectfully,

ALLEN J. FULLER,
Assistant in Charge of Distribution.

Schedule of Pipe and Special Castings Inspected, Rejected and Accepted during the Year 1897.

Manufacturer.	STRAIGHT PIPE.	Ordered.	Inspected.	Rejected.	Cancelled.	ACCEPTED.		Remarks.
	Sizes in Inches.					Quantity.	Cost.	
Camden Iron Works, Camden, N. J.....	6	15,440	27,859	12,419	.....	15,431	\$47,534 65	Nine 6 in. rejected pipe. Shipped. Thrown out by receiver.
	8	500	688	183	.....	500	2,053 17	
	10	800	939	139	.....	800	4,533 96	
	12	2,575	2,869	294	20	2,555	19,482 56	
	16	1,000	1,098	98	.....	1,000	11,098 83	
Donaldson Iron Co., Emaus, Pa.....	20	200	218	18	.....	200	3,039 10	
	<i>Special Castings.</i>							
Donaldson Iron Co., Emaus, Pa.....	Small 3 in. to 18 in.....	4,328	4,710	382	.....	4,328	9,564 41	
Reading Foundry Co., Reading, Pa.....	Large 20 in. to 48 in.....	164	168	4	20	164	3,104 31	
Gray's Ferry Foundry and Boiler Co., 29th and Gray's Ferry road.....	Loam Casting.....	56	56	.....	.....	56	3,389 77	
D. S. Creswell, Nicetown, Pa.....	Stop boxes and covers...	215	227	12	.....	215	1,403 29	
Total.....		25,278	38,827	13,549	40	25,249	\$105,245 15	

For Bureau of Surveys, Account of Pennsylvania Avenue Subway.

Manufacturer.	STRAIGHT PIPE.	Ordered.	Inspected.	Rejected.	Cancelled.	ACCEPTED.		Remarks.
	Sizes in Inches.					Quantity.	Cost.	
McNeal Pipe and Foundry Co., Burlington, N. J.....	6	59	68	9	.....	59	\$81 05	Total weights, 937,397 pounds.
	12	26	28	2	.....	26	230 39	
	20	50	57	7	.....	50	866 93	
	24	180	191	11	.....	180	4,501 91	
	30	25	27	2	.....	25	932 95	
	48	24	25	1	.....	24	1,289 05	
<i>Special Castings.</i>								
McNeal Pipe and Foundry Co., Burlington, N. J.....	Small 4 in. to 18 in.....	41	54	13	.....	41	2,480 16	Total weights, 243,016 pounds.
	Large 20 in. to 48 in.....	62	65	3	.....	62		
Total.....		467	505	38	.....	467	\$10,332 44	
Grand Total.....		25,745	39,332	13,587	40	25,716	\$115,627 59	

DEPARTMENT OF PUBLIC WORKS.

BUREAU OF WATER.

Philadelphia, January 19, 1898.

MR. ALLEN J FULLER,
Assistant in Charge of Distribution.

DEAR SIR:—I have the honor to submit the following report of inspections made during the year 1897, with the aid of two assistants, of pipes and special castings, manufactured at the foundries named below, for the Department of Public Works, Bureau of Water:

Camden Iron Works.

Donaldson Iron Works.

Reading Foundry Company, Limited,

Gray's Ferry Foundry and Boiler Company.

McNeal Pipe and Foundry Company.

The quantities of castings inspected, rejected, cancelled and accepted will be found in list attached hereto.

Yours respectfully,

THEO. S. S. BAKER,

Chief Pipe Inspector.

SERVICE AND SUPPLY MAINS LAID DURING 1897.
FIRST DISTRICT.

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

Purposes for which used.		SIZE IN INCHES.					Total in feet and pounds.
		3	4	6	8	10		16
New pipe or feet added.	Service mains.....			12,129			12,129
	Supply mains.....					125	125
	Service supply connections.....		33				33
	Fire hydrant connections.....			709			709
	Fire connections (private).....		13		80		93
	Supply connections (private).....		48				48
	Total..... { Feet.....		94	12,838	80		125	13,137
{ Pounds.....		1,786	423,654	3,360		13,750	442,550
Pipe used but adding nothing to feet in ground.	Pipe relaid.....			22,805			22,805
	Repairs general.....			288	17	19	324
	Pipe taken up.....	808	21,068	30			21,906
	Pipe raised.....	18					18
	Total..... { Feet.....	826	21,698	22,623	17	19		44,553
{ Pounds.....	12,390	400,292	746,559	714	1,045		1,161,000
Total handled..... { Feet.....	826	21,162	35,461	97	19	125	57,690
{ Pounds.....	12,390	402,978	1,170,213	4,074	1,945	13,750	1,603,550
Pipe cut off and abandoned.....		472					472

SECOND DISTRICT.

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

Purposes for which used.	SIZE IN INCHES.							Total in feet and pounds.
	3	4	6	8	10	12	36	
New pipe or feet added.	Service mains.....			36,118	2,879	2,667	1,131	42,795
	Service main connections.....			9		7		16
	Bye-pass connections.....					26		26
	Meter inspection connections.....			37	16		37	90
	Service supply connections.....		26					26
	Fire hydrant connections.....		215	2,038				2,253
	Fire connections (private).....	25						25
	Supply connections (private).....	27	81	51				159
	Drains.....				56			56
	Total { Feet.....	52	322	38,253	2,951	2,700	1,168	45,446
Pounds.....	780	6,118	1,262,349	128,942	148,500	84,096	1,625,785	
Pipe used but adding nothing to feet in ground.	Pipe relaid.....			3,515	1,910			5,425
	Repairs general.....	7	32	492	54	50	62	710
	Pipe taken up.....	1,711	61	98				1,870
	Pipe lowered.....			132				132
	Total { Feet.....	1,718	93	4,237	1,964	50	62	8,137
Pounds.....	25,770	1,767	139,321	82,488	2,750	4,464	262,546	
Total handled { Feet.....	1,770	415	42,490	4,915	2,750	1,230	13	53,583
Pounds.....	26,550	7,885	1,402,170	206,430	151,250	88,560	5,486	1,888,331
Pipe cut off and abandoned.....	1,577	1,965		32				3,574

THIRD DISTRICT.

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

Purposes for which used.	SIZE IN INCHES.									Total in feet and pounds.	
	3	4	6	8	10	12	16	30	48		
New pipe or feet added.	Service mains.....				551		8,073			27,827	
	Supply mains.....						7,683	6,746		14,429	
	Supply main connections.....				248					244	
	Bye-pass connections.....					12	15			27	
	Meter inspection connections.....								83	83	
	Service supply connections.....		119							119	
	Fire-hydrant connections.....			2,032						2,032	
	Fire connections (private).....		17							17	
	Drains.....			58	5					63	
Total	{ Feet.....		136	26,293	804	12	10,771	6,746	83	41,845	
	{ Pounds.....		2,584	837,669	33,768	660	775,060	742,060	48,555	2,470,808	
Pipe used, but adding nothing new to feet in ground.	Pipe relaid.....			4,617						4,617	
	Repairs general.....	4	9	943	67	33	59			1,157	
	Pipe taken up.....	26	4,046	-54	58					4,226	
	Pipe lowered.....			75					1,492	1,567	
	Pipe raised.....			630						650	
	Pipe shifted.....			13						13	
Total	{ Feet.....	30	4,055	6,352	125	33	59		1,492	84	12,230
	{ Pounds.....	450	77,045	209,616	5,250	1,815	4,248		495,344	49,140	842,938
Total handled	{ Feet.....	30	4,191	32,645	929	45	10,830	6,746	1,492	167	57,075
	{ Pounds.....	450	79,629	1,077,285	39,018	2,475	779,760	742,060	495,344	97,695	3,313,716
Pipe cut off and abandoned.....	52	663	66							781	

FOURTH DISTRICT.

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

Purposes for which used.	Size in Inches.												Total in feet and pounds.	
	3	4	6	8	10	12	16	20	22	24	30	48		
New pipe or feet added.	Service mains.....			11,945	3,985	536	1,194							17,660
	Service main connections.....			12										12
	Supply main connections.....			3		13								86
	Bye-pass connections.....			80					70					89
	Service supply connections.....		36											36
	Fire hydrant connections.....			739										739
	Fire connections (private).....			17										17
	Supply connections (private).....		181	804										985
	Motor connections (private).....	18												18
	Drains.....			17										17
Total { Feet.....		18	217	13,617	3,985	549	1,194							19,650
Pounds.....		270	4,123	449,361	167,370	30,195	85,968		11,130					748,417
Pipe used but adding nothing to feet in ground.	Pipe relaid.....			5,506	72		55		609		1,811	408	271	8,732
	Repairs, general.....			201	4	14	93		12					338
	Pipe taken up.....		4,469	233	20				41	746				5,509
	Pipe lowered.....													1,212
	Pipe raised.....			16										16
	Pipe shifted.....			216										216
	Total { Feet.....			4,469	6,172	96	14	143	14	662	746	1,811	408	1,483	16,023
Pounds.....			84,911	203,676	4,032	770	10,656	1,540	103,258	186,500	561,410	135,456	867,555	2,161,764
Total handled { Feet.....		18	4,686	19,789	4,081	563	1,342	14	732	746	1,811	408	1,483	35,673
Pounds.....		270	89,034	653,037	171,402	30,965	96,624	1,540	116,388	183,500	561,410	135,456	867,555	2,910,181
Pipe cut off and abandoned.....				417							207		397	1,021

FIFTH DISTRICT.

Comprising the Twenty-first and Part of the Thirty-eighth Wards.

Purposes for which Used.		Size in Inches.									Total in Feet and Pounds.	
		4	6	10	12	16	18	20	30	36		48
New pipe or feet added	Service mains.....		3,594	320								3,914
	Pumping mains.....										220	220
	Fire hydrant connections.....		116									116
	Drains.....		209	66	390		180	38	120			1,008
	Total..... { Feet..... Pounds.....		3,919 129,327	386 129,230	390 28,080		180 25,200	38 6,042	120 39,840		220 128,700	5,253 378,419
Pipe used, but adding nothing to feet in ground.	Pipe relaid.....								90	12		102
	Repairs general.....	12	78		5			6				101
	Pipe taken up.....					72	27	78	105	24		396
	Pipe lowered.....		85									85
	Total..... { Feet..... Pounds.....	12 228	163 5,379		5 360	72 7,920	27 3,780	174 27,666	105 34,860	36 15,192		594 95,385
Total handled..... { Feet..... Pounds.....	12 228	4,082 134,706	386 21,230	395 28,440	72 7,920	207 28,980	212 33,708	225 74,700	36 15,192	220 128,700	5,847 478,804	

RECAPITULATION OF WORK ON WATER PIPES.

	SIZE IN INCHES.														Total in feet and pounds.	
	3	4	6	8	10	12	16	18	20	22	24	30	36	48		
PURPOSES FOR WHICH USED.																
New pipe or feet added.	Service mains.....			111,949	7,485	4,973	10,705									135,112
	Supply mains.....				508		7,683	6,871								15,062
	Pumping mains.....														220	220
	Service main connections.....			108		7	21									136
	Supply main connections.....			3	248	13				70						334
	Bye-pass connections.....			96		38	15									149
	Meter inspection connections.....			37	16		37								83	173
	Service supply connections.....		612													612
	Fire hydrant connections.....		215	7,231												7,446
	Fire connections (private).....	25	30	70	80											205
	Supply connections (private).....	27	310	867												1,204
	Motor connections (private).....	18														18
	Drains.....			284	61	66	390		180	38			120			1,139
Total.....	{ Feet.....	70	1,167	120,645	3,398	5,097	18,851	6,871	180	108					303	161,810
	{ Pounds.....	1,050	22,173	3,981,285	352,716	280,335	1,357,272	755,810	25,200	17,172		120		39,840	177,255	7,010,108
Pipe used but adding nothing to feet in ground.	Pipe relaid.....			37,312	3,342	1,061	386			699		1,811	408	12	271	45,902
	Repairs, general.....	11	82	2,501	147	161	234	14		18				13	42	3,223
	Pipe taken up.....	2,545	30,108	746	78			72	27	119	746		105	24	42	34,612
	Pipe lowered.....			1,786									1,492		1,212	4,490
	Pipe raised.....	18		953		743										1,714
	Pipe shifted.....			229												229
	Total.....	{ Feet.....	2,574	30,190	43,527	3,567	2,565	620	86	27	836	746	1,811	2,005	49	1,567	90,170
{ Pounds.....		38,610	573,610	1,436,391	149,814	141,075	44,640	9,460	3,780	132,924	186,500	561,410	665,660	20,678	916,695	4,881,247
Total handled.....	{ Feet.....	2,644	31,357	164,172	11,965	7,662	19,471	6,957	207	944	746	1,811	2,125	49	1,870	251,980
	{ Pounds.....	39,660	595,783	5,417,676	502,530	421,410	1,401,912	765,270	28,980	150,096	186,500	561,410	705,500	20,678	1,093,950	11,891,355
Pipe cut off and abandoned.....	2,989	6,329	199								207		397			10,121

RECAPITULATION BY DISTRICTS.

Districts.	SIZE IN INCHES.													Feet.	Pounds.								
	3	4	6	8	10	12	16	18	20	22	24	30	36			48							
New pipe or feet added.	First.....		94	12,838	80			125											18,137	442,550			
	Second.....	52	322	38,253	2,951	2,700	1,163												45,446	1,625,785			
	Third.....		136	26,293	804	12	10,771	6,746											83	44,845	2,470,808		
	Fourth.....	18	217	13,617	3,985	549	1,194				70									19,650	748,417		
	Fifth.....			3,919		386	390			180	38						120			220	5,253	478,419	
	Sixth.....		398	25,725	578	1,450	5,328														33,479	1,344,129	
	Total.....																						
	Feet.....	70	1,167	120,645	8,398	5,097	18,851	6,871	180	108						120			303	161,810			
	Pounds.....	1,050	22,173	3,981,285	352,716	280,335	1,357,272	755,810	25,200	17,172						39,840			177,255		7,110,103		
Pipe used, but adding nothing to feet in ground.	First.....	826	21,063	22,623	17	19															44,553	1,161,000	
	Second.....	1,718	93	4,237	1,954	50	62															8,137	262,546
	Third.....	30	4,055	6,352	125	33	59							13							84	12,230	842,908
	Fourth.....		4,469	6,172	96	14	148	14			662	746	1,811			408				1,483	16,023	2,161,764	
	Fifth.....		12	163			5	72	27	174					105				36		594	95,385	
	Sixth.....		493	3,980	1,365	2,449	346															8,633	357,644
	Total.....																						
	Feet.....	2,574	30,190	43,527	3,567	255	620	86	27	836	746	1,811	2,005	49	1,567					90,170			
	Pounds.....	38,610	573,610	1,436,391	149,814	141,075	44,640	9,460	3,780	132,924	186,500	561,410	665,660	20,678	916,695							4,881,247	
Total handled.....																							
	Feet.....	2,644	31,357	164,172	11,965	7,662	19,471	6,957	207	944	746	1,811	2,125	49	1,870					251,980			
	Pounds.....	39,660	595,783	5,417,676	502,530	421,410	1,401,912	765,270	28,980	150,096	186,500	561,410	705,500	20,678	1,093,950							11,891,355	
Pipe cut off and abandoned.....																							
		2,989	6,329	199																			

SIXTH DISTRICT COMPRISING THE TWENTY-SECOND, AND MOST OF THIRTY-FIRST AND THIRTY-SECOND STREETS

SIXTH DISTRICT.

Comprising the Twenty-second, and part of Thirty-third, Thirty-seventh and Thirty-eighth Wards.

	Purposes for which used.	SIZE IN INCHES.					Total in feet and pounds.	
		3	4	6	8	10		12
New pipe or feet added.	Service mains.....			23,960	70	1,450	5,307	30,787
	Supply mains.....				508			508
	Service main connections.....			87			21	108
	Bye-pass connections.....			16				16
	Service supply connections.....		398					398
	Fire hydrant connections.....			1,597				1,597
	Fire connections (private).....			53				53
	Supply connections (private).....			12				12
	Total... { Feet.....		398	25,725	578	1,450	5,328	33,974
	{ Pounds.....		7,562	848,925	24,276	79,750	383,616	1,344,129
Pipe used but adding nothing to feet in ground.	Pipe relaid.....			1,369	1,360	1,661	331	4,721
	Repairs, general.....			29	499	5	45	593
	Pipe taken up.....		464	331				795
	Pipe lowered.....			1,494				1,494
	Pipe raised.....			287		743		1,030
		Total... { Feet.....		493	3,980	1,365	2,449	346	8,633
	{ Pounds.....		9,367	131,340	57,330	134,695	24,912	337,644
	Total handled... { Feet.....		891	29,705	1,943	3,899	5,674	42,112
	{ Pounds.....		16,929	980,265	81,606	214,445	408,528	1,701,773
	Pipe cut off and abandoned	1,360	2,812	101				4,273

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*Work Done by the Holmesburg Water Co. (Private).
Not included in the tabulations.*

Street.	Location.	Ward.	SERVICE MAINS.		FIRE HYDRANTS.			STOPS.		
			Size.	Feet.	Style.		Total.	Size.	Style.	Total.
					No. 1.	No. 2.				
Meridian.	From 25 ft. 10 in. southeast of northwest house line of Honey-suckle ave. to centre of Union or Walkerst.	35	6	1,143	3	1	4	6	Ludlow	4
Walker....	F'm centre of Meridian northeast to connect.	35	6	33						
Totals.....				1,176			4			4

Recapitulation of Fire Hydrants Set, Renewed and Removed.

Districts.		STYLE.				Total.
		O. S.	No. 1.	No. 2.	No. 3.	
Set.	First.....		66	2		68
	Second.....		130	9		139
	Third.....		155	9		164
	Fourth.....		47	17	1	65
	Fifth.....		9			9
	Sixth.....		97	24		121
Total.....			504	61	1	566
Renewed.	First.....		33			33
	Second.....	4	34	38		76
	Third.....		41	6		47
	Fourth.....					
	Fifth.....		15			15
	Sixth.....		69	20		89
Total.....		4	192	64		260
Total new hydrants.....						86
Removed.	First.....	9				9
	Second.....	8	7	2	6	23
	Third.....	17	3	1	1	22
	Fourth.....	5	3	4	4	16
	Fifth.....					
	Sixth.....	14	5			19
Total.....		53	18	7	11	89
Total added during 1897.....						477

Fire Hydrants, by Wards.

WARDS.	STYLE.						Total.
	O. S.	No. 1.	No. 2.	No. 3.	No. 4.	No. 5.	
First.....	19	346	156	17			538
Second.....	13	97	86	16			212
Third.....	11	66	43	6			126
Fourth.....	2	61	32	14			109
Fifth.....	26	96	51	12		1	186
Sixth.....	11	66	46	12			135
Seventh.....	14	101	83	9		1	208
Eighth.....	15	97	100	6		1	219
Ninth.....		116	70	6		1	193
Tenth.....	1	93	66	3		4	167
Eleventh.....	10	62	29	1			102
Twelfth.....	7	48	31	6			92
Thirteenth.....	35	48	55	10			148
Fourteenth.....		73	83				156
Fifteenth.....	18	169	171	11	1	2	372
Sixteenth.....	2	65	41	4	1		113
Seventeenth.....	14	74	30	2			120
Eighteenth.....	21	130	62	10			223
Nineteenth.....	38	240	124	7			409
Twentieth.....	37	106	123	2			268
Twenty-first.....	113	104	81	5			383
Twenty-second.....	150	682	248	56			1,136
Twenty-third.....	40	275	81	1			397
Twenty-fourth.....	95	192	127	18			432
Twenty-fifth.....	23	370	133	1			532
Twenty-sixth.....	14	168	121	15			313
Twenty-seventh.....	85	324	124	13		1	547
Twenty-eighth.....	36	332	219	40			627
Twenty-ninth.....	43	151	167	18		1	380
Thirtieth.....	12	104	111	6			233
Thirty-first.....	2	166	72	7			247
Thirty-second.....	19	98	85	12		1	215
Thirty-third.....	39	335	185	25	1		585
Thirty-fourth.....	42	297	70	19		1	429
Thirty-fifth.....		53	11				69
Thirty-sixth.....	23	153	100	31			312
Thirty-seventh.....	10	77	70	6			163
Total.....	1,050	6,120	3,487	427	3	14	11,101

Statement of the number of Fire Hydrants by Districts and Wards during 1897, and total previous thereto.

	FIRST DISTRICT.					SECOND DISTRICT.					THIRD DISTRICT.					FOURTH DISTRICT.					FIFTH DISTRICT.		SIXTH DISTRICT.		Total.																						
	Wards.					Wards.					Wards.					Wards.					Total.		Total.																								
	1	2	3	4	Total.	5	6	7	8	9	10	24	27	34	11	12	16	17	18	19	22	23	25	31	33	35	13	14	15	20	25	29	32	37	38	21	38	Total.	443	432	17	2	19	22	33	37	38
Prior to 1897.....	1,830	1,982	443	432
During 1897.....	65	7	2
Total.....	1,898	2,047	443	432	
Taken out, 1897.....	
Total in City.....	1,889	2,081	452	

Number of attachments for fire purposes previously reported..... 641

First District.....	2
Second District.....	1
Third District.....	1
Fourth District.....	1
Fifth District.....	.....
Sixth District.....	3
Total.....	649

Fire Hydrants by Purveyors' Districts.

Districts.	STYLE.						Total.
	O. S.	No. 1.	No. 2.	No. 3.	No. 4.	No. 5.	
First.....	96	1,005	680	108			1,889
Second.....	283	1,381	708	101		10	2,483
Third.....	192	1,792	763	58	2		2,807
Fourth.....	172	870	909	75	1	4	2,031
Fifth.....	116	246	83	7			452
Sixth.....	191	826	344	78			1,439
Total.....	1,050	6,120	3,487	427	3	14	11,101

*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.										Reamed for larger attachments.	Re-driven.	Discontinued.	Transfer.	REPAIRS.		Total.	DRAWN.				Drawn and re-driven.	
	½-inch.	⅝-inch.	¾-inch.	1-inch.	1¼-inch.	1½-inch.	2-inch.	3-inch.	4-inch.	6-inch.					Total.	Not drawn.		Drawn and re-driven.	Discontinued and Abandoned.	Delinquent.	Leak.		Total.
First.....	1,095	29	17	18	.....	4	5	1	4	.....	1,173	8	47	28	.....	39	122	4	4	97	105	4
Second.....	2,156	136	35	124	1	11	8	.....	.....	.....	2,471	57	66	122	3	50	298	16	1	96	113	227
Third.....	1,209	24	33	30	.....	10	18	.....	4	.....	1,328	9	52	30	4	10	155	134	19	145	298	262
Fourth.....	1,288	45	23	25	3	6	10	1	.....	.....	1,401	28	101	24	1	41	244	41	.....	130	171	230
Fifth.....	161	.....	1	8	.....	2	.....	.....	.....	.....	172	.....	1	6	3	17	56	.....	.....	2	2	4
Sixth.....	1,002	32	11	9	.....	5	6	1	.....	4	1,073	7	21	5	110	3	11	157	1	.....	.....	1
Total.....	6,911	266	123	214	4	38	47	3	8	4	7,618	109	288	215	121	71	228	1,032	196	24	470	690	736

Permits Issued During the Year 1897.

Aquaria	1	Ice cream saloons	6
Bakeries	30	Ice machines	2
Barber shops.....	86	Lawn sprinklers	2
Bars.....	10	Laundries	44
Brick yards.....	1	Laboratories.....	1
Basins and sinks in dwellings....	2,176	Machines for scouring, rinsing, etc	28
Basins and sinks in offices and stores.....	497	Milk houses.....	47
Baths in dwellings	8,851	Motors, beer.....	13
Baths in hotels, etc.....	35	Motors, organ	17
Baths, shower.....	6	Photograph galleries.....	3
Bidets.....	1	Pantry sinks.....	270
Boats, etc., supply of.....	148	Pools, swimming.....	1
Bottling establishments.....	16	Pools in churches	2
Building purposes.....	521	Restaurants and eating saloons..	25
Carriages and wagons.....	52	Screw nozzles	56
Cellar drainers.....	5	Slaughter houses.....	3
Dwellings, half.....	18	Stables.....	48
Drug stores.....	37	Stalls in stables	599
Dye houses.....	6	Steam boilers.....	78
Factories.....	4	Steam boilers, horse power.....	1,986
Ferrules, number.....	7,197	Steam engine, number.....	27
Filters.....	3	Steam engines, horse power.....	165
Fire hydrants, for use of.....	158	Street sprinklers... ..	265
Fish troughs and stands	7	Tubs, vats and tanks.....	126
Forges.....	2	Urinals in stores, offices, etc	63
Fountains, counter.....	29	Urinal troughs.....	43
Fountain, garden.....	3	Wash paves.....	4,656
Greenhouses.....	45	Wash paves for watering horses..	24
Heating boilers.....	19	Wash tubs, stationary.....	2,250
Hydrants in new buildings.....	8,069	Water closets in dwellings.....	17,244
Hydraulic elevators.....	1	Water closets in stores, etc.....	450

Premises Supplied and Appliances in Use January 1, 1897.

