

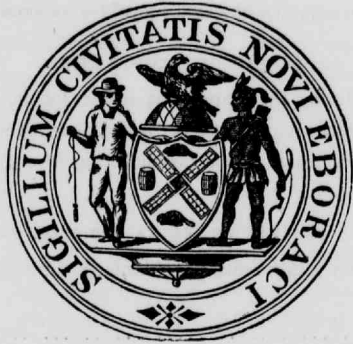
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DEPARTMENT OF PUBLIC WORKS.

Report for the Quarter ending June 30, 1879.

DEPARTMENT OF PUBLIC WORKS,
COMMISSIONER'S OFFICE, ROOM 19, CITY HALL,
NEW YORK, August 12, 1879.

Hon. EDWARD COOPER, Mayor :

SIR—Herewith I have the honor to submit the following report of the transactions of this Department for the three months ending June 30, 1879 :

SUMMARY OF EXPENDITURES.

On account of appropriations raised by taxation	\$348,870 69
On account of assessment fund for street improvements	67,300 04
On account of funded debt for improvement and extension of water supply	64,066 34
Total	\$480,237 07

Expenditures for the Corresponding Quarter for the past Six Years.

Second quarter of 1874	\$1,815,339 81
" 1875	1,316,484 95
" 1876	1,392,597 61
" 1877	798,614 37
" 1878	691,207 94
" 1879 (as above)	480,237 07

The reduction of expenditures, as compared with the corresponding quarter of last year, is \$210,970⁸⁷/₁₀₀—more than thirty per cent. Of this amount, \$52,647⁰⁶/₁₀₀ is to be placed to the account of "Repaving, under the law of 1875," the Board of Aldermen not having authorized any repaving until after June 30, while last year a large amount of this work had been accomplished before the close of the second quarter.

Expenditures for the First Six Months of 1874, 1875, 1876, 1877, 1878, and 1879.

Six months ending June 30, 1874	\$3,612,064 74
" " 1875	2,461,362 34
" " 1876	2,280,682 44
" " 1877	1,321,313 82
" " 1878	1,250,714 37
" " 1879	831,146 98

A detailed account of the several appropriations and funds, and the various items of expenditures, will be found in the financial statements "B" and "C," hereto annexed.

BUREAU OF WATER PURVEYOR.

Street Pavements.

In my last quarterly report I referred to the delay of action by the Board of Aldermen on my recommendation of March 4th, naming certain streets to be repaved out of the appropriation of \$300,000 for this year. I regret very much that the delay extended over the whole of last quarter, the resolution to authorize the repaving being finally adopted by the Board on the 8th, and approved by the Mayor on the 12th of July. The Department lost no time in advertising for proposals for the work, which were opened on July 25, and the contracts awarded to the lowest bidders. Judging from past experience the examination of sureties, signing of contracts, and arrangements of contractors to obtain large quantities of materials, will consume several weeks more, and under the most favorable circumstances it is hardly possible to complete all these pavements this year. More than four months—the best part of the season—are lost. The procurement of nearly four million paving blocks is crowded into a short space of time, enhancing the difficulties of obtaining, and probably the cost of the stone. With prompt action on the part of the Aldermen hundreds of laborers would have been employed for several months past in cutting out and laying the paving blocks, and one-half of the eight miles of streets to be repaved would now be redeemed from their rough and filthy condition.

The ordinary repairs of pavements, under the appropriation of \$150,000, have been prosecuted with all possible energy, and with considerable improvement to the condition and appearance of the streets. Without larger appropriations, however, the improvement in the pavements will be slow. We have on Manhattan Island 330 miles of paved streets, the carriageways of which cover an area of 7,639,000 square yards. About one-fourth of this is cobble, wood, and concrete pavement; 890,000 square yards is Macadam pavement, and the remainder is stone-block pavement. The remnant of the wooden and concrete pavements (about 200,000 square yards) will have disappeared when the work covered by this year's appropriations shall be completed. As to the cobble pavement, of which there are 1,714,000 square yards, it is not a proper pavement for the streets of a large commercial city; it is rough in its best condition, and under heavy traffic its surface will always be full of ruts and holes, preventing surface drainage, and favoring the accumulation of dirt and garbage.

Of the stone-block pavements a large portion has been so badly laid that it requires very frequent repairs to keep it in fair condition. The blocks are not of the proper size and shape to

present an even resistance to the pressure of wheels, and in many cases the necessary preparation of the roadbed and foundation for the pavements appears to have been entirely neglected. In making repairs such pavements are found in all parts of the city without a particle of sand under them. The pavements laid during the past three years are of a different character. The specifications were changed so as to require oblong blocks, of greater depth, laid in a good bed of sand, and joints broken so as to secure a bond and an even resistance to vehicles.

The greatest obstacle to the proper maintenance of the pavements in this city is the frequency of excavations in the streets by builders, plumbers, gas companies, and other parties who are authorized to lay and repair pipes, and to connect houses with sewers, water and gas pipes. If the pavements thus taken up were in all cases properly replaced, there would soon be a vast improvement in the condition and appearance of the streets. During the year 1878 permits were given for 2,600 excavations to make or repair sewer connections, and 9,880 excavations to make and repair water connections; and three of the seven gas companies reported 3,400 excavations in connection with their gas service. The whole number of such excavations at the present time may safely be computed at 20,000 per annum, and the impossibility of exercising such supervision over them as to insure the proper replacing of the pavements by the plumbers, builders, and gas companies must be apparent. The privileges granted by State laws to railroad, telegraph, and gas companies, in the use of the streets, are so broad that the city has little, if any, authority over them; and the moral obligation of restoring pavements disturbed by them to perfect condition, and of making their use of the streets as little obstructive and objectionable as possible, is too often disregarded by them.

To remedy the evil as far as it is in the power of the city authorities, I have caused the following ordinance to be drafted, which has the approval of the Counsel to the Corporation, and is now before the Board of Aldermen :

AN ORDINANCE to secure the proper repavement of streets, avenues and places in the City of New York, after excavations for whatever purpose, except those directly authorized by law.

The Mayor, Aldermen and Commonalty of the City of New York, in Common Council convened, do ordain as follows :

Section 1. It is hereby made the duty of the Commissioner of Public Works, whenever granting a permit for any excavation, opening, or disturbance of the pavement of the carriageway of any street, avenue or public place in the City of New York, or sidewalk thereof, except in cases where such opening, excavation or disturbance shall be directly authorized by law, to require of the person or persons by whom or for whose benefit any excavation or opening is to be made, for any purpose whatever, a deposit of such sum as shall be deemed sufficient to cover and pay all the expense on the part of the Department of Public Works of furnishing such material, doing such work, and taking such means as shall be required to properly restore and secure against sinkage the street and sidewalk pavement, curb and flagging necessary to be replaced in consequence of making such excavation, opening or disturbance; which deposit shall be a full discharge from all liability and claim against the person or persons making such deposit and payment for the work herein provided for and required of the Department of Public Works.

Sec. 2. The Commissioner of Public Works shall deposit weekly with the City Chamberlain all moneys received by him under the provisions of the first section hereof, an account of which moneys shall be kept separate and distinct from all other accounts and funds whatsoever by the Commissioner of Public Works and the City Chamberlain, who shall receive the same as a "special fund," which is hereby created and established, subject to such payments as are hereinafter provided for.

Sec. 3. Whenever any pavement, sidewalk, curb, or gutter, in any street, avenue or public place, shall be taken up it shall be the duty of the Commissioner of Public Works to restore such pavement, sidewalk, curb or gutter to its proper condition as soon thereafter as is practicable, requiring the person or persons by whom or for whose benefit the same is removed to deposit the material composing the superstructure without breaking or injuring the same, and in a manner which will occasion the least inconvenience to the public; and to fill in any excavation made, and to leave the same properly packed, rammed and prepared for the repaving required. And the said Commissioner of Public Works is hereby authorized to establish such rules and regulations as, in his judgment, he shall deem necessary for the purpose of carrying out the provisions of this ordinance.

Sec. 4. Such sums as shall be certified by the Commissioner of Public Works to have been necessarily expended by him for any repaving done pursuant to this ordinance shall be paid from the special fund hereby created, upon the requisition of said Commissioner, after examination, audit and allowance of the accounts by the Finance Department, in the same manner that payments are or shall be required by law to be made from the City Treasury, provided that the amount so certified and paid shall not exceed the aggregate amount of such special fund.

The adoption and enforcement of this ordinance will secure a great improvement in the pavements. A similar ordinance is in force in the City of Brooklyn, with very favorable results.

With the special view of applying the repair fund towards the improvement of the sanitary condition of the streets, and thus aiding the health authorities in preventing the generation of epidemic diseases, a general inspection of the streets of the city has been made, and all places noted where dirt or stagnant water is liable to accumulate on account of depressions or irregularities in the street surfaces, and these places are being repaired as rapidly and as thoroughly as the means at the disposal of the Department will permit.

By the Law of 1875, the city is authorized to expend \$500,000 annually in repaving streets, the money to be raised by general taxation. This appears a large item to be included in the annual tax levy, but in view of the large extent and area of our streets, the condition of the pavements, and the great benefits to commerce and public health from a judicious application of such a sum in replacing rough and dilapidated pavements with a smooth and durable roadway, the expense cannot be considered too great or burdensome. The people are liable to forget that prior to the passage of the Charter of 1873, when the Common Council had authority to order streets to be repaved out of the assessment fund, and assessments levied therefor on adjoining property, the expenditure for repaving was much greater, though in consequence of the bad quality of most of the pavements then laid, the work in many cases was of doubtful benefit. In the three years preceding the Charter of 1873, 557,350 square yards of pavements were laid on streets that had previously been paved, at an expense of over \$2,000,000. The reassessment of property for paving was in many instances an unjust imposition;

but the renovation of the pavements from time to time is a necessity which cannot be disregarded, and the more rapid progress we make in removing and replacing bad pavements the sooner will we be relieved of the large expense and reap the benefit of smooth and clean streets. With this view, I shall again, in making the departmental estimate for the coming year, ask the Board of Estimate and Apportionment to appropriate the full amount of \$500,000 designated by the law.

In my report for the second quarter of 1878 I presented some views on the subject of asphalt pavements of various kinds and styles. These smooth and noiseless pavements have been extensively used within the past few years in London, Paris, Berlin, and other cities of Europe, as well as in Washington, and to a less extent in other cities of this country. Small portions were laid down a few years since in Fifteenth, Eighteenth, Twenty-eighth, and Thirty-eighth streets. Last season short pieces were laid at private expense in Pine and William streets.

The London Neuchatel Asphalt Company, which has met with success in paving the streets of London and other European cities, sent an agent to this country for the purpose of introducing, if possible, similar pavements in the United States. As a trial upon a small scale I gave an order to this company to repair with concrete foundations and an asphalt covering the block in Fifth avenue, between Twenty-sixth and Twenty-seventh streets, which work has been done at a nominal cost to the city. Materials and skilled workmen were sent by the company from England, and I believe the work has been done in a style equal to the best pavements of this class in London.

BUREAU OF STREET IMPROVEMENTS.

Work is in progress under thirteen different contracts for regulating, grading, curbing, guttering, and flagging streets. The following are the more important works:

Grading Madison avenue, from Ninety-ninth to One Hundred and Fifth street; Ninety-third street, from Second avenue to East river; One Hundred and Second street, from Fifth avenue to Harlem river; One Hundred and Third street, from First to Fifth avenue; Eleventh avenue, from One Hundred and Fifty-fifth street to Kingsbridge road. Also the completion of the arch, retaining walls, etc., in Forty-second street, between First and Second avenues.

Two contracts, viz.: Grading Ninety-ninth street, from First to Third avenue, and Ninth avenue, from Sixty-third street to the Boulevard, were completed during the quarter.

The aggregate quantities of work done under this Bureau during the three months are as follows:

8,400 cubic yards rock excavation.
7,548 cubic yards earth excavation.
33,641 cubic yards filling put in embankment.
1,981 lineal feet curb-stone set.
1,411 lineal feet gutter-stone set.
20,475 square feet flagging laid.
1,541 lineal feet picket fence built.

The improvement of the Fort Gansevoort property for the purposes of a public market, as directed by a resolution of the Common Council, is in progress, under the direction of the Superintendent of Street Improvements, and will be completed at an early day.

BUREAU OF SEWERS.

The following sewers and sewerage works were in course of construction at the close of the quarter:

Sewers in One Hundred and Tenth street, Morningside avenue, West, and in One Hundred and Twenty-second street, adjoining Morningside Park.

Sewers in One Hundred and Fourth street, between Ninth and Tenth avenues; in Eighty-third street, between Tenth avenue and the Boulevard; in Seventy-third street, between Eighth and Tenth avenues; in One Hundred and Seventh street, between Fourth and Fifth avenues; in Sixty-ninth street, between the Boulevard and Ninth avenue; in Seventy-second street, between First and Second avenues; in One Hundred and Twenty-ninth street, between Seventh and Eighth avenues; in One Hundred and Twenty-eighth street, between Second and Third avenues; in One Hundred and Fourth street, between Ninth and Tenth avenues; in Lexington avenue, between One Hundred and Third and One Hundred and Fourth streets.

The force employed in repairing and cleaning sewers has performed a large amount of work, of which the following are the principal quantities:

1,268 receiving basins cleaned.
2,755 lineal feet of sewers cleaned.
2,275 lineal feet of sewers rebuilt.
22 lineal feet of culvert rebuilt.
99 lineal feet of spur pipe laid.
8 receiving basins rebuilt.
37 receiving basins repaired.
93 manholes repaired.
7 new granite basin heads furnished and set.
19 new basin covers furnished and set.
54 new manhole heads and 86 new covers furnished and set.
2,543 cart loads dirt removed.

BUREAU OF STREETS.

The uptown roadways and unpaved streets which are under the care of this Bureau have received proper attention, and have been kept in a condition to afford the necessary facilities for travel in the suburban districts. The roads which are used for pleasure driving are kept in perfect order, and are sprinkled whenever necessary for the comfort of the public.

BUREAU OF LAMPS AND GAS.

During the quarter the number of street-lamps was increased from 21,600 to 21,715.

By chapter 478 of the Laws of 1879, passed at the last session of the Legislature, the lamps in the public parks and places, hitherto under the exclusive care and control of the Park Department, are to be included in the contracts made by the Gas Commission for lighting public lamps, and this Department is charged with their care and maintenance; the Park Department retaining, however, the authority to decide when and where new lamps shall be put up and lighted in the parks. The total number of lamps thus transferred to the care of the Department is 1,276, of which 265 are in the Central Park, 36 are on the Harlem river bridges, and 975 are on the smaller parks and places. Of the total number only 637 were lighted when the transfer took place, July 1, but the Department contemplates relighting a number of those not now in use.

BUREAU OF REPAIRS AND SUPPLIES.

The improvement of the exterior of the City Hall has been continued by restoring the brown stone ashlar, and the stoop at the northerly entrance. Two fires occurred in Fulton Market on

April 16 and May 31, respectively, causing considerable damage, especially to the roof, which has been repaired at an expense of nearly \$2,000. A new felt and gravel roof has been put on a portion of Clinton Market. Work is in progress in fitting up offices in the new addition to the County Court-house. The Dog Pound has been rebuilt near the old site. Other minor repairs have been made in various public buildings and offices, markets, armories, etc.