Aquaria.....	8	Filters.....	12
Arsenals.....	2	Fire stations.....	42
Asylums.....	8	Fountains, garden.....	31
Bakeries.....	1,401	Fountains, counter.....	462
Barber shops.....	1,324	Forges.....	1,114
Bars.....	1,599	Furnaces.....	26
Basins and sinks in dwellings.....	55,732	Gas-works and holders.....	6
Basins and sinks in offices and stores.....	25,494	Glass-works.....	14
Baths in dwellings.....	153,196	Greenhouses.....	949
Baths, public.....	1,137	Grindstones.....	133
Baths, shower.....	230	Halls and club houses.....	212
Baths, foot.....	105	Hatters' planks, per set.....	16
Beam houses and tanneries.....	21	Hydrants.....	231,230
Bidets.....	437	Hospitals.....	43
Bottling establishments.....	602	Hotels.....	51
Brick yards.....	21	Hydraulic elevators.....	214
Brick yards, gangs of men.....	93	Ice-cream saloons.....	275
Broveries.....	89	Institutions, charitable.....	76
Barrels brewed.....	1,996,784	Ice machines.....	141
Cars, steam and electric.....	1,139	Laundries.....	607
Carriages and wagons.....	8,433	Lawn sprinklers.....	260
Cellar drainers.....	14	Laboratories.....	33
Cemeteries.....	26	Machines for washing, scouring, etc.....	2,556
Churches.....	496	Marble yards.....	76
Coal yards.....	248	Malt houses.....	13
Coloring rooms.....	157	Market houses.....	67
Condensers.....	13	Milk houses.....	442
Depots and railroad stations.....	108	Mint.....	1
Dwellings with water.....	219,508	Motors, beer.....	1,523
Dwellings without water.....	3,123	Motors, organ.....	134
Dwellings half without water.....	9,465	Photograph galleries.....	123
Dyers.....	687	Photograph galleries, operators..	66
Drug stores.....	303	Police stations and patrols.....	40
Dye houses.....	636	Polishing wheels.....	23
Engines on railroads.....	269	Pools, swimming.....	20
Factories, foundries and mills.....	1,619	Pools in churches.....	71

Premises Supplied and Appliances in Use—Continued.

Printing establishments.....	164	Steam engines, horse-power.....	32,596
Prisons.....	3	Steam saws.....	61
Rectifying establishments.....	9	Steam presses and hammers.....	53
Restaurants and oyster saloons...	928	Shops and stores with water.....	4,321
Screw nozzles.....	4,568	Shops without water.....	974
Shot towers.....	1	School houses.....	298
Slaughter houses.....	459	Theatres.....	18
Soap-boiling establishments.....	17	Tubs, vats and tanks.....	1,954
Standpipes for watering engines..	26	Turbine wheels.....	23
Stables.....	7,279	Urinals in dwellings.....	172
Stalls in stables.....	48,303	Urinals in stores, offices, etc.....	4,124
Stalls in markets....	6,891	Urinal troughs.....	473
Stalls, fish, and troughs.....	83	Vinegar establishments.....	8
Steam boilers, number.....	2,983	Wash-paves.....	84,966
Steam boilers, horse-power.....	99,539	Wash-paves for watering horses..	515
Steam boilers, heating, num- ber.....	724	Wash-tubs, stationary.....	21,583
Steam boilers, heating, horse- power.....	4,612	Water-closets in dwellings.....	162,915
Steam engines, number.....	1,857	Water-closets in stores, etc.....	24,749
		Wool washers.....	83

Service Attachments Laid to the Curb (on Streets to be Paved or Repaved) by the Bureau of Water.

Districts.	SIZE.			Total.
	$\frac{1}{2}$ -inch.	$\frac{3}{8}$ -inch.	1-inch.	
First.....	165			165
Second.....	598	2	2	602
Third.....	199			199
Fourth.....	40	4		44
Fifth.....	57			57
Sixth.....	451			451
Total.....	1,510	6	2	1,518

Account of New Stops and Check Valves for 1897.

Districts.	BUREAU OF WATER.		VINEY.		Smith's Patent.	Check Valves.	Total.
	2-Way.	Butterfly.	3-Way.	4-Way.			
First.....	90				1		91
Second.....	329		2		20		351
Third.....	240		3	8	2		253
Fourth.....	75	4	5	10	2		96
Fifth.....	21	3		3		1	28
Sixth.....	152				1		153
Total.....	907	7	10	21	26	1	972

*Repairs to Mains, Stops and Fire Hydrants, also Stops and
Fire Hydrants Removed during 1897.*

DISTRICTS.	Repairs to Mains.	STOPS.			FIRE HYDRANTS.		
		Repaired.	Renewed.	Removed.	Repaired.	Renewed.	Removed.
First.....	45	124	32	.....	258	33	9
Second.....	230	145	14	10	278	76	23
Third.....	209	301	82	1	211	47	22
Fourth.....	333	592	1	7	1,820	.....	16
Fifth.....	11	.....	2	.....	.....	15	.....
Sixth.....	59	14	23	1	29	89	19
Total.....	887	1,176	154	19	2,596	260	89

Location of Check Valves.

Street.	Location.	Ward.	Size.
Queen Lane Pumping Station, East Fairmount Park.....	145 feet southeast of southeast side of engine house.....	38	48

Total Number of Stop Valves in the City—Arranged by Districts.

PATTERN.	Size.	Outlets.	DISTRICTS.						TOTAL.
			1st.	2d.	3d.	4th.	5th.	6th.	
	3	2 Way.	1	201	.....	10	2	13	227
	4	2 Way.	97	221	196	166	38	97	815
	6	2 Way.	3,402	3,668	3,711	3,085	544	1,886	16,296
	8	2 Way.	117	289	73	77	7	44	607
	10	2 Way.	134	266	210	272	25	153	1,060
	12	2 Way.	64	328	224	124	42	148	930
	16	2 Way.	36	38	43	22	.....	38	177
	18	2 Way.	.....	.....	5	.....	.....	1	6
	20	2 Way.	24	39	14	48	11	16	152
	30	2 Way.	8	10	22	38	10	3	91
	36	2 Way.	3	4	8	12	6	.....	33
	48	2 Way.	.....	.....	3	10	.....	.....	13
	Totals.....		3,886	5,064	4,509	3,864	685	2,399	20,407
Butterfly. Bureau of Water.	20	2 Way.	.....	4	2	8	3	2	19
	30	2 Way.	2	1	1	8	9	1	22
	36	2 Way.	.....	.....	.....	17	1	.....	18
	48	2 Way.	.....	.....	1	23	17	.....	41
	Totals.....		2	5	4	56	30	3	100
Barton.	6	4 Way.	3	2	1	12	.....	.....	18
	8	4 Way.	.....	.....	.....	5	.....	.....	5
	6	5 Way.	12	32	.....	.....	.....	.....	44
	6	6 Way.	.....	7	.....	.....	.....	.....	7
	Totals.....		15	41	1	17	.....	.....	74

Total Number of Stop Valves, etc.—Continued.

PATTERN.	Size.	Outlets.	DISTRICTS.						TOTALS.
			1st.	2d.	3d.	4th.	5th.	6th.	
Viney.	6	2 Way.	7	.....	4	3	.....	.....	14
	6	3 Way.	54	67	40	232	6	10	409
	8	3 Way.	.....	5	.....	.....	.....	.....	5
	10	3 Way.	.....	.....	.....	3	.....	.....	3
	12	3 Way.	.....	2	.....	3	.....	.....	5
	6	4 Way.	20	45	24	118	3	15	225
	8	4 Way.	1	6	2	.....	.....	.....	9
	10	4 Way.	.....	5	.....	14	.....	.....	19
	12	4 Way.	.....	.....	.....	.....	.....	4	4
	6	5 Way.	26	6	2	29	.....	.....	63
Totals.....			108	136	72	402	9	29	756
Smith Patent.	3	2 Way.	.....	4	.....	.....	.....	.....	4
	4	2 Way.	.....	9	.....	.....	.....	.....	9
	6	2 Way.	.....	16	7	2	6	1	32
	8	2 Way.	1	.....	3	.....	.....	.....	4
	10	2 Way.	.....	.....	2	.....	.....	.....	.....
	12	2 Way.	.....	2	5	.....	.....	.....	7
	16	2 Way.	.....	.....	2	.....	.....	.....	2
	20	2 Way.	.....	2	.....	.....	.....	.....	.....
Totals.....			1	33	19	2	6	1	62
Ludlow.	3	2 Way.	.....	1	.....	.....	.....	.....	1
Total number of stops.....			4,012	5,280	4,604	4,341	722	2,423	21,400
Check Valves.	30	.....	.....	.....	1	.....	2	2	5
Bureau of Water.	48	.....	.....	.....	4	4	6	.....	14
Totals.....			.....	.....	5	4	8	2	19

*Number of Valves Raised in the several Districts during
the Year 1897.*

DISTRICTS.	BARTON.			VINEY.			SINGLE GATE.						Total.	
	4-way.	5-way.	6-way.	3-way.	4-way.	5-way.	3-inch.	4-inch.	6-inch.	8-inch.	10-inch.	16-inch.		30-inch.
First	4	.....	.....	.....	.....	.....	.....	.....	5	.....	.....	.....	.....	9
Second.....	.....	10	1	.....	2	.....	1	.....	13	1	1	1	5	35
Third.....	1	1	.....	4	1	1	.....	1	15	.....	.....	.....	.....	24
Fourth.....	3	.....	.....	3	3	1	1	1	24	.....	.....	.....	1	37
Total.....	8	11	1	7	6	2	2	2	57	1	1	1	6	105

Number of Complaints and Examinations during 1896 and 1897.

Months.	Hydrants.		Service Pipes.		Wash-paves.		Spigots.		Water-closets.		Horse-troughs.		No Leaks.		Total.	
	1896	1897	1896	1897	1896	1897	1896	1897	1896	1897	1896	1897	1896	1897	1896	1897
January.....	170	132	125	117	10	15	5	1	8	19	.....	2	15	10	333	296
February.....	128	90	172	92	7	11	3	.....	6	9	.....	.....	19	9	335	211
March.....	113	120	101	125	3	8	.....	6	1	19	2	.....	17	12	237	290
April.....	87	116	92	75	2	7	.....	2	9	50	1	2	7	10	198	262
May.....	104	136	84	72	4	8	.....	.....	10	37	2	1	10	8	214	362
June.....	89	132	103	77	1	6	4	1	12	71	.....	1	14	3	223	291
July.....	76	105	68	87	3	6	1	3	22	34	1	.....	9	11	180	246
August.....	82	100	90	96	9	5	2	2	16	10	.....	1	11	13	210	227
September.....	86	106	70	69	4	9	.....	3	12	12	.....	.....	9	3	181	202
October.....	103	72	88	79	5	7	4	4	12	20	1	.....	8	6	221	188
November.....	115	116	65	70	4	3	1	5	9	19	2	1	11	3	207	217
December.....	107	103	111	123	5	9	3	4	13	17	.....	1	15	12	254	269
Totals.....	1,260	1,328	1,169	1,082	57	94	23	31	130	317	9	9	145	100	2,793	3,061

New Meters Set.

Ward.	Occupant.	Location.	Business.	Date when set.	Name of meter.	SIZE.										Total.	Gallons consumed.	Remarks.
						5/8-inch.	3/4-inch.	1-inch.	1 1/2-inch.	2-inch.	3-inch.	4-inch.	6-inch.	48-inch.				
1	Alburger & Co.....	S. W. cor. Snyder avenue and Second street.	Packing house.....	April 27.....	Trident.....						1					1	2,610,000	
1	India Refining Co.....	{ S. side McKean street, 169 feet west of } { Meadow street..... }	Refinery.....	Dec. 20.....	Crown.....						1					1	3,091,500	
1	Weaver, J.....	1400-40 South Front street.....	Gypsum factory ..	May 14.....	Trident ..		1	1								2	480,750	
2	Tomson, G., & Co.....	913 Otsego street and 938 Swanson street.	Soap works.....	April 13.....	Crown.....			1								1	57,750	
2	Tomson, G., & Co.....	953 Otsego street and 938 Swanson street.	Soap works.....	April 23.	Trident.....		1									1		
3	Rubinstein, Abe.	312 Carpenter street.....	Bath house.....	Sept. 14.....	Trident ..						1					1	222,000	
5	Gruber, ———	323 South Lawrence street.....	Produce.....	Dec. 14.....	Crown.....						1					1		No water used.
5	Myer, C. A. A.....	228 South Fourth street.....	Office building.....	Oct. 6.....	Crown.....			1								1		No water used.
5	Stedwell, A. F.....	121 South Water street.....	Produce.....	April 29.....	Union.....						1					1	81,750	
8	American Bap't Pub- lication Society.....	1420-22 Chestnut street	Office building.....	Sept. 18.....	Crown.....								1			1	460,500	
8	American Bap't Pub- lication Society.....	1420-22 Chestnut street.....	Office building.....	Dec. 14.....	Crown.....								1					
8	Continental Hotel.....	S. E. cor. Ninth and Chestnut streets.....	Hotel.....	May 8.....	Gem.....									1		1	23,250,000	
8	Hamilton & Diesinger.	1208 Chestnut street.....	Silversmiths.....	May 5.....	Gem.....						1					1	1,191,000	
8	Hopkins, Charles E.....	1111 Walnut street.....	Boarding house.....	Sept. 16.....	Crown.....						1					1	303,750	
8	Power, A.....	1618 Walnut street.....	Club house.....	Oct. 20.....	Crown.....						1					1	148,500	

New Meters Set.—Continued.

Ward.	Occupant.	Location.	Business.	Date when Set.	Name of Meter.	SIZE.										Total.	Gallons Consumed.	Remarks.
						5/8-inch.	7/8-inch.	3/4-inch.	1-inch.	1 1/2-inch.	2-inch.	3-inch.	4-inch.	6-inch.	48-inch.			
8	Presbyterian Board of Publication.....	1319-23 Walnut street.....	Office building.....	Aug. 10.....	Gen.....								1	1	2,335,500			
8	Stock, ———.....	202 South Twelfth street.....	Boarding house.....	Aug. 23.....	Empire.....			1						1	48,750			
8	Weightman, William.....	1521-26 Chestnut street.....	Office building.....	May 26.....	Gen.....							1		1	1,467,000			
8	White, S. S., Dental Manufacturing Co. }	211-17 South Twelfth street.....	Dental factory.....	June 15.....	Gen.....							1		1	1,728,000			
9	Bell Telephone Co.....	N. W. cor. Eleventh and Filbert streets.....	Telephones.....	Sept. 2.....	Crown.....							1		1	765,750			
9	Bringhurst R. R.....	38 N. Eleventh street.....	Undertaker.....	Sept. 3.....	Crown.....				1					1	5,250			
9	Harrison C. C.....	1001-5 Market street.....	Store.....	April 29.....	Gen.....					1				1	903,750			
9	M. L. Ins. Co. of N. Y.....	1001-11 Chestnut street.....	Insurance office.....	Dec. 5.....	Gen.....							1		1	1,4250			
9	M. L. Ins. Co. of N. Y.....	1001-11 Chestnut street.....	Insurance office.....	Dec. 21.....	Gen.....					1				1				
9	M. L. Ins. Co. of N. Y.....	1001-11 Chestnut street.....	Insurance office.....	Dec. 21.....	Crown.....				1					1				
9	Philada Inquirer Co.....	N. s. Hunter st., 66 feet W. of Eleventh st.....	Boiler room.....	May 24.....	Gen.....					1				1	4,104,750			
9	Reading Term. Market.	Arch street, S. E. cor. Twelfth street.....	Market House.....	May 13.....	Trident.....			1						1		No water used		
9	Strawbridge J. C.....	813-15 Filbert street.....	Power house.....	Jan. 3.....	Gen.....							1		1	3,417,750			
10	Medico Chi. College.....	N. side Cherry, east of Eighteenth street.....	College building.....	Jan. 18.....	Thomp'n.....							1		1	2,445,750			
11	Binder J. G.....	606-8 St. John street.....	Brewery.....	March 23.....	Crown.....							1		1	1,932,750			

New Meters Set—Continued.

Ward.	Occupants:	Location.	Business.	Date when set.	Name of meter.	SIZE										Total.	Gallons consumed.	Remarks.
						5/8-inch.	3/4-inch.	1-inch.	1 1/4-inch.	2-inch.	3-inch.	4-inch.	6-inch.	48-inch.				
11	Binder, J. G.....	606-8 St. John street.....	Brewery.....	July 9.....	Trident.....				1						1			
11	Elkinton, L. M. & Sons.	532 St. John street.....	Soap Works.....	April 13.....	Crown.....			1							1	18,750		
11	Jewette, Benj.....	452 Belrose street.....	Morocco factory.....	Dec. 2.....	Crown.....				1						1	21,000		
11	Ortlieb, T.....	845 North Third street and rear.....	Brewery.....	May 3.....	Trident.....					1					1	1,443,000		
12	Bogner, Peter.....	501 Green street.....	Saloon.....	Aug. 5.....	Empire.....			1							1	203,250		
14	Farmers' Creamery Co.	N. W. cor. Eleventh and Wood streets.....	Creamery.....	June 7.....	Gem.....						1				1	932,250		
14	Heller, A.....	1122-24 Spg. Garden st., and S. E. c. Ridge av.	Mathematical Inst. mfg	Oct. 26.....	Crown.....				1						1	18,750		
14	Park Theatre.....	N. E. cor. Broad st. and Fairmount ave.....	Theatre.....	Jan. 13.....	Gem.....							1			1	6,750		
14	Phila. Elec. Light Co....	1108-24 Noble street.....	Electric Light Plant.....	Dec. 17.....	Crown.....			1							1	16,500		
15	Bement Miles & Co.	N. E. cor. Twenty-fourth and Wood sts.....	Machine shop.....	June 7.....	Trident.....				1						1	180		
15	Ellis, H. V.....	2319-21 Vine street.....	Machine shop.....	Dec. 16.....	Crown.....				1						1	2,250		
15	Levering, J. L.....	Fifteenth st., E. side, from Pearl to Wood..	Bath house.....	April 7.....	Trident.....						1				1			
15	Levering, J. L.....	Fifteenth st., E. side, from Pearl to Wood..	Bath house.....	April 8.....	Crown.....			1							1			
15	Levering, J. L.....	Fifteenth st., E. side, from Pearl to Wood..	Bath house.....	April 8.....	Crown.....			1							1			
15	Wright, J. K.....	S. W. cor. Twenty-sixth and Aspen sts.....	Printing ink works.....	Dec. 16.....	Crown.....				1						1	155,250		

New Meters Set—Continued.

Ward.	Occupant.	Location.	Business.	Date when set.	Name of meter.	Size.									Total.	Gallons Consumed.	Remarks.
						5/8-inch.	3/4-inch.	3/4-inch.	1-inch.	1 1/2-inch.	2-inch.	3-inch.	4-inch.	6-inch.			
17	Peterson, J.....	518 Master and S. E. cor. Randolph sts.....	Tannery.....	Dec. 18.....	Crown.....				1						1		No water used.
17	Rieger & Gretz.....	1534-38 and rear Germantown ave.....	Brewery.....	April 26.....	Trident.....			1							1	287,250	
17	Volmer, Mrs.....	1420-26 Randolph st. and rear.....	Brewery.....	July 19.....	Gem.....					1					1	751,500	
18	Hanifen, John & Co.....	S. W. cor. Thompson and Savery sts.....	Hosiery mill.....	May 1.....	Gem.....					1					1	21,000	
18	Keen & Coats.....	72 Laurel street.....	Morocco factory.....	March 25.....	Crown.....				1						1	123,000	
20	Class & Nachod.....	1728-38 Mervine st., 1721 N. Twelfth.....	Brewery.....	April 24.....	Trident.....					1					1	} 4,140,000	
21	Class & Nachod.....	1728-38 Mervine st., 1721 N. Twelfth.....	Brewery.....	April 21.....	Gem.....					1					1		
21	Schofield, Wm.....	South side of Church st., E. of Hamilton.....	Machine shop.....	July 20.....	Trident.....			2							2	122,250	
21	Burton, John.....	N.W. side Willow Grove ave., S.uthampton.	Florist.....	August 12.....	Gem.....					1					1	6,750	
22	Friedberger & Co.....	N. E. cor. E. Logan and Eighteenth sts.....	Lace mill.....	May 1.....	Trident.....				1						1	252,750	
22	Houston Est., H. H.....	{ S. E. side of Willow Grove ave., S. W. } cor. Thirty fourth st.....	Bath house.....	January 1.....	Thomp's.....						1				1	418,500	
22	Kuhn, John.....	North side of Tabor road, West of Fourth...	Florist.....	April 22.....	Union.....					1					1	42,000	
22	Meyers, Frank P.....	S. E. side Willow Grove ave., N. E. Queen...	Florist.....	July 16.....	Crown.....					1					1	207,000	
22	Schwehm, John M.....	N. side Wister, E. of Germantown ave.....	Mill.....	Aug. 18.....	Crown.....				1						1	404,230	
22	Young Rep. Club.....	6123 Main street.....	Club House.....	Nov. 10.....	Crown.....				1						1	No water used.	

New Meters Set—Continued.

Ward.	Occupant.	Location.	Business.	Date When Set.	Name of Meter.	SIZE.										Total.	Gallons Consumed.	Remarks.
						5/8-inch.	1/2-inch.	3/4-inch.	1-inch.	1 1/4-inch.	2-inch.	3-inch.	4-inch.	6-inch.	48-inch.			
23	Bowman, Fremont	S. W. cor. Kensington ave. and Green st.....	Planing Mill.....	Sept. 18.....	Crown.....			1								1	102,000	
23	Glover Bros.....	S. W. side Mill street, cor. E. Paul.....	Foundry.....	Aug. 5.....	Empire.....				1							1	135,000	
23	Harding, J. W. R.....	S. W. side Gillingham st., S. E. of Franklin.	Umbrella Factory.....	Dec. 2.....	Trident.....				1							1	750	
23	Kneedler & Co.....	N. W. side Edom street, N. E. of Kennedy..	Shoddy Mill.....	Jan. 6.....	Trident.....					1						1	69,750	
24	Beiswanger Bros.....	658 N. Forty-first street.....	Stable.....	Aug. 6.....	Empire.....			1								1	71,250	
24	Haupt, L. M.....	107 N. Thirty-fifth street.....	Dwelling	May 20.....	Trident.....			1								1	25,500	
24	Martindale, T.....	413 N. Thirty-third street.....	Dwelling	May 2).....	Trident.....			1								1	21,750	
24	Trautwine, Wm., Agt...	4106 Girard avenue.....	Dwelling	Sept. 7.....	Trident.....			1								1	1,260	
24	Trautwine, Wm., Agt...	4104 Girard avenue.....	Dwelling	Sept. 8.....	Trident.....			1								1	166,500	
24	Trautwine, Wm., Agt...	4102 Girard avenue.....	Dwelling	Sept. 8.....	Trident.....			1								1	33,000	
24	Trautwine, Wm., Agt...	1126 N. Forty-first street	Dwelling	Sept. 9.....	Trident.....			1								1	39,000	
24	Trautwine, Wm., Agt...	1123 N. Forty-first street	Dwelling	Sept. 9.....	Trident.....			1								1	30,000	
24	Trautwine, Wm., Agt...	1132 N. Forty-first street	Dwelling	Sept. 9.....	Trident.....			1								1	20,250	
24	Trautwine, Wm., Agt...	721 N. Forty-second street.....	Dwelling	Sept. 10.....	Trident.....	1										1	17,250	
24	Trautwine, Wm., Agt...	726 N. Forty-second street.....	Dwelling	Sept. 10.....	Trident.....	1										1	17,250	

New Meters Set—Continued.

Ward.	Occupant.	Location.	Business.	Date when Set.	Name of Meter.	SIZE.									Total.	Gallons Consumed.	Remarks.
						$\frac{5}{8}$ -inch.	$\frac{1}{2}$ -inch.	$\frac{3}{4}$ -inch.	1-inch.	$1\frac{1}{2}$ -inch.	2-inch.	3-inch.	4-inch.	6-inch.			
21	Trautwine, Wm., Agt...	728 N. Forty-second street.....	Dwelling.....	Sept. 10.....	Trident...	1									1	23,250	
24	Trautwine, Wm., Agt...	730 N. Forty-second street.....	Dwelling.....	Sept. 10.....	Trident...	1									1	3,750	
24	Trautwine, Wm., Agt...	732 N. Forty-second street.....	Dwelling.....	Sept. 10.....	Trident...	1									1	9,750	
24	Trautwine, Wm., Agt...	707 N. Forty-second street.....	Dwelling.....	Sept. 13.....	Trident...	1									1	122,250	
24	Trautwine, Wm., Agt...	709 N. Forty-second street.....	Dwelling.....	Sept. 13.....	Trident...	1									1	80,250	
24	Trautwine, Wm., Agt...	711 N. Forty-second street.....	Dwelling.....	Sept. 13.....	Trident...	1									1	9,750	
24	Trautwine, Wm., Agt...	713 N. Forty-second street.....	Dwelling.....	Sept. 13.....	Trident...	1									1	29,250	
24	Trautwine, Wm., Agt...	715 N. Forty-second street.....	Dwelling.....	Sept. 13.....	Trident...	1									1	10,500	
25	P. & R. Railway Co.....	N side Toronto st., from Bath to Elm st.....	Coal yard.....	Jan. 24.....	Gem.....						1				1	1,097,250	
25	Reed Electric Light Co.	3445 Waterloo street and 3444 Trenton ave...	Electric works.....	Jan. 8.....	Hersey...					1					1	79,500	
26	O'Neill, Jno.....	N. E. cor. Chadwick and McKean streets.....	Mill.....	Nov. 11.....	Trident...			1							1	1,070	
27	New Tabern'le Bap. Ch..	4017-21 Chestnut street.....	Church.....	July 8.....	Trident...					1					1	672,750	
27	New Tabern'le Bap. Ch..	4017-21 Chestnut street.....	Church.....	July 8.....	Gem.....							1		1			
27	Pugh, J. T.....	3111 Ludlow street.....	Auger works.....	Dec. 18.....	Crown...				1						1	76,500	
27	Smith, E. E.....	4514 Chester avenue.....	Dwelling.....	May 20.....	Trident...				1						1	71,250	

New Meters Set—Continued.

Ward.	Occupant.	Location.	Business.	Date when Set.	Name of Meter.	Size.										Total.	Gallons Consumed.	Remarks.
						5/8-inch.	1/2-inch.	3/4-inch.	1-inch.	1 1/2-inch.	2-inch.	3-inch.	4-inch.	6-inch.	48-inch.			
23	Clarkson, Helen.....	2223 Venango street.....	Dwelling.....	Aug. 19.....	Empire.....			1							1	24,750		
23	Class, C. F.....	3246 Germantown ave. and 3317 N. 18th st...	Brewery.....	Jan. 11.....	Trident.....					1					1	2,100,000		
23	Elec. Magnetic R. W. Co.....	S. E. side Sedgley av. E. of Twenty-fourth st..	Coal yard.....	April 14.....	Crown.....			1							1	6,127		
8	Miller, Hiram.....	1609 Allegheny avenue.....	Dwelling.....	June 30.....	Empire.....				1						1	27,000		
3	Midvale Steel Works.....	Rear N. W. cor. G. & C. H. R. R., on Cottage ave., above Richmond Br. P. & R. R. R.....	Steel works.....	Dec. 28.....	Gen.....								2		2		No water used.	
23	Tissot, L.....	4216-52 Ridge avenue.....	Hotel.....	March 24.....	Crown.....				1						1	30,000		
29	Bergner & Engel Co.....	3126-30 Thompson street.....	Stable.....	Feb. 22.....	Crown.....				1						1	317,250		
29	Rothacker & Son.....	West side 31st, 1st house N. of Thompson.....	Brewery.....	March 27.....	Crown.....						1				1	3,036,750		
30	Am. Anthracite Co.....	N. E. cor. Sutherland av. and Penna. av.....	Coal company.....	April 30.....	Gen.....						1				1		No water used.	
30	Philada Traction Co.....	E. side Sutherland av., S. E. cor. Kansas.....	Power-house.....	Dec. 14.....	Crown.....			1							1		No water used.	
31	Remmey, R. C. & Son.....	2637 E. Cumberland street.....	Pottery.....	May 28.....	Trident.....						1				1	1,032,750		
33	Hoffman, Henry.....	827 Indiana avenue.....	Saloon.....	May 21.....	Trident.....					1					1	1,194,750		
84	Haverford L. & B. Assoc.	East side Sixty-second, N. of Girard av.....	Laundry.....	Jan. 1.....	Crown.....			1							1	70,500		
34	Hestonville Ice Mfg Co.	5160-70 Jefferson street.....	Ice factory.....	Dec. 29.....	Crown.....							1			1		No water used.	
34	Jones, Lewis.....	S. W. cor. 60 1/2 and Media streets.....	Machine shop.....	April 16.....	Trident.....			1							1	9,000		

New Meters Set—Continued.

Ward.	Occupant.	Location.	Business.	Date when set.	Name of meter.	SIZE.										Total.	Gallons consumed.	Remarks.
						5/8-inch.	1/2-inch.	3/4-inch.	1-inch.	1 1/2-inch.	2-inch.	3-inch.	4-inch.	6-inch.	48-inch.			
31	Scott, Charles.....	S. W. cor. Elm avenue and 48th street.....	Saw-mill.....	June 2.....	Trident.....					1						1	102,750	} Water furnished by Holmesburg Company.
34	George's Hill Reservoir	George's Hill.....	Supply pipes.....	June 2.....	Gem.....								2		2	7,977,675		
35	New County Prison.....	Holmesburg.....	Prison.....	April 15.....	Gem.....								1		1	70,614,000		
36	Ridgeway B. & Son.....	1514 S. Twenty-fifth street.....	Marble-yard.....	July 9.....	Trident.....				1						1	15,750		
36	Rosengarten, Sam'l G....	N. E. cor. Thirty-sixth and Wharton sts....	Chemical works.....	July 7.....	Trident.....				1						1	4,500	} No water used.	
38	Horning, J.....	West side Clearfield st., 61 ft. E. of 22d....	Brewery.....	Dec. 6.....	Crown.....				1						1	6,750		
38	Slifert, J. H.....	3131 Bancroft street.....	Machine shop.....	Dec. 15.....	Crown.....			1							1		No water used.	
	Bureau of Water.....	Wentz Farm Reservoir.....	Pumping main.....	Sept. 30.....	Venturi.....									1	1		No water used.	
	Total.....					10	24	20	21	18	8	10	5	1	117	154,245,612		

General Summary of Meter Operations for the Year 1897

SIZE OF METERS.	IN USE JANUARY 1, 1897.										SET DURING 1897.							RENEWED.					DISCONTINUED.				IN USE DECEMBER 31, 1897.										STOCK ON HAND DEC. 31, 1897.																							
	Crown.	Gen.	Nash.	Deacon.	Worthington.	Union.	Venturi.	Thompson.	Hersey.	Total.	Crown.	Gen.	Trident.	Thompson.	Hersey.	Union.	Venturi.	Empire.	Total.	Taken Out.					Put In.					Taken Out.				Crown.	Gen.	Nash.	Deacon.	Worthington.	Union.	Venturi.	Thompson.	Hersey.	Trident.	Empire.	Total.	Crown.	Gen.	Nash.	Deacon.	Trident.	Empire.	Total.	Crown.	Gen.	Nash.	Deacon.	Trident.	Empire.	Total.	
																				Crown.	Gen.	Nash.	Trident.	Total.	Crown.	Gen.	Trident.	Union.	Empire.	Total.	Crown.	Gen.	Nash.																											Total.
1/2-inch.....	34		8						42											4	1	5	3			3	2	2	31	7															38	5	4				9	47								
3/8-inch.....									10		10																																													10	10			
1/4-inch.....	231		18						249	5	16						3			24	15	2	17	6	7	1	14	8	1	9	219	15									23	4	261	22	18	7	1	48	309											
1-inch.....	219		11		1				231	12	5						3			20	22	2	24	27	1	28	13	1	14	223	8	1						6	3	241	44	24	4	2	74	315														
1 1/2-inch.....	128		14		2	1		2	147	10	8		1	2					21	15	4	19	6	5	3	1	15	4	4	125	10	2	6					3	13	1	160	3	17			20	189													
2-inch.....	162	94							256	4	9	5							18	29	8	37	19	7	5		31	5	3	8	151	99							10		260	15	10			25	285													
3-inch.....	62	84						2	148	2	3	1	2						8	9	5	15	2	7	8		17	1	5	6	56	84						4	8	152	4	6		2	12	164														
4-inch.....	45	175		1					221	3	7								10	10	10	20	5	17			22	2	4	6	41	185	1								227	4	7	1		12	239													
6-inch.....	4	23		6					33		5								5		4	4	2				2		3	3	4	23	6							33	1	4	4		9	42														
12-inch.....								1	1																																												1	1						
20-inch.....								1	1																																																	1	1	
48-inch.....								1	1								1																																										2	2
Totals.....	885	376	51	7	3	1	3	2	1,330	36	24	45	2	1	2	1	6		117	104	27	9	1	141	68	33	26	3	2	132	35	15	2	52	850	391	40	7	3	6	4	4	4	3	70	8	1,986	98	27	63	5	13	3	209	1,595					

NOTE—One 1-inch Crown, three 1/2-inch Crown, eight 2-inch Crown, and two 4-inch Crown Meters are dismantled and do not show in above table.

MISCELLANEOUS WORK.

SIZE.	METERS.																												
	REPAIRED.							USED IN SERVICE.				PURCHASED.					TESTED.												
	Crown.	Gen.	Nash.	Deacon.	Union.	Trident.	Thompson.	Total.	Crown.	Gen.	Nash.	Total.	Gen.	Trident.	Union.	Venturi.	Empire.	Total.	Crown.	Gen.	Nash.	Trident.	Thompson.	Hersey.	Union.	Empire.	Lambert.	Venturi.	Total.
1/2-inch	2		1					3	1			1							9		1		1	1	1	1			14
3/8-inch														10				10				10		1					10
1/4-inch	30		3			1		34					30				5	35	4		1	31	1	1	1	6			45
1-inch	36					1		37	3			3	10				5	15	40		1	11	1	1	1	6			61
1 1/2-inch	15		1		2			18			1	1	10	5		1		16	15		1	11	1	1	6	1			36
2-inch	22	18				3		43	1	2		3	9	10				19	21	16	1	11	1	1	1		1		53
3-inch	9	23					1	33	2			2	5	5				10	4	6	1	5		1	1		1		19
4-inch	11	71						82					10					10	5	11	1		1	1	1				20
6-inch	1	7		1				9					2					2	1	3	1		1						7
48-inch															1			1										2	2
Totals	126	119	5	1	2	5	1	259	7	2	1	10	26	75	5	1	11	118	99	36	8	79	7	8	12	14	2	2	267

EXAMINATIONS.					MISCELLANEOUS.						Statements.
Attachments.	Meters.	Leaks.	Short supply.	Total.	New boxes.	Boxes repaired.	Iron covers.	Fish traps.	Service pipes repaired.	Total.	
1,552	1,019	26	41	2,638	142	2	33	91	514	782	22,375

Attachments Made and Delivered to Districts during the year 1897.

DISTRICTS.	Attachments made and delivered.	LEAD PIPE—FEET.			TOTAL FEET.
		5/8-inch.	3/4-inch.	1 1/4-inch.	
First	153	1,672	.....	.....	1,672
Second.....	678	13,360	26	50	13,436
Third	208	2,787	.....	.....	2,787
Fourth.....	36	540	.....	.....	540
Fifth	53	810	.....	.....	810
Sixth.....	587	9,211	.....	.....	9,211
Total.....	1,720	28,380	26	50	28,456

DISTRIBUTION EXPENSES
DURING THE YEAR 1897.

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

Material and Labor.	First District.	Second District.	Third District.	Fourth District.	Fifth District.	Sixth District.	Distribution.	Meter Shops.	Main Office.	Totals.
Lead	1,395 50	3,137 47	2,796 65	1,393 76		1,392 43				10,115 81
Gasket.....	34 71	41 46	35 18			33 20				144 55
Coke.....	32 10	32 00	64 00	107 40	31 00	73 20				339 70
Wood.....						38 40				38 40
Pipes.....							87,743 66			87,743 66
Locm castings.....							2,733 13			2,733 13
Small specials.....							9 642 41			9,642 41
Large specials.....							3,104 31			3,104 31
Frames and covers.....	646 77	808 69	337 48	872 08	94 05	388 13				3,147 20
Viney stops.....			150 00	3,300 00						3,450 00
Hauling, trans. and hotel.....	75 00	180 00	67 26	50 00	5 00	75 00	4,257 05	420 00		5,129 91
Supplies, tools, small stores, etc.....	790 61	3,665 80	1,304 73	3,236 35	630 19	2,632 01	3,978 71	6,783 79	341 78	22,764 67
Plumbing and plumbing supplies.....		12 25	5 25	3 00	2 50	26 36		1 50		50 86
Meters, etc.....								8,449 90		8,449 90
Repairs to building, etc.....	9 70			133 65						193 35
Brick, stone, lime and cement.....	40 16	144 00	166 97	365 20	215 00	206 60				1,187 93

Distribution Expenses—Continued.

Material and Labor.	First District.	Second District.	Third District.	Fourth District.	Fifth District.	Sixth District.	Distribution.	Meter Shops.	Main Office.	Totals.
Lumber.....	\$2,255 51	\$139 39	\$1,686 13	\$2 8 27	\$151 99	\$363 82		\$503 92		5,369 03
Hay, feed, etc.....	654 49	440 71	771 36	779 70	1:8 79	90 94				2,875 99
Stable supplies.....	555 17	235 55	229 64	238 07	4 21	260 88				1,523 55
Stable repairs.....	322 34	291 45	367 73	136 16	5 75	5 45				1,128 90
Stable medicines.....	76 50	111 70	37 25	27 70						253 15
Stable shoeing.....	164 50	127 50	177 25	205 09	27 89	19 85				722 99
Supplies, stationery.....	223 52	265 40	212 69	271 54	42 83	162 86	\$373 43	419 55	\$1,930 82	3,902 64
Wages... { Per diem.....	20,072 58	24,441 51	55,190 71	37,691 29	8,391 50	32,070 03	3,405 80	10,762 00	4,102 00	196,127 42
{ Salary.....	4,649 00	5,975 63	6,216 05	7,950 69	1,734 79	2,789 37				29,315 44
Total cost of labor and material on account of distribution.....	\$31,998 16	\$39,450 51	\$69,816 33	\$57,980 88	\$11,475 43	\$40,629 13	\$115,239 10	\$27,340 66	\$6,374 60	399,404 80
Buildings, grounds and reservoirs.....		\$339 49	\$162 75	\$3,119 34	\$2,559 48	\$893 12		\$734 95		7,809 13
Bureau of Surveys, Pennsylvania avenue subway.....				*12,893 87						12,893 87
Girard College.....				†92 25						92 25
Total labor and material.....	\$31,998 16	\$39,790 60	\$69,979 08	\$73,186 34	\$14,034 91	\$41,522 5	\$115,239 10	\$28,075 61	\$6,374 60	420,000 05

* \$12,810.87 of this amount was paid by the Bureau of Surveys.

† Paid by the Trustees of Girard College.

Summary of Work Done in Connection with the Distribution, 1897.

	Feet.	Pounds.
New pipe laid during 1897.....	161,810	7,010,108
Repairs and relays during 1897.....	90,170	4,881,247
Total.....	251,980	11,891,355
Pipe in use December 31, 1897.....	6,561,471	425,893,269
Repairs and relays to December 31, 1897.....	1,504,604	58,703,878
Total.....	8,066,075	484,597,147
Additional stops.....		971
Additional fire hydrants.....		477
Fire hydrants in use.....		11,101
Meters in use.....		1,386
New service attachments....		7,618

APPENDIX D.

REPORT

OF THE

Superintendent of the Construction and Repair Shop,

TWELFTH AND REED STREETS,

For the year 1897.

Philadelphia, January 8, 1898.

MR. JOHN C. TRAUTWINE, JR.,
Chief of Bureau.

DEAR SIR:—There were made, at the shop, during the year, eight hundred and eleven (811) fire hydrants and two hundred and eighty-one (281) were repaired. Eleven hundred and eighty-two (1,182) stop valves were made, ranging from 6-inch to 36-inch. Two (2) 20-inch, four (4) 30-inch and six (6) 48-inch rotary stop valves were also made, four of the latter being of the new style.

Work to the amount of fifteen thousand eight hundred and twenty-six (15,826) dollars and fifty-nine (59) cents was done for the different pumping stations and reservoirs.

A new seven (7) ton crane was built and erected in the shop, to facilitate the handling of heavy work, for which there is an increased demand.

The mound on the lot in the rear of the shop has been graded down and carted away, and the lot fenced in from the public.

The driveway into the shop from Reed street should be paved with Belgian block, and I recommend that it be done at an early date.

The stable and wagon house which is in the course of erection in the rear of the shop is nearly completed.

I respectfully submit the following report, in detail, of the operations of the shop for the year ending December 31, 1897.

Respectfully,

(Signed)

JAMES H. DEAN,

Superintendent of Shop.

MERCHANDISE.	DR.
To stock per inventory, January 1, 1897.....	\$28,582 20
Bolts and nuts.....	1,151 83
Hardware.....	334 15
Steel.....	713 01
Wrought iron.....	1,647 05
Iron castings.....	15,079 59
Brass castings.....	5,522 72
Lead coating.....	333 77
Lumber.....	1,392 42
Paints, brushes, etc.....	229 52
Oils and tallow.....	88 28
Chandlery.....	114 18
Coal.....	950 41
Coke.....	38 10
Gum goods.....	168 88
Plug valves.....	1,522 14
Brass fittings.....	166 16
Packing.....	11 30
Lead.....	1,742 78
Bricks, lime, cement, etc.....	610 05
Wrought iron pipe.....	57 54
Miscellaneous.....	681 96
Wages.....	34,707 09
Total.....	\$95,895 13

MERCHANDISE.	CR.
First District.....	\$5,310 50
Second District.....	13,422 10
Third District.....	13,014 43
Fourth District.....	10,768 40
Fifth District.....	1,071 83
Sixth District.....	6,617 21
	\$50,204 47
Spring Garden Pumping Station.....	5,249 88
Fairmount Pumping Station.....	875 28
Fairmount Reservoir.....	491 55
Belmont Pumping Station.....	1,818 68
Queen Lane Pumping Station.....	3,082 61
Queen Lane Reservoir.....	261 22
Roxborough Pumping Station.....	2,621 18
Roxborough Reservoir.....	512 90
Mount Airy Pumping Station.....	368 97
Frankford Pumping Station.....	408 39
East Park Reservoir.....	135 93
	\$15,826 59

Distribution.....	\$3,363 24	
Main office.....	54 06	
Meter department.....	1,166 57	
General buildings and grounds.....	3,142 73	
Hydrographic work.....	632 21	
Fixed patterns.....	557 66	
Shop machinery.....	884 98	
Construction and repair shop.....	1,140 99	
Old metals.....	1,280 90	
		<u>\$12,223 34</u>
		<u>\$78,254 40</u>
Total Cr.....	\$78,254 40	
Inventory January 1st, 1898.....	30,483 28	
		<u>\$108,737 68</u>
Total Dr.....	95,895 13	
Balance.....		<u>\$12,842 55</u>

Inventory January, 1898.

67 No. 1 fire hydrants, at \$25.00.....	\$1,675 00	
2 4-inch stop valves, at \$11.00.....	22 00	
13 6-inch stop valves, at \$12.00.....	156 00	
17 8-inch stop valves, at \$20.00.....	340 00	
21 10-inch stop valves, at \$30.00.....	630 00	
2 12-inch stop valves, at \$35.00.....	70 00	
3 16-inch stop valves, at \$60.00.....	180 00	
4 20-inch stop valves, at \$95.00.....	380 00	
2 30-inch stop valves, at \$190.00.....	380 00	
2 36-inch stop valves, at \$300.00.....	600 00	
		<u>\$4,433 00</u>
Finished parts of fire hydrants.....	\$1,142 07	
Finished parts of stop valves.....	2,235 40	
Finished parts of rotary valves.....	2,443 50	
		<u>5,820 97</u>
3 Unfinished 36-inch check valves, at \$90.00	\$270 00	
9 Unfinished drilling machines.....	60 00	
3 Unfinished bell cranks, at \$15.00.....	45 00	
1 Unfinished pump rod.....	25 00	
1 Finished air-pump barrel.....	15 00	
		<u>415 00</u>
		<u>\$10,668 97</u>
41 Old style stop screws.....	\$283 50	
59 Viney stop screws, at \$2.00.....	118 00	
5 Barton stop screws, at \$3.50.....	17 50	

12 Barton stop bonnets, at \$8.00.....	\$96 00	
512 New style stop screws.....	1 274 75	
130 Socket screws, at \$1.75.....	227 50	
65 Spindles, at \$1 50.....	97 50	
		<hr/>
		\$2,114 75
194 4-inch iron bands, at \$1.00.....	\$194 00	
155 6-inch iron bands, at \$1.25.....	193 75	
156 8-inch iron bands, at \$2.00.....	312 00	
26 10-inch iron bands, at \$4.00.....	104 00	
12 12-inch iron bands, at \$5.00.....	60 00	
19 16-inch iron bands, at \$7.50.....	142 50	
16 20-inch iron bands, at \$9.50.....	152 00	
6 30-inch iron bands, at \$15.00.....	90 00	
9 35-inch iron bands, at \$17.00.....	153 00	
7 48-inch iron bands, at \$20.00.....	140 00	
		<hr/>
		1,541 25
557 Fire hydrant valves.....	\$518 50	
44 Frost valves, at 50c.....	22 00	
293 Fire hoe heads, at \$1.75.....	512 75	
614 Wooden plugs, at 50c.....	307 00	
127 Iron plugs, at \$1.00.....	127 00	
721 Brass plugs.....	192 00	
21 Cast-iron risers, at \$2.00.....	42 00	
		<hr/>
		1,721 25
38 Pairs cast-iron monkey legs, at \$1.50.....	\$57 00	
41 Pairs wrought-iron monkey legs, at \$3.50	143 50	
5 Drilling machine spindles, at :6.50.....	32 50	
2 24-inch furnaces, at \$17.00.....	34 00	
12 24-inch furnace rings.....	80 50	
6 20-inch furnace rings, at \$15.00.....	90 00	
8 Furnace grates, at \$5.00.....	40 00	
100 Old style plug nuts, at 75c.....	75 00	
		<hr/>
		552 50
22 Stop keys, at \$5.25.....	\$115 50	
9 Hydrant keys, at \$2.25.....	20 25	
43 Lead pots.....	80 00	
40 Tail clamps, at 75c.....	30 00	
25 Air pump rod straps, at \$9.50.....	237 50	
70 Air pump rod brasses, at \$2.25.....	157 50	
20 Sets of gibs and keys, at \$4.25.....	85 00	
6 Pressure caps, at \$2.00.....	12 00	
45 Ferrule mandrils, at \$1.00.....	45 00	
20 Taper reamers, at \$3.50.....	70 00	

63 Flat drills, at 50c.....	\$31 50	
72 Bursting wedges, at 25c.....	18 00	
26 Plug wrenches, at \$1 00 ..	26 00	
492 Chisels, at 35c.....	172 20	
120 Gouges, at 40c.....	48 00	
40 Pipe cutters, at 60c	24 00	
84 Diamond points, at 60c.....	50 40	
55 Sets caulking tools.....	179 50	
	<hr/>	\$1,402 35
8 Drill sockets, at 50c.....	\$4 00	
12 Gasket iron, at 60c.....	7 20	
	<hr/>	11 20
82,787 Pounds wrought iron, at 1½c.....	\$1,241 81	
2,500 Pounds iron forgings, at 8c.....	200 00	
10,225 Pounds machinery steel, at 2c.....	204 50	
6,642 Pounds cast steel, at 5½c.....	365 31	
1,000 Pounds tool steel, at 15c.....	150 00	
347 Pounds self-hardening steel, at 35c.....	121 45	
2,600 Pounds expansion metal, at 25c.....	650 00	
42,152 Pounds lead, at 3½c.....	1,475 32	
550 Pounds Babbitt metal, at 8c.....	44 00	
168,334 Pounds stop-valve castings, at 1 $\frac{3}{10}$ c.....	2,289 34	
80,552 Pounds fire hydrant castings, at 1½c.....	1,208 28	
4,500 Pounds machinery castings, at 1 $\frac{4}{10}$ c.....	63 00	
12,965 Pounds brass castings, at 10c.....	1,296 50	
3,572 Pounds Ajax metal castings, at 21½c.....	754 59	
1,090 Pounds rolled brass, at 16c.....	174 40	
	<hr/>	10,238 50
Hardware.....	\$72 60	
Bolts and nuts.....	1,021 64	
Oils and tallow.....	50 87	
Paints, oils and brushes.....	59 92	
Chandlery.....	43 44	
Gum goods.....	111 49	
Lumber.....	872 55	
	<hr/>	2,232 51
Total.....		\$30,483 28

Principal Articles Delivered to Purveyors' Districts, etc.

Districts.	WEDGE STOP VALVES.								ROTARY STOP VALVES.				PLUGS.		Stop Boxes.	Stop Box Risers.	Fire Hoe Heads	FISH TRAPS.				
	4-inch.	6-inch.	8-inch.	10-inch.	12-inch.	16-inch.	20-inch.	30-inch.	30-inch.	20-inch.	30-inch.	48-inch—New Style.	48-inch—Old Style.	Wood.				Brass.	1½-inch.	2-inch.	3-inch.	4-inch.
First.....	90	6	105	1	.....	.....	.....	.....	.....	.....	.....	.....	.....	180	152	.....	.....	.....	.....	.....	.....
Second.....	232	.....	415	15	12	1	.....	.....	.....	.....	.....	.....	.....	205	84	.....	.....	.....	.....	.....	.....
Third.....	213	.....	197	39	22	34	15	1	.....	.....	.....	.....	.....	286	324	.....	.....	.....	.....	.....	.....
Fourth.....	111	.....	80	9	2	7	1	6	1	.....	.....	.....	.....	128	288	.....	.....	.....	.....	.....	.....
Fifth.....	24	6	16	.....	.....	.....	2	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Sixth.....	112	4	128	14	14	12	.....	.....	.....	.....	.....	.....	.....	142	96	.....	.....	.....	.....	.....	.....
Distribution .....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Meter Department.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Works.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Total	782	16	947	62	51	67	17	7	2	2	4	4	2	941	914	.....	.....	.....	.....	.....	.....