The new Free Floating Bath has been completed, and is now in position at the Battery, where it is daily thronged with bathers.

The other public baths, six in number, were opened for the season on the 1st of June, and the total attendance to June 30 was 494,889, of which 142,287 were females.

BUREAU OF INCUMBRANCES.

This Bureau has issued during the quarter 685 notices for the removal of obstructions, 2,226 permits to place building materials on streets, 157 miscellaneous permits, and 514 notices to repair sidewalks. It also made 40 seizures of articles incumbering streets, and removed 478 cart-loads of stone and refuse material.

BUREAU OF WATER REGISTER.

The amounts collected for water rents, penalties, and for tapping Croton pipes during the quarter are as follows:

Water rents.....	\$475,131 20
Penalties.....	1,344 40
Tapping pipes.....	2,644 50
Total.....	\$479,120 10

The collection of revenue from these sources, for the six months ending June 30, are \$583,486.31, which is an increase of \$60,456.09 over the amount collected during the same period last year.

OTHER REVENUE.

The Department also collected and paid into the City Treasury:

For vault permits.....	\$8,109 56
For sewer permits.....	6,166 37
For sewer pipe sold to contractors.....	281 80
For articles removed as obstructions.....	18 00
For miscellaneous items.....	645 96
Total.....	\$15,221 69

BUREAU OF CHIEF ENGINEER OF THE CROTON AQUEDUCT.

On June 21, the natural flow of the Croton river ceased to furnish a full supply for the Croton Aqueduct, and there was drawn from the Boyd's Corner reservoir, to June 30, 112,000,000 gallons of water to make up the deficiency.

The water in the new reservoir on the middle branch of the Croton is within ten inches of the overflow. All the natural lakes and ponds tributary to our water supply are full.

In June a contract was made for sodding the outer face and top of the dam of the Middle Branch reservoir, and the work has been commenced.

The work of strengthening and improving the weak points in the aqueduct, as described in previous reports and in another part of this report, was resumed in May. At the close of the quarter, five sections of the structure which rest on embankments, having an aggregate length of 1,546 feet, had been put in complete order, and the leaks in the arch and sides at these places were stopped. With the aid of a transfer of \$20,000 from another Bureau of the Department to this account this necessary work will be carried forward more rapidly than the appropriations for the past few years would allow, and about 5,000 lineal feet of the aqueduct will be strengthened and repaired in this manner during this season.

The ordinary repairs on the aqueduct during the quarter include the following quantities of work:

252 cubic yards protection wall built.
575 lineal feet new fence built.
2,400 lineal feet fence repaired.

The repairs on one of the two lines of six-foot pipes in Ninetieth street, and in Eighth avenue, have been completed, and it is now in use.

Four contracts, embracing the laying of a large quantity of Croton pipes, have been completed, and four new contracts for such work were made. The total length of water-pipes laid during the quarter is 21,293 lineal feet. One hundred and forty new fire-hydrants were placed in position.

The work under the contract for removing the old aqueduct structure, and building the foundations for the new high-service works between Ninety-seventh and Ninety-eighth streets, near Ninth avenue, is progressing rapidly. Contracts have also been made for the engine-house, tower, boilers, and other appurtenances of these works.

At the close of last winter, the water in the Central Park reservoir had fallen sixteen feet below the top of the overflow, in consequence of the reckless waste during cold weather. To regain the proper level and pressure as early as possible, all the water from the aqueduct was turned into one of the two divisions of the reservoir, but the consumption has been so great that only eight feet of water has been gained, and with the advent of hot weather the gain has ceased. Many complaints are made of deficient pressure in the delivery of water; but the Department is distributing as much as the aqueduct can bring into the city, and relief can only be had, in the elevated parts of the city, by the completion of the new high-service works, and in the city generally, by additional conduits to the city, and the suppression of waste.

The house inspections to detect waste of water numbered 17,622 during the quarter, and resulted in the detection of 3,550 cases of leakage and waste.

The amount collected in the three months, for water supplied to shipping and for buildings in course of erection, is \$41,012.03.

THE WATER SUPPLY.

Having, in several reports since I took charge of this Department in January, 1876, given my views upon the important question of the city's water supply, and having from time to time stated the results of various surveys made in furtherance of this object, I now propose to state the conclusions at which I have arrived, and the plans proposed to be carried out by this Department for the procurement and maintenance of an adequate supply of pure and wholesome water for the city, and to present such views, generally, as have been formed after a careful consideration of the whole subject.

I have frequently called attention to the necessity of providing, without longer delay, an additional supply of water beyond that which can be furnished by the present aqueduct, though filled and

running to its utmost capacity; but defective laws, and a general indisposition to increase expenditures during the past four years of business and financial depression, have prevented the prosecution of the necessary works, and the efforts of the Department have been directed to preparatory surveys; to the maintenance of the present aqueduct, the suppression of waste, the addition of new pumping works, and to the procurement of sufficient water in the Croton basin by the aid of artificial reservoirs and the lakes of that region, so as at least to insure the filling of our single aqueduct to its maximum capacity, even in seasons of drought, and every day of the year.

During the first year of my term (1876), I was confronted with the alarming fact that the city was threatened with a water famine, from the combined effects of extraordinary drought, and an entirely inadequate store of water to meet such a contingency, arising from neglect to commence in proper time an additional reservoir. This unprecedented drought continued with unabated severity through the year 1877, and although the great reservoir on the middle branch of the Croton (commenced in the Spring of 1875) was pressed forward with all possible vigor, it was not completed and made available until the close of 1878. During these two seasons of drought it was only by great efforts in utilizing the waters of several lakes not previously drawn upon, by cutting down their outlets, that even a diminished supply was delivered in the city, and to do this the Central Park reservoir was drawn down to a depth of ten feet, while its full depth should be about thirty-four feet. This state of things caused great discomfort, and loud complaint of reduced quantity and diminished pressure. These facts were fully set forth in my quarterly reports at the time, and in appeals to the public through the daily press to avoid waste, and thus aid in averting a dire calamity. Happily in both seasons the autumnal rains brought relief before a time of complete exhaustion was reached, but had the drought continued many days longer, in 1877, the consequences would have been serious. I only allude to these past experiences now, to show how absolutely necessary it is to make timely provision for the steadily increasing demand for water in this great and rapidly growing city. Had the capacious reservoir on the middle branch of the Croton been commenced, as it should have been, three years sooner, no inconvenience would have been felt in the severe droughts of 1876 and 1877. Had the new high-service works now in course of erection in the city been commenced eighteen months ago, as I desired and intended, the inconvenience of diminished pressure in the upper part of the city during the past winter, caused by drawing down the Central Park reservoir ten feet, would have been avoided.

The time has fully arrived, and can no longer be postponed, when the works for introducing an additional supply of water must be commenced, and carried through to completion with all practicable speed. The consumption increases at the rate of about two millions of gallons a year, and, in view of the improvement in business and the growth of the city, the increased demand for water will undoubtedly be very great during the next five or ten years. As an aid in maintaining the supply and pressure, waste of water must be suppressed. The plans adopted by the Department for carrying out these purposes will be described in this report.

Provision for any considerable increase in the water supply of this city necessarily involves a large expenditure of money, and the subject must be considered and treated in a broad and comprehensive manner. Desirable as it is to reduce the city's debt and its annual tax levy, it would be false economy to falter in making the necessary expenditures to meet every reasonable demand for a sufficient and even liberal supply of pure and wholesome water. It is now more than forty years since the construction of the Croton Aqueduct was authorized and commenced. The population of the city was then but 300,000, but the authorities did not hesitate, in view of the great object to be attained, to undertake a work which cost over ten millions of dollars. The most sanguine anticipations were realized in large revenues from water rents, and in the promotion of the growth of the city, and the health, comfort, and happiness of its inhabitants. It is true that the projectors of the Croton Aqueduct counted on its adequacy to meet the demand for a period far exceeding forty years, as they did not anticipate so vast an increase in population, and certainly they underrated the increased rate of consumption which has resulted from modern improvements, the large demand for commercial and manufacturing purposes, and the not unimportant item of waste.

Had the city not been loaded with enormous debt, taxation, and assessments by the frauds and maladministration of its own officers and guardians, within a few years past, steps would probably have been taken ere this to add to the water supply, by the construction of another large aqueduct from the Croton basin. Considering that the citizens allowed themselves to be saddled with a debt of fifty millions, more or less, with but little to show for it, they would hardly have objected to an outlay of ten or fifteen millions, at the proper time, for so useful and necessary a purpose as the procurement of a liberal supply of water. Weighed down, however, by the oppressive load of debt and still further embarrassed by the depression of business and the shrinkage of values in real estate, taxpayers have been in no condition to listen to propositions for even the most useful improvements, and municipal officers have felt indisposed to call for any appropriations, except for works of the most imperative necessity. As I have before remarked, though no additional conduit has been commenced during my term of office (about three and a half years), yet some useful work has been accomplished in securing an unfailing supply for the present aqueduct, and in strengthening and repairing that structure in some of its weakest points, in suppressing waste to a certain extent, and in the preparation of plans for introducing additional supplies, and for still further suppressing waste.

Before entering upon a description of the plans proposed for increasing and maintaining the city's water supply, I would call your attention to one of the documents accompanying this report, which gives some account of the various projects from the earliest years for introducing water into the city, and of the history generally of this subject up to the present time. This paper has been prepared from authentic sources, and is made up in part of extracts from the reports of Boards and Engineers; it may prove interesting at the present time to those who would never see these obsolete documents, and will, at all events, serve to recall the labors which have been bestowed upon this important subject in the past, and perhaps to aid us in our plans for the future.

The plans and methods by which this Department proposes to increase, improve, and maintain the city's water supply, will be considered under several heads, as follows:

First—The present Croton Aqueduct: its repair and maintenance in the most thorough and efficient manner and at whatever cost. However opinions may differ as to necessities and plans for new conduits and new sources of supply, there can be but one opinion as to the duty of maintaining in perfect condition the single artery on which the life and property of the city depend.

Second—High-service works.

Third—Additional supply of water from the Bronx river valley and Rye ponds, and Byram river valley.

Fourth—Suppression of waste.

Fifth—The Housatonic river as a source of supply to a new Aqueduct.

Sixth—Storage Reservoirs.

Seventh—A new Aqueduct from the Croton basin.

Eighth—Distribution of water.

CROTON AQUEDUCT.

In the accompanying document, marked "A," will be found a description of this structure, prepared by Mr. John B. Jervis about the time of the completion of the work. It was, in the greater part of its length, constructed in a most substantial and durable manner, but experience has shown that in crossing low grounds, where the aqueduct rests upon an embankment or wall of dry stone masonry, the method of construction is defective, these walls having settled in several places from three to thirteen inches, by which cracks have been caused in the aqueduct proper. It is greatly to be regretted that a strong foundation of concrete masonry had not been prepared on which to erect these embankment walls. This course, with a better class of masonry in the walls, either dry or laid in cement, would have entailed a considerable expense, but it would have prevented any yielding of the aqueduct in a vertical direction, and have avoided the serious trouble which has arisen from this cause.

There is, however, another defect in the aqueduct itself. This perhaps cannot be called a defect in the original design when it is considered that it was not contemplated that the water line of the aqueduct would rise above the springing of the arch, so that at most, the depth of water would not exceed five feet. It was computed that this volume would furnish sixty millions of gallons daily, and provision was probably not made for delivering a greater quantity. The upper part of the aqueduct, its arch, spandrels and sustaining walls, were therefore not constructed with a view to the pressure of water raised nearly to the roof.

It is now eight or nine years since it was found necessary to carry water in the aqueduct far above the springing line. It is evident this must have been the case to meet the demand of ninety to one hundred millions of gallons daily. This increased pressure, added to the settlement of the lower walls, caused cracks in the arch, from which water leaked, and, finding its way through the dry walls to the ground, caused a still greater settlement of the embankment. Steps should have been immediately taken at that time (if not earlier) to strengthen and repair the upper portion of the aqueduct, in the manner pursued for the past three years. Had this been done we would have been saved from great anxiety, and from what might have resulted in a serious calamity. When Mr. Jervis retired from the charge of the aqueduct, he addressed the Board of Water Commissioners, earnestly impressing upon them the utmost care and watchfulness in maintaining the new structure. In the document "A," will be found extracts from this letter.

The plan of improvement above alluded to, and which is now in progress at some of the weakest points, is to lighten the pressure on the top of the arch by removing from two to three feet of the earth covering, and placing it on the outer slope. When the aqueduct was built it was thought necessary, in order to protect the work against frost, to make a covering of from four to five feet, but experience has shown that a depth of two feet is sufficient. The cracks, as far as possible from the outside, are thoroughly filled with cement; an additional ring of brick is laid on the arch, and the spandrel walls raised nearly to the level of the crown of the extrados. The retaining walls which support the earth are also raised to the upper angle of the embankment. This is all the work that can be done from the outside. When the water of the aqueduct is drawn off, the cracks are repaired from the inside, large forces of men being employed night and day in this work, and in general repairs and cleaning the aqueduct for about seventy-two hours, which is as long as the water supply can be shut off without too great a draft on the Central Park reservoir; and even this suspension reduces the level of that reservoir about eight feet.

In my annual report for the year 1878, it was stated that 3,100 feet in length of the aqueduct had then been repaired in the manner above described; and that about 19,000 lineal feet required strengthening in the same way, 9,000 feet of which should receive immediate attention. During this present season about 5,000 feet will be repaired, being all that is possible with our limited appropriation, including the additional sum of \$20,000, which has been transferred from another Bureau of the Department to this necessary work.

The most defective portions have as a matter of course been first repaired, and the good results thus far attained, inspire the hope that further ruptures may be prevented, and the settlement of the foundation walls over low grounds and valleys arrested. If, however, from any cause there should prove to be one or more places, incurable by the plans adopted, the line of the aqueduct must be changed at these points, and a new structure erected upon firm foundations, and in the most approved manner dictated by experience. I am in hopes that the necessity for this alternative will not arise, but I wish it to be understood that so far as it lies in the power of this Department nothing shall be left undone to secure and maintain the aqueduct in the highest possible state of efficiency.

To accomplish this it will be necessary to make large appropriations for the coming year. We have for the past two years failed to secure from the Board of Estimate and Apportionment the sums required to repair some of the weakest points, although I urged the necessity of the appropriations in the most earnest manner, and it has only been by the aid of supplementary appropriations, through the means of transfers from other branches of the Department, that even the present extent of repair has been effected. This Department has a very grave responsibility in the care and charge of this conduit, and it should be afforded the most liberal aid in carrying on the works deemed necessary for its thorough maintenance. Accordingly I shall ask such sum for the coming year as I think can be judiciously expended, and having done so, the responsibility must rest with the Board which ultimately decides upon the appropriations.

It is not, perhaps, practicable, nor is it necessary, to complete the entire work in one season, as the process of repair is somewhat slow, and must be conducted with careful and prudent supervision. After completing those parts demanding immediate attention, all the remainder, where the slightest tendency to settlement is observed, should be treated in the same manner, so as to arrest entirely, if it be possible to do so, all subsidence and rupture.

The total length of the aqueduct which is not built on solid ground, or in cuttings and tunnels, is a little over 8 miles, or.....	44,000 lineal feet.
Of which there will have been repaired up to the close of this season.....	8,000 "
	36,000 "
Provision should be made for 1880 to repair.....	14,000 "
Leaving for completion in another year.....	22,000 "

There should be appropriated for extraordinary repairs of the aqueduct in 1880 the sum of \$150,000. There is also required for a four-foot main in place of the larger six-foot pipes, which are unreliable, the sum of \$50,000, making altogether, for aqueduct maintenance and repairs, ordinary and extraordinary, for 1880, \$300,000.

A detailed statement of the length and other dimensions of the Croton Aqueduct will be found in Document "A" attached to this report. The distance from the Croton Dam to the Central Park

Reservoir is 38.3-10 miles. The length of masonry conduit from Croton Dam to the High Bridge is 32.88-100 miles. The total length of masonry conduit, including that portion now remaining on Manhattan Island, is 34.40-100 miles. The inner dimensions of the aqueduct are:

Extreme height, 8 feet 5½ inches.

Extreme width, 7 feet 5 inches.

Area, 53.34-100 square feet.

HIGH-SERVICE WORKS.

The late Croton Aqueduct Board, with the view of supplying the high grounds at Washington Heights and Manhattanville, caused a reservoir, tower, and pumping works to be erected near the southerly end of the High Bridge. These works were brought into use in 1871, and, an additional engine having since been provided, about three millions of gallons daily are distributed from this point. These works having a greater capacity than required at that locality (the population being yet sparse), the surplus has been delivered to other elevated districts in the upper part of the city. As the pressure of the water in Central Park reservoir has been diminished by extension of pipes, the demand for high-service water has been most pressing. It is very evident that there is a limit to such supply with the present capacity of the works. That limit has some time since been reached. It seemed to me, however, soon after I entered upon my duties, that the distribution of water on all the high grounds of the city would be greatly facilitated, and the health and comfort of citizens promoted, by erecting new high-service works on a larger scale, and without delay, on the lots previously occupied by the aqueduct between Ninety-seventh and Ninety-eighth streets, near the Ninth avenue, and which had been reserved for this purpose. Accordingly steps were taken to prepare for the work, when it was found that further legislation was required. During the session of 1877 the bill which had been introduced for this purpose failed to pass both branches of the Legislature for want of time. In the session of 1878 the necessary legislation was granted, and on December 11, 1878, the Common Council passed an ordinance prepared by this Department, authorizing the construction of the works at a cost not exceeding \$220,000. Work was commenced February 3, 1879, but the past winter was so severe that its progress has been slow. All parts of the structure and machinery are now under contract to experienced and responsible parties, and I am in hopes that the works may be brought into use by the close of this year.

The structure will embrace engine-house, stand-pipe, and a tower 170 feet in height. The superstructure to be of brick, trimmed with Wyoming valley blue sand-stone. The machinery consists of two large pumping-engines, each capable of raising seven and a half millions of gallons of water with ease 100 feet high every twenty-four hours. One engine is intended to be kept in reserve. Provision is made in the building for a third engine when it shall be required, so that in time, fifteen millions of gallons may be furnished from these high-service works daily. All the work is to be first-class, and the structure, architecturally considered, will be creditable in appearance.

There are many parts of the city so elevated that water under the ordinary pressure could only be delivered in basements or first floors, and some which are beyond reach at all by the low service.

For a work of moderate expenditure, this improvement will be of great advantage. Its need has been seriously felt for the past few years, for it has not been entirely a lack of water in certain districts, but of pressure, which has called forth complaint. The works will be completed within the original estimate of \$220,000.

ADDITIONAL SUPPLIES FROM THE BRONX AND BYRAM RIVERS.

With the view of increasing the supply of water for at least several years by some other plan than that of a costly aqueduct from the Croton basin, and which should at the same time always remain a valuable part of the water system, my attention was directed to the Bronx river and Rye ponds as a source from which a considerable supply might be obtained in a short time, and at comparatively moderate cost. A survey was accordingly made in 1877 of the watershed drained by these waters.

As the Bronx valley below White Plains embraces many villages and some manufacturing establishments, it is necessary, in order to avoid impurities, as well as to secure sufficient head, to tap the stream about three miles above White Plains, near Kensico Station, on the Harlem Railroad. Above this point the area drained is 13.33-100 square miles, including the Rye ponds, which are situated on one of the branches of the Bronx.

The various small streams which form the Bronx have their sources in the towns of New Castle, North Castle, and Mount Pleasant, Westchester county, in the hills which divide their waters from those of the Croton, the Sawmill, and Byram rivers. The country in geological formation is similar to that of the Croton valley, and the water is of the purest character.

In my letter to you of March 21, 1879, I stated that ten million gallons daily might be drawn from the Bronx river, and delivered at the city by means of an iron pipe 48 inches in diameter, for the sum of \$1,500,000. Since that time, with the view of making the supply as large and as certain as possible, the plans for storage have been enlarged, and the price of iron having also advanced, the estimated cost of the Bronx project is increased to about \$1,850,000.

In previous reports I stated that it was feasible to unite the waters of the Byram river with those of the Bronx, and thus add considerably to the daily supply. To ascertain the facts with certainty, a survey has been made this season of the Byram river. This stream, which lies east of the Bronx, rises in the State of New York, Wampus pond, and Byram pond forming the headwaters of its two principal tributaries. These unite near the Connecticut line, and thence the river, running through Connecticut, empties into Long Island sound at Portchester. The waters of the Byram, like those of the Bronx, are very pure, there being no towns or factories to pollute them above the point where the stream would be diverted. This diversion can be made within the State of New York, by means of a short tunnel of 2,600 feet, and some open cutting.

The watershed of the Byram, above the point selected for diverting its waters to the Bronx, contains an area of 8.66-100 square miles, which, added to the drainage area of the Bronx (13.33-100) gives a total available drainage area for the two streams of twenty-two square miles.

The principal cost of using the Byram waters will consist in the damages for water-rights and mill privileges, there being seven manufacturing establishments on the stream, all within the State of Connecticut. The estimated value of these will be found detailed in the annexed report of Mr. George W. Birdsall, First Assistant Engineer in charge of the Croton Bureau. If reasonable terms can be made with the proprietors of these works, the waters of the Byram may be used on the plan above proposed; but if not, we can fall back upon the Bronx project alone, at a less cost. I am in hopes, however, of making satisfactory arrangements, so that from the two streams a supply of eighteen or twenty millions of gallons daily may be obtained. As the manufacturing works upon the Byram lie within the State of Connecticut, the damages for water-rights cannot be adjudicated as provided under the laws of this State, by a commission. I have already instituted negotiations with the mill proprietors, and after tendering a reasonable compensation for the use of the waters diverted, the differences, if any, may possibly be submitted to arbitration.

As the Bronx lies wholly within the State of New York, compensation for its water-rights may be made either by agreement, or through the medium of a commission appointed by the Supreme Court, as has been done in the matter of water-rights and privileges in Putnam County.

The general plan for utilizing the waters of both the Bronx and Byram rivers is as follows:

First—To erect a dam at the outlet of Little Rye Pond, fifteen feet high, which will make one lake of the two ponds of 280 acres in extent, capable of storing one thousand and fifty millions of gallons.

Second—To erect a dam on the Bronx near Kensico, forty-five feet high, making a reservoir of 250 acres, with an available capacity of one thousand six hundred and twenty million gallons.

Third—To erect a dam across the Byram river, fifteen feet high, 1,100 feet north of the State line, which will create a lake of seventy-five acres in area, and of a capacity of 180,000,000 gallons. At this point a channel of 3,800 feet in length will be cut to unite the Byram river with the Bronx.

Fourth—To tap the water at the Kensico dam at an elevation of 210 feet above tide, and carry it through an iron pipe of four feet diameter along the valley of the Bronx to a reservoir near William's Bridge in the upper part of the Twenty-fourth Ward, its elevation being 180 feet above tide water, and 65 feet above the Croton Aqueduct, and having a capacity of one hundred million gallons. The length of this conduit will be fifteen and one-fifth miles. From the Reservoir at William's Bridge water can be delivered in pipes to the upper wards, and a connection made with the Croton Aqueduct, so as to carry the surplus to the Central Park Reservoir.

Fifth—The storage capacity of the proposed reservoirs will be as follows:

Byram Pond.....	550,000,000 gallons.
Byram Dam and Reservoir.....	180,000,000 "
Rye Ponds.....	1,050,000,000 "
Kensico Reservoir.....	1,620,000,000 "
William's Bridge Reservoir.....	100,000,000 "
Total.....	3,500,000,000 gallons.

As before stated, the drainage area of the two streams is twenty-two square miles. According to the observations for fourteen years in the Croton basin the minimum quantity per day running in the stream, and which might be collected in reservoirs, was one million gallons per square mile, which would give twenty-two million gallons daily for the Bronx and Byram District.

According to the observations at the water shed of Lake Cochituate, near Boston, the area being nineteen square miles, the average daily yield was 20,700,000 gallons, and the minimum quantity 14,300,000 gallons, which would give for the Bronx and Byram area (22 square miles) a minimum daily quantity of 16,500,000 gallons.

With the data furnished by daily observations in the Croton basin, and taking the exceptionally dry year of 1876, and the minimum yield of the Cochituate as a criterion, it is computed by the Engineer that a storage capacity of 2,500,000,000 gallons at the Bronx and Byram would furnish, in connection with the natural flow of the streams, sixteen million gallons daily. In order to increase this quantity, and to make liberal provision for the whole project, the works are planned upon a basis of three thousand five hundred million gallons storage capacity, which it is estimated will furnish an average daily supply of twenty million gallons.

It may be here stated that until within a few years the city of Boston received its whole supply of water from the Cochituate river and lake, which receive their supply from an area of nineteen square miles, while the drainage area of the Bronx and Byram, now under consideration, is twenty-two square miles.

The estimated cost of the whole work is as follows, the details of which will be found in the accompanying reports of the Engineers:

Bronx river project, including extra storage for the Byram water, and a conduit of sufficient size to carry the waters of both streams—

Land and dam at Rye Ponds.....	\$41,950
Land and dam at Kensico.....	190,612
Conduit pipe and land for same.....	1,037,400
Reservoir at William's Bridge.....	202,877
Connection with Croton Aqueduct.....	44,000
Water rights on river.....	257,000
Connecting William's Bridge reservoir with the present distributing pipes of the Twenty-third and Twenty-fourth Wards.....	72,500
For changes of gate-houses, and a new 48-inch main across Manhattan Valley.....	203,150
Add five per cent. for engineering and contingencies.....	102,475
	<u>\$2,151,964</u>

BYRAM RIVER.

Dam across Byram river.....	\$48,750
Uniting Byram river with the Bronx.....	73,290
Byram Pond.....	88,000
Water rights on Byram river.....	285,883
Add ten per cent. for engineering and contingencies.....	49,592
Total.....	<u>\$2,697,479</u>

Two of the above items, viz.: \$72,500 for connecting the William's Bridge reservoir with the distributing system of the upper wards, and \$203,150 for new gate-houses and additional main at Manhattan Valley, amounting, with the five per cent. added, to nearly \$300,000, were not included in former estimates of this project, as it was supposed they would be met from other funds. They would be necessary under any plan for increasing the water supply, and in order to make the estimate full and complete, they have been included in the estimate now presented. Deducting them from the total estimate there would remain \$2,400,000, as the cost of the Bronx and Byram plan proper.

The above detailed estimate amounts to \$2,697,479, and although it seems to be liberal as to quantities and prices, yet in view of the possible increase in the cost of iron pipe, which constitutes a large item of the work, and because long experience has taught me to make full allowance for works of such magnitude, I shall state its total cost in round numbers at three millions of dollars.

The only other way in which twenty million gallons daily can be supplied is by the construction of a new aqueduct from the Croton basin. Such a work would require several years to complete it. It would cost, including two new storage reservoirs, twelve millions of dollars. A reinforcement of water is needed in the shortest possible time. The interest on the extra cost of a new aqueduct over the conduit now proposed would amount to more than \$400,000 per annum, which in a few years would equal the cost of the lesser work. It is true such interest charge must be met when a new aqueduct is built, as built it must be before a great many years, but I am not without hope, by the measures proposed for suppressing waste taken in connection with the additional supply from the Bronx and Byram, that the necessity for constructing a new aqueduct may not arise for several years—how many I cannot undertake to say, as this will depend upon the success of the measures to suppress waste.

There are undoubtedly some strong arguments in favor of a new and large aqueduct, chief of which is that this great city should not be dependent on a single line for its water supply, and that the use of the new one would permit the water to be drawn from the present aqueduct, to repair, strengthen, and protect it in the most efficient manner. After a full consideration of the subject, I have come to the conclusion that it is wise to proceed at once with the Bronx river project. It might have been commenced earlier but for the doubt which existed as to the legal authority to do so. This has been relieved by a law passed at the last session of the Legislature, chapter 516, entitled An act to amend chapter 445 of the Laws of 1877, to perpetuate the right and title of the City of New York to property, water, water-rights, etc.

Chapters 56 and 328 of the Laws of 1871, chapter 476 of the Laws of 1875, chapter 445 of the Laws of 1877, and chapter 516 of the Laws of 1879, all relate to this subject, and authorize the Commissioner of Public Works to expend such sums as he may deem necessary, not exceeding a million dollars in any one year, for increasing the water supply of the City of New York. Under this limitation about three years would be consumed in completing the conduit and other necessary works which have been described in this branch of my report. This time might be somewhat shortened if the limit of one million per annum could be exceeded. The laws provide for meeting the expense by an issue of bonds.

SUPPRESSION OF WASTE OF WATER.

In the accompanying "Document A" will be found statements in regard to the waste of water, a habit which seems to have been commenced a few years after the introduction of Croton water into the city. Year after year the officers in charge of the water department enjoined greater economy, but with little or no effect.

While a sufficient and even liberal supply should be furnished, waste should and must be suppressed. Something has been done in this direction within the past three years by increasing the number of meters; by house to house inspections, and by the supplying of water to shipping, and to buildings in course of erection, directly by the Department instead of through a contract.

The present condition of our water supply, the probable rapid growth of the city within the next three years, and the fact that until the end of that time no increased supply can be obtained, demand that radical and decisive measures should be taken to suppress waste. The present aqueduct is running to its full capacity—about ninety millions of gallons daily. This quantity must suffice until a reinforcement can be obtained, no matter how much the population may increase.

The Commissioner of Public Works is authorized to place meters "in all stores, workshops, hotels, manufactories, public edifices, at wharves, ferry-houses, stables, and at all places where water is furnished for business consumption." Under this authority, circulars have already been issued to many large establishments, requiring meters to be placed therein, and skillful persons have been designated to act under the Engineers of the Croton Bureau in carrying out these orders with all possible dispatch. About ten thousand places have already been selected, and when these shall have been metered, I anticipate favorable results.