Principal Articles Manufactured.

811 No. 1 fire hydrants, at \$25.....	\$20,275 00
952 6-inch stop valves, at \$12.....	11,424 00
76 8-inch stop valves, at \$20.....	1,520 00
75 10-inch stop valves at \$30.....	2,250 00
52 12-inch stop valves, at \$35.....	1,820 00
15 16-inch stop valves, at \$60.....	900 00
10 20-inch stop valves, at \$95.....	950 00
2 36-inch stop valves, at \$300.....	600 00
2 20-inch rotary stop valves, at \$265.....	530 00
4 30-inch rotary stop valves, at \$885.....	1,540 00
3 48-inch rotary stop valves, old style, at \$665.....	1,330 00
3 48-inch rotary stop valves, new style flanged, at \$765.....	2,295 00
1 48-inch rotary stop valve, new style, Bell end....	740 00
3 screens for Fairmount reservoir.....	372 00
2 truss foot bridges for Roxborough reservoir.....	512 90
6 screens for Queen Lane Intake.....	820 20
2 automatic stream flow gauges, at \$120.....	240 00
1 automatic registering gauge.....	102 00
1 new rod and plunger, No. 4, Belmont	530 00
148 stop boxes, at \$2.25.....	332 00
346 stop box risers, at 35c.....	121 10
957 wooden plugs, at 50c.....	478 50
200 brass plugs, at 25c.....	50 00
254 iron bands	361 75
414 fire hoe heads, at \$1.75	724 50
148 fish traps	532 00
	<hr/>
	\$51,350 95

APPENDIX E.

Report of Assistant in Charge of Hydrographic Work.

Philadelphia, January 1, 1898.

MR. JOHN C. TRAUTWINE, JR.,
Chief of Bureau.

SIR:—The following report on Hydrographic Work and data collected during the year 1897, is respectfully submitted.

Rainfall observations at twenty-two stations, three of which are provided with automatic rain gauges, have been continued, completing fifteen years continuous records of data relating to precipitation.

Stream flow observations by automatic stream gauges on the Perkiomen, Neshaminy and Tohickon streams have been continued, completing fourteen years continuous records.

Observations on the flow of the Wissahickon were begun in April of this year. A suitable place, about 100 yards above the mouth, for metering the stream was selected and a sufficient number of observations were taken to plot a curve of flow. These data were also compared with the computed flow over the breast of the stone dam. In August sufficient data had been collected to permit the use

of an automatic recording stream gauge which has been in operation since that time. The observations have been computed and tabulated in Table IX, with the former mentioned streams.

An automatic recording stream gauge has also been placed in the wheel house at Fairmount to record the height of water in Fairmount pool. This gauge will record a continuous line showing, in feet above City datum, the height of water in Fairmount pool. The height of water has heretofore been referred to an indeterminate level commonly called the "Legal Comb of the Dam." This "legal comb" was the supposed level of the comb of the dam built in 1842 and its use as a datum was misleading, for the reason that when the height of water in the pool was given, for example, as 24 inches on the dam, it did not mean that 24 inches were being wasted over the present dam, but that 10 inches for the cap log and 12 inches for the flash boards must be first deducted leaving only 2 inches wasted over the top of the present flash boards. The reference to one fixed datum for stating the height of water surface in the pool and that of the crest, on line of overflow, shows at once when water is wasting over the flash boards. A new brass gauge-board, reading to feet and tenths, has been placed in the wheel house near the automatic gauge, and the use of the old gauge-board in the forebay, which was found to be $4\frac{1}{2}$ inches too low, has been discontinued.

The amount of rainfall for the year ending September 30, 1897, on the area comprising the watershed of the three streams, was 45.53 inches, being 3 inches less than the average for the past fourteen years, and 0.4 inches more than the amount for 1896.

The greatest monthly rainfall during the year, 8.45 inches, occurred in May, and the least, 1.62 inches, in September.

There was a deficiency of rainfall in the months of January, February, March, August and September, and an excess in the months of May and July. The remaining months show an average rainfall. No rain storms of great severity occurred during the year, and, consequently, no heavy freshets were produced.

The total precipitation registered by the automatic gauge at Thirty-second and Spruce streets, for the year ending December 31, 1897, was 46.01 inches. This is collected at a point 13 feet above the ground, and the quantity gathered in storms with a high wind, is diminished by the roof of the building.

The total amount collected by the ground gauge was 47.10 inches, 10.12 more than in 1896, and 12.53 more than in 1895.

The automatic gauge recorded fifteen storms in which the rate exceeded 0.25 inch per hour, and one hundred and twenty-two days on which 0.01 inch or more of rain fell.

The greatest amount for a single storm was on July 27th and 28th, when 3.26 inches fell in forty hours and thirty minutes. The maximum fall was 0.40 inches in 20 minutes, or at the rate of 1.20 inches per hour. This storm was accompanied by a high wind on the morning of July 28th, which did some damage to trees in Fairmount Park and parts of the City.

The amount of rain recorded at stations outside of the City exceeded that recorded by the Water Bureau gauges by from 10 to 25 per cent.

On October 12th a heavy fall of rain was recorded at Reading. Mr. E. F. Smith furnished the following data in relation to this storm:

"The rainfall was entirely local and amounted to 4.47 inches in four and a half hours, as follows:

6.30 A. M.	}	2.17 inches.
to		
7.50 A. M.		
7.50 A. M.	}	1.92 inches.
to		
9.30 A. M.		
9.30 A. M.	}	0.38 inches.
to		4.47 "
11 A. M.		

Maximum rainfall, 6.30 to 7.50 A. M. — 1.63 inches per hour.

7.50 to 9.30 A. M. — 1.15 " "

Average of entire storm, 6.30 to 11 A. M., 0.99 inches per hour.

The automatic gauge at Spring Mount, or Frederick, recorded eighteen storms in which the rate exceeded 0.25 inch per hour. The greatest amount in a single storm was on July 13th, when 2.22 inches fell in eleven hours. The maximum fall was at the rate of 1.75 inches per hour.

The greatest amount for a short period of time was on May 12th, when 0.85 inch fell in 25 minutes, or at the rate of 2.04 inches per hour.

The automatic gauge at the Forks of the Neshaminy recorded twenty storms in which the rate exceeded 0.25 inch per hour. The greatest amount recorded in a single storm was on July 20th and 21st, when 5.75 inches fell in 37 hours. The maximum fall was at the rate of 0.60 inch per hour. The greatest amount for a short period of time occurred on August 16th, when 0.90 inch fell in 20 minutes, or at the rate of 2.70 inches per hour.

The following tables, compiled as in previous years, accompany this report:

I. Monthly precipitation on sundry water sheds.

II. }	Rain storms exceeding $\frac{1}{4}$ inch per hour.	Philadelphia.
III. }		Forks of Neshaminy.
IV. }		Frederick.
		Perkiomen Valley.

V. Inches of rainfall flowing in the Perkiomen, Neshaminy and Tohickon.

VI. Average annual yield of streams.

VII. Comparative stream flow	Perkiomen.
	Neshaminy.
	Tohickon.
	Wissahickon.
	Schuylkill.

VIII. Evaporation, etc., observed at Queen Lane Reservoir.

IX. Monthly and daily yield of Perkiomen, Neshaminy and Tohickon.

Attention is called to the following facts which appear in the foregoing tables.

The average daily flow of the Perkiomen for the past fourteen years (the year ending September 30th) was 169,842,000 gallons.

The daily flow for 1897 was 139,491,639 gallons, being 30,350,361 gallons less than the average for the past fourteen years, and 36,209,953 gallons more than the flow for 1896. The rainfall on the water-shed was 3.09 inches less than the average, and 0.83 inches less than in 1896. The average inches of rainfall flowing in the stream for the past fourteen years was 23.47. The number of inches flowing during 1897 was 19.27.

The average daily flow of the Neshaminy for the past fourteen years was 152,202,000 gallons. The daily flow for the year 1897 was 131,098,041 gallons, being 21,103,959 gallons less than the average for the past fourteen years, and 36,218,193 more than the flow of 1896. The rainfall on the water-shed was 2.69 inches less than the average, and 2.42 inches more than in 1896. The average inches of rainfall flowing in the stream for the past fourteen years, was 22.80.

The number of inches flowing in 1897 was 19.77.

The average daily flow of the Tohickon for the past fourteen years was 138,624,900 gallons. The daily flow for the year 1897 was 109,784,168 gallons, being 29,841,000 gallons less than the average for the past fourteen years, and 28,305,000 more than the flow of 1896. The rainfall on the water-shed was 3.20 inches less than the average, and 0.43 less than in 1896.

The average inches of rainfall flowing in the stream for the past fourteen years was 28.52. The number of inches flowing in 1897 was 22.57. The month of May was the month of greatest rainfall and greatest flow-off; the month of September was the month of least rainfall and least flow-off.

Observations on the flow of the Wissahickon have been continued for seven (7) months, beginning with 27 days in May.

The average daily flow for this time was 70,444,052 gallons. The month of least flow was October, and the greatest was July. The flow of this stream for October seems to be very much in excess of the other streams. No satisfactory reason can be given for this discrepancy, owing to the short length of time during which observations have been made.

The sum of the daily record of inches of water wasted over the top of the flash boards at Fairmount dam during 1897 amounted to a total of 103 feet 9 inches, or more than double that of 1896, and more than four times that of 1895. The computed flow of the Schuylkill river into Fairmount pool, and the average daily flow is given in the following tabulated form:

	Gallons.
Total flow over flash boards	2,8,202,470,816
Steam pumpage.....	93,999,191,121
Water pumpage.....	7,590,276,582

Water power (30 gallons to pump one).....	227,708,295,960
Leakage at dam and locks.....	2,555,000,000
	<hr/>
Total	600,055,234,429

This gives an average daily flow of 1,644,000,000 gallons.

The month of maximum flow was May, and the month of minimum flow was October.

The average rainfall, at seventeen (17) stations in the Valley, was 49.17 inches, of which about 18 inches are computed as flowing in the stream Schuylkill.

The accompanying table of stream flow in the Perkiomen, Neshaminy and Tohickon, from October, 1883, to 1897, inclusive, compiled from the records of this survey, the first published by the writer in a paper submitted to the Engineers' Club of Philadelphia (Proceedings, Vol. XIV, No. 2, July, September, 1897), is here reproduced with the permission of the Club. The data are here completed to the end of 1897.

This table shows forcibly the great importance of continuing stream flow observations over a long series of years; for the results obtained in 1895 show that an estimate of the availability of these streams, based upon the data obtained from 1884 to 1894, inclusive, would have been far too high and therefore seriously misleading.

Attached to this report is a table accompanying your letter to the Director of the Department of Public Works, showing the minimum flow of the Schuylkill river at Vincents Dam.

In this table the flow of the Schuylkill at Vincent, as estimated by me from the flow of the Perkiomen at Frederick, is compared with the flow at Vincent as deduced from estimates of the flow at Fairmount by Mr. E. F. Smith, Superintendent and Engineer, Canal Division, Philadelphia & Reading Railway. The two estimates are

not rigorously comparable, but Mr. Smith's figures are the best obtainable for the Schuylkill, and the comparison shows that my estimate is not far wrong.

A visit of inspection was made in October, in company with the General Superintendent, to the Croton and Boston water supply districts. A portion of one day was spent at the new Croton Dam, inspecting the method of excavating and depositing the soil and rock removed to secure a firm foundation, and the method of handling the stone and cement forming the masonry structure of the dam. The bottom of the foundation is about one hundred feet below the surface of the ground.

Cable railways and improved machinery are used for excavating, hoisting, removing and dumping the material.

One day was spent in going over the Croton water-shed, visiting the various dams, reservoirs and stop-houses, making notes of such points as seemed useful in our several departments of work.

One day was spent at the site of the new Jerome Park Reservoir. Most of the work here is in rock excavation. Compressed air is extensively used as a motive power for drilling and hoisting machinery. There will be several years' work of this before the reservoir is finished.

In Boston, one day was spent in visiting the Chestnut Hill reservoir and the Cambridge Pumping Station. One day was spent at the site of the New Nashua Reservoir, and in driving over the conduit from the reservoir to Basin No. 5. A portion of the conduit is in tunnel. We went down shaft No. 4, and examined the methods of work, hoisting machinery, etc., construction of tunnel of conduit in earth and open or canal conduit, in all about 15 miles of construction. The Nashua Reservoir, when finished, will be the largest artificial impounding reservoir so constructed by any Water Board, the total capacity being computed at 63,000,000,000 gallons.

The following named persons have been engaged as observers and rodmen during the year:

John G. Hilsman, rodman and gauge observer, Rush Valley P. O.

George W. Wood, rodman and gauge observer, Spring Mount, Pa.

A. F. Stover, rodman and observer, Point Pleasant, Pa.

Dr. George M. Grim, gauge observer, Ottsville.

George Louder, gauge observer, Smith's Corner.

Dr. J. A. Roth, gauge observer, Seisholtzville.

A. W. Walton, gauge observer, Doylestown.

H. L. Schull, gauge observer, Lansdale.

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

Mr. Thomas MacKellar, Germantown, Philadelphia.

Mr. J. L. Heacock, Quakertown, Pa.

Sergeant L. M. Dey, U. S. Signal Service.

Mr. Benjamin Showmaker, Pennsylvania Hospital, Philadelphia.

Mr. E. F. Smith, Engineer of Canals, Reading, Pa.

Mr. Thomas J. Beans, Moorestown, N. J.

Dr. Charles Moore, Pottstown, Pa.

During 1897 all observations on rainfall were taken uniformly in accordance with the instructions given at the beginning of the year.

Respectfully,

JOHN E. CODMAN,

In Charge of Hydrographic Work.

BOSTON SOCIETY
OF CIVIL ENGINEERS

TABLE II.

Rain Storms exceeding in rate 0.25 inches per hour, as recorded by the Automatic Rain Gauge at Philadelphia for the year 1897.

Date of Observations, 1897.	AUTOMATIC RAIN GAUGE.					Remarks.
	TOTAL FALL.		MAXIMUM FALL.			
	Amount in Inches.	Duration in Hrs. Min.	Amount in Inches.	Duration in Minutes.	Rate per hour during maximum fall.	
January 26th and 21st, rain storm..	.97	8—35	.30	20	.90	
February 21st and 23d, rain storm..	1.56	17—55	.30	15	1.20	
May 13th, rain storm.....	1.46	14—45	.45	20	1.35	
June 8th and 9th.....	1.82	21—20	.30	60	.30	
June 15th, shower.....	.40	1—50	.35	15	1.40	
June 20th, shower.....	.94	3—15	.65	15	2.60	
July 20th, shower.....	.40	.45	.30	20	.90	
July 13th, rain storm.....	1.13	17—00	.45	20	1.35	
July 23d, showers.....	.80	3—50	.35	15	1.40	
July 27th and 28th, rain storm.....	3.26	40—30	.40	20	1.20	
July 27th and 28th, rain storm.....	3.26	40—30	.35	25	.84	
August 9th, shower.....	.57	3—50	.52	50	.62	
August 11th, shower.....	1.44	4—00	.80	35	1.37	
November 1st and 2d, rain storm..	2.25	30—20	.20	60	.60	
November 27th, rain storm.....	1.16	35—00	.20	20	.60	
December 12th, rain storm.....	.53	3—30	.20	10	1.20	

TABLE I.
MONTHLY PRECIPITATION ON SUNDRY WATERSHEDS,
Compared with U. S. Weather Bureau Observations, at Philadelphia, 1897.
ELEVATIONS ARE IN FEET ABOVE SEA LEVEL.

Elevation	PHILADELPHIA SERIES.								SCHUYLKILL SERIES.								PERKIOMEN SERIES.				DELAWARE SERIES.						TOHICKON SERIES.						NESHAMINY SERIES.										
	U. S. WEATHER BUREAU.	WATER BUREAU, AUTOMATIC.		WATER BUREAU, GROUND GAUGE.		PENNSYLVANIA HOSPITAL.		GERMANTOWN.		LEBANON.		READING.		POTTSTOWN.		BROWERS.		HAMBURG.		SEISHOLTZVILLE.		FREDERICK.		EASTON.		MOORESTOWN.		WEST CHESTER.		OTTSTVILLE.		QUAKERTOWN.		SMITH'S CORNER.		POINT PLEASANT.		LANSDALE.		FORKS OF NESHAMINY.		DOYLESTOWN.	
1897.	207	66		49		25		368		480		207		150		86		365		870		300		340		65		465		390		586		480		119		350		143		406.	
	Precipitation in inches.	Precipitation in inches.	Difference.	Precipitation in inches.	Difference.	Precipitation in inches.	Difference.	Precipitation in inches.	Difference.	Precipitation in inches.	Difference.	Precipitation in inches.	Difference.	Precipitation in inches.	Difference.	Precipitation in inches.	Difference.	Precipitation in inches.	Difference.	Precipitation in inches.	Difference.	Precipitation in inches.	Difference.	Precipitation in inches.	Difference.	Precipitation in inches.	Difference.	Precipitation in inches.	Difference.	Precipitation in inches.	Difference.	Precipitation in inches.	Difference.	Precipitation in inches.	Difference.	Precipitation in inches.	Difference.	Precipitation in inches.	Difference.	Precipitation in inches.	Difference.		
January.....	2.17	1.83	-0.34	1.95	-0.22	3.24	+1.07	2.92	+0.75	2.26	+0.09	1.69	-0.48	2.80	+0.63	2.00	-0.17	2.50	+0.33	2.28	+0.11	1.81	-0.36	1.92	-0.25	2.33	+0.16	2.44	+0.27	2.42	+0.25	2.14	-0.03	1.82	-0.35	1.85	-0.32	2.39	+0.22	1.89	-0.28		
February.....	2.97	3.82	+0.85	3.98	+1.01	4.35	+1.38	2.96	-0.01	3.75	+0.78	2.94	-0.03	5.02	+2.05	4.34	+1.37	4.61	+1.64	2.73	-0.24	3.07	+0.10	1.28	-1.69	4.52	+1.55	3.03	+0.06	3.74	+0.77	2.60	-0.37	3.06	+0.09	2.94	-0.03	2.94	-0.03	3.73	+0.76		
March.....	2.03	2.10	+0.07	2.11	+0.08	1.71	-0.32	2.57	+0.54	3.46	+1.43	2.02	-0.01	2.53	+0.50	2.04	+0.01	3.49	+1.46	2.47	+0.44	2.29	+0.26	0.82	-1.21	2.55	+0.52	2.52	+0.49	2.71	+0.68	2.54	+0.51	2.08	+0.05	1.78	-0.25	2.28	+0.25	2.58	+0.55		
April.....	3.03	3.26	+0.23	3.30	+0.27	2.77	-0.26	3.45	+0.42	3.51	+0.48	3.89	+0.86	3.80	+0.77	3.38	+0.35	3.76	+0.73	3.53	+0.50	3.06	+0.03	1.20	-1.83	3.06	+0.03	3.28	+0.25	3.32	+0.29	3.30	+0.27	2.91	-0.12	3.36	+0.33	2.93	-0.10	3.80	+0.77		
May.....	4.33	5.47	+1.14	5.65	+1.32	4.80	+0.47	5.14	+0.81	6.52	+2.19	9.70	+5.37	7.27	+2.94	7.00	+2.67	8.15	+3.82	8.58	+4.25	8.85	+4.52	5.75	+1.42	7.47	+3.14	7.81	+3.48	7.77	+3.44	10.05	+5.72	9.98	+5.65	8.62	+4.29	6.34	+2.01	7.89	+3.56		
June.....	4.53	5.01	+0.48	5.17	+0.64	5.20	+0.67	5.32	+0.79	3.00	-1.53	3.03	-1.50	4.90	+0.37	4.29	-0.24	4.59	+0.06	3.12	-1.41	3.22	+1.31	3.26	-1.27	2.43	-2.10	5.55	+1.02	3.81	-0.72	6.00	+1.47	5.04	+0.51	4.22	-0.31	6.42	+1.89	4.99	+0.46		
July.....	7.70	8.57	+0.87	8.72	+1.02	7.92	+0.22	11.57	+3.87	5.89	-1.91	5.77	-1.93	6.27	-1.43	7.13	-0.57	6.99	-0.71	5.61	-2.09	9.97	+2.27	8.04	+0.34	9.91	+2.21	6.82	-0.88	8.06	+0.36	10.22	+2.52	8.76	+1.06	7.17	-0.53	12.25	+4.55	8.11	+0.41		
August.....	3.52	3.30	-0.22	3.30	-0.22	4.07	+0.55	3.53	+0.01	2.51	-1.01	2.54	-0.98	2.64	-0.88	2.41	-1.11	4.16	+0.64	3.27	-0.25	2.19	-1.33	3.20	-0.32	2.58	-0.94	4.87	+1.35	3.43	-0.09	3.75	+0.23	2.93	-0.59	3.20	-0.32	3.09	-0.43	3.87	+0.35		
September.....	1.10	1.02	-0.08	1.04	-0.06	1.25	+0.15	1.42	+0.32	1.57	+0.47	1.54	+0.44	1.54	+0.44	1.84	+0.74	1.83	+0.73	2.02	+0.92	1.22	+0.12	2.49	+1.39	1.27	+0.17	1.88	+0.78	1.50	+0.40	2.05	+0.95	1.24	+0.14	1.12	+0.02	1.20	+0.10	1.67	+0.57		
October.....	2.76	2.26	-0.50	2.26	-0.50	2.45	-0.31	2.11	-0.65	2.36	-0.40	5.93	+3.17	2.38	-0.38	2.37	-1.39	1.79	-0.97	2.04	-0.72	2.08	-0.68	1.85	-0.91	2.61	-0.15	1.54	-1.22	2.29	-0.47	1.68	-1.08	1.79	-0.97	2.48	-0.28	2.41	-0.35	2.60	-0.16		
November.....	4.44	4.62	+0.18	4.88	+0.44	4.88	+0.44	5.41	+0.97	5.76	+1.32	5.43	+0.99	6.48	+2.04	5.23	+0.79	7.04	+2.60	6.99	+2.55	5.78	+1.34	6.20	+1.76	5.08	+0.64	4.80	+0.36	5.58	+1.14	5.03	+0.59	4.70	+0.26	5.62	+1.18	5.12	+0.68	4.95	+0.51		
December.....	4.52	4.75	+0.23	4.74	+0.22	4.07	-0.45	4.81	+0.29	4.05	-0.47	4.00	-0.52	5.00	+0.48	4.32	-0.20	6.25	+1.73	4.48	-0.04	4.26	-0.26	5.63	+1.11	4.21	-0.31	4.71	+0.19	4.70	+0.18	4.57	+0.05	4.57	+0.05	4.69	+0.07	5.16	+0.64	4.68	+0.16		
Total.....	43.10	46.01	+2.91	47.10	+4.00	46.71	+3.61	51.21	+8.11	44.64	+1.54	48.48	+5.38	50.63	+7.53	46.35	+3.25	55.16	+12.06	47.12	+4.02	47.80	+4.70	41.64	-1.46	48.02	+4.92	49.25	+6.15	49.33	+6.23	53.93	+10.83	48.88	+5.78	47.05	+3.95	52.53	+9.43	50.76	+7.66		
Percentage.....	100	106	109	108	119	104	112	117	107	128	109	110	96	111	114	114	125	113	109	122	118		
15 years { Inches.....	38.47	39.82	42.36	43.82	47.55	45.46	43.23	48.90	43.42	44.77	50.04	46.60	46.41	51.56	49.47	49.51	50.58	50.28	46.34	48.58	47.75		
yearly averages. { Percentages...	100	103	110	114	123	118	112	127	113	117	130	121	121	134	128	128	131	130	120	126	124		
Average Deficiency or Increase, 1897.....	4.63	6.19	4.74	2.89	3.66	0.82	5.15	1.73	2.93	10.38	2.91	1.27	4.77	3.54	0.22	0.24	3.35	1.40	0.51	2.95	3.01		
Percentage Deficiency or Increase.....	12.0	15.6	11.2	6.5	7.5	1.8	11.9	3.4	6.7	23.1	5.7	2.7	10.3	6.9	0.4	0.4	6.6	2.7	0.1	8.1	6.3		

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 1897.