It has not been considered desirable to place meters in private houses, and yet there is undoubtedly great waste in such buildings. Without resort to meters, I am in hopes that a system which I have had under consideration for some time, may be applied to the suppression of waste in private dwellings. Mr. Benjamin S. Church, who for over twenty years has been one of the assistant engineers of the Croton Aqueduct Bureau, has devised a portable waste water-gauge, which, when applied to the service-pipe connecting the mains with houses, shows instantly, by figures upon its face, the quantity of water per hour running in the service-pipe. A stop-cock and pipe at the curb will be required at every house. The greatest waste occurs at night, particularly in the winter season. During the past cold winter the drafts in this way were so great that the Central Park reservoir lost ten feet in depth, which caused widespread evil. By means of the waste water-gauge, applied at night, the amount running to waste in any house can be instantly detected. It would not be known where or when it would be applied, but the knowledge that inspectors with the gauge were making their silent rounds would result in vast saving, and in measures on the part of householders to protect their pipes and to stop a reckless extravagance which has already cost the city so much money, and caused so great inconvenience and discomfort. The cost at each house of stop-cock, box, and cover, would probably not exceed ten dollars—perhaps less.

This method is in some respects similar to the Deacon system, which has met with much success in Liverpool, Manchester, Glasgow, and other cities of Great Britain. The arrangement of the mains in this city does not admit of the application of the Deacon system, but Mr. Church's plan seems to have the advantage of ascertaining directly at each house the exact measure of waste. I propose to try this plan upon about one hundred houses, to ascertain its workings and effect. If successful it can be extended as deemed advisable.

I have in previous reports urged that the service pipes in the houses should be protected against frost, and placed under the supervision, either of the Croton Bureau or the Department of Buildings. If the present laws are not sufficient, additional and stringent laws should be passed and rigidly enforced.

With all the measures above suggested, and with the construction of the Bronx conduit, great improvement may be anticipated in the water supply and pressure. It will take some time to carry them all into execution, but the necessity of the case demands that no time shall be lost in their early commencement and completion.

THE HOUSATONIC RIVER.

With the view of ascertaining with certainty the practicability of using the waters of the Housatonic, in aid of the supply for a new aqueduct from the Croton basin, I directed a survey to be made in 1878, and now present herewith the final report of Mr. Horace Loomis, the Assistant Engineer charged with this duty. The results may be stated as follows:

Three experimental lines were traced upon the ground, the plan contemplating the delivery at the head of the Croton, of about one hundred millions of gallons daily.

First Line—The initial point is near Fall's Village, in Connecticut, and just below the dam of the Housatonic Railroad Company, at an elevation of 622 feet above tide. The line by an open canal follows the valley of the Housatonic to Salmon Brook; thence up the valley of the latter stream to the ridge dividing the Housatonic from the Weebatuc, a branch of the Ten Mile river. Here a tunnel two and a half miles long is required, after which natural water-courses can be used for a distance of more than eight miles. Entering the State of New York, an artificial canal again becomes necessary, and is recommenced at an elevation of 460 feet above tide. From this point it is located in the valleys of Ten Mile river and Swamp river, to Pawling, where it would discharge into the Croton.

The length of this line within the State of Connecticut is 12.31 miles.
In New York 28.82 "

Total 41.13 miles.

Which is divided as follows:

Open canal.....	30.19 miles.
Tunnel.....	2.50 "
Natural water courses.....	8.44 "
Total.....	41.13 miles.
Engineer's estimate cost.....	\$2,188,688.45.

Second—The other two lines are identical from the head of the Croton to a point opposite Bull's Bridge on the Housatonic. Above Bull's Bridge the second route follows the valley of the Housatonic to West Cornwall, where it receives the waters of the Housatonic. The Ten Mile river is crossed at an elevation of 126 feet, and other large ravines are encountered, which render the work expensive.

The West Cornwall line is 26.8-10 miles long, consisting entirely of open canal. Its estimated cost is \$1,894,209.47.

Third—The third route, starting from Bull's Falls on the Housatonic, is the shortest, being 14 77-100 miles long. The water of the river, however, must be raised by pumping to a height of 106 feet to the head of the canal, whence it would flow by gravity in an open channel to the Croton basin. This line was examined with the view of raising the water by means of water power, but in low stages of the river the power would be entirely inadequate to raise one hundred millions of gallons daily to the required height, thus compelling a resort to steam power.

The estimated first cost of the third line is \$1,762,852.08, but the annual cost of steam power would be so great that this line may be considered impracticable.

A canal from the Housatonic to the Croton basin, on either the Fall's Village or West Cornwall route, would necessarily be located for several miles along steep hillsides, and at great elevation above the level of the streams, and the work of construction would be very expensive.

To enable the Croton river, from Pawling southerly, to carry the increased volume of water contributed by the canal its channel must be widened and deepened, at a cost, as estimated by the engineers, of \$81,312.

The area of country drained by the Housatonic river, according to the best data at command, is as follows:

Above Fall's Village, 631 square miles.
Above West Cornwall, 709 square miles.
Above Bull's Bridge, 790 square miles.

The average daily flow of the river for the season from May to November, as gauged by Mr. Loomis, was 300,000,000 gallons—the maximum 470,000,000 gallons, and the minimum 170,000,000 gallons. In seasons of great drought the flow would no doubt be much reduced.

Although the route leading from Fall's Village is the longer, and encounters a tunnel of two and a half miles, yet, as it avoids the crossing of some very deep and wide valleys, I think it would be found the preferable line on a final and careful location. It would also receive the waters of the Weebatuc, which drains an area of forty square miles.

The canal is planned to have an area of eighty square feet, and a descent of one foot per mile. This section and slope, it is computed, will furnish one hundred million gallons daily. The estimates of cost give about two millions of dollars for either route, but as the work is heavy, and difficult to be estimated with great accuracy on a preliminary survey, its probable cost, including water-rights, may be stated at two and a half millions of dollars.

It must be understood that this estimate provides merely for leading the Housatonic waters to the Croton basin as a feeder to a new and large aqueduct, when it shall be built. It will then become a question of comparison between the Housatonic project and the construction of several storage reservoirs on the Croton. When that question comes up for decision, the survey of the Housatonic, with the reports, maps, and plans which will be placed upon record, will furnish valuable information.

As there are several manufacturing works on the upper Housatonic in Massachusetts, the Engineer was instructed to examine the matter. His special report thereon is also hereto annexed.

Professor Chandler, at my request, has kindly analyzed the water taken from the Housatonic at Fall's Village. The following table exhibits the result in comparison with Croton water:

One U. S. gallon of 231 cubic inches contains—		
	HOUSATONIC.	CROTON.
Chloride of sodium.....	0.2019 grains.	0.284 grains.
Sulphate of potash.....	0.1300 "	0.205 "
" soda.....	0.1842 "	0.024 "
" lime.....	0.0489 "	0.024 "
Carbonate of lime.....	3.0362 "	1.698 "
" magnesia.....	1.5430 "	0.935 "
Alumina and oxide of iron.....	0.0816 "	0.058 "
Silica.....	0.5540 "	0.222 "
Organic and volatile matter.....	0.5832 "	0.874 "
Total solids.....	6.3630 "	4.324 "
Hardness.....	3.6 degrees.	2.5 degrees.
Parts in 1,000,000:		
Free ammonia.....	0.0210	0.0700
Allumenoid ammonia.....	0.0674	0.2450

The Engineer, after quoting the language of Dr. Chandler and others, on the subject of the pollution of rivers, says:

"It is therefore plain that no defilement can result to the waters of the Housatonic at Fall's Village, from factory or other refuse discharged into the river at a point at least seventeen miles distant. The result of the analysis is abundant proof of this. If we consider that from this point the water is designed to be carried forty-one miles in an open canal, and thence thirty-five miles by the Croton, before it reaches the aqueduct, there can be no doubt that the water of this river will be a valuable addition to the Croton, and eminently fit to form a part of the water supply of New York."

STORAGE RESERVOIRS.

Artificial and Natural.

The reservoirs and lakes within the Croton basin, and now available for storage purposes, are as follows:

	Gallons.
Boyd's Corners Reservoir.....	2,727,000,000
Middle Branch Reservoir.....	4,004,000,000
Lake Mahopac.....	575,000,000
" Kirk.....	565,000,000
" Gleneida.....	165,000,000
" Gilead.....	380,000,000
" Waccabuc.....	200,000,000

	Gallons.
Lake Tonetta	50,000,000
Barrett's Pond	170,000,000
China "	105,000,000
White "	100,000,000
Pine "	75,000,000
Long "	60,000,000
Peach "	230,000,000
Cross "	110,000,000
Haines' "	25,000,000
Total gallons.	9,000,000,000

Of which the artificial reservoirs furnish 6,700,000,000 gallons, and the natural lakes 2,300,000,000.

The minimum flow of the Croton river being twenty-seven millions of gallons a day, and the capacity of the present aqueduct ninety-five million gallons, it follows that the reservoirs will be required to furnish sixty-eight million gallons daily, which they are capable of doing for 132 days, so that a full supply to the present aqueduct is assured even in seasons of extraordinary drought.

The two large artificial reservoirs already built, one upon the west branch, and the other upon the middle branch of the Croton, are works of great magnitude, and have cost together the sum of \$1,510,000.

In the years 1857 and 1858 the Croton Aqueduct Board caused an accurate survey to be made of the Croton watershed, with the view of locating the most available sites for storage reservoirs. Fifteen sites were reported as eligible, with drainage areas and capacities as follows:

RESERVOIR.	DRAINAGE AREA—SQUARE MILES.	CAPACITY—GALLONS.
A	20.45	5,211,000,000
B	15.20	1,701,800,000
C	13.71	6,589,100,000
D	41.95	9,033,600,000
E	20.37	3,370,000,000
F	12.51	6,120,300,000
G	20.90	4,860,000,000
H	75.46	2,490,062,500
I	70.52	4,205,820,654
J	11.91	2,314,074,700
K	78.90	5,671,449,219
L	26.86	2,328,217,733
M	23.34	4,392,131,445
N	30.96	1,676,049,171
O	17.32	2,182,337,109

Total drainage area of the basin 339 square miles.

Of the above, E (Boyd's Corners), and G (Middle Branch), reservoirs have been built and are now in use. When a new aqueduct is built, selections can be made from the proposed sites for the additional reservoirs required, as may from time to time be necessary according to the increasing demand of the city.

The following table, prepared from daily observations for several years by the Engineers of the Croton Bureau, shows the rain-fall and the average daily quantity of water running in the Croton river:

YEAR.	RAINFALL AT BOYD'S CORNERS RESERVOIR.	AVERAGE DAILY FLOW OF THE CROTON RIVER AT CROTON DAM.	PERCENTAGE OF RAINFALL RUNNING IN THE STREAM.
	Inches.	Gallons.	Per Cent.
1866	51.77	440,705,558	51.
1867	50.77	541,318,397	65.
1868	50.33	600,524,194	74.
1869	48.36	456,575,841	58.
1870	44.63	347,935,318	47.
1871	48.94	357,175,341	45.
1872	40.74	307,208,408	49.
1873	43.87	444,236,877	67.
1874	42.37	427,638,306	63.
1875	43.66	425,021,738	59.
1876	40.68	367,872,936	56.
1877	46.03	346,503,178	45.
1878	54.14	462,854,308	52.

From which it appears that the greatest average daily flow was six hundred million gallons, the general daily average for the fourteen years was three hundred and ninety-four million gallons, and the minimum average daily flow was three hundred and seven million gallons. Allowing that the present aqueduct receives one hundred million gallons daily, there would remain a surplus of over two hundred million gallons daily (even in the driest year), which now runs over the Croton Dam into the Hudson river. When another aqueduct is built from the Croton basin, it will be necessary to build several storage reservoirs (constructing them from time to time, as required by the growth of the city), to insure an adequate supply in the driest seasons.

These observations also show that about one million gallons daily may be safely counted on for collection and storage for each square mile of drainage area, even in years of greatest drought. The drainage area of the Croton basin is 339 square miles. The daily average flow of the river in 1876, a year of extraordinary drought, was three hundred and sixty-seven million gallons. Taking this year as a criterion, it is estimated that forty thousand million gallons must be stored, to meet a daily demand of two hundred and fifty million gallons. The cost of storing water by means of artificial reservoirs will depend upon the site, length, and height of dam, shape of the basin, plan, etc. The cost of the new reservoir on the middle branch of the Croton (a favorable site) has been \$660,000, and its capacity being four thousand millions of gallons, the cost per million of gallons stored is \$165.

It is estimated that the average cost, per million gallons, of all the reservoirs projected in the Croton basin, will be \$200.

NEW AQUEDUCT FROM THE CROTON BASIN.

My predecessor, General Porter, caused surveys to be made in the year 1875, with a view to the construction of a new aqueduct. His report, with those of the engineers, were never published in documentary form, though the Commissioner's report appeared in full in some of the daily papers.

No examinations on this subject have been made during my term, and I shall merely allude to it now in respect to the method of supplying it with water, whether by resort to storage reservoirs alone, or in part to the Housatonic river.

The plan of General Porter is an aqueduct one-half larger than the present conduit, and calculated to deliver 150,000,000 gallons daily, or 250,000,000 gallons by both aqueducts, being a sufficient supply for two and a half millions of people, or upon a supposition of decreasing waste probably of three millions of inhabitants. The daily average quantity of water running in the Croton river, at the dam, in the driest year, is over 300,000,000 gallons, of which the present aqueduct will require one-third, leaving 200,000,000 gallons as the quantity now discharged into the Hudson. I have stated the minimum average flow at 307,000,000, which occurred in the year 1872. In 1876, a year of great drought, the average daily quantity for the year was 367,000,000. It therefore seems safe to count upon 250,000,000 gallons, with the aid of sufficient storage.

The present amount of storage capacity, including the natural lakes, is nine thousand million gallons, which it is estimated will, in addition to the natural flow of the river, be sufficient to fill the present aqueduct every day of the year.

To supply another aqueduct with 150,000,000 gallons daily, also upon the basis of the driest years, additional storage to the extent of about thirty thousand million gallons must be provided. This, at \$200 per million gallons, would cost six millions of dollars, though it would only be necessary to construct the reservoirs from time to time, as the consumption increased; or, if the Housatonic project should be adopted, the amount of storage capacity required would be very much reduced.

General Porter estimates the cost of the new aqueduct at ten millions of dollars, exclusive of the cost of the additional storage reservoirs required.

The city must be prepared before many years to construct this new aqueduct. With an honest government, and a wise, prudent, and enlightened management of its finances, the cost of such a work will then bear with comparative lightness upon a population of increased numbers, and upon taxable property largely augmented in value.

Meantime it will be well to give the plan and location of the work in all its branches careful and exhaustive study, so that in good time it may be ready for construction. The cost of surveys, even the most elaborate, is an insignificant fraction in a work upon which many millions must be expended, and upon which such vast interests will depend, and by such small outlay the best and most economical line would be obtained, and the safety and the permanency of the structure most certainly assured.

With the three conduits which have been spoken of in this report, New York will possess a magnificent water system, capable of supplying, in most liberal measure, the demands of three millions of people.

DISTRIBUTION.

With a view of ascertaining whether any improvement could be made in the present system of distributing water throughout the city, I directed the Chief Engineer of the Croton Aqueduct, in May, 1878, to report upon the subject.

Julius W. Adams, the late Chief Engineer of the Brooklyn Water Department, was designated to make the necessary investigations, and on the first of August he made an elaborate report, which, as a matter of interest in connection with the whole subject of the water supply, I submit with this report.