Date of Observations, 1897.	AUTOMATIC RAIN GAUGE.					Remarks.
	TOTAL FALL.		MAXIMUM FALL.			
	Amount in inches.	Duration in Hrs. Min.	Amount in inches.	Duration in minutes.	Rate per hour during maximum fall.	
January 20th and 21st, rain storm..	1.35	8—45	.40	60	.40	
May 2d and 3d, rain storm.....	2.24	15—30	.15	10	.90	
May 12th, shower.....	.31	0—15	.31	15	1.24	
May 31st, rain storm.....	1.06	9—15	.25	10	1.50	
June 4th and 5th, rain storm. ....	.85	10—20	.60	35	1.03	
June 8th and 9th, rain storm.....	3.66	26—15	.86	30	1.72	
June 25th, shower.....	.45	0—30	.45	30	.90	
July 18th, rain storm.....	1.35	33—30	.35	30	.70	
July 20th, rain storm.....			1.35	90	.90	
July 21st, rain storm.....			.40	40	.60	
July 22d, rain storm.....	5.75	37—10	.40	40	.60	
July 23d, rain storm.....	1.02	3—15	.80	60	.80	
July 28th, rain storm.....	2.33	37—45	.40	60	.40	
August 16th, shower.....	.55	8—05	.40	20	1.20	
August 16th, shower.....	.94	0—30	.90	20	2.70	
August 21st, shower.....	.63	3—00	.60	20	1.80	
September 24th, rain storm.....	.91	24—05	.35	30	.70	
October 12th, shower.....	.45	2—15	.30	20	.90	
November 1st and 22d, rain storm..	2.64	30—00	.25	20	.75	
November 27th, rain storm.....	.81	12—00	.45	25	.90	
December 12th, rain storm.....	.48	10—30	.3	40	.45	
December 14th, rain storm.....	2.34	19—10	.20	60	.20	

TABLE IV.

Rain Storm exceeding in rate 0.25 inches per hour, as recorded by the Automatic Rain Gauge at Frederick, for the year 1897.

Date of Observation, 1897.	AUTOMATIC RAIN GAUGE.					Remarks.
	TOTAL FALL.		MAXIMUM FALL.			
	Amount in inches.	Duration in Hrs. Min.	Amount in inches.	Duration in minutes.	Rate per hour during max- imum fall.	
January 20th and 21st, rain storm.	.95	6—55	.20	60	.20	
May 2d, rain storm	2.63	21—35	.38	20	1.14	
May 12th and 13th, rain storm.....	2.20	10—00	.85	25	2.04	
May 13th, showers.....	.45	4—45	.35	15	1.40	
May 24th, shower.....	1.91	4—00	.62	20	1.86	
May 31st, shower.....	.90	2—20	.20	20	.60	
June 4th and 6th, rain storm.....	1.10	16—05	.60	20	1.80	
July 1st, shower.....	1.50	4—50	1.30	60	1.30	
July 13th, shower.....	2.22	11—00	1.60	55	1.75	
July 18th, shower.....	1.27	4—15	.40	40	.60	
July 21st and 22d, rain storm.....	1.54	27—50	.64	30	1.28	
July 23d, shower.....	3.89	3—10	.80	40	1.20	
July 27th and 28th.....	2.20	4 ¹ —25	.20	20	.60	
September 17th, shower.....	.30	4—00	.25	10	1.50	
September 24th, rain storm.....	.90	23—00	.25	15	1.00	
October 12th, shower.....	.41	3—10	.15	15	.60	
November 1st and 25th, rain storm.	3.06	30—25	.30	60	.30	
November 27th, rain storm.....	1.20	35—30	.70	30	1.40	

TABLE V.

Inches of Rainfall Flowing in the Perkiomen, Neshaminy and Tohickon Creeks.

WATERSHEDS.	Area in Miles.	PERCENTAGE OF TOTAL AREA.				AVERAGE FOR FOURTEEN YEARS (1883—1897).												
		Woodland.	Cultivated.	Flats.	Roads.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Annual.
Perkiomen, at Frederick, 14 years.....	152	25	71	2	2	2.98	3.56	3.74	2.22	1.34	0.92	1.45	1.00	1.01	0.90	1.71	2.04	23.48
Neshaminy, below Forks, 14 years.....	139.3	6	92	1/2	2	3.42	4.11	3.51	2.06	1.65	0.82	1.13	0.90	0.90	0.70	1.50	2.25	22.80
Tohickon, 14 years.....	102.2	24	72	2	2	4.00	4.79	4.58	2.53	2.04	0.95	1.47	1.30	1.21	0.88	2.09	2.61	23.52
Perkiomen, at Frederick.....	Maximum 14 years.....					5.40	9.73	5.58	3.48	6.66	2.65	4.89	2.48	3.63	2.36	6.67	3.77	
	Minimum 14 years.....					0.59	1.25	2.38	0.97	0.46	0.28	0.17	0.28	0.16	0.20	0.34	0.91	
Neshaminy, below Forks.....	Maximum 14 years.....					6.77	10.44	5.55	3.57	7.41	2.46	5.47	3.37	3.51	2.55	6.31	4.56	
	Minimum 14 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 14 years.....					7.34	10.41	6.37	4.76	8.56	3.43	6.41	3.75	5.49	3.54	7.97	4.28	
	Minimum 14 years.....					0.54	1.19	2.98	0.73	0.30	0.08	0.11	0.10	0.04	0.05	0.14	0.67	

TABLE VI—Average Annual Yield of Sundry Watersheds to October 1, 1897.

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.....	14	152.9	47.810	23.476	49.102	62,009,448,321	169,842,000	1.729	0.0360
Neshaminy, below Forks.....	14	139.3	47.770	22.803	49.830	55,199,997,570	151,202,000	1.679	0.0350
Tobickon.....	14	102.2	50.005	28.520	57.104	50,651,125,150	138,624,900	2.099	0.0419
Wissahickon.....	8 months	64.6	36.367	15.369	42.000	.....	70,444,052	1.87	0.0261
Sudbury, Mass.....	22	75.2	45.748	22.284	48.720	29,094,880,000	79,712,000	1.841	0.0357
Croton, N. Y.....	18	333.0	45.970	22.760	49.500	135,400,000,000	371,600,000	1.680	0.0365

TABLE VII—Comparative Daily Stream Flow, 1896 and 1897.

Watersheds.	Area of watershed.	MAXIMUM.		MINIMUM.		MAXIMUM PER SQ. MILE.		MINIMUM PER SQ. MILE.	
		Gallons.	Date.	Gallons.	Date.	Average for month.	Date.	Average for month.	Date.
Perkiomen.....	152.	3,067,000,000	May 13.....	4,912,000	Sept. 12.....	2,231,000	May.....	169,000	September..
Neshaminy.....	139.3	3,033,000,000	June 9.....	11,970,000	Oct. 11, '97..	1,538,000	May.....	126,000	September..
Tobickon.....	102.2	2,319,000,000	May 13.....	2,244,000	Sept. 30.....	2,601,000	May.....	69,000	September..
Wissahickon.....	64.6	1,847,600,000	July 22.....	15,200,000	Oct., '97.....	2,042,000	July.....	322,000	October.....
Schuykill.....	1,910	12,278,000,000	May 15.....	391,000,000	Sept.....	1,757,000	May.....	200,000	September..

TABLE VIII.
Evaporation from Water Surface at Queen Lane Reservoir.

	TEMPERATURE.						RAIN-FALL.	EVAPO-RATION.	Observations Lost.
	AIR.			WATER.					
	Max.	Min.	Mean.	Max.	Min.	Mean.	Inches.	Inches.	
January.....									
February.....									
March.....									
April.....									
May.....	82	44	63	67	60	63	5.40	4.78	7 days—Rain and wind.
June.....	92	48	69	79	61	70	5.38	6.07	3 days—Rain and wind.
July.....	94	62	76.5	85	76	79.3	11.42	6.36	4 days—Rain and wind.
August.....	89	60	73.7	81	75	78.5	2.64	6.22	
September.....	86	44	68.6	82	69	75.6	1.44	5.92	3 days—Rain and wind.
October.....	89	38	58.3	88	41	60.5	2.34	3.84	2 days—Rain and wind.
November.....	53.5	38.9	46.2	56	32		5.01	2.89	4 days—Rain and wind.
December.....	43.5	31.6	38.6	44	32		4.37	1.67	{ 7 days—Rain, wind and ice on surface of water.
Totals.....							38.00	37.75	

MINIMUM FLOW OF SCHUYLKILL RIVER AT
VINCENT DAM AS DEDUCED FROM

(A)—*Minimum flow at Fairmount, as given by Mr. Edwin F. Smith, in proceedings Engineers' Club of Philadelphia, Vol. XIII, No 3, November, 1896, and in Report, Bureau of Water, Philadelphia, for 1896.*

(B)—*Observations on stream flow of Perkiomen Creek by Bureau of Water, Philadelphia, as given by Mr. John E. Codman in proceedings Engineers' Club of Philadelphia, Vol. XIV, No. 2, July.—Sept. 1897.*

Years.	A.	B.	SCHUYLKILL AT VINCENT. MILLIONS OF GALLONS PER DAY. DEDUCED FROM		Duration of flow of less than 230 mil- lion gallons per day at Vincent. (Smith.)
	Schuylkill at Fairmount. Millions of gallons per day. (Smith.)	Perkiomen at Springmount. Thousands of gallons per sq. mile per day. (Codman.)	(Smith.) = $\frac{1}{13}$ A.	(Codman.) = 1.1 B.	
1884.....	282	190	163	209	56
1885.....	230	96	133	106	113
1886.....	253	183	146	146	68
1887.....	347	231	201	254	83
1888.....	321	141	186	155	49
1889.....	556	* 317	322	348	15
1890.....	520	* 322	301	354	15
1891.....	455	209	263	230	68
1892.....	220	115	127	127	116
1893.....	258	166	149	183	143
1894.....	256	190	148	209	61
1895.....	185	97	107	107	134
1896.....	194	170	112	187	29
			13) 2,358	13) 2,615	
	Averages.....		181	201	

* For 1889-90, in which the duration of low water was only fifteen days, the figures given in *Column B* are those for the fifteen days of minimum flow, and not those for the entire month.

TABLE IX—PRECIPITATION AND STREAM FLOW ON PERKIOMEN, NESHAMINY, TOHICKON AND WISSAHICKON WATERSHEDS.

DATE, 1896.	PERKIOMEN AT FREDERICK.							NESHAMINY, BELOW FORKS.					TOHICKON.					WISSAHICKON.																		
	AREA OF WATERSHED, 152 SQUARE MILES.							AREA OF WATERSHED, 139.3 SQUARE MILES.					AREA OF WATERSHED, 102.2 SQUARE MILES.					AREA OF WATERSHED, 646 SQUARE MILES.																		
	Rainfall in inches.	Inches of rainfall flowing off.	Percentage flowing off.	Monthly yield of stream.	Average daily yield of stream.			Average yield in cubic feet per second per square mile.	Rainfall in inches.	Inches of rainfall flowing off.	Percentage flowing off.	Monthly yield of stream.	Average daily yield of stream.			Average yield in cubic feet per second per square mile.	Rainfall in inches.	Inches of rainfall flowing off.	Percentage flowing off.	Monthly yield of stream.	Average daily yield of stream.			Average yield in cubic feet per second per square mile.	Rainfall in inches.	Inches of rainfall flowing off.	Percentage flowing off.	Monthly yield of stream.	Average daily yield of stream.			Average yield in cubic feet per second per square mile.				
			Cubic feet.	Cubic feet.	Gallons.						Cubic feet.	Cubic feet.	Gallons.						Cubic feet.	Cubic feet.	Gallons.						Cubic feet.	Cubic feet.	Gallons.							
October.....	4.715	1.475	30	521,095,680	16,809,538	125,744,069	1.286	2.636	0.928	30	300,844,800	9,704,670	72,595,973	0.806	2.672	1.064	40	252,668,160	8,150,586	60,970,617	0.923															
November.....	4.715	2.058	44	726,840,000	24,228,000	181,238,022	1.845	4.130	1.521	37	493,188,480	16,439,616	122,976,860	1.366	4.082	2.340	57	555,370,560	18,512,332	138,482,001	2.096															
December.....	0.645	0.808	125	285,500,160	9,209,632	68,893,205	0.701	0.846	0.755	89	244,339,200	7,881,910	58,960,781	0.655	0.940	0.801	85	190,114,560	6,132,728	45,876,191	0.694															
1897.																																				
January.....	2.045	1.180	157	416,776,320	13,444,400	100,571,090	1.023	2.043	1.292	63	418,184,640	13,439,827	100,910,907	1.121	2.205	1.806	80	428,811,840	13,832,650	103,475,401	1.566															
February.....	2.900	2.936	100	1,036,843,200	37,030,114	277,004,484	2.820	3.203	2.534	79	820,290,240	29,296,080	219,149,896	2.434	3.107	2.927	94	694,872,000	124,816,957	183,642,979	2.810															
March.....	2.380	1.826	77	644,699,520	20,796,780	153,570,716	1.583	2.213	1.734	78	561,142,080	18,101,357	135,407,545	1.503	2.462	2.192	89	520,490,880	16,790,028	125,598,123	1.901															
April.....	3.295	1.643	50	579,242,880	19,308,096	144,434,587	1.470	3.363	1.532	45	495,797,760	16,526,592	123,627,486	1.373	3.202	1.550	48	368,070,400	12,269,013	91,529,081	1.355															
May.....	8.715	3.980	45	1,405,581,120	45,341,326	339,176,651	3.452	7.616	2.782	36	887,708,160	28,635,766	214,210,389	2.380	8.902	4.648	52	1,101,885,120	35,544,681	265,892,674	4.025	5.030	1.686	33	253,264,320	9,380,160	70,168,469	1.680								
June.....	3.170	0.925	29	326,540,160	10,884,672	81,421,000	0.830	5.210	2.461	47	796,538,880	26,551,296	198,617,475	2.206	5.100	1.713	33	406,753,920	13,558,464	101,424,350	1.535	4.770	2.551	53	382,890,240	12,763,008	95,474,028	2.285								
July.....	7.790	1.557	20	549,771,840	17,731,300	132,639,337	1.350	9.100	2.964	33	959,143,680	30,940,112	231,448,108	2.570	8.465	2.680	32	636,318,720	20,526,410	153,543,208	2.324	9.380	3.643	38	546,739,200	17,636,750	131,932,043	3.160								
August.....	2.730	0.595	21	210,081,600	6,776,826	50,694,178	0.516	3.390	1.078	32	349,056,000	11,260,000	84,230,645	0.955	3.745	0.731	19	173,465,280	5,595,654	41,853,396	0.633	3.365	2.623	78	393,716,160	12,700,521	95,006,493	2.273								
September.....	1.620	0.292	18	103,299,840	3,443,323	25,757,881	0.262	1.330	0.218	16	70,485,120	2,349,504	17,575,510	0.195	1.917	0.119	6	28,244,160	941,472	7,042,699	0.107	1.270	0.811	64	121,677,120	4,055,904	30,340,282	0.727								
Total.....	44.720	19.274	43	6,806,272,320	18,647,321	139,491,639	1.420	45,080	19,770	44	6,396,719,040	17,525,260	131,098,041	1.453	46,799	22,570	48	5,357,065,600	14,673,900	109,781,168	1.662															
October.....	2.060	0.217	10	76,947,840	2,482,190	18,568,060	0.189	2.496	0.163	6	52,634,880	1,697,900	12,700,173	0.141	1.825	0.075	4	17,755,200	572,760	4,284,617	0.064	2.291	0.574	25	85,235,840	2,781,800	20,809,308	0.498								
November.....	6.885	1.750	27	617,884,640	20,596,155	154,069,937	1.570	5.230	1.174	22	379,978,560	12,665,952	94,747,899	1.052	5.027	1.782	35	423,083,520	14,102,784	105,496,148	1.597	5.511	1.217	22	182,787,840	6,092,928	45,578,266	1.092								
December.....	4.370	2.764	63	976,155,840	31,438,870	235,553,102	2.398	4.843	3.264	67	1,056,240,000	34,072,260	254,881,260	2.831	4.637	4.084	88	969,701,760	31,280,702	233,935,807	3.543	4.750	2.264	46	339,845,760	10,962,766	82,008,134	1.964								
Totals for 1897.....	47.460	19.665	41	6,943,824,800	19,024,130	142,310,748	1.441	50,037	21,160	43	6,347,200,000	18,759,450	140,330,423	1.560	50,594	24,307	48	5,779,152,800	15,807,000	118,241,565	1.790	36.367	1.359	42	2,307,156,480	9,417,000	70,444,052	1.687								

* 27 days.

Table of Stream Flow in the Perkiomen, Neshaminy and Tohickon, 1883 1897.

MONTHS.	PERKIOMEN, 1883-1884.						NESHAMINY, 1883-1884.						TOHICKON, 1883-1884.					
	Total Rainfall in Inches.	STREAM FLOW FROM GAUGINGS.					Total Rainfall in Inches.	STREAM FLOW FROM GAUGINGS.					Total Rainfall in Inches.	STREAM FLOW FROM GAUGINGS.				
		Inches Flowing in Stream.	Loss or Evaporation.	Average Loss for Years.	Cubic Feet per Minute per Sq. Mile.	Gallons per 24 Hours per Sq. Mile.		Inches Flowing in Stream.	Loss or Evaporation.	Average Loss for Years.	Cubic Feet per Minute per Sq. Mile.	Gallons per 24 Hours per Sq. Mile.		Inches Flowing in Stream.	Loss or Evaporation.	Average Loss for Years.	Cubic Feet per Minute per Sq. Mile.	Gallons per 24 Hours per Sq. Mile.
October.....	5.27	1.42	3.85	.....	73.6	790,000	3.80	0.48	3.32	.....	25.9	279,000	4.40	0.88	3.52	.....	45.6	495,000
November.....	1.93	0.91	1.02	.....	48.3	520,000	1.43	0.35	1.08	.....	19.8	213,000	1.61	0.57	1.07	.....	30.9	333,000
December.....	4.00	1.04	2.96	.....	54.4	584,000	3.06	0.85	2.21	.....	46.0	496,000	4.04	0.97	3.07	.....	50.2	540,000
January.....	5.14	5.40	.....	.....	280.7	3,016,000	5.58	6.77	.....	.....	365.3	3,936,000	5.32	7.34	.....	.....	381.7	4,112,000
February.....	5.04	9.73	.....	.....	540.0	5,800,000	6.27	10.45	.....	.....	602.0	6,484,000	5.45	10.41	.....	.....	577.7	6,223,000
March.....	5.04	5.29	.....	.....	274.4	2,947,000	5.20	5.55	.....	.....	299.6	3,227,000	5.19	6.02	.....	.....	313.3	3,371,000
April.....	2.63	2.37	0.26	.....	127.4	1,550,000	2.42	1.64	0.78	.....	91.9	989,000	2.52	1.89	0.63	.....	101.9	1,098,000
May.....	3.40	1.36	2.04	.....	74.8	801,000	3.24	0.35	2.39	.....	19.1	206,000	3.54	0.64	2.90	.....	33.2	357,000
June.....	4.65	1.26	3.39	.....	66.6	726,000	5.24	0.82	4.42	.....	45.6	492,000	6.48	3.43	3.05	.....	183.3	1,971,000
July.....	7.44	2.16	5.28	.....	113.5	1,219,000	4.89	0.52	4.37	.....	27.8	300,000	7.05	2.82	4.23	.....	141.2	1,522,000
August.....	3.44	0.65	2.79	.....	31.7	362,000	3.58	0.51	3.07	.....	27.4	296,000	3.99	0.28	3.71	.....	14.4	155,000
September.....	0.59	0.31	0.28	.....	17.7	190,000	0.31	0.06	0.25	.....	2.5	27,000	0.46	0.07	0.39	.....	3.9	41,400
Total.....	48.57	31.90	21.87	.....	.....	.....	45.02	28.35	22.39	.....	.....	.....	50.08	35.32	22.57	.....	.....	.....

Table of Stream Flow in the Perkiomen, Neshaminy and Tohickon, 1883-1897—Continued.

MONTHS.	PERKIOMEN, 1884-1885.						NESHAMINY, 1884-1885.						TOHICKON, 1884-1885.					
	Total Rainfall in Inches.	STREAM FLOW FROM GAUGINGS.					Total Rainfall in Inches.	STREAM FLOW FROM GAUGINGS.					Total Rainfall in Inches.	STREAM FLOW FROM GAUGINGS.				
		Inches Flowing in Stream.	Loss or Evaporation.	Average Loss for Years.	Cubic Feet per Minute per Sq. Mile.	Gallons per 24 Hours per Sq. Mile.		Inches Flowing in Stream.	Loss or Evaporation.	Average Loss for Years.	Cubic Feet per Minute per Sq. Mile.	Gallons per 24 Hours per Sq. Mile.		Inches Flowing in Stream.	Loss or Evaporation.	Average Loss for Years.	Cubic Feet per Minute per Sq. Mile.	Gallons per 24 Hours per Sq. Mile.
October	3.69	0.37	3.32	.....	20.1	213,000	3.05	0.06	2.99	.....	2.4	26,000	4.00	0.12	3.88	.....	6.8	73,700
November	3.26	0.91	2.35	.....	49.4	530,000	3.69	0.33	3.36	.....	17.6	189,000	3.51	1.16	2.35	.....	62.9	677,000
December	6.08	3.77	2.31	.....	194.6	2,090,000	5.70	4.56	1.14	.....	238.5	2,569,000	6.23	3.94	2.32	.....	205.9	2,218,000
January	3.76	3.27	0.49	.....	171.0	1,826,000	3.76	3.50	0.26	.....	170.5	1,860,000	4.35	4.48	.....	233.9	2,520,000	
February	4.41	2.16	2.25	.....	124.3	1,332,000	4.93	5.18	.....	263.0	2,833,000	4.83	3.57	1.26	.....	198.2	2,186,000	
March	1.32	2.52	.....	.....	131.1	1,405,000	1.04	1.84	.....	90.5	976,000	1.57	2.98	.....	.....	154.8	1,668,000	
April	2.41	2.75	.....	.....	147.9	1,093,000	2.26	2.21	0.05	.....	76.4	824,000	2.69	3.98	.....	.....	213.9	2,304,000
May	2.49	0.82	1.67	.....	56.3	603,000	2.44	0.56	1.88	.....	28.9	312,000	2.16	0.50	1.66	.....	25.7	277,000
June	1.48	0.28	1.20	.....	14.8	159,000	1.68	0.08	1.60	.....	4.2	45,100	0.84	0.08	0.76	.....	3.9	42,000
July	2.18	0.17	2.01	.....	9.0	96,000	2.19	0.04	2.15	.....	2.6	28,000	2.30	0.23	2.07	.....	11.4	123,000
August	6.17	1.23	4.94	.....	64.5	691,000	6.38	0.96	5.42	.....	50.0	539,000	8.17	1.23	6.94	.....	65.6	706,000
September	0.87	0.16	0.71	.....	8.6	96,000	1.11	0.03	1.13	.....	1.7	18,100	0.53	0.04	0.49	.....	1.9	21,200
Total	38.12	18.41	21.25	.....	.....	.....	38.28	19.35	19.98	.....	.....	.....	41.21	22.31	21.73	.....	.....	.....

Table of Stream Flow in the Perkiomen, Neshaminy and Tohickon, 1883-1897—Continued.

MONTHS.	PERKIOMEN, 1885-1886.						NESHAMINY, 1885-1886.						TOHICKON, 1885-1886.					
	Total Rainfall in Inches.	STREAM FLOW FROM GAUGINGS.					Total Rainfall in Inches.	STREAM FLOW FROM GAUGINGS.					Total Rainfall in Inches.	STREAM FLOW FROM GAUGINGS.				
		Inches flowing in Stream.	Loss or Evaporation.	Average Loss for Years.	Cubic Feet per Minute per Square Mile.	Gallons per 24 hours per Square Mile.		Inches flowing in Stream.	Loss or Evaporation.	Average Loss for Years.	Cubic Feet per Minute per Square Mile.	Gallons per 24 hours per Square Mile.		Inches flowing in Stream.	Loss or Evaporation.	Average Loss for Years.	Cubic Feet per Minute per Square Mile.	Gallons per 24 hours per Square Mile.
October.....	4.74	0.43	4.31	.....	22.2	240,000	5.56	0.17	5.39	.....	9.0	96,700	4.80	0.33	4.47	.....	18.1	195,000
November.....	3.88	1.79	2.09	.....	94.7	1,020,000	4.50	1.53	2.97	.....	79.6	860,000	4.67	2.57	2.10	.....	138.5	1,492,000
December.....	3.18	2.45	0.73	.....	126.5	1,362,000	2.88	1.73	1.15	.....	86.0	927,000	3.06	1.77	1.29	.....	93.0	1,002,000
January.....	4.21	3.03	1.18	.....	158.1	1,702,000	5.11	5.21	.....	.....	262.3	2,826,000	4.15	4.36	.....	.....	22.8	2,452,000
February.....	5.08	5.64	.....	.....	323.1	3,480,000	6.18	6.55	.....	.....	263.2	3,912,000	6.01	9.19	.....	.....	534.4	5,756,000
March.....	3.96	2.56	1.38	.....	132.6	1,428,000	3.72	2.30	1.42	.....	114.7	1,235,000	4.76	4.28	0.48	.....	224.5	2,424,000
April.....	3.00	3.42	.....	.....	182.5	1,965,000	2.93	3.57	.....	.....	183.7	2,901,000	3.42	4.76	.....	.....	257.2	2,770,000
May.....	6.60	2.64	3.96	.....	135.4	1,458,000	5.79	2.09	3.70	.....	104.8	1,130,000	7.14	3.33	3.71	.....	173.4	1,921,000
June.....	5.26	1.89	3.37	.....	100.9	1,086,000	5.67	0.91	4.76	.....	47.3	509,000	4.53	1.40	3.13	.....	75.8	816,000
July.....	5.06	1.11	3.95	.....	57.3	617,000	5.40	0.81	4.59	.....	39.6	434,000	5.48	0.77	4.71	.....	40.4	435,000
August.....	1.44	0.85	1.09	.....	17.7	189,000	1.69	0.15	1.45	.....	7.9	79,000	1.09	0.10	0.99	.....	5.3	57,000
September.....	1.87	0.23	1.14	.....	12.4	133,000	0.91	0.05	0.86	.....	2.2	23,000	1.30	0.03	1.27	.....	1.5	158,000
Total.....	47.78	25.56	23.20	.....	.....	.....	50.25	25.07	26.21	.....	.....	.....	50.41	32.99	22.15	.....	.....	.....