Since 1864 the number and area of mains leading from the Central Park Reservoir have been largely increased, as will appear from the following table:

	1864.		1878.	
	No. of Mains.	Area in Square Feet.	No. of Mains.	Area in Square Feet.
Crossing of Seventy-fifth street	5	36.52	7	61.60
" Thirty-fifth street	4	23.95	6	30.40
" Twenty-fifth street	4	21.16	6	30.40
" Fourteenth street	3	19.	6	27.66
" Thirteenth street	3	14.19	6	27.66
" Houston street	2	8.08	4	19.02

By the above table it will be seen that the combined areas of the great supply mains are 62 per cent. greater than they were in 1864, and the area of the mains at the crossing of Houston street is two-thirds of that at crossing of Thirty-fifth street, instead of being only one-third, as they then were, and the area of mains at Houston street is now 30 per cent. of the great mains at crossing of Seventy-fifth street, instead of 22 per cent., as in 1864. The area of the mains where they cross Houston street has been more than doubled within a few years.

Since 1864 the mains have been connected at shorter intervals than had been the previous practice, and the smaller supply-pipes have been more frequently connected with the mains. Great improvements have also been effected within a few years past in the distribution by connecting dead ends and otherwise promoting the circulation.

The increase in number and size of the large mains leading to the lower part of the city has aided very much in the extinguishment of fires. Several large fires have occurred below Houston street within the past year, at which large numbers of the fire engines were employed at one time, without showing any deficiency in the water supply. By an arrangement with the Fire Department, on their telegraphing to the Central Park reservoir, the gates can be opened so as to deliver an increased volume of water in the mains where it is needed.

The conclusion arrived at is, that no material improvement can be effected in the distribution and pressure except by introducing an additional supply of water, by suppressing waste, and by means of the high-service works now in course of construction.

Respectfully submitted,

ALLAN CAMPBELL,
Commissioner of Public Works.

Index to Report of Department of Public Works for Second Quarter of 1879.

DOCUMENTS.	
"A." Review of History of New York Water Supply.	"J." Mr. J. W. Adams' Report on Distributing System.
"B." Statement of Appropriations and Expenditures.	"K." Report of Bureau of Water Purveyor.
"C." Detailed Statement of Expenditures.	"L." " " " Street Improvements.
"D." List of Contracts Made and Contracts Completed.	"M." " " " Sewers.
"E." Report of Bureau of Chief Engineer of Croton Aqueduct.	"N." " " " Streets.
"F." Engineer's Report of Bronx River Survey.	"O." " " " Lamps and Gas.
"G." " " " Byram River Survey.	"P." " " " Repairs and Supplies.
"H." " " " Housatonic River Survey.	"Q." " " " Incumbrances.
"I." " " " on quality of Housatonic Water.	"R." " " " Water Register.

Document "A."

A Review of the History of the Water Supply of the City of New York

PRIOR TO THE INTRODUCTION OF CROTON WATER.

As early as 1774, when the population of the city was but 22,000, an attempt was made to establish a uniform water supply, under the direction of Christopher Colles, Civil Engineer, by the construction of a reservoir on the easterly side of Broadway, north of the present Pearl street. The water was to be obtained by pumping machinery from a large well in the vicinity of the Collect Pond, near the present site of the Tombs. City bonds were issued to the amount of £2,500 in 1774, and £2,600 in 1775, and the land for the reservoir was purchased for £1,050, but the breaking out of the war of the revolution put an end to the whole project.

After the close of the war, in 1784, the subject again came to the surface, and between 1784 and 1798, various propositions were made to the Common Council for supplying the city with water by private enterprise. All of these contemplated the collection and use of well water, but with the rapid growth of the city the impurities of this water became more and more apparent, and attention was finally drawn to sources outside the city. In December, 1798, a committee of the Common Council, to whom the subject had been committed for examination, reported in favor of the project of Dr. Joseph Brown, to convey the waters of the Bronx river to the city by pipes, and recommended the employment of Mr. William Weston, Civil Engineer, to further examine the project and report his opinion thereon, with plans and estimates. He recommended the construction of a dam at the Rye Ponds, raising the water six feet; thence to be conveyed to Harlem river in an open canal, and across that river in a two feet iron pipe to a reservoir, from which it was to be distributed through the city by pipes. Considering the time, and the proportions of the city when this project was put forward, it reflects credit on the sagacity, foresight and liberality of its authors and promoters. Private interests, however, succeeded in defeating it. The Manhattan Company was incorporated for the ostensible object of carrying out this plan, or a similar one, for supplying the city with water, but all the company did towards that object was to construct works at Chambers and Reade streets, and to lay some miles of pipes, for distributing the old well water; and for twenty years its interests succeeded in suppressing every movement for a better water supply.

Under the Mayoralty of Stephen Allen, in 1821, the Bronx project was again taken up, and Mr. Canvas White was employed to make surveys and plans, and in 1824 he submitted a plan to take the water of the Bronx near Tuckahoe factory and convey it by an arched canal to Harlem river, crossing the river by iron pipes, and continuing to a reservoir at a sufficient elevation to distribute the water throughout the city—the expense being estimated at \$1,949,542. He estimated that 6,000,000 gallons of water per day could thus be obtained, and at a daily consumption of 27 gallons per capita (which the experience of Philadelphia had indicated as an adequate supply), this quantity would supply a population of 244,000.

In the meantime another plan for supplying the city with water was put forward. The New York and Sharon Canal Company was incorporated by the Legislature in 1823, for the purpose of constructing a navigation canal from the western boundary of the village of Sharon, in the State of Connecticut, to the Harlem river, with the privilege of taking the waters of all intersecting streams along the route, and of using the surplus water in supplying the population of New York City. The canal was to begin at the confluence of the Oblong river with the stream which flows from the Mudge and other ponds, following the course of the Oblong river to Dover, thence entering the valley of Swamp river, and passing through the towns of Pawling and Paterson to the east branch of the Croton river near Crawford's mills, making a distance of forty miles. From the Croton the route was by a winding course requiring two tunnels, respectively 1,320 and 1,760 yards long, reaching McComb's dam on the Harlem river, a distance of fifty-two miles, with an elevation of ninety-seven feet above tide. In 1825 the New York Water Works Company was incorporated, with authority to supply the city with water, and it employed Mr. Canvas White as engineer, who recommended to the directors the Bronx river project, stating that at an expense of \$1,450,000 for works, a daily supply of 9,100,000 gallons could be brought to the city from the Bronx, taking the water near Underhill's bridge; but the Company's charter proved defective, and a proposed amendment to it was defeated by the Sharon Canal Company, who claimed all the water on the route of their canal.

None of these schemes advanced beyond the stage of mere projects.

Attempts to procure a sufficient supply of water from artesian and other wells also failed.

A large fire in 1828, by which more than \$600,000 worth of property was destroyed, mainly because of the difficulty of procuring water, led to a further investigation by the Common Council as to the best method of procuring a sufficient supply of water. In 1829 Alderman Samuel Stevens, in a report to the Common Council, says: "Various institutions have been chartered for the purpose of bringing water into the city, but none has yet ever complied with the main object of their charter, so far as the public is interested." * * * "The water pipes of the Manhattan Company extend to such parts of the city as they may deem advisable to put them, on the score of profit; and the upper part of our city, although not possessed of good water, have it, however, of a quality superior to that of the Manhattan Company, and therefore they are unwilling generally to take the Manhattan water. The result is, that all that part of the city lying above Grand street on Broadway, or Pearl street on the east side of the city, has not the use of the Manhattan water for the extinguishment of fires. It has, therefore, become absolutely necessary for the Corporation in some manner to give the upper part of the city a supply of water for that purpose."

The report then shows the impracticability of procuring water from the rivers on each side of the city for extinguishing fires, and recommends the construction of a large wooden reservoir, holding 2,000 hogheads, at Fourteenth street and Broadway, with two lines of pipes running through the Bowery to Chatham street, and through Broadway to Canal street, respectively; the expense of the whole work, with hydrants or fire-plugs, being estimated at \$26,000.

The Common Council approved the report, and empowered a committee to select a site for the reservoir and to contract for the iron pipes, but, in the meantime, other propositions again came forward.

A memorial from Mr. Francis B. Phelps, on May 17, 1830, proposed four different sources:

- 1st. To bring the water from the Rye ponds in 28-inch iron pipes; estimated cost, \$2,600,000.
- 2d. To bring in the Croton river by an open canal, at an expense of \$1,834,000, or by iron pipes, at a cost of \$3,600,000.
- 3d. To bring the water of the Passaic, above the Paterson Falls, crossing the Hudson by iron pipes, to cost \$1,932,000.
- 4th. A plan to procure water from wells and springs on the island; estimated cost, \$792,000.

In December, 1831, Mr. Samuel Stevens again made a report upon the subject, in which the possibility of supplying the city from wells or springs on Manhattan Island is considered and discarded. The Croton river plan, while admitted to insure the most abundant supply, is put aside by reason of its great cost, and because the Bronx river presented an adequate resource nearer by and at less expense. The Bronx river plan is therefore recommended, with an arched aqueduct, the water to be forced across Harlem river in iron pipes by machinery to be propelled by tide water, and thence through pipes to a reservoir at Thirteenth street.

The report was accompanied by the draft of a bill embodying its views, which was forwarded to the Legislature, but failed to become a law.

In December, 1832, in response to a resolution of the Joint Committee on Fire and Water of the Common Council, Colonel De Witt Clinton reported upon the best method of procuring an abundant supply of pure and wholesome water.

After reviewing all previous plans, he comes to the deliberate conclusion that the city should rely on the Croton, setting forth as its advantages the purity and unfailing abundance of its waters, and the great elevation at which they could be delivered in the city, which he estimates at 137 feet above tide. His plan and estimates for bringing water to the city are summarized as follows:

"From the best opinion I can form, I am satisfied that the waters of the Croton river may be taken at Pine's Bridge and delivered on the island for a sum not exceeding \$750,000 in an open canal, and with stone linings, ditches, and walls, and including drainages and other contingencies, it may swell the cost to \$850,000. The expense of distribution and reservoirs on the island may amount to \$1,650,000 more, which would make the whole cost of the work \$2,500,000."

The inadequacy of these estimates is accounted for by the fact that Colonel Clinton made no surveys of the route of the proposed canal.

In January, 1833, the Legislature, at the request of the Common Council, passed an act, to remain in force one year, authorizing the Governor to appoint five Water Commissioners for the City of New York, to examine and consider all matters relative to supplying the city with a sufficient quantity of pure and wholesome water; the Commissioners to employ the necessary engineers, surveyors, etc., and to report to the Common Council on or before the 1st November, 1833, and to the Legislature on or before the second Monday in January, 1834, giving their opinion as to the best plan, and the estimated expense.

The Governor appointed as such Commissioners Messrs. Stephen Allen, B. M. Brown, S. Dusenbury, Saul Alley and W. W. Fox, and on the 5th of June, the Common Council having appropriated \$5,000 for their use, the Commissioners employed Canvas White and Major D. B. Douglas, formerly Professor of Engineering at West Point, to make the requisite surveys, plans and estimates, with instructions to make examinations of the Croton, Sawmill and Bronx rivers, in the counties of Westchester and Putnam, together with their several tributaries, and to furnish the Commissioners with a

map and profile of the country, and their opinion of the quality of the water, the supply that might be depended on in all seasons, and the practicability of conveying it to the city at sufficient elevation to preclude the use of machinery, and answer all the purposes contemplated. Also, to designate the most feasible route and the best manner of constructing the conduits and reservoirs; the probable amount required to pay for lands, water-rights, damages and cost of construction.

Mr. White was prevented, by engagements on the Raritan and Delaware Canal, from acting, but Major Douglas proceeded at once to make the surveys and examinations. In his report to the Commissioners, made in October, 1834, he recommends the Croton river as the source, a masonry aqueduct for the conduit, and describes two separate routes, the "inland route," and the "Hudson river route," the former being forty-three miles, and the latter forty-seven miles long, from the proposed dam on the Croton to the distributing reservoir on Murray Hill. Major Douglas estimates that a minimum supply of 27,000,000 gallons per day may be delivered by either route into the reservoir, at an elevation of 117 feet above tide. The cost of the inland route he estimates at \$4,500,000, and the Hudson river route at \$4,768,197. In speaking of the Bronx river, the report gives 5,752,000 gallons per day, as the supply that can safely be depended on at all seasons, which is considered inadequate, and could not be delivered at sufficient elevation to preclude the use of machinery.

In November, the Water Commissioners submitted their report to the Common Council, and in January following (1834) to the Legislature, reviewing the various plans that had from time to time been presented, with reference to the city's water supply, and indorsing the views and conclusions submitted by Major Douglas.

The act of 1833 having expired, a new law was enacted by the Legislature (chapter 256, Laws of 1834), again authorizing the appointment of five Water Commissioners, to examine and consider all matters relating to a sufficient supply of pure and wholesome water for the city. The act further provided that the Commissioners should employ engineers and other persons necessary in the performance of their duty, and should adopt such plan as they might deem most advantageous for procuring such supply of water; the plan to be submitted to the Common Council, and, if approved, to be submitted to a vote of the electors of the city, at the next charter election.

In the event of its adoption by the popular vote, the Common Council was authorized to issue water stock to the amount of \$2,500,000, and to instruct the Commissioners to proceed with the work. Ample power was also given for the purchase of lands, water-rights, etc., and provision made for having the work done by contract.

The Governor reappointed the Commissioners of 1833, and the Common Council appropriated \$5,000 for their use. Their report to the Common Council was made in February, 1835, and after reviewing and rejecting the various projects put forward in opposition to the Croton river plan, they approve, substantially, the plan presented by Major Douglas in 1833, of a masonry aqueduct from the Croton, at an estimated expense of \$5,500,000.

The Common Council promptly approved the action of the Commissioners in the following terms:

"Resolved, That the plan adopted by the Water Commissioners for the City of New York, for supplying the City of New York with a sufficient quantity of pure and wholesome water, for the use of its inhabitants, and described in their report made to the Board of Aldermen, the 16th of February last, be and the same is hereby approved.

"Resolved, That a poll be and hereby is appointed to be opened on the days upon which the next annual election for charter affairs for this city is by law appointed to be held, to the end that the electors may express their assent or refusal to allow the Common Council to proceed in raising the money necessary to construct the work aforesaid, by depositing their ballots in a box to be provided for that purpose in their respective wards, according to the provision of the act, 'To provide for supplying the City of New York with pure and wholesome water.'

These resolutions were adopted March 2, and approved by the Mayor, March 11, 1835, and in accordance therewith a poll was held on the 14th, 15th, and 16th of April following, at which the project was approved by a vote of 17,330 to 5,963.

On the 7th of May, the Common Council passed an ordinance, instructing the Commissioners to proceed with the work, and authorizing a loan of \$2,500,000, at 5 per cent. interest, to provide for the expense.

THE CONSTRUCTION OF THE AQUEDUCT.

After receiving the authority to proceed with the execution of their plans, the Water Commissioners, on the 2d of June, 1835, appointed Major David P. Douglas, their Chief Engineer, and directed him to organize a corps of engineers as soon as practicable. An engineering party of seventeen persons took the field on the 6th of July, and proceeded to stake out the land required for the lake formed by the Croton dam, and for the line of the aqueduct, the Commissioners being restricted from using any land before it was acquired by purchase or appraisement.

The surveys and resurveys for this purpose were not completed until the latter part of the summer of 1836, and during their progress the route was in several places amended and shortened. In October, 1836, Mr. John B. Jervis succeeded Major Douglas as Chief Engineer, and under his direction the map, drawings, and working-plans were completed during the winter 1836 to 1837. In the spring of 1837, the work of construction was fairly begun by placing a portion of it under contract.

In 1839 the Legislature passed an act requiring that the Harlem river be crossed by a high bridge (in place of the low bridge and inverted syphon then embraced in the plans of the Water Commissioners), and the contract for the bridge was made in August of that year.

In 1841, on January 7, a freshet of unusual proportions and violence carried away the earth embankment forming a portion of the newly constructed Croton dam, causing great destruction of property and the loss of three lives.

On June 27, 1842, the water was first received through the aqueduct into the reservoir at Eighty-sixth street with appropriate ceremonies, and on the 4th of July following it was received into the Murray-hill reservoir.

The celebration of the introduction of Croton water took place on October 14, 1842.

High Bridge was completed in 1848.

With the completion of High Bridge the Water Commissioners appointed by the Governor, finished their labors, and the whole water system came under the charge of the Croton Aqueduct Board. Since that time some important alterations and additions were made to the conduit and its appurtenances.

In 1853-4 an additional pipe of four feet diameter was laid across Manhattan valley.

In 1858 the construction of the new large reservoir in Central Park was begun, and it was completed in 1862.

In 1860-61 the large iron pipe of 7 feet 6 3/4 inches diameter, and equal to the full capacity of the aqueduct, was laid on High Bridge, over which the water had theretofore been passed through two 36-inch pipes.

In 1861 another pipe of five feet diameter was laid across Manhattan valley.

In 1865-6, in pursuance of an act of the Legislature, the masonry aqueduct below Ninety-second street was discontinued, and replaced by two lines of 6-foot pipes, laid through Ninetieth street and Eighth avenue to the reservoir in Central Park.

In 1866 the present high-service works at High Bridge were commenced, and completed so as to be brought into use in 1870, since which time their capacity has been enlarged by the construction of another pumping engine and the laying of additional pipes.

In the same year (1866), the construction of the storage reservoir at Boyd's Corners, on the west branch of the Croton river, was begun. It was not completed to be available for use until March, 1873.

By an act of the Legislature of 1870, the remaining portion of the masonry aqueduct, on Manhattan Island above the surface of the ground, viz.: between Ninety-second and One Hundred and Thirtieth streets, described in Mr. Jervis' reports as Clendenning bridge, was ordered to be replaced by underground conduits. The conduits decided upon were four lines of four-feet pipes, laid under the surface of Tenth avenue. They were completed in 1875.

In 1872 the then Commissioner of Public Works purchased the land for the new storage reservoir on the middle branch of the Croton river, near Carmel, but for some reason it was not put under contract until October 1874. It was completed and water let into it in April, 1878.

In 1842, Mr. John B. Jervis wrote a very full description of the aqueduct and its appurtenances, which has not been published in any official report. The following extracts from the paper will give a sufficiently clear idea of the character of the aqueduct route and structure:

"The Croton dam, where the water enters the aqueduct, is about six miles above the mouth of the river, and raises the water of the river forty feet to an elevation of 166 feet above mean tide. From the dam the aqueduct passes along the valley of the Croton to near its mouth, and thence into the valley of the Hudson, passing through the villages of Sing Sing, Tarrytown, Dobbs' Ferry, Hastings, and Yonkers. From the latter place it leaves the valley of the Hudson, crosses the valleys of Sawmill river and Tibbit's brook, thence along the side of the ridge on the southerly side of Tibbit's brook valley to the summit of the country between the Hudson and East rivers, and along this summit to the Harlem river, one mile northwesterly from McComb's dam. From the Croton dam to Harlem river the aqueduct is an uninterrupted conduit of hydraulic stone and brick masonry, 32 88-100 miles long. The width of Harlem river valley at the level of the aqueduct is 1,450 feet. The water is conveyed across the Harlem by iron pipes on a stone bridge, at an elevation of 114 feet above high tide. The southerly shore of the Harlem is a bold, precipitous rock, rising at an angle of about 30 degrees to a height of 220 feet. The masonry aqueduct is here resumed and continued for a distance of 2 15-1000 miles to the northerly side of Manhattan valley. This valley is three-fourths miles wide at the level of the aqueduct, below which it descends 102 feet. The conduit of masonry here gives place to iron pipes, which descend to the bottom of the valley and rise again to the proper level on the opposite side, from which point the masonry conduit is again resumed, and crossing the Asylum ridge and Clendenning valley, is continued 2.173 miles to the receiving reservoir at York hill, Central Park. From the receiving reservoir a double line of iron pipes, three feet in diameter, laid down in Eightieth street and in Fifth avenue convey the water a distance of 2.176 miles to the distributing reservoir on Murray hill.

"The length of the aqueduct from the Croton dam to the distributing reservoir is 40.562 miles, to wit:

Masonry conduit in Westchester county.....	32.880 miles.
Masonry conduit on New York Island.....	4.187 "
Total length of masonry conduit.....	37.067 "
Receiving reservoir from end of aqueduct to effluent gates.....	0.172 "
Distributing reservoir.....	0.080 "
Iron pipes across Harlem river.....	0.275 "
Iron pipes across Manhattan valley.....	0.792 "
Iron pipes between reservoirs.....	2.176 "
Total.....	40.562 "

"Description of the Plan of Work for the Aqueduct and its Appurtenances."
"AQUEDUCT."

"The form and dimensions of the interior of the aqueduct are as follows:
"The bottom is an inverted arch, the cord or span line is six feet and nine inches, and the versed sine nine inches.

"The masonry of the side walls rises four feet above the spring line of the inverted arch, with a bevel of one inch to a foot rise, or four inches on each side, which brings the width of the top of the side walls seven feet and five inches, forming the abutments of the roofing arch, which is a semi-circle, having a radius of three feet eight inches and a half, or a cord line of seven feet five inches. It will, therefore, be perceived the greatest interior width is seven feet five inches and the greatest height eight feet five inches and a half. The area of the interior is 53.34 square feet. In rock tunnels the roofing arch is generally dispensed with, but the bottom and sides are formed with masonry similar to the above described.

"There is an exception to this form in the first 4.949 miles of the upper end of the aqueduct, where the side walls have an extra height on account of the bottom being depressed to draw the water at a lower level from the Croton Reservoir. The plan, dimensions, and character of masonry are as follows: In excavation a bed of concrete masonry is laid down as a foundation. It is laid level across the bottom three inches thick at the centre of the inverted arch, and covered on its upper surface to form a bed for the arch, which brings it twelve inches thick at the spring line, and is carried three inches thick under the side walls or abutments. The abutments are two feet eight inches thick at the spring line of the inverted arch, and two feet at the top or spring line of the roofing arch. The inverted arch is of brick, four inches thick. The roofing arch is also of brick, eight inches thick. The abutments or side walls are of rubble-stone with a brick facing four inches thick. Spandrels of stone are carried up solid from the exterior angle of side wall, on a line that is tangent to the arch. Where the bed of concrete is formed for the inverted arch a heavy course of plastering is laid over it, on which the arch is laid. When the stone wall of the side walls was up, the face that received the brick lining had its irregularities filled with successive courses of plastering, and finally a uniform course of one-fourth of an inch in thickness over the whole, in front of which the brick facing was laid up. A course of plastering was also put over the roofing arch. The concrete masonry was formed by mixing one part of hydraulic cement, three parts of clean sand, and three parts of fine broken stone; in some cases fine pebbles were in part substituted for broken stone. The masonry was all laid up in hydraulic cement obtained mostly from the hydraulic lime of Ulster county. The mortar for the stone work was composed of one measure of cement to three of clean sharp sand, and for the brick masonry and plastering one of cement to two of sand.

"It may be proper to remark, that every cargo of cement was tested by actual experiment, after it was brought on the ground, before any was allowed to be used. This precaution has had a very salutary effect on the character of the work. The cement in all cases, where it is exposed to view, in its exterior, or broken up for examination, or otherwise, has appeared highly satisfactory. In the commencement of the work there was much difficulty in getting the workmen to lay their stone and brick in a thorough full bed of mortar, which is obviously very important in hydraulic masonry. But a rigid system of inspection, requiring all imperfect work to be taken down and relaid, was successful in obtaining work of great compactness and solidity.

"The area of a cross-section of masonry in the aqueduct is:	
"Concrete masonry.....	4.605
"Stone in side walls.....	21.572
"Stone in spandrels.....	2.690
	28.867
"Brick in arches and side-facing.....	13.658

"Total square feet..... 42.525"

"A limited departure from the above area has been made, where peculiar circumstances seemed to justify or require it; the most important in extent is, where the aqueduct passes over low grounds or valleys, and a dry wall of stone is raised to the proper level to support the conduit masonry, and generally for the depressed bottom of the 4.949 miles at the upper end of the aqueduct, and in a few other cases in the first contracts, where the bottom arch and brick facing is eight inches thick. On the foundation walls the concrete masonry is laid one foot extra thickness and three feet extra width, the base of the side walls is also increased, and the proportion of cement to sand in concrete and mortar for stone work is one to two and a half. In other respects the masonry in conduit is similar in foundation walls to that in excavation. The proportion of line of aqueduct masonry in foundation walls over valleys to that in excavation is about as one to eight. The masonry of the aqueduct is covered with earth to a sufficient depth to protect it from frost.

"GRADE LINE OF AQUEDUCT."

"The general declivity of the aqueduct in Westchester county is 0.021 foot per hundred, or a fraction over thirteen and one quarter inches per mile.

"The top of the conduit, pursuing this grade, corresponds with the top of the dam on the Croton, but, in order to adapt the aqueduct to draw at a lower level from the Croton reservoir, the bottom grade was depressed at the head 2.93 feet, and a declivity of 0.0113 foot per 100 feet, or 0.59664 foot per mile, for 4.949 miles, where it intersects the regular grade. The top of the aqueduct was depressed only 0.583 foot, and carried level 2,276 feet, where it intersected the regular grade line of the top.

"This gave an extra height of side walls, enlarging the capacity of the aqueduct more than equivalent to the diminution of declivity, and provides for drawing from the reservoir to a depth of six feet, and still leave the capacity of the conduit 35,000,000 of imperial gallons.

"The grade of the aqueduct, from Harlem river to Manhattan valley, is the same as the general declivity in Westchester county, but that from Manhattan valley to the receiving reservoir, 2.1727 miles, is nine inches per mile."

MAINTENANCE OF THE AQUEDUCT.

In a report to the Water Commissioners, dated January 16, 1843, Mr. John B. Jervis uses the following impressive language in reference to the necessity of the constant and vigilant care of this only conduit for our water supply:

"The aqueduct and its appurtenances have been subjected to the trial of near seven months, and I have endeavored to detail fully the effect the water has produced, and the prospect of its capacity to fulfill, with regularity and permanence, the object of its construction. It has been the subject of intense solicitude and care, and although there is good ground to believe that in the main the work will have the stability and permanence that is necessary, it will still, for some time to come, require a vigilant watchfulness. The deep interest I feel in the success of the work, as also its great importance to the city, induces me to urge that the persons to whose care it may be committed be selected with reference to their acquaintance with the work, and their known ability and faithfulness for the supervision required. After the work before mentioned shall have been completed, the ordinary work of supervision and repairs, if well directed, will probably be obtained at a moderate expense. At the same time it should be distinctly urged that economy or efficiency can only be expected from the supervision of men who are intimately familiar with the method of construction and the character of the work, and who will deeply feel the high responsibility confided to their industry and fidelity. The main burden of this duty will consist in an unwavering perseverance; watching with scrutinizing care every part of the work, and seasonably providing for and making such repairs as may be necessary. The extent of the work, the variety of its structures, the severe pressure to which many of its parts are necessarily exposed, and the great importance to the city of maintaining it in a condition that will insure a regular and full supply of water, must give to every reflecting mind a strong sense of the high responsibility that will rest on those to whose care it is confided. Not expecting to be much longer engaged in the general charge of the work, I have felt it to be a duty that I owed, not more to my own reputation than to the interests of the city in this great work, to urge the above remarks in relation to its future management."

As early as 1841, before the whole structure had been completed, the necessity of strengthening the portions built on embankments over low grounds developed to a degree which called for active measures.

Under date of June 30, 1841, Mr. John B. Jervis reports to the Water Commissioners as follows:

"The Board are aware of the fact that in several cases where the aqueduct is constructed on dry foundation walls, erected to maintain the grade line across low grounds, a settlement has taken place in the foundation, which has caused a slight check in the masonry of the arch. These checks have not been such as to cause any considerable leaking, and in most cases the fine sediment of the water that passes over the bottom, has been sufficient to render them entirely impervious, and the water has passed over them for months without any evidence of leaking. Over the most prominent of these cases the water was several times let on last fall, and during the great flood in January last, the water passed over the breast of the gateway at the head of the aqueduct, and filled the same to

near the top of the arch, discharging by the waste weir at Sing Sing, and at Mill river; but no perceptible leakage or unfavorable impression was made on the places referred to. The extent of aqueduct so affected is comparatively small, and it is believed its permanent security will be effected at a moderate expense. The greatest part of the work considered necessary for this repair has been done, and the remainder is in progress. The principal settlement above mentioned is believed to have arisen from the too rapid prosecution of the work at those places, the work not having time to become properly consolidated before the superstructure was put on. This view is sustained by the fact that in the more elevated foundation walls there has no check occurred worth mentioning, while the most important have been in walls not exceeding twelve feet in height, and some not over four feet. In most cases the settlement appears to have come to a rest, not having indicated any change for several months, and it is confidently believed the measures in progress will be an effectual security."

Again, under date of December 31, 1841, Mr. Jervis reports:

"The appearance of the work strongly indicated that those parts had come to a permanent rest, there being nothing discovered to show any material change for several months, and in some cases more than one year. It is however possible that some further settlement may take place, and more required to be done to secure the work in a few places. But as this settlement has now had from one to two years to reach a permanent rest, and as it has rarely exceeded three or four inches, producing checks or cracks in the wall, that with few exceptions range within one-eighth of an inch, it is confidently believed the work done will prove sufficient for its permanent safety. The general appearance of the interior of the aqueduct is highly satisfactory, and considering the great variety of soil, and the very undulating character of the surface that has been met in providing the foundations for a continuous line of thirty-three miles of hydraulic masonry of very unequal and abrupt changes in elevation, the range and extent of unequal settlement must be regarded as very small, and not of a character to produce any serious apprehension that heavy repairs will be required."

In their report for the six months ending December 31, 1846, the Water Commissioners say:

"The Commissioners made a general inspection of the embankment, protection wall and culverts of the whole line of the aqueduct, on the 22d and 23d of October last, in which they were accompanied by the Chief and Resident Engineers. There were indications on several of the sections, showing the necessity of improvement. Some of the protection walls, though well constructed originally, now require rebuilding; and in some situations, where the embankment is much elevated, it has been necessary to erect stone buttresses at their foot."