Table of Stream Flow in the Perkiomen, Neshaminy and Tohickon, 1883-1897—Continued.

MONTHS.	PERKIOMEN, 1886-1887.						NESHAMINY, 1886-1887.						TOHICKON, 1886-1887.					
	Total Rainfall in Inches.	STREAM FLOW FROM GAUGINGS.					Total Rainfall in Inches.	STREAM FLOW FROM GAUGINGS.					Total Rainfall in Inches.	STREAM FLOW FROM GAUGINGS.				
		Inches flowing in Stream.	Loss or Evaporation.	Average Loss for Years.	Cubic Feet per Minute per Square Mile.	Gallons per 24 hours per Square Mile.		Inches flowing in Stream.	Loss or Evaporation.	Average Loss for Years.	Cubic Feet per Minute per Square Mile.	Gallons per 24 hours per Square Mile.		Inches flowing in Stream.	Loss or Evaporation.	Average Loss for Years.	Cubic Feet per Minute per Square Mile.	Gallons per 24 hours per Square Mile.
October.....	2.35	0.26	2.09	.....	13.0	140,000	2.77	0.06	2.71	.....	2.6	28,000	2.59	0.05	2.54	.....	2.3	25,000
November.....	5.28	1.53	3.75	.....	82.9	900,000	3.92	0.55	3.37	.....	28.7	310,000	5.16	1.96	3.20	.....	105.6	1,138,000
December.....	3.76	1.43	2.33	.....	74.9	807,000	3.30	2.34	0.96	.....	117.1	1,261,000	3.83	2.38	1.45	.....	124.4	1,340,000
January.....	4.55	4.00	0.55	.....	206.6	2,225,000	4.63	4.22	0.41	.....	211.0	2,273,000	4.24	5.04	.....	.....	263.8	2,847,000
February.....	5.64	4.23	1.41	.....	242.9	2,616,000	5.05	3.94	1.11	.....	218.2	2,350,000	5.47	5.25	0.22	.....	303.4	3,268,000
March.....	2.90	3.03	.....	.....	156.8	1,690,000	3.58	3.25	0.33	.....	163.6	1,761,000	3.06	3.83	.....	.....	200.5	2,160,000
April.....	2.84	1.23	1.59	.....	67.4	726,000	3.17	1.46	1.71	.....	75.9	817,000	2.41	1.01	1.40	.....	54.5	588,000
May.....	1.85	0.72	1.13	.....	37.9	408,000	2.15	0.71	1.44	.....	35.2	378,000	2.59	0.93	1.66	.....	49.2	581,000
June.....	5.87	0.76	5.11	.....	40.7	489,000	7.27	1.67	5.60	.....	85.8	925,000	5.77	1.21	4.56	.....	64.6	697,000
July.....	8.63	2.07	6.56	.....	107.6	1,150,000	8.15	1.96	6.19	.....	97.3	1,047,000	8.13	1.63	6.50	.....	85.3	920,000
August.....	2.76	1.43	1.33	.....	74.5	801,000	3.84	0.81	3.03	.....	40.2	482,000	5.29	1.96	3.33	.....	101.4	1,094,000
September.....	3.54	0.62	3.02	.....	32.6	351,000	4.06	0.41	3.65	.....	21.8	236,000	3.36	0.40	2.96	.....	22.3	241,000
Total.....	50.16	21.33	28.87	.....	.....	.....	51.89	21.38	30.51	.....	.....	.....	51.90	25.65	27.82	.....	.....	.....

Table of Stream Flow in the Perkiomen, Neshaminy and Tohickon, 1883-1897—Continued.

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MONTHS.	PEFKIOMEN, 1887-1888.						NESHAMINY, 1887-1888.						TOHICKON, 1887-1888.					
	STREAM FLOW FROM GAUGINGS.						STREAM FLOW FROM GAUGINGS.						STREAM FLOW FROM GAUGINGS.					
	Total Rainfall in Inches.	Inches Flowing in Stream.	Loss or Evaporation.	Average Loss for Years.	Cubic Feet per Minute per Sq. Mile.	Gallons per 24 Hours per Sq. Mile.	Total Rainfall in Inches.	Inches Flowing in Stream.	Loss or Evaporation.	Average Loss for Years.	Cubic Feet per Minute per Sq. Mile.	Gallons per 24 Hours per Sq. Mile.	Total Rainfall in Inches.	Inches Flowing in Stream.	Loss or Evaporation.	Average Loss for Years.	Cubic Feet per Minute per Sq. Mile.	Gallons per 24 Hours per Sq. Mile.
October	1.45	0.43	1.02	.....	22.7	245,000	1.90	0.36	1.54	.....	18.0	194,000	1.93	0.25	1.68	.....	13.3	142,000
November.....	1.61	0.40	1.21	.....	21.4	231,000	1.63	0.26	1.37	.....	13.6	147,000	1.42	0.76	1.16	.....	14.0	151,000
December.....	6.65	2.13	4.52	.....	109.3	1,177,000	6.13	2.88	3.25	.....	143.9	1,550,000	6.53	3.20	3.33	.....	166.3	1,790,000
January	5.01	3.66	1.35	.....	188.8	2,036,000	4.47	4.60	.....	.....	210.0	2,585,000	5.31	6.38	.....	.....	335.4	3,612,000
February.....	4.08	4.41	.....	.....	244.8	2,641,000	3.98	5.49	.....	.....	305.4	3,290,000	4.34	6.72	.....	.....	373.9	4,030,000
March	5.15	5.10	0.05	.....	266.6	2,876,000	5.15	4.89	0.26	.....	251.9	2,760,000	5.23	6.27	.....	.....	324.7	3,522,000
April	3.43	3.45	.....	.....	185.6	2,001,000	3.88	2.79	0.09	.....	150.8	1,627,000	4.08	4.28	.....	.....	230.6	2,470,000
May	3.16	0.92	2.24	.....	48.0	517,000	2.87	0.52	2.35	.....	27.5	300,000	3.03	0.52	2.51	.....	27.1	292,000
June.....	1.62	0.39	1.23	.....	20.8	224,000	2.34	0.22	2.12	.....	10.8	116,000	1.69	0.15	0.54	.....	8.8	96,000
July	2.77	0.25	2.52	.....	13.0	141,000	3.71	0.15	3.56	.....	7.9	85,000	3.20	0.06	3.14	.....	4.2	43,000
August.....	8.03	1.53	6.50	.....	79.4	856,000	5.78	0.64	5.14	.....	34.6	372,000	8.07	1.78	6.29	.....	32.0	391,000
September.....	7.35	3.68	3.67	197.4	2,128,000	6.93	2.63	4.30	140.9	1,518,000	8.32	5.49	2.83	293.2	3,168,000
Total.....	50.31	26.35	24.31				48.78	25.43	23.98				53.15	35.36	21.48			

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Table of Stream Flow in the Perkiomen, Neshaminy and Tohickon, 1883-1897—Continued.

MONTHS.	PERKIOMEN, 1838-1889.						NESHAMINY, 1388-'839.						TOHICKON, 1888-1889.					
	Total Rainfall in Inches	STREAM FLOW FROM GAUGINGS.					Total Rainfall in Inches.	STREAM FLOW FROM GAUGINGS.					Total Rainfall in Inches.	STREAM FLOW FROM GAUGINGS.				
		Inches Flowing in Stream.	Loss or Evaporation.	Average Loss for Years.	Cubic Feet per Minute per Sq. Mile.	Gallons per 24 Hours per Sq. Mile.		Inches Flowing in Stream.	Loss or Evaporation.	Average Loss for Years.	Cubic Feet per Minute per Sq. Mile.	Gallons per 24 Hours per Sq. Mile.		Inches Flowing in Stream.	Loss or Evaporation.	Average Loss for Years.	Cubic Feet per Minute per Sq. Mile.	Gallons per 24 Hours per Sq. Mile.
October.....	3.41	1.26	2.15	.....	64.9	702,000	3.76	1.05	2.71	.....	55.4	600,000	4.06	1.54	2.52	.....	81.0	873,000
November.....	3.42	2.46	0.96	.....	133.2	1,438,000	3.49	2.34	1.15	.....	128.9	1,389,000	3.66	3.11	0.55	.....	162.2	1,745,000
December.....	4.37	2.88	1.49	.....	148.7	1,638,000	3.72	3.16	0.56	.....	163.8	1,765,000	4.35	3.48	0.87	.....	182.2	1,966,000
January.....	3.86	3.27	0.59	.....	171.2	1,851,000	3.61	2.92	0.69	.....	153.2	1,651,000	4.43	4.38	0.05	.....	228.3	2,440,000
February.....	1.99	1.47	0.52	.....	84.9	918,000	1.90	0.90	1.00	.....	89.7	967,000	2.37	1.62	0.85	.....	87.7	946,000
March.....	3.17	3.01	0.16	.....	155.2	1,678,000	3.37	2.90	0.47	.....	149.7	1,613,000	3.67	3.86	.....	.....	200.0	2,160,000
April.....	5.05	2.07	2.98	.....	111.8	1,209,000	4.83	2.07	2.76	.....	110.6	1,193,000	4.90	2.88	2.02	.....	155.0	1,673,000
May.....	4.55	1.58	2.97	.....	82.2	885,000	4.89	1.49	3.40	.....	92.2	993,000	5.41	1.70	3.71	.....	88.7	957,000
June.....	7.16	2.65	4.51	.....	142.6	1,536,000	5.25	1.16	4.09	.....	62.5	673,000	6.94	2.29	4.65	.....	111.1	1,200,000
July.....	12.23	4.89	7.34	.....	252.5	2,786,000	12.42	5.47	6.95	.....	283.5	3,051,000	12.33	6.41	5.92	.....	334.5	3,611,000
August.....	3.99	2.48	1.51	.....	128.7	1,386,000	4.75	3.37	1.28	.....	176.6	1,900,000	4.63	3.75	0.88	.....	196.0	2,108,000
September.....	7.00	2.80	4.20	.....	151.0	1,633,000	8.56	3.51	5.05	.....	190.6	2,054,000	7.91	3.49	4.51	.....	186.0	2,007,000
Total.....	60.20	30.32	29.38	.....	.....	.....	60.55	30.34	30.21	.....	.....	.....	64.66	38.32	26.53	.....	.....	.....

Table of Stream Flow in the Perkiomen, Neshaminy and Tohickon, 1883-1897—Continued.

MONTHS.	PERKIOMEN, 1889-1890.						NESHAMINY, 1889-1890.						TOHICKON, 1889-1890.					
	Total Rainfall in Inches.	STREAM FLOW FROM GAUGINGS.					Total Rainfall in Inches.	STREAM FLOW FROM GAUGINGS.					Total Rainfall in Inches.	STREAM FLOW FROM GAUGINGS.				
		Inches Flowing in Stream.	Loss or Evaporation.	Average Loss for Years.	Cubic Feet per Minute per Square Mile.	Gallons per 24 Hours per Square Mile.		Inches Flowing in Stream.	Loss or Evaporation.	Average Loss for Years.	Cubic Feet per Minute per Square Mile.	Gallons per 24 Hours per Square Mile.		Inches Flowing in Stream.	Loss or Evaporation.	Average Loss for Years.	Cubic Feet per Minute per Square Mile.	Gallons per 24 Hours per Square Mile.
October.....	4.780	2.342	2.41	.....	122.9	702,000	5.09	2.55	2.54	.....	130.8	1,410,000	4.57	2.33	2.24	.....	121.6	1,311,000
November.....	8.665	6.670	1.99	.....	363.2	1,438,000	8.53	6.31	2.22	.....	337.4	3,635,000	8.86	7.97	0.89	.....	430.4	4,636,000
December.....	1.700	1.275	0.43	.....	117.8	1,608,000	1.88	1.88	.....	.....	98.2	1,057,000	1.99	1.92	0.07	.....	100.9	1,030,000
January.....	2.810	2.051	0.76	.....	106.9	1,151,000	2.88	1.60	1.28	.....	83.9	905,000	2.82	2.06	0.76	.....	106.4	1,148,000
February.....	4.370	3.583	0.79	.....	206.8	2,229,000	4.28	3.00	1.28	.....	171.1	1,842,000	4.73	3.78	0.95	.....	217.8	2,350,000
March.....	6.565	5.580	0.98	.....	329.5	3,123,000	5.36	5.09	0.27	.....	267.1	2,880,000	6.77	6.37	0.40	.....	353.3	3,812,000
April.....	2.795	2.509	0.28	.....	140.2	1,511,000	2.46	1.77	0.69	.....	95.5	1,030,000	2.48	1.79	0.69	.....	95.6	1,032,000
May.....	6.430	3.151	3.28	.....	165.7	1,785,000	5.20	1.51	3.69	.....	78.0	841,000	6.30	3.09	3.21	.....	158.5	1,710,000
June.....	2.400	0.936	1.40	.....	50.2	541,000	4.51	0.99	3.52	.....	57.1	616,000	3.93	0.75	3.18	.....	40.4	434,000
July.....	5.195	1.091	4.10	.....	56.1	604,000	4.47	0.63	3.84	.....	32.4	340,000	5.81	0.87	4.94	.....	46.1	498,000
August.....	6.750	1.080	5.67	.....	57.4	618,000	5.30	0.53	4.77	.....	27.2	294,000	5.75	0.92	4.83	.....	47.3	510,000
September.....	3.710	1.299	2.41	.....	70.4	752,000	2.99	0.39	2.60	.....	16.6	180,000	2.98	1.22	1.76	.....	65.7	709,000
Total.....	56.170	31.567	24.59	.....	.....	.....	52.95	26.25	26.70	.....	.....	.....	56.99	33.07	23.92	.....	.....	.....

Table of Stream Flow in the Perkiomen, Neshaminy and Tohickon, 1883-1897.

MONTHS.	PERKIOMEN, 1890-1891.						NESHAMINY, 1890-1891.						TOHICKON, 1890-1891.					
	Total Rainfall in Inches.	STREAM FLOW FROM GAUGINGS.					Total Rainfall in Inches.	STREAM FLOW FROM GAUGINGS.					Total Rainfall in Inches.	STREAM FLOW FROM GAUGINGS.				
		Inches Flowing in Stream.	Loss or Evaporation.	Average Loss for Year.	Cubic Feet per Minute per Square Mile.	Gallons per 24 Hours per Square Mile.		Inches Flowing in Stream.	Loss or Evaporation.	Average Loss for Years.	Cubic Feet per Minute per Square Mile.	Gallons per 24 Hours per Square Mile.		Inches Flowing in Stream.	Loss or Evaporation.	Average Loss for Years.	Cubic Feet per Minute per Square Mile.	Gallons per 24 Hours per Square Mile.
October.....	5.48	2.35	3.13	.....	122.	1,314,000	6.18	2.16	4.02	.....	112.8	1,215,000	6.21	3.54	2.67	.....	187.9	2,025,000
November.....	1.12	0.87	0.25	.....	47.0	507,000	1.06	0.78	0.28	.....	42.1	452,000	1.01	0.69	0.32	.....	36.8	398,000
December.....	2.71	1.14	1.57	.....	58.3	633,000	2.86	1.37	1.49	.....	70.9	764,000	2.75	1.51	1.24	.....	79.3	858,000
January.....	6.30	5.29	1.01	.....	275.9	2,971,000	6.28	5.78	0.50	.....	302.8	3,270,000	6.15	6.15	.....	.....	319.4	3,447,000
February.....	3.34	4.18	0.34	.....	241.0	2,605,000	4.61	4.47	0.14	.....	258.5	2,791,000	4.58	5.68	1.10	.....	318.0	3,431,000
March.....	6.07	4.29	1.78	.....	242.6	2,614,000	4.91	4.32	0.59	.....	226.3	2,440,000	4.79	5.03	0.24	.....	261.7	2,824,000
April.....	1.98	1.80	0.18	.....	97.3	1,048,000	1.90	1.48	0.42	.....	79.6	860,000	1.97	1.58	0.39	.....	84.5	911,000
May.....	1.99	0.65	1.34	.....	34.6	372,000	2.92	0.32	2.60	.....	16.8	130,000	2.83	0.28	2.55	.....	14.5	167,000
June.....	3.02	0.36	2.66	.....	19.4	209,000	3.46	0.24	3.22	.....	13.4	140,000	3.38	0.17	3.21	.....	10.2	109,000
July.....	7.78	0.85	6.58	.....	43.7	471,000	5.71	0.34	5.37	.....	17.4	186,000	7.49	0.90	6.59	.....	47.7	515,000
August.....	7.57	2.04	5.53	.....	106.7	1,150,000	6.73	1.95	4.78	.....	101.4	1,086,000	8.90	3.92	4.98	.....	205.1	2,214,000
September.....	2.63	1.53	1.10	.....	82.5	889,000	2.54	1.27	1.27	.....	66.0	780,000	1.37	0.94	0.43	.....	49.8	538,000
Total.....	50.44	25.35	25.09	.....	.....	.....	49.16	24.48	24.68	.....	.....	.....	51.48	30.39	22.38	.....	.....	.....

Table of Stream Flow in the Perkiomen, Neshaminy and Tohickon, 1883-1897.

MONTHS.	PERKIOMEN, 1891-1892.						NESHAMINY, 1891-1892.						TOHICKON, 1891-1892.					
	Total Rainfall in Inches.	STREAM FLOW FROM GAUGINGS.					Total Rainfall in Inches.	STREAM FLOW FROM GAUGINGS.					Total Rainfall in Inches.	STREAM FLOW FROM GAUGINGS.				
		Inches Flowing in Stream.	Loss or Evaporation.	Average Loss for Years.	Cubic Ft. per Minute per Sq. Mile.	Gallons per 24 hours per Sq. Mile.		Inches Flowing in Stream.	Loss or Evaporation.	Average Loss for Years.	Cubic Ft. per Minute per Sq. Mile.	Gallons per 24 hours per Sq. Mile.		Inches Flowing in Stream.	Loss or Evaporation.	Average Loss for Years.	Cubic Ft. per Minute per Sq. Mile.	Gallons per 24 hours per Sq. Mile.
October.....	3.53	0.56	2.97	.....	29.0	313,000	3.66	0.55	3.11	.....	27.9	300,000	3.81	0.46	3.35	.....	22.9	247,000
November.....	1.99	0.60	1.39	.....	31.4	340,000	1.88	0.56	1.32	.....	31.0	335,000	1.98	0.63	1.35	.....	33.9	366,000
December.....	4.73	2.89	1.84	.....	149.6	1,611,000	4.19	3.02	1.17	.....	157.4	1,696,000	5.09	4.28	0.81	.....	222.5	2,400,000
January.....	5.56	4.79	0.77	.....	250.1	2,694,000	5.09	5.14	0.05	.....	273.3	2,860,000	5.49	6.53	1.04	.....	340.2	3,668,000
February.....	1.25	1.17	0.08	.....	63.2	681,000	1.07	0.97	0.10	.....	53.6	570,000	1.22	1.19	0.03	.....	66.1	711,000
March.....	4.99	4.05	0.94	.....	211.6	2,280,000	4.13	3.56	0.57	.....	185.9	1,990,000	4.13	4.87	0.74	.....	254.2	2,743,000
April.....	1.79	1.16	0.63	.....	61.4	672,000	2.24	1.03	1.21	.....	54.0	580,000	1.95	0.84	1.11	.....	45.1	486,000
May.....	5.32	1.83	3.49	.....	95.0	1,023,000	5.83	1.29	4.54	.....	82.9	890,000	5.55	2.05	3.50	.....	110.5	1,192,000
June.....	3.18	0.89	2.29	.....	49.2	530,000	3.38	0.58	2.80	.....	30.4	330,000	3.20	0.70	2.50	.....	38.3	413,000
July.....	5.9	0.73	4.46	.....	39.7	428,000	4.8	0.53	4.30	.....	28.5	306,000	4.26	0.51	3.75	.....	26.3	284,000
August.....	2.69	0.76	1.93	.....	39.4	424,000	3.37	0.20	3.17	.....	10.3	111,000	3.76	0.31	3.45	.....	17.0	183,000
September.....	2.21	0.33	1.88	.....	17.3	190,000	2.59	0.11	2.48	.....	5.8	61,000	2.91	0.19	2.72	.....	14.2	151,000
Total.....	42.43	19.76	22.67				42.26	17.51	24.72				43.34	22.56	20.79			

Table of Stream Flow in the Perkiomen, Neshaminy and Tohickon, 1883-1897.

MONTHS.	PERKIOMEN, 1892-1893.						NESHAMINY, 1892-1893.						TOHICKON, 1892-1893.					
	STREAM FLOW FROM GAUGINGS.						STREAM FLOW FROM GAUGINGS.						STREAM FLOW FROM GAUGINGS.					
	Total Rainfall in Inches.	Inches Flowing in Stream.	Loss or Evaporation.	Average Loss for Years.	Cubic Ft. per Minute per Sq. Mile.	Gallons per 24 hours per Sq. Mile.	Total Rainfall in Inches.	Inches Flowing in Stream.	Loss or Evaporation.	Average Loss for Years.	Cubic Ft. per Minute per Sq. Mile.	Gallons per 24 hours per Sq. Mile.	Total Rainfall in Inches.	Inches Flowing in Stream.	Loss or Evaporation.	Average Loss for Years.	Cubic Ft. per Minute per Sq. Mile.	Gallons per 24 hours per Sq. Mile.
October.....	0.48	0.20	0.28	.....	10.8	115,000	.40	0.04	0.36	.....	21.6	23,300	0.64	0.09	0.55	.....	4.92	53,000
November.....	6.64	2.13	4.51	.....	113.6	1,218,000	7.14	1.79	5.35	.....	94.6	1,008,000	7.10	3.19	3.91	.....	171.4	1,842,000
December.....	1.88	1.22	0.66	.....	61.4	690,000	1.69	1.15	0.54	.....	60.0	646,000	1.58	1.67	0.09	.....	87.1	957,000
January.....	2.38	1.45	0.93	.....	75.7	816,000	3.13	2.00	1.13	.....	104.2	1,123,000	2.96	2.21	0.75	.....	115.9	1,250,000
February.....	5.53	4.04	1.49	.....	232.9	2,508,000	5.68	4.9	0.79	.....	284.7	3,066,000	5.88	6.64	0.76	.....	384.7	4,154,000
March.....	2.90	4.93	2.03	.....	256.2	2,767,000	2.66	4.66	.....	243.2	2,620,000	2.46	4.53	2.07	.....	286.0	2,543,000	
April.....	4.11	2.30	1.81	.....	125.0	1,343,000	4.97	2.85	2.09	.....	156.2	1,682,000	4.96	3.22	1.74	.....	172.0	1,853,000
May.....	5.36	3.27	2.09	.....	167.8	1,821,000	4.03	2.94	1.09	.....	150.4	1,663,000	4.98	3.78	1.20	.....	195.7	2,108,000
June.....	3.75	0.56	3.19	.....	29.8	321,000	3.20	0.45	2.75	.....	24.0	260,000	4.05	0.44	3.61	.....	23.5	253,000
July.....	2.00	0.30	1.70	.....	15.1	166,000	1.60	0.13	1.47	.....	6.9	74,000	2.10	0.10	2.00	.....	5.5	60,000
August.....	6.45	0.96	5.49	.....	50.8	546,000	7.41	1.12	6.29	.....	57.0	614,000	8.67	1.56	7.11	.....	81.3	878,000
September.....	3.14	0.60	2.54	.....	33.2	357,000	3.36	0.57	2.79	.....	30.8	332,000	3.20	0.83	2.37	.....	44.5	480,000
Total.....	44.61	21.96	22.66	.....			45.27	22.61	24.65	.....			48.68	28.26	20.32	.....	

Table of Stream Flow in the Perkiomen, Neshaminy and Tohickon, 1883-1897—Continued.

MONTHS.	PERKIOMEN, 1893-94.						NESHAMINY, 1893-1894.						TOHICKON, 1893-94.					
	Total Rainfall in Inches.	STREAM FLOW FROM GAUGINGS.					Total Rainfall in Inches.	STREAM FLOW FROM GAUGINGS.					Total Rainfall in Inches.	STREAM FLOW FROM GAUGINGS.				
		Inches flowing in Stream.	Loss or Evaporation.	Average Loss for Years.	Cubic Feet per Minute per Square Mile.	Gallons per 24 hours per Square Mile.		Inches flowing in Stream.	Loss or Evaporation.	Average Loss for Years.	Cubic Feet per Minute per Square Mile.	Gallons per 24 hours per Square Mile.		Inches flowing in Stream.	Loss or Evaporation.	Average Loss for Years.	Cubic Feet per Minute per Square Mile.	Gallons per 24 hours per Square Mile.
October.....	2.82	0.89	1.93	.....	45.5	485,000	3.30	0.59	2.71	.....	80.3	326,000	3.73	0.60	3.13	.....	31.9	344,000
November.....	4.22	1.84	2.38	.....	98.9	1,061,000	4.41	2.58	1.83	.....	138.7	1,491,000	4.38	2.63	1.75	.....	143.2	1,542,000
December.....	2.75	1.90	0.85	.....	94.8	1,026,000	2.78	2.61	0.17	.....	136.2	1,465,000	3.17	3.10	0.07	.....	161.5	1,738,000
January.....	1.78	0.70	1.08	.....	36.5	393,000	1.71	0.79	0.92	.....	41.0	442,000	1.82	0.80	1.02	.....	41.8	451,000
February.....	4.22	2.42	1.80	.....	140.2	1,510,000	4.05	2.68	1.37	.....	154.2	1,665,000	3.96	3.80	0.16	.....	219.0	2,360,000
March.....	1.45	2.38	.....	.....	124.2	1,336,000	1.61	2.67	.....	.....	139.1	1,498,000	1.65	3.09	.....	.....	161.3	1,738,000
April.....	2.54	1.71	0.83	.....	92.1	992,000	3.04	2.00	1.04	.....	107.5	1,160,000	2.91	2.28	0.63	.....	122.7	1,322,000
May.....	11.63	6.66	4.97	.....	346.3	3,735,000	13.49	7.41	6.08	.....	385.6	4,154,000	13.53	8.58	4.95	.....	446.4	4,808,930
June.....	3.61	1.13	2.48	.....	60.7	653,000	2.55	1.05	1.50	.....	61.4	662,000	2.63	0.53	2.10	.....	28.9	311,000
July.....	2.93	0.58	2.35	.....	30.5	328,000	3.72	0.43	3.29	.....	22.2	239,000	2.28	0.19	2.09	.....	9.8	105,000
August.....	2.23	0.34	1.89	.....	17.7	190,000	2.68	0.34	2.34	.....	17.5	188,000	2.04	0.12	1.92	.....	5.9	64,000
September.....	6.6	1.67	4.60	.....	93.1	1,002,000	8.18	2.27	5.91	.....	122.2	1,317,000	9.44	3.34	6.10	.....	179.4	1,933,000
Total.....	46.54	22.22	25.25	.....	.....	.....	51.52	25.42	26.16	.....	.....	.....	51.54	29.06	28.92	.....	.....	.....

Table of Stream Flow in the Perkiomen, Neshaminy and Tohickon, 1883-1897—Continued.

MONTHS.	PERKIOMEN, 1894-1895.						NESHAMINY, 1891-1895.						TOHICKON, 1894-1895.					
	Total Rainfall in Inches.	STREAM FLOW FROM GAUGINGS.					Total Rainfall in Inches.	STREAM FLOW FROM GAUGINGS.					Total Rainfall in Inches.	STREAM FLOW FROM GAUGINGS.				
		Inches Flowing in Stream.	Loss or Evaporation.	Average Loss for Years.	Cubic Feet per Minute per Square Mile.	Gallons per 24 Hours per Square Mile.		Inches Flowing in Stream.	Loss or Evaporation.	Average Loss for Years.	Cubic Feet per Minute per Square Mile.	Gallons per 24 Hours per Square Mile.		Inches Flowing in Stream.	Loss or Evaporation.	Average Loss for Years.	Cubic Feet per Minute per Square Mile.	Gallons per 24 Hours per Square Miles.
October.....	6.24	1.66	4.58	.....	86.4	936,000	5.25	1.48	4.77	.....	77.7	836,000	5.18	2.10	3.08	.....	169.3	1,177,000
November.....	2.30	1.85	0.95	.....	99.6	1,073,000	3.02	2.37	0.65	.....	127.5	1,374,000	3.01	2.67	0.34	.....	144.0	1,551,000
December.....	4.81	2.33	1.98	.....	117.5	1,589,000	4.14	2.31	1.83	.....	120.3	1,296,000	4.60	3.57	1.03	.....	185.8	2,091,000
January.....	4.30	3.06	1.24	.....	159.4	1,717,000	4.63	3.46	1.22	.....	177.2	1,908,000	4.19	3.96	0.23	.....	205.9	2,218,000
February.....	1.58	1.25	0.33	.....	72.0	776,000	1.12	1.77	.....	.....	102.2	1,101,000	0.96	1.70	.....	.....	98.1	1,055,000
March.....	2.96	3.91	.....	.....	203.6	2,192,000	3.17	4.26	.....	.....	221.8	2,389,000	3.11	5.37	.....	.....	279.5	3,011,000
April.....	6.12	3.18	2.64	.....	187.3	2,018,000	5.32	3.34	1.93	.....	179.4	1,932,000	5.50	4.65	0.85	.....	250.3	2,695,000
May.....	3.45	0.98	2.47	.....	51.0	549,300	2.54	0.70	1.84	.....	36.2	390,000	2.99	0.66	2.33	.....	34.1	367,600
June.....	3.55	0.43	3.13	.....	23.2	250,100	4.30	0.52	3.78	.....	27.7	298,600	4.49	0.27	4.22	.....	14.6	157,000
July.....	3.96	0.61	3.35	.....	31.8	342,600	3.74	0.88	2.86	.....	45.7	492,000	3.53	0.81	2.72	.....	42.0	452,000
August.....	3.36	0.28	3.08	.....	14.5	155,600	3.37	0.67	2.70	.....	35.1	377,000	4.43	0.38	4.05	.....	18.9	203,600
September.....	0.93	0.18	0.75	.....	9.0	97,400	0.74	0.05	0.69	.....	2.9	30,800	0.67	0.05	0.62	.....	1.9	21,300
Total.....	44.07	20.52	24.50				41.39	21.76	22.32				42.66	26.19	19.47			

Table of Stream Flow in the Perkiomen, Neshaminy and Tohickon, 1883-1897—Continued.

MONTHS.	PERKIOMEN, 1895-96.					NESHAMINY, 1895-1896.					TOHICKON, 1895-1896.							
	Total Rainfall in Inches.	STREAM FLOW FROM GAUGINGS.				Total Rainfall in Inches.	STREAM FLOW FROM GAUGINGS.				Total Rainfall in Inches.	STREAM FLOW FROM GAUGINGS.						
		Inches Flowing in Stream.	Loss of Evaporation.	Average Loss for Years.	Cubic Feet per Minute per Sq. Mile.		Gallons per 24 Hours per Sq. Mile.	Inches Flowing in Stream.	Loss of Evaporation.	Average Loss for Years.		Cubic Feet per Minute per Sq. Mile.	Gallons per 24 Hours per Sq. Mile.	Inches Flowing in Stream.	Loss of Evaporation.	Average Loss for Years.	Cubic Feet per Minute per Sq. Mile.	Gallons per 24 Hours per Sq. Mile.
October.....	3.46	0.23	3.23	.....	12.43	133,900	3.23	0.08	3.18	.....	4.23	46,100	3.85	0.09	3.76	.....	4.82	51,900
November.....	1.86	0.34	1.52	.....	20.25	218,100	2.21	0.11	2.10	.....	6.00	64,600	2.11	0.14	1.97	.....	11.76	126,400
December.....	3.13	0.91	2.22	.....	47.46	511,600	1.85	0.40	1.45	.....	20.88	225,000	2.51	0.67	1.84	.....	31.72	374,000
January.....	0.91	0.59	0.32	.....	30.90	333,000	1.31	0.59	0.72	.....	30.66	330,000	1.18	0.54	0.64	.....	27.94	301,000
February.....	5.97	3.50	2.47	.....	194.76	2,098,000	7.79	4.73	3.06	.....	263.28	2,836,000	7.90	4.53	3.32	.....	273.48	2,946,000
March.....	4.43	3.83	0.60	.....	199.1	2,143,000	5.09	4.37	0.72	.....	227.6	2,451,000	5.44	5.48	.....	285.02	3,071,000	
April.....	1.85	0.97	0.88	.....	52.1	361,000	1.63	1.07	0.66	.....	57.36	618,000	1.48	0.73	0.75	.....	39.3	423,500
May.....	3.70	0.16	3.24	.....	24.34	267,000	2.85	0.38	2.47	.....	19.8	213,400	3.18	0.30	2.88	.....	16.1	173,600
June.....	4.53	0.48	4.5	.....	25.80	278,000	4.70	0.41	4.29	.....	21.7	234,300	4.07	0.18	3.89	.....	9.5	101,900
July.....	9.31	2.01	7.30	.....	104.19	1,122,000	5.12	1.04	4.08	.....	54.3	584,400	8.06	2.54	5.52	.....	132.1	1,423,000
August.....	1.21	0.34	0.87	.....	15.81	170,200	0.98	0.20	0.78	.....	10.6	114,200	1.63	0.19	1.64	.....	9.6	103,800
September.....	5.18	0.65	4.53	.....	31.8	375,000	5.88	0.96	4.92	.....	51.6	556,000	5.83	1.12	4.71	.....	60.4	650,000
Total.....	45.54	14.31	31.23				42.67	14.34	28.33				47.24	16.56	30.68			

Table of Stream Flow in the Perkiomen, Neshaminy and Tohickon, 1883-1897—Continued.

MONTHS.	PERKIOMEN, 1896-1897.						NESHAMINY, 1896-1897.						TOHICKON, 1896-1897.					
	Total Rainfall in Inches.	STREAM FLOW FROM GAUGINGS.					Total Rainfall in Inches.	STREAM FLOW FROM GAUGINGS.					Total Rainfall in Inches.	STREAM FLOW FROM GAUGINGS.				
		Inches Flowing in Stream.	Loss or Evaporation.	Average Loss for Years.	Cubic Feet per Minute per Sq. Mile.	Gallons per 24 Hours per Sq. Mile.		Inches Flowing in Stream.	Loss or Evaporation.	Average Loss for Years.	Cubic Feet per Minute per Sq. Mile.	Gallons per 24 Hours per Sq. Mile.		Inches Flowing in Stream.	Loss or Evaporation.	Average Loss for Years.	Cubic Feet per Minute per Sq. Mile.	Gallons per 24 Hours per Sq. Mile.
October.....	4.72	1.48	3.24	.....	76.8	827,000	2.64	0.93	1.71	.....	48.4	521,000	2.67	1.06	1.61	.....	55.4	596,500
November.....	4.72	2.06	2.66	.....	110.7	1,192,000	4.13	1.52	2.61	.....	81.96	882,000	4.08	2.34	1.74	.....	125.7	1,354,000
December.....	0.65	0.81	.....	.....	42.1	453,000	0.85	0.76	0.09	.....	49.3	423,000	0.94	0.81	0.13	.....	41.7	440,000
January.....	2.05	1.18	0.87	.....	61.4	661,000	2.04	1.29	0.75	.....	67.3	724,000	2.21	1.80	0.41	.....	94.0	1,012,000
February.....	2.90	2.93	.....	.....	169.2	1,822,000	3.20	2.53	0.67	.....	146.0	1,573,000	3.11	2.93	0.18	.....	168.6	1,816,000
March.....	2.38	1.83	0.55	.....	95.0	1,023,000	2.21	1.73	0.43	.....	90.2	972,000	2.46	2.19	0.7	.....	114.0	1,223,000
April.....	3.30	1.64	1.66	.....	88.2	950,000	3.06	1.53	1.83	.....	81.4	837,000	3.20	1.55	1.65	.....	83.1	895,000
May.....	8.72	3.98	4.74	.....	207.1	2,231,000	7.62	2.76	4.86	.....	142.8	1,538,000	8.90	4.65	4.25	.....	241.5	2,601,000
June.....	3.17	0.93	2.24	.....	49.8	536,000	5.21	2.46	2.75	.....	132.4	1,426,000	5.10	1.71	3.39	.....	92.0	992,000
July.....	7.79	1.56	6.23	.....	81.0	872,000	9.10	2.96	6.14	.....	154.2	1,661,000	8.47	2.68	5.79	.....	130.5	1,504,000
August.....	2.73	0.59	2.14	.....	31.0	333,000	3.39	1.08	2.31	.....	56.4	604,000	3.75	0.73	3.02	.....	38.0	409,000
September.....	1.62	0.29	1.33	.....	15.7	169,000	1.33	0.22	1.11	.....	11.7	126,000	1.92	0.12	1.80	.....	6.4	69,000
October.....	2.06	0.22	1.84	.....	11.3	122,000	2.0	0.15	2.31	.....	8.4	91,000	1.83	0.08	1.75	.....	3.9	41,900
November.....	6.39	1.75	4.64	.....	94.1	1,013,000	5.23	1.74	3.49	.....	63.1	680,000	5.03	1.78	3.25	.....	95.8	1,031,000
December.....	4.37	2.76	1.61	.....	143.8	1,550,000	4.84	3.26	1.58	.....	169.8	1,830,000	4.64	4.08	0.56	.....	212.6	2,269,000
Total.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....

APPENDIX F.

REPORT OF CHIEF DRAFTSMAN.

BUREAU OF WATER.

Philadelphia, January 20, 1898.

MR. JOHN C. TRAUTWINE, JR.,
Chief of Bureau.

DEAR SIR:—The following report of work under my charge in the drafting room for the year 1897, is respectfully submitted.

Two hundred and four drawings, as follows, relating to the construction of buildings, boilers, engines, reservoirs, intakes, conduits, maps and profiles have been made and recorded, besides a large quantity of material relating to statistics, of which diagrams were made but not recorded.

Miscellaneous castings.. .. .	6
Plans of buildings, etc.....	9
Plans and details of Reservoirs.....	30
Special machinery.....	18
Details of engines and boilers.....	6
Surveys and maps.....	15
Pipe plans traced	21
Furniture.....	27
Illustrating various reports	72

Many of these drawings required much time and labor in perfecting them.

Specifications were prepared for work which required to be advertised. From data prepared by the Inspectors of this Bureau about one hundred and eighty calculations for boiler horse-power were made. From these calculations are determined the water rents to be paid by owners of steam boilers using City water.

During the year the photographer employed by the Bureau, and detailed to this Department, made about 3,000 blue prints of various parts of machinery, detail plans, etc., which were used at the machine shops and stations, and about 350 photographic prints, including views showing repairs at Fairmount, Roxborough and Queen Lane stations and reservoir.

Several views were taken to show the break in the 30-inch main at Twenty-third and Parrish streets, on September 30th, and views showing location of fire plugs on Worrall street, Frankford.

An arrangement for ascertaining the evaporation from water surfaces was designed and put in operation at the Queen Lane Reservoir.

Tests of the Frankford engine were made on June 16th and 19th, at which the draftsman and engineers in this Department were detailed to make observations at the weir erected at the reservoir and the Venturi meter placed in the pumping main near the reservoir.

In April last, in company with the General Superintendent, I visited Boston to inspect the pumping engine in the water supply and sewage departments of that city, a written report of which visit was made shortly afterwards.

A visit to Pittsburg was also made to inspect a condensing plant for which bids are to be asked. It is proposed to erect this plant at the Spring Garden Pumping Station so as to dispense with the separate air pumps now in use on the several engines.

The general principle upon which this condenser works is to form a vacuum in an upright column above the surface of the water which stands in the bottom of the column at an elevation equivalent to the pressure of the atmosphere, the vapor being condensed by a jet of cold water forced into the top of the column and allowed to fall by gravity through the exhaust steam brought to the condenser by a pipe from one or more engines. The condenser which we inspected at the steel works at Braddock condensed the vapor from engines at a number of different places in the works, aggregating about 3,500 to 4,000 horse-power, and produced much better vacuum than any single air pump could do, and with a great deal less expenditure of power.

The daily pumpage chart and the daily stream flow charts for hydrographic work have been prepared as in former years.

At your request I have estimated the cost of our existing works, including pumping stations, mains and reservoirs; and the result is given in the appended table. In preparing this table I have used the actual costs of construction when the records were available and where the actual cost is probably not widely different from what the present cost would be. In other cases I have estimated what it would now cost to replace the existing appliances. The estimate may therefore be taken as an approximation to what it would now cost to replace our existing works. It will be noticed that, of the total of nearly \$35,000,000 nearly \$25,000,000 is buried under ground, and, therefore, out of sight.

Yours respectfully,

JOHN E. CODMAN,
Chief Draftsman.

*Estimate of First Cost of Existing Works for the Water
Supply of Philadelphia (exclusive of Real Estate), January,
1898.*

1—PUMPING STATIONS.

A—Stations taking from rivers.

FAIRMOUNT.

	*	Date.		
Turbines, Nos. 1, 2, 4.....	13	1851	\$262,500 00	
Turbines, Nos. 5, 7, 8, 9.....	33	1870	333,108 00	\$615,608 00
	—			
	46			
Wheel House and Dam.....				409,404 00
Forebay and Mound Dam.....				75,000 00
Machine tools, etc.....				2,000 00
				\$1,102,012 00

SPRING GARDEN.

PUMPING ENGINES:

Nos. 2 and 3, Holly.....	60	1895	\$162,571 00	
No. 5, Southwark.....	20	1894	72,500 00	
No. 6, Simpson.....	10	1872	80,000 00	
No. 7, Cramp.....	20	1876	67,000 00	
No. 8, Worthington.....	10	1882	43,970 00	
Nos. 9 and 10, Worthington...	30	1884	81,000 00	
No. 11, Gaskill.....	20	1887	69,000 00	
	—			\$576,041 00
	170			
46 Boilers.....	15,000			284,488 00
Electric light plant.....				7,000 00
Donkey and feed pumps.....				5,000 00
Machine tools.....				6,000 00
Car tracks.....				3,000 00
Steam pipes.....				4,000 00
Engine house.....		1881		16,500 00
Engine-house, boiler-house and stack		1884		49,621 00
Coal-shed and storehouse		1884		20,200 00
Boiler-house		1891-2		36,595 00
Engine-house.....		1893		39,600 00
Old building				48,000 00
Forebay and conduit from river.....		1852		50,200 00
				1,176,245 00

* Daily capacity of pumps, in millions of U. S. gallons of 231 cubic inches, and indicated horse-power of boilers.

I.—PUMPING STATIONS—*Continued.*

BELMONT.

PUMPING ENGINES:

	*	Date.			
Nos. 1, 2 and 3 Worthington.	18	{ 1870 } { 1871 }	\$153,935	00	
No. 4 Worthington.....	20	1894	67,80	00	
	—				\$221,735 00
	38				
5 Boilers.....	1,500	1886	19,985	00	
7 Boilers.....	2,100	1883	23,058	00	
	—				43,043 00
	3,600				
Engine-house, boiler-house and stack.....					98,850 00
Steam pipe.....					5,500 00
Forebay and conduit from river.....					15,005 00
Electric plant.....					5,000 00
					\$389,133 00

QUEEN LANE.

PUMPING ENGINES:

	*	Date.			
4 Triple expansion, South- wark.....	80	{ 1894 } { 1896 }			\$294,148 00
24 Boilers.....	7,500	1894			85,400 00
Steam pipe.....		1894			1,000 00
Special machinery.....		1894			3,000 00
Electric light plant.....		1894			2,500 00
Electric crane.....		1894			7,435 00
Tracks, scales, coal cars and turn- table.....		1894			3,500 00
Machine tools.....		1894			1,500 00
Engine-house, boiler-house and stack.....		1894			146,542 00
Forebay.....		1894			25,000 00
Suction mains.....		1894			45,000 00
Smoke flues.....		1894			5,000 00
Boiler foundations.....		1894			5,000 00
Grading, etc.....		1894			7,000 00
					632,025 00

* Daily capacity of pumps, in millions of U. S. gallons of 231 cubic inches, and indicated horse-power of boilers.

I.—PUMPING STATIONS—Continued.

PUMPING ENGINES:		ROXBOROUGH.		
	*	Date.		
No. 2 Worthington.....	5	1869	\$70,100 00	
No. 3 Worthington.....	7	1885	50,000 00	
No. 1 Southwark.....	12	1894	82,000 00	
			<hr/>	\$202,100 00
13 Boilers.....	3,900			42,387 00
Steam pipe.....				2,000 00
Machine tools.....				5,000 00
Electric light.....				3,000 00
Donkey pumps.....				3,500 00
Engine-house, boiler-house and stack.....				87,500 00
Forebay and conduit.....				49,900 00
			<hr/>	<hr/>
				346,287 0

PUMPING ENGINES:		FRANKFORD.		
	*	Date.		
No. 1 Cramp.....	10	1877	\$46,000 00	
No. 2 Wetherill.....	10	1884	45,000 00	
No. 3 Southwark.....	22	1895	47,290 00	
			<hr/>	\$138,290 00
12 Boilers.....	3,600			66,320 00
Electric light.....				3,000 00
Donkey pump.....				2,000 00
Forebay and conduit.....				17,500 00
Engine-house, boiler-house and stack.....		1877		65,380 00
Engine-house, boiler-house and stack.....				75,500 00
			<hr/>	<hr/>
				367,990 00
Total of pumping stations drawing from rivers.....				<hr/>
				\$4,013,692 00

B—High-Service Stations.

		MOUNT AIRY.		
	*	Date.		
Pumping Engines.....	3	1882	\$6,800 00	\$6,800 00
Boilers.....		1882		4,296 00
House.....		1882		5,000 00
Machine tools.....				3,000 00
			<hr/>	<hr/>
				\$19,096 00

* Daily capacity of pumps, in millions of U. S. gallons of 231 cubic inches, and indicated horse-power of boilers.

I—PUMPING STATIONS—Continued.

CHESTNUT HILL.

	Date.		
Pumping Engines.....	$\frac{3}{4}$	.....	\$1,500 00
Boilers.....	74	.....	1,800 00
Tower, tank and engine-house.....		.....	6,700 00
			<u>10,000 00</u>
			\$10,000 00

ROXBOROUGH.

Pumping Engine, Worthington... 5	1893	\$15,000 00	\$15,000 00
Engine and boiler-house and stack..			36,590 00
Boilers.....			12,760 00
Foundation.....			5,000 00
Machine tools.....			1,500 00
			<u>70,850 00</u>

BELMONT.

Pumping Engine, Worthington. $2\frac{1}{2}$		\$4,150 00	\$4,150 00
Engine, boiler-house and stack.....			36,590 00
Boilers.....			12,760 00
Foundation.....			5,000 00
Machine tools.....			1,500 00
			<u>60,000 00</u>
Total of high-service pumping stations.....			\$159,946 00
Total of pumping stations drawing from rivers.....			4,013,692 00
			<u>\$4,173,638 00</u>

RECAPITULATION.

PUMPING ENGINES.

Fairmount (Turbines).....		\$615,608 00	
Spring Garden.....		576,041 00	
Belmont.....		221,735 00	
Queen Lane.....		294,148 00	
Roxborough.....		202,100 00	
Frankford.....		138,290 00	
		<u>\$2,047,922 00</u>	
High Service.			
Mount Airy.....		\$6,800 00	
Chestnut Hill.....		1,500 00	
Roxborough.....		15,000 00	
Belmont.....		4,150 00	
		<u>27,450 00</u>	
			\$2,075,372 00

* Daily capacity of pumps, in millions of U. S. gallons of 231 cubic inches, and indicated horse-power of boilers.

I.—PUMPING STATIONS—*Continued.*

BOILERS.

Spring Garden.....	\$284,488 00	
Belmont.....	43,048 00	
Queen Laue.....	85,400 00	
Roxborough.....	43,287 00	
Frankford.....	66,329 00	
	<hr/>	\$522,536 00

High Service.

Mount Airy.....	\$4,296 00	
Chestnut Hill.....	1,800 00	
Roxborough.....	12,760 00	
Belmont.....	12,760 00	
	<hr/>	31,616 00
		<hr/>
		\$554,154 00

BUILDINGS, INTAKES, ETC.

Fairmount.....	\$484,404 00	
Spring Garden.....	290,716 00	
Belmont.....	113,855 00	
Queen Lane.....	223,542 00	
Roxborough.....	87,400 00	
Frankford.....	153,380 00	
	<hr/>	\$1,358,297 00

High Service.

Mount Airy.....	\$5,000 00	
Chestnut Hill.....	6,700 00	
Roxborough.....	41,590 00	
Belmont.....	41,590 00	
	<hr/>	94,880 00
		<hr/>
		1,453,177 00

SUNDRIES.

Fairmount.....	\$2,000 00	
Spring Garden.....	25,000 00	
Belmont.....	10,500 00	
Queen Lane.....	23,935 00	
Roxborough.....	13,500 00	
Frankford.....	5,000 00	
	<hr/>	\$34,935 00

High Service.