In his last report as Chief Engineer of the Aqueduct, December 30, 1848, Mr. Jervis repeats the warning he gave in 1843, as follows:

"The great duty in taking care of the aqueduct hereafter, will consist in a vigilant and intelligent watchfulness, by which small repairs, made in the proper time, will most probably save it from expensive ones that will be necessary if the work is allowed to become weak by the gradual process of deterioration that must inevitably follow protracted neglect. The expense of repairs, however, is the last evil to be apprehended. Any disaster that should suspend the supply of water on which half a million of people depend, would be, not an inconvenience merely, but a most serious calamity, and I regard it an imperative duty to urge in the most earnest manner the importance of the most vigilant attention, even while no general appearance of danger would be seen by an ordinary observer. On former occasions, as will be seen in my reports, I have, in as urgent language as I was able, expressed my anxiety on this subject. The work has so far stood well, and there is every reason to believe it will continue to stand, if it have proper attention; but it has its location to a great extent on precipitous grounds, where sudden and heavy floods may do great damage, if the defenses of the work are neglected and its strength impaired (probably by slow degrees) for the want of timely and intelligent attention."

The whole subsequent history of the aqueduct shows how necessary it is that the will, intelligence, and means to preserve the structure in the highest state of efficiency, shall never be wanting.

A few extracts from the official reports of the officers in charge of the work will sufficiently illustrate this.

In their annual report for 1850 the Croton aqueduct Board say:

"During the next year a considerable outlay of money will be required on the great embankment over Sawmill river at Yonkers. This embankment has always exhibited less of care and solidity in its construction than generally marks the line of the aqueduct; it has therefore required and received more attention and watchfulness, and though not yet showing any decided symptoms of displacement in any part of the structure, prudence requires that strong sustaining walls should be built outside of the present embankment, filled in between and carried up to a sufficient height to assure the thoroughness of the work hereafter."

Slight fissures in the masonry, such as were referred to in the reports of Mr. Jervis, continued to show themselves at each recurring semi-annual or annual examination. In 1860 a more serious break occurred, and is described in the report of the Croton Aqueduct Board for that year, as follows:

"On Friday, the 21st day of December, at one o'clock, water was discovered issuing in large quantities from the side of the aqueduct, or main conduit of masonry, about forty-two miles from the city and two miles this side of the Croton dam. The aqueduct here crosses the valley of Bailey's Creek on a high embankment. The Chief Engineer was immediately notified by telegraph, but the injury to the aqueduct was evidently so great that the Superintendent of that division shut down the gates at the dam without waiting for his arrival to receive orders to that effect. As soon in the night as the height of water in the aqueduct was reduced sufficiently to enable our men to enter it, such a force of mechanics and laborers as could be got together in the country, was put to work. It was found that this was a crack through the masonry of the bottom of the aqueduct, extending about 425 feet in length, and being from one quarter of an inch to an inch and a quarter in width. Owing to the great length of the required repairs, the difficulty of making cement set properly in such cold weather, and the limited force which could be procured, there was at first danger of another serious interruption to our water supply. The work, however, was prosecuted without intermission throughout Friday night and Saturday, and until half-past three o'clock on Sunday morning. At this time the work of repair was complete, the gates opened, and the aqueduct again in operation, the water having been shut off thirty-eight hours and a half."

In the report for 1861 reference is made to another large leak. In this year, as in the preceding one, the annual inspection of the interior had been omitted, as the supply delivered by the then existing pipes on High Bridge, and the state of the city reservoirs would not warrant the risk of shutting off the water for the time required for inspection and repairs. The report says: "It being injudicious, for the reasons above stated, to shut off the water for general repairs, the various portions of the aqueduct which have at times shown symptoms of settlement, have been watched with increased care, and materials held in constant readiness for work, should a sudden contingency absolutely require operations at any particular point. During the month of June such a contingency occurred. A leak was discovered at an embankment about two miles above the High Bridge. It was too considerable to be disregarded, and the water was shut off at once. The leak was found to proceed from a fissure in the bottom of the aqueduct, extending about 350 feet in length. With materials and a good force available, and aided by favorable weather, we were enabled to repair the damage in about twenty-four hours. * * * Leaks have shown themselves in one or two other places on the line of the aqueduct, but not of sufficient volume to indicate immediate danger."

The foregoing instances of leaks and fissures, showing constant settlement of the structure, where built on embankments, occurred when two 36-inch pipes were laid across High Bridge and not more than 40,000,000 gallons of water could daily be passed through the aqueduct. With the new large pipe on High Bridge, completed in 1862, and fully equal to the utmost capacity of the aqueduct, the quantity of water carried into the city has been constantly increased until in late years it has reached ninety million gallons per day, and the necessity of strengthening the weak points of the structure is correspondingly enhanced.

The subsequent reports of the Croton Aqueduct Board show that these indications of weakness could not be overcome by mere temporary repairs. In their report for 1863, they say:

"Originally the checks or cracks in the masonry, which required yearly attention, were apparently caused by the settlement of the foundation walls under the weight of the aqueduct and that of the covering embankment. These cracks occur wherever the conduit is upon embankments. They are for the most part longitudinal, running along the top of the arch (at or nearly in its centre), and in the bottom of the invert, or at its junction with the side walls. The bond once broken, whether by settlement or otherwise, it is not easy, by ordinary repairs, to restore its full strength, and the structure must remain less able to meet and resist the lateral pressure of the water, which is constantly tending to force its walls outward and apart. Had it been possible to have built the conduit throughout upon foundations as positively rigid and unyielding as they are in the rock cuts, the weight and strength of the masonry would probably have been sufficient to meet the strain put upon it; but the bond once broken, the whole structure is weakened. This weakness is shown whenever any temporary emergency makes it necessary to increase the flow and consequent depth of water in the conduit. Leaks also are sometimes discovered on high embankments (where repairs have been previously made) immediately after a sudden fall of the temperature to extreme cold. The possible cause in such instances is that the retaining walls of the earth embankments, which lie against the side walls of the conduit, contract, and the pressure of the earth against the side walls is immediately lessened. Without this aid the weight alone of the walls (there being no perfect bond), is not sufficient to resist the outward pressure of the water, and the leak again appears. From close and long observation it appears certain that, in its present condition it would be unsafe to increase to any great extent the depth of the present flow in the aqueduct, and that before this conduit can be made available to its full capacity, it will be necessary to strengthen the masonry, wherever it is supported upon embankments."

From 1863 to 1869 the Croton Aqueduct Board reported (and repaired) the length of cracks or fissures in the masonry conduit, as follows:

In 1863.....	7,321 feet.
In 1864.....	3,788 feet.

In 1865	4,830 feet.
In 1866	4,865 feet.
In 1867	3,623 feet.
In 1868	5,138 feet.
In 1869	4,706 feet.

With increased population and consumption it became necessary to increase the volume of water in the aqueduct beyond anything ever contemplated by its designers and constructors. Mr. John B. Jervis estimated the full capacity of the conduit at 60,000,000 gallons per day, and assuming, on the experience of other large cities with similar appliances for furnishing water, that thirty-nine gallons per day for each inhabitant would be an ample supply, this would suffice for a population of two millions. To deliver this quantity the aqueduct need only be filled to the spring line of the arch; a glance at the sketch showing a cross section of the masonry conduit will show that above that line the power to resist pressure from the inside is greatly diminished. When it became necessary, therefore, to increase the supply to 90,000,000 gallons per day (which has been the case for several years past), and to increase the depth of water to within a few inches of the inner crown of the arch, those parts of the conduit which are built on embankments and not embedded in earth or rock, comprising about nine miles of the thirty-two miles of masonry conduit, had to be strengthened to meet the increased pressure. The general plan adopted for this purpose and pursued for the past three years, is as follows: An additional arch is turned over the old arch, the spandrel walls are raised eighteen inches above the spring line; the earth covering on top is reduced from five feet to two feet in depth, and the surplus earth is placed on the side embankments; the retaining or protection walls are carried up several feet to a level with the top of the arch. This plan has the approval of Mr. John B. Jervis, the designer and constructor of the aqueduct, and is illustrated in the annexed sketch.

The usual yearly maintenance appropriation was not intended, and is not sufficient to meet the expense of this work, for which an extra and liberal allowance should be made. With careful husbanding of the appropriation, however, and with the aid of some small balances from other appropriations, the Department was enabled up to January 1, 1879, to apply this improvement on 3,090 lineal feet of the aqueduct.

CONSUMPTION OF WATER.

The highest estimate made in any of the reports of the Water Commissioners or the Croton Board, or their engineers, of the quantity of water required for a liberal supply for all necessary purposes, is 30 gallons daily per capita. That this rate has long ago been exceeded in this city will be shown by the following table of the population and daily consumption since the introduction of Croton water:

Population, Amount of Water Used, and Area of Pipes in the City of New York, since the introduction of Croton Water.

Date.	Population.	Used per Day, Average Gallons.	Area Pipes from Reservoirs and Aqueduct, Square Feet.	REMARKS.
1835	268,089	.....	.....	Area Aqueduct 53.34 square feet. Surveys and examinations under a commission to introduce water into the city.
1840	312,710	.....	.....	Water introduced into the city—two 35-inch pipes.
1842	.....	12,000,000	14.14	
1845	371,223	.....	.....
1850	515,547	40,000,000	19.05	30-inch main laid from Reservoirs through Third avenue. The Croton Aqueduct Department reports "that the last drop of water, which the works in their present state can supply, is now delivered in the city."
1854	.....	.....	.....	48-inch main laid across Manhattan Valley, and proceedings to take land for new reservoirs.
1855	629,810	.....	23.96	30-inch main laid from Reservoir through Eighth avenue.
1860	805,658	.....	.....
1861	.....	.....	.....	90-inch main laid across High Bridge.
1862	.....	.....	26.14	60-inch main laid across Manhattan Valley, and 20-inch main connected with this to supply Harlem. Croton Aqueduct report "that 338,832,128 gallons per day is obtainable from the Croton Basin." New Reservoir in Central Park completed.
1863	.....	54,404,174	.....	Croton Aqueduct Department report: "Unsafe to increase flow of water in Aqueduct."
1865	726,386	.....	38.71	48-inch main laid from New Reservoir through Fourth avenue.
1866	.....	66,000,000	.....
1867	.....	72,000,000	.....
1868	.....	78,000,000	.....
1869	.....	75,000,000	.....	Dry season.
1870	942,292	77,000,000	.....	Dry season.
1871	.....	79,000,000	40.99	20-inch main from Reservoir at High Bridge.
1872	.....	81,000,000	.....
1873	.....	88,000,000	.....	36-inch main laid from Forty-second street to Chambers street.
1874	.....	92,000,000	53.56	48-inch main laid from Reservoir through Eighth and Tenth avenues.
1875	1,041,886	95,000,000	59.19	36-inch mains from N. Gate-house, New Reservoir, connected with 20-inch mains on Fifth and Eighth avenues.
1876	.....	90,000,000	.....	Very dry season.
1877	.....	89,600,000	.....	Very dry season.
1878	.....	93,400,000	73.94	48-inch main laid from Reservoirs through First avenue, and 20-inch main connected with Aqueduct at Fordham.

The great waste of water engaged the attention of the authorities from the earliest period of the present water supply, as will be seen from the following extracts from official reports:

Water Commissioners' Report of December 31, 1847.

"The gauge of the reservoir on the 31st of October was 27 feet in depth, and on the 9th of November it was reduced to 8 feet, showing a reduction of about 26 inches per day (while the aqueduct was closed for examination and repair). In 1844 and 1845 the reduction did not exceed 12 inches in depth of the whole surface water of the receiving reservoir each day. In 1846, the reduction was increased to 15 inches per day, and in 1847 it was increased, as shown above, to 26 inches. Now, if the use of the water is to increase in anything like this ratio, as the population, buildings, and sewerage increases, then it is evident there will be little or no surplus to spare in case of emergency, for every additional sewer increases the number of water-closets and a proportional increase in the use of the water."

"We still say there will be a sufficient quantity of water from the Croton river, provided such water is only used for necessary purposes and not wantonly wasted, and provided a sufficient quantity is kept in store for use in case of emergency. We found this opinion upon the experience of large cities, such as London, a city at least twice as large as this city can be, should the whole island be filled with a population as dense as that part now built upon; and such as Philadelphia, which, including the districts of Kensington, Spring Gardens, Northern Liberties, Moyamensing, and Southwark, contains a population not far short of our own. In the former case, the quantity of water daily furnished is about 30,000,000 gallons, and in the latter not exceeding 10,000,000 daily."

CROTON AQUEDUCT BOARD—REPORT FOR THE YEAR 1849.

"The unnecessary and even wanton waste of water during the whole year, but especially in the hot months, cannot have escaped the observation of the Common Council. Street hydrants are opened and kept running for months together, street washers are converted into jets for the amusement of children and domestics; the streets are saturated, and the dust changed into a semi-liquid mud by those employed to sprinkle them, to the ruin of the pavements; street sweepers, instead of collecting into heaps, and carting away the accumulations of the gutters, find it more convenient, with a full head of water from a street hydrant, to wash the whole into a receiving basin, and thence to the public sewers, to be removed at four fold greater cost; while in many of the stores in the lower wards, no care is taken to close the various openings supplying water closets and wash basins, and the water may be heard during the still hours of the night, rushing through numerous lateral drains into the street sewers. To these prolific causes of waste must also be added great carelessness in shutting hydrants along the wharves, used to supply steamboats, especially those employed upon the different ferries."

"The necessity for a more rigid police and more stringent rules regulating the use of water will be apparent, when it is stated that very nearly the whole volume of the Croton river has been delivered in the city during many weeks of the past summer, amounting to at least sixty imperial gallons each twenty-four hours for every inhabitant; a supply three times greater than any legitimate use of it would demand."

REPORT OF 1850.

"The most unremitting and zealous exertions of the Department to abate the intolerable waste of water have produced an effect scarcely perceptible to the public eye, though the daily returns from the distributing reservoir, exhibit the trifling gain of an average head of two feet above that of former summers; the influent pipes to that reservoir, with the addition recently made, are now capable of pouring into it the prodigious quantity of thirty millions of gallons per day; yet it frequently happens, on Saturdays especially, when zealous housewifery puts every street washer in requisition (whether necessary or not), that the reservoir is drawn down to half its capacity, equal to ten millions of gallons more, and making an aggregate of forty millions of gallons for a single day's consumption, in a population (within the water district) of not more than four hundred and thirty thousand persons, or ninety gallons to each individual."

"If this Board could by any process divest itself of the consciousness that it is entrusted with duties connecting it immediately with the daily conveniences and comforts of every individual in the city, and upon the proper administration of which the future growth and prosperity of the city so essentially depend, it could not forget that the law under which it is organized enacts that 'They shall be responsible for the supply of water, and the good order and security of all the works, from the Croton lake to the city, inclusive, for the exactness and durability of the structures which may be erected, and of the daily work performed, and for the sufficiency of the supply in the pipe-yard to meet every casualty, and for the fidelity, care and attention of all persons employed by the Department in watching the works, and in making constructions and repairs.' Under these direct and sufficiently onerous responsibilities, this Board now warns the Common Council, and through it every citizen, that the last drop of water which the works in their present state can supply is now daily delivered in the city—a supply more than equal to any and all the legitimate wants of a population of a million and a half."

In each of the succeeding annual reports a special chapter is devoted to the subject of waste.