Mount Airy.....	\$3,000 00	
Roxborough.....	1,500 00	
Belmont.....	1,500 00	
	<hr/>	6,000 00
		<hr/>
		\$9,935 00

Total of all pumping stations.....		<hr/>	\$4,173,638 00
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II.—RESERVOIRS AND STAND-PIPES.

	*	Date.	
Fairmount.....	26	1815	\$150,000 00
Corinthian.....	37	{ 1836 } { 1852 }	200,000 00
Spring Garden.....	13	1844	75,000 00
East Park:			
Original construction.....	1871	\$1,326,565 00	
Basin No. 1.....	1887	100,000 00	
Basin No. 2.....	1858	361,667 00	
Basin No. 3.....	685	1889	405,837 00
			2,194,069 00
Queen Lane:			
Original construction.....	383	1837	\$1,159,591 00
Repairs.....			401,000 00
			1,560,591 00
Belmont.....	40	1870	359,854 00
Belmont stand-pipe.....	$\frac{1}{10}$	1895	10,425 00
Mount Airy.....	$4\frac{1}{2}$		16,000 00
Roxborough, old.....	13	1864	75,000 00
Roxborough, new:			
Original construction.....	147	1893	532,709 00
Repairs.....			186,000 00
			659,709 00
Roxborough stand-pipe.....	$\frac{1}{10}$	1895	10,425 00
Frankford.....	36	1877	154,570 00
Lehigh.....	29	1852-71	150,000 00
			\$5,615,643 00

III.—DISTRIBUTION.

Material in use at the end of 1897, as per annual report:

Pumping and distributing mains, 484,597,147 pounds at 5c.....	†\$24,229,857 00
Fire hydrants, 11,101 at \$28.....	310,828 00
Stops, 21,419 at \$15.....	321,285 00
	\$24,861,970 00

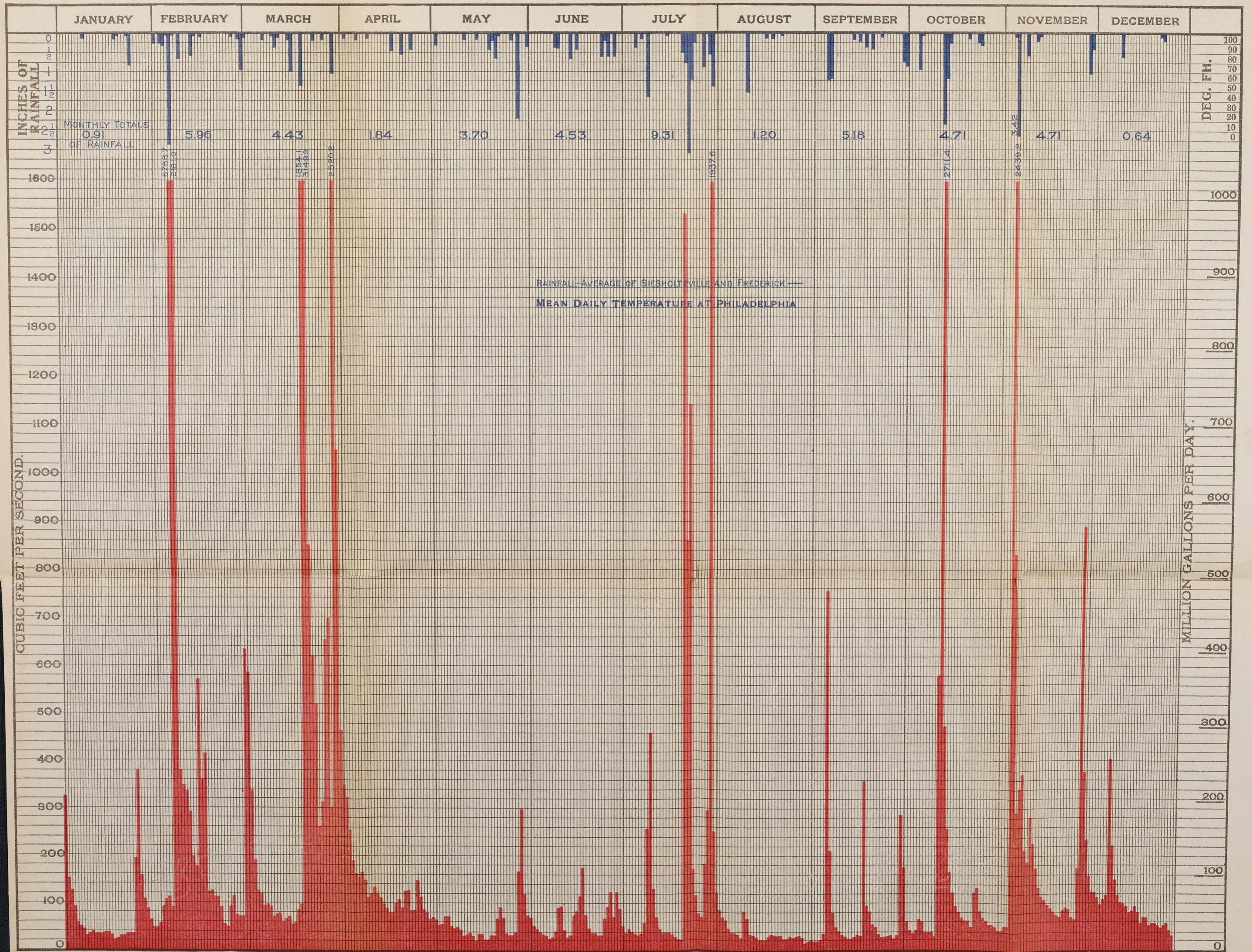
RECAPITULATION.

I. Pumping stations.....	\$4,173,638 00
II. Reservoirs and stand pipes.....	5,615,643 00
III. Distribution.....	24,861,970 00
	\$34,651,251 00

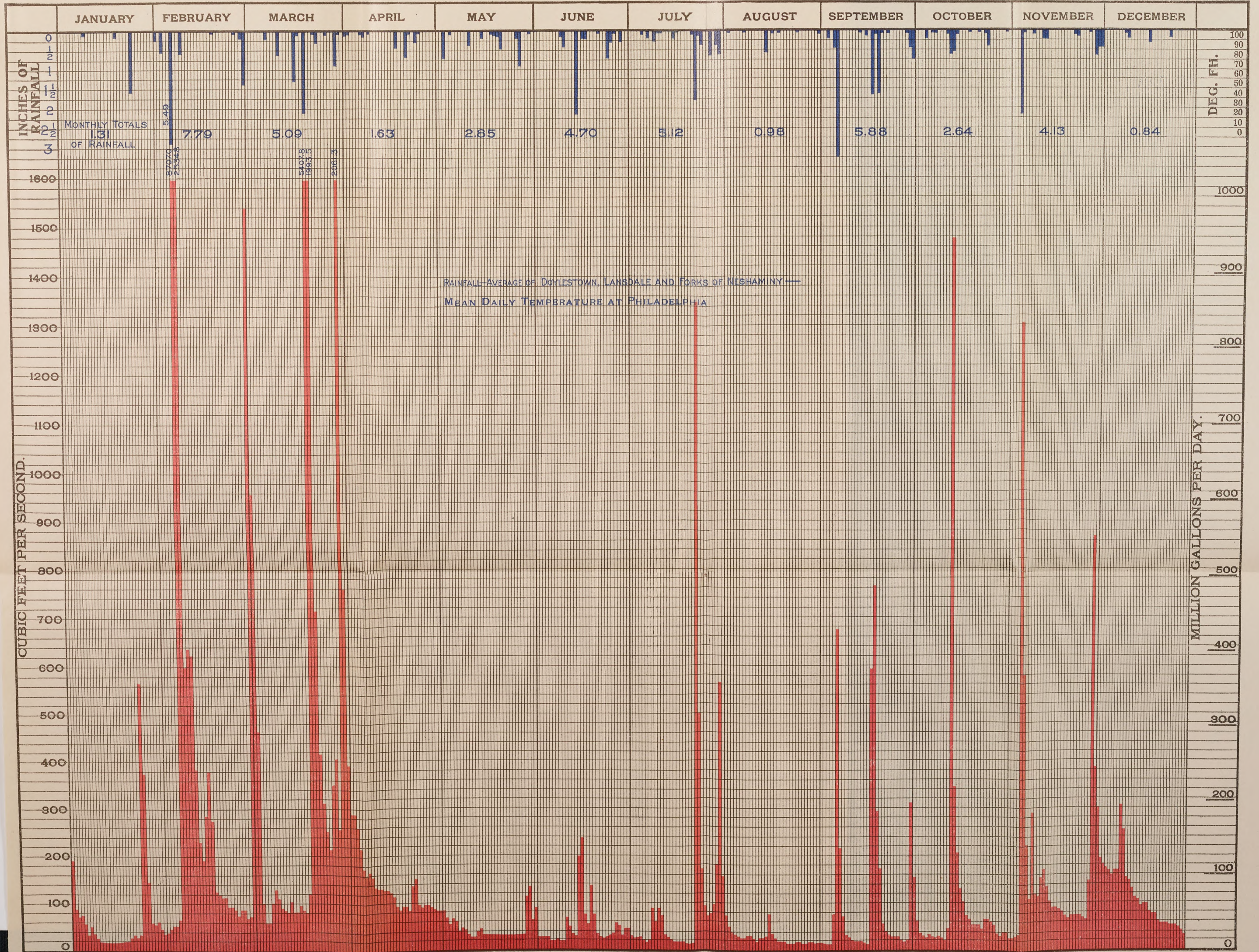
* Daily capacity of pumps, in millions of U. S. gallons of 321 cubic inches, and indicated horse-power of boilers.

† Compare table of "Distribution, Drills, Pipes, etc.," at end of report of Water Department for 1882.

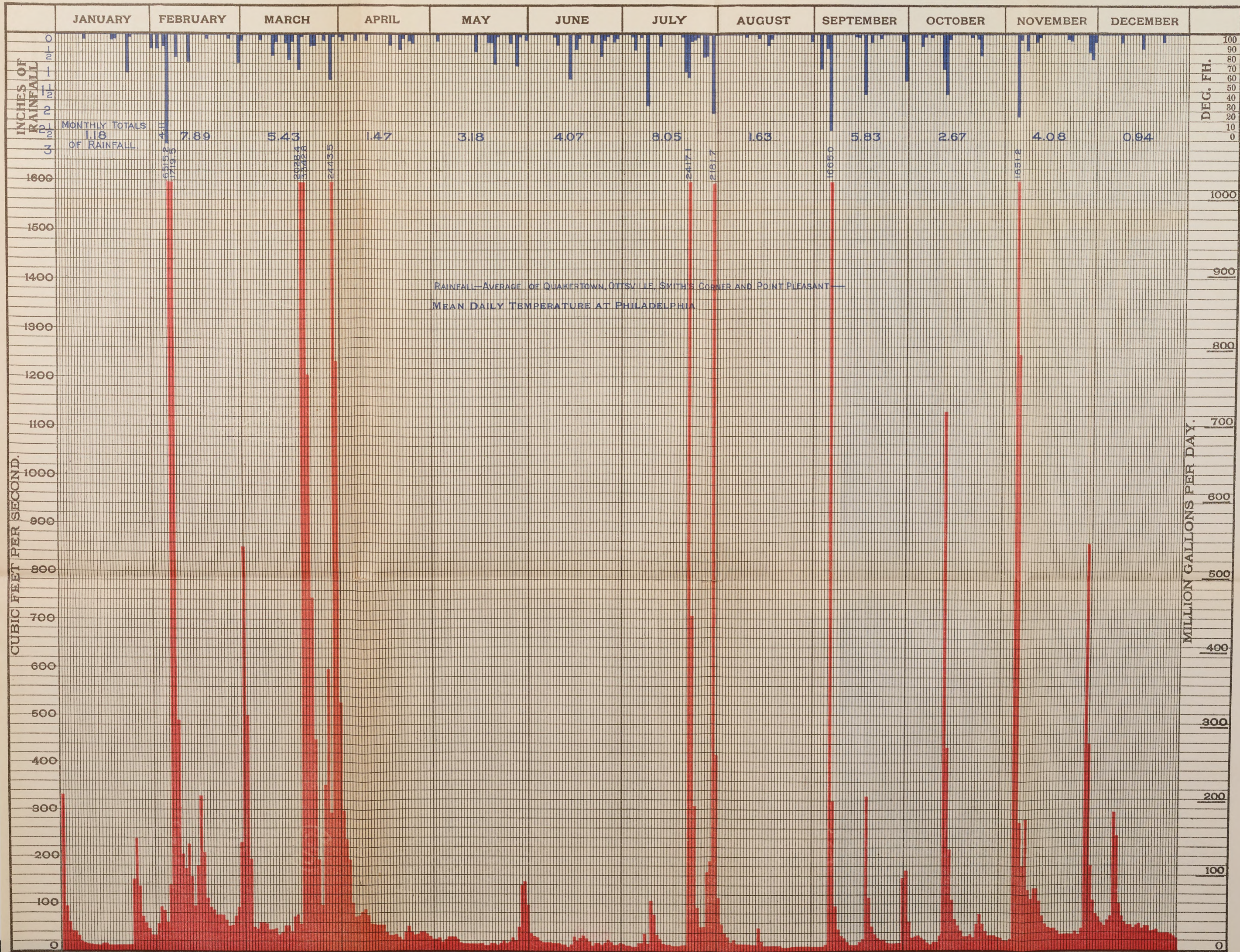
STREAM FLOW 1896.—PERKIOMEN CREEK AT FREDERICK.



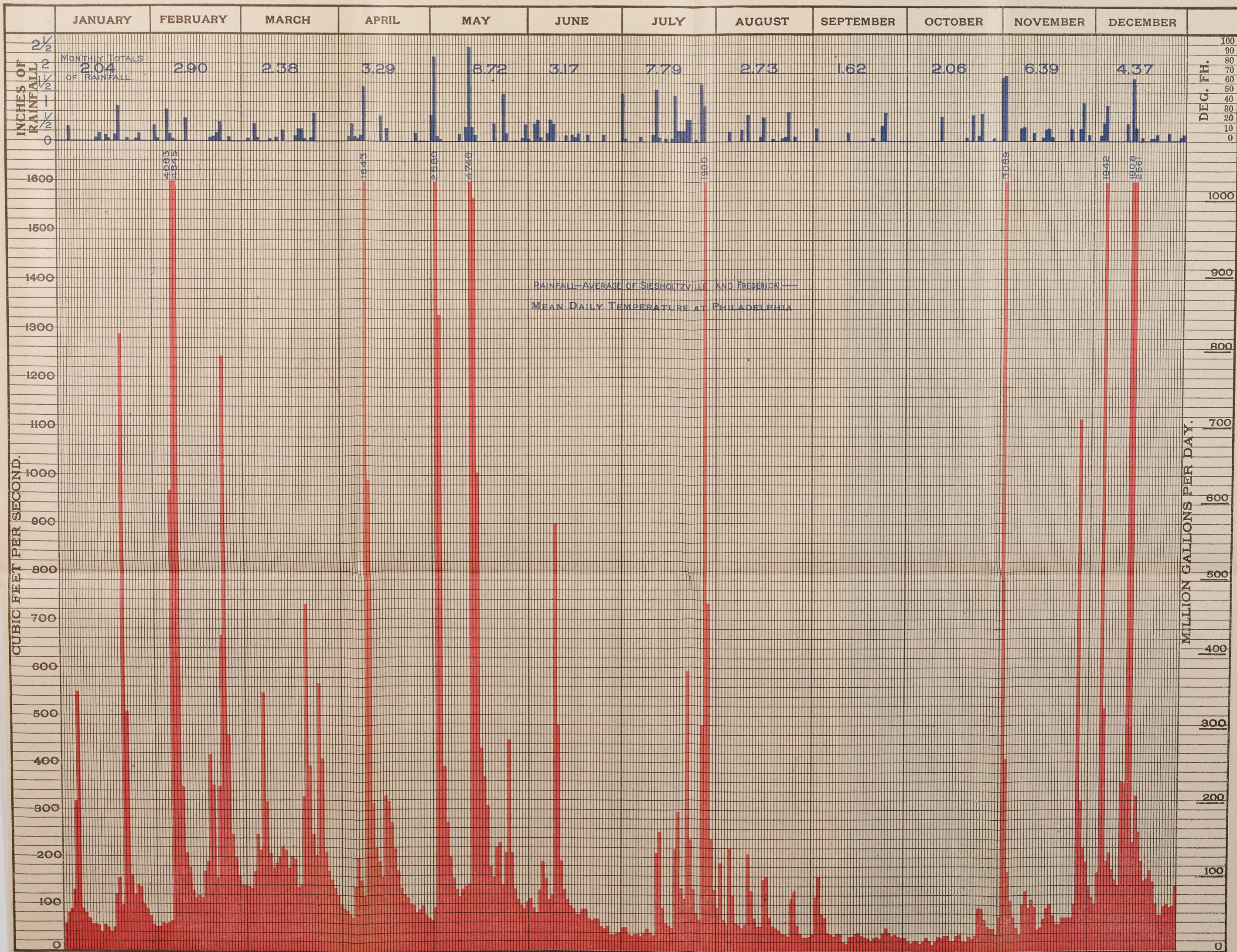
STREAM FLOW 1896.—NESHAMINY CREEK BELOW FORKS.



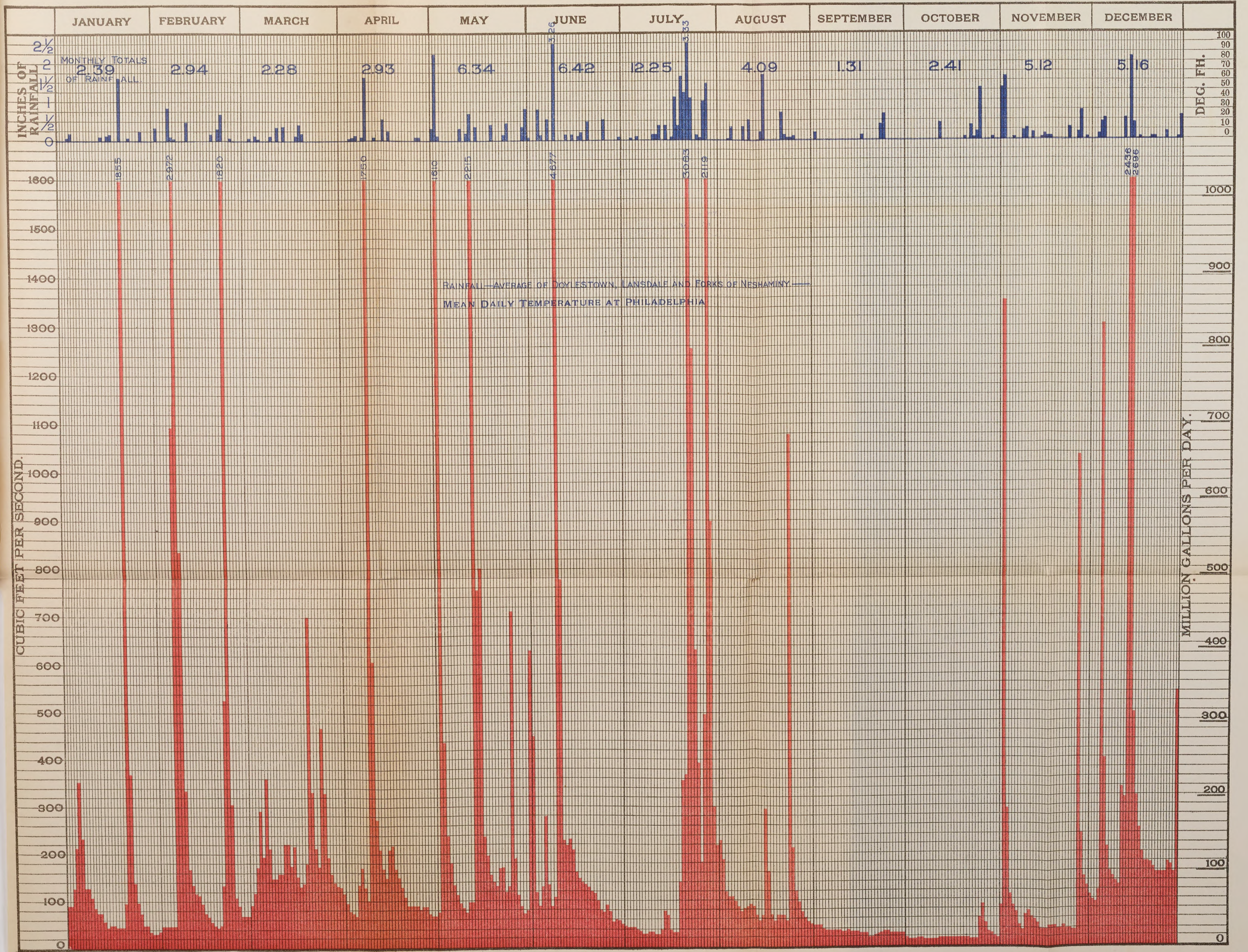
STREAM FLOW 1896.—TOHICKON CREEK.



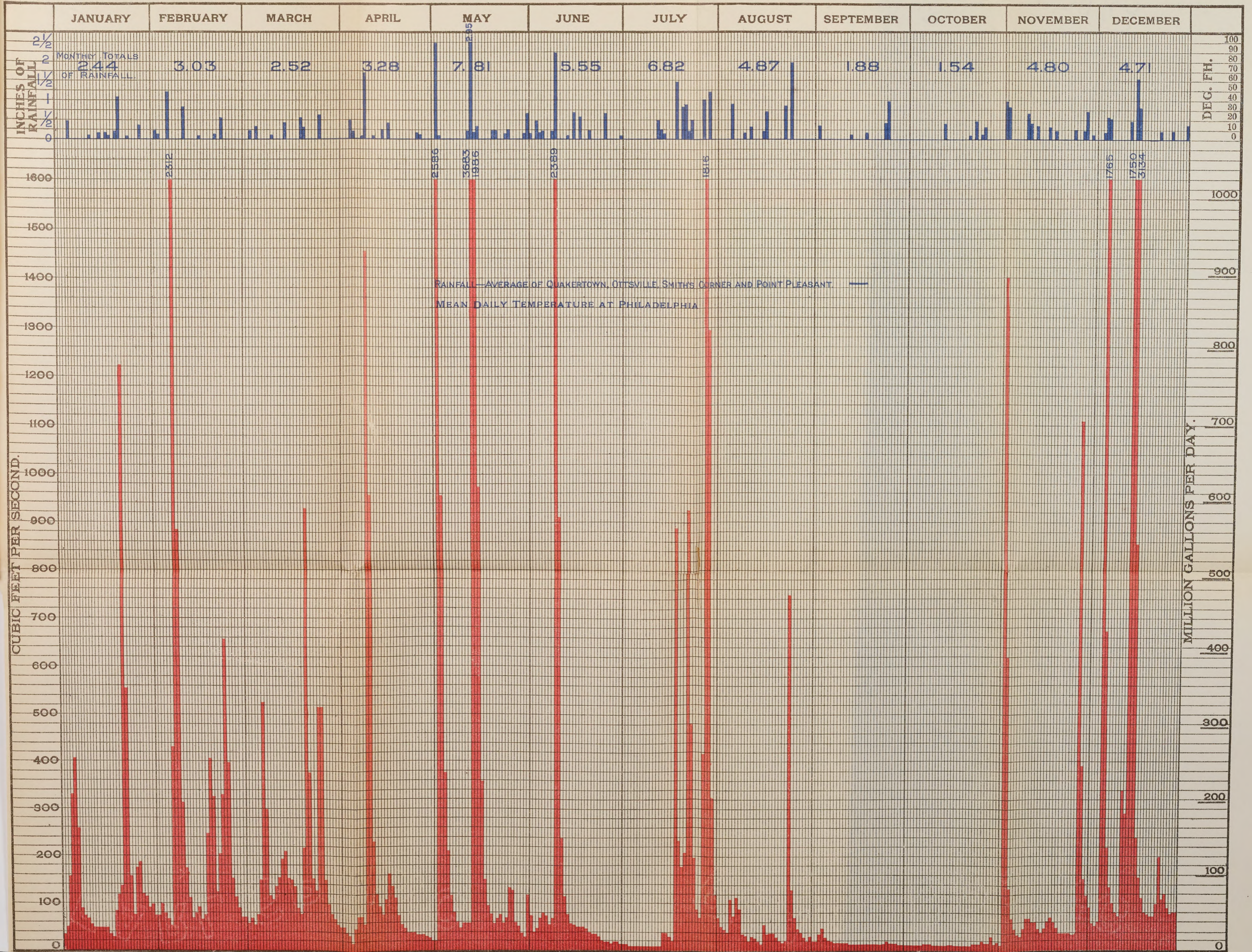
STREAM FLOW 1897.—PERKIOMEN CREEK AT FREDERICK.



STREAM FLOW 1897.—NESHAMINY CREEK BELOW FORKS.



STREAM FLOW 1897.—TOHICKON CREEK.



STREAM FLOW 1897.—WISSAHICKON CREEK.