The report of 1860 has the following reference to waste in freezing weather, which has in late years become so enormous and troublesome:

"From close observations and experiments made during the fortnight previous to the 4th December, it became evident that the usual (though dishonest) habit of letting water run waste in dwelling houses and stores, to prevent its freezing, had already been commenced for the winter, and that it was impossible, with such a drain through the out-let pipes to fill the receiving reservoir to the height deemed necessary before the examination of the aqueduct could be entered upon with safety. During this time the thermometer was not down to freezing point, and even the usual inadequate excuse for this criminal waste was wanting. It was very evident that, should the weather become suddenly colder during the time set for the repairs, the waste from this cause would be increased, and equally evident from past experience, that, should this waste be added to the usual consumption during the time the gates were closed, the city would be without water before the examination and repairs could be finished."

In the report of 1865 the Commissioners say:

"We are satisfied that the great object in the construction of the Croton works was obtained when abundant water was brought to every door, and its convenient delivery assured. Its moderate consumption and comparatively limited distribution during the early years of the operation of the works drew lightly upon the capacity of the pipes, and, of course, the temporary convenience of higher head was naturally felt; this has, unfortunately led to unreasonable expectations, on the part of the first consumers, and now that the city has greatly increased in area and population, with consequent increased demands upon the water-service, they are inclined to consider that an unjust deprivation which, after all, but moderates an excessive privilege."

Beyond these frequent complaints and admonitions no active measures were taken to suppress or restrict waste of water so long as the supply from the aqueduct was capable of expansion, and it was possible to meet the increased consumption and keep up the pressure in the pipes by increasing the volume of water in the aqueduct.

The first practical steps against waste were taken in the fall of 1876, by establishing a system of house inspections to detect and prevent leaks in plumbing and water connections, and willful waste by keeping faucets open unnecessarily. These inspections have produced favorable results, although the appropriations have been so limited that a sufficient force of inspectors to make inspections as frequent as desirable could not be employed. Against such waste as occurs in cold weather, when people have the water running day and night, the inspections are but an inadequate remedy, because the greatest waste occurs in the night when houses are closed.

A large saving of water was effected by abrogating the system of supplying water to shipping and to builders or masons through a contractor, under a contract or license. The last of these contracts, made in 1872, expired in June, 1877. It was, of course, the contractor's interest to collect as much money as possible at the least expense to himself, and the consequence was an indiscriminate use of the hydrants and water-pipes along the water front. Since that time, June, 1877, this service is performed by employees of the Department, and with a large increase in the city revenue from this source, the use of water along the piers and docks is now under proper control.

The last and most effective measure against waste is the application of water meters. Though authority was given, by Laws of 1870 and 1873, to place meters in all stores, workshops, hotels, manufactories, public edifices, at wharves, ferry houses, stables, and in all places in which water is furnished for business consumption, except private dwellings, only 260 water meters were in use in this city on the 1st of January, 1877. Since then 407 new meters have been applied, principally along the water front and in omnibuses, railroad, and livery stables. Preparations have been made to apply meters, to the number of several thousand, to workshops, hotels, factories, and other places embraced in the provisions of the Law of 1873.

The waste in freezing weather should be obviated by the proper protection of the service pipes and fixtures in houses from frost, and the Building Laws should be so amended as to strictly require such protection under severe penalties.

DISTRIBUTION OF WATER.

Several years before the consumption of water had reached the capacity of the aqueduct complaints were made that water was not delivered with sufficient pressure to force it to the upper stories of buildings in some parts of the city. In the report for 1864, when the population of the city was 726,386 (census of 1865), and the daily consumption of water about 55,000,000 gallons, the Croton Aqueduct Commissioners say:

"It has been a matter of complaint that consumers in the lower districts of the city failed to get water in the upper stories of their buildings; latterly the evil has been so urgently presented on the part of a few persons that we deemed it expedient to have some special investigation made with a view to its correction. By this investigation it has been found that the defects in our pipe distribution arise mainly from these causes:

- "First—An insufficiency of large pipe-mains through the city.
- "Second—The infrequent connection of the existing large pipe-mains with the small supply pipes.
- "Third—The infrequent connection of the supply pipes with each other."

After recounting the measures and the large expense necessary for a rearrangement and improvement of the distributing system, the temporary interruption of supply, and the necessity of tearing up the streets while changes and improvements are in progress, and the merely temporary character of the relief that could thus be obtained, the Commissioners come to the following conclusion: "We feel therefore obliged to suggest that the most immediate and efficient relief would be found in an economical use of the water on the part of all takers. We feel even justified in saying that a portion of the lost pressure might be restored in the whole service if the citizens themselves would be careful in its management. In their hands the remedy to a certain extent lies; it is their duty to arrest the utterly wicked waste that everywhere prevails, and to which their neglect universally contributes. They are to consider that when they claim so special a protection, they are made equally responsible for any abuse. And we now can only express our disappointment, that, after repeated representations of the evil, neither conscience nor interest has seemed to operate in checking this reckless extravagance."

The improvements in the distributing system referred to in this report, viz.: the introduction of larger mains to the lower part of the city; the more frequent connection of supply pipes with large mains, and the frequent connection of supply pipes with each other, together with a complete system of stop-cocks, whereby the supply in any part of the city can be regulated and controlled, have since been carried out from time to time, especially within the past five or six years, until there is no further room for improvement in that respect, as regards the central and lower part of the city.

The greatest aid however, in the delivery of water and compensation for loss of pressure by increased consumption, is found in the high-service works. The present works at High Bridge were commenced in 1866 and completed in 1870. They were originally intended only to supply the high ground in and about Carmansville, which is considerably above the level of the city reservoirs, but since their completion their capacity has been increased by additional pumping machinery, and the service from them extended to the high grounds on Murray Hill, in Yorkville, Lenox Hill, and Beekman Hill.

But their utmost capacity is not sufficient to supply all the points where the pressure from the ordinary service is inadequate for the convenient delivery of water; and additional pumping works of nearly twice the capacity of the present ones, are now being erected on city property, at Ninth avenue and Ninety-seventh street, which will give a fair pressure of water to a large portion of the city which is now inadequately supplied.

With the completion of these works the capabilities of our present water system may be said to be exhausted. In view of the past experience it may well be doubted whether a daily supply of thirty gallons per capita is adequate to the wants of a population so densely massed as that of New York City, and educated to the enjoyment of modern conveniences in the use of water which are unknown in many other large cities. It is certain that the margin for saving by restrictive measures is not so great that we can longer postpone practical steps to secure an increased supply of water; and we thus arrive at the question how such increased supply can best be secured.

SOURCES OF SUPPLY.

The Croton River and Basin.

The first reference to any actual measurement of the floor of the Croton river, which the official reports of the Water Commissioners contain, is in the report of December 31, 1838, as follows:

"The uncommon drought which prevailed in many parts of the United States during the last summer will be remembered for many years hereafter. That section of the counties of Putnam and Westchester through which the Croton river passes has felt the effects of the dry season fully equal, if not exceeding, any other part of the State, and the river was consequently remarkably low. In order to test the flow of the stream under these unfavorable circumstances, and to compare it with an

unusual dry time in 1835, Horatio Allen, Esq., our principal Assistant Engineer, made a gauge of the running water on the 16th of August last, at two different stations on the stream. At the first station there was found running 26,386,560 gallons, and at the second station 28,738,000 gallons every twenty-four hours, averaging 27,584,780 gallons. This quantity, with the present population of the city, is nearly three times as much as will be required for its use. It may be within the memory of some of the members of the Common Council that on the 5th of September, 1833, Major Douglas made a gauge of the river and found running every twenty-four hours 51,522,486 gallons; and that Albert Stein, Esq., also gauged the river on the 25th of the same month, when there was running 50,077,044 gallons per diem. These gauges were not taken when the water was at its least or greatest flow, but at a medium, and may therefore be considered as a fair average of what may be depended on, as there are seasons when several hundred millions of gallons pass through the Croton river to the Hudson river daily. It is estimated also that the Croton reservoir will contain about one hundred million gallons to each foot in depth from the surface. The dam may be drawn down five or six feet, say five hundred millions of gallons, and in addition to this we have 158,000,000 gallons in the receiving reservoir, and 19,000,000 gallons in the distributing reservoir, making a total of 177,000,000 gallons, exclusive of the running water and what may be drawn from the Croton reservoir, providing a surplus in cases of drought sufficient for any emergency, either probable or possible."

In his report of July 12, 1842, Mr. Jervis says:

"The Croton reservoir (which has received the name of Croton Lake) covers about 400 acres of land, and it is available as a reservoir for 500,000,000 imperial gallons of water, above the level that would allow the aqueduct to discharge 35,000,000 gallons per day. The flow of the Croton river is about 27,000,000 in twenty-four hours at the lowest stages, which continue, with moderate rises by occasional rains, from two to three months in the year. This may be considered the minimum capacity of the river. When the wants of the city shall require a daily supply of 35,000,000 gallons it will be necessary during the season of lowest water to draw daily from this reservoir 8,000,000 gallons to make up the deficiency in the natural flow of the river. This amount the reservoir would supply for sixty-two days without any aid from occasional rains, which may safely be relied upon to keep up the required supply from the reservoir beyond any drought we have ground to apprehend. The supply of the Croton, from its daily flow, aided by this reservoir, may therefore be taken with great confidence at 35,000,000 gallons, which will be very ample for the wants of the city for a long time to come, and when the day arrives that it will require a larger quantity it may be obtained by constructing reservoirs further up the stream, where there are abundant facilities for such purpose."

In 1857-8 a topographical survey of the Croton basin was made under the direction of the Croton Aqueduct Board, and the report for 1858 alludes to it as follows:

"As stated in our last annual report, the object of this survey is to establish suitable points for storage reservoirs, and to obtain further hydraulic information which will be useful in extending the work when necessary. The party engaged in this survey have, during the two seasons, run and closely examined lines amounting in length to 480 miles, have made instrumental examinations of sixteen sites for reservoirs, and obtained all the information necessary to estimate the cost and capacity of each, and to enable the Board to make a proper selection from among them. The length of ridge line enclosing the valley or defining the watershed of the Croton river above the point at which the aqueduct begins has been found to be one hundred and one miles. Within this circuit there are thirty-one natural lakes and ponds. The length of the main stream of the Croton river, above the Croton dam, is thirty-nine miles, and the aggregate length of all the principal tributaries is one hundred and thirty-six miles. The total area or watershed of the Croton, above the commencement of the aqueduct, is ascertained to be three hundred and fifty-two square miles."

In the report for 1862 the Commissioners say:

"The necessity for storage reservoirs was shown in our last annual report, and a request was made that you should pass a resolution authorizing the necessary appropriations for a commencement of the work. No steps having been taken in the matter it is again respectfully suggested for your consideration. With an aggregate annual precipitation of rain and snow of forty-two inches vertical height (which is about the average for many years past), the quantity falling upon the Croton basin, tributary to our works, is equal to an average of 677,674,257 gallons (U. S.) per day. Judging from examinations made in other localities, the physical and geological features of which, while resembling the Croton basin to some degree, are less favorable as a whole, the loss from evaporation, vegetation, and such absorption as does not subsequently reappear in springs, may be put down as equal to fourteen inches vertical height of the total annual rainfall. Make a further deduction equivalent to one-sixth of the entire annual rainfall, to cover loss by evaporation and filtration from storage reservoirs, and we find that a quantity equal to an average of 338,832,128 gallons per day would find its way to the Croton dam and the inlet of our aqueduct. Were it necessary to use the entire yield of Croton basin, a great portion, if not the whole of this quantity could, by a proper system of storage reservoirs, be saved and made available. This quantity is nearly nine times that which is now daily brought to the city. Notwithstanding this immense wealth of water there are periods in the summer months when the yield from the Croton river is but 38,400,000 gallons per day. To add to this quantity a daily supply sufficient to fill our aqueduct to its utmost capacity it is only necessary to store up a small portion from the profusion which we have shown to be wasted. Our examination of the Croton basin has developed many sites for storage reservoirs of sufficient capacity to meet our wants, while the increasing consumption of the city shows that some such provision against the limited supply of the dry seasons will soon be required. We beg leave to urge upon your Honorable Body earnest consideration of this important subject."

The Croton Aqueduct Board continued to urge the necessity of storage reservoirs in each succeeding annual report, and to ask authority to begin their construction. In their report for 1864 they say:

"From the 27th of June to the 18th of August, a period of 52 days, no water passed over the weir at Croton dam. On the 3d of August the supply had been so much reduced that the surface water behind the dam was four feet six inches below the lip of the weir. This fact is put before you without comment, being of itself sufficient to awaken your attention to the importance of early action. A drought of longer continuance, combined with an increased daily consumption of water in the city, may yet find us unprepared with the proper remedy, notwithstanding the peculiar facilities for its provision."

In April, 1865, the Legislature passed an act authorizing the construction of storage reservoirs in Westchester, Putnam, and Dutchess counties, and the Croton Aqueduct Board selected from among the available sites the one on the westerly branch of the Croton, at Boyd's Corners. They acquired the necessary land, and put the construction of the dam under contract in August, 1866. Tardiness of contractors, severe winters, heavy rains, and changes in the plans, delayed the completion of the reservoir until the spring of 1873, when the water was let into it. Its capacity is 2,750,000,000 gallons.

In the meantime very severe droughts occurred in 1869 and 1870. In the former year the supply furnished from the Park reservoirs toward the end of the dry season had diminished to about one-third the present daily supply; and yet the reservoir was nearly drained before the autumnal rains brought relief. In 1870 the emergency was partly met by the temporary acquisition of the right to draw down some of the natural lakes and ponds in Putnam county. These rights have since been permanently acquired.

In 1872 the first steps were taken towards the construction of a second large storage reservoir, on the middle branch of the Croton river, by the purchase of the necessary lands for the dam; but, for some unaccountable reason, the work was not put under contract until November, 1874. It was completed, so as to be available for use, in the spring of 1878.

In the meantime Boyd's Corners Reservoir and the lakes and ponds were brought into requisition every year, and several times they were drawn down to the lowest level at which the water from them is available.

In the year 1873 they furnished one-thirteenth of the entire supply, and in 1874 and 1875 nearly an equal quantity was drawn from them.

The drought of 1876 exceeded in severity and duration anything known in this section of country for half a century.

The situation and the condition of the water supply brought forth a special statement to the public from Mr. Allan Campbell, the Commissioner of Public Works, dated October 18, 1876, from which the following extracts are made:

"Although the public are generally aware of an extraordinary drought during the past summer, it is probably not known that from June until the present time, a period of over four months, the drought in the Croton valley and its tributaries, has been unexampled within the past fifty years. Since the 22d of June no water has run over the Croton dam, except for the short space of four days. The Croton river itself has dwindled to the dimensions of a mere brook, and resort has necessarily been had to the artificial reservoir at Boyd's Corners, and to the natural lakes of Westchester and Putnam counties. During this period of unprecedented drought 4,470,000,000 gallons of water have been drawn from the waters stored in these basins."

"Although we had every reason to anticipate relief from summer showers and autumnal rains, the attention of the Department has been unremitting in procuring such additional supplies as could by any possibility be commanded. Lakes hitherto not possessed by the city have been purchased or leased, their outlets cut down, and large volumes of water thus added to the Croton river. These purchases and works, while affording indispensable relief in the present extremity, will forever remain a useful and necessary part of the water system of the city."

The effects of this drought upon the Croton water supply were felt until the very close of the year, inasmuch as it was necessary during the last three months, October, November, and December, to draw 1,770,000,000 gallons of water from the storage reservoir and lakes, to supplement the natural flow of the river. The total quantity drawn from the reservoir and lakes in 1876 was 6,173,000,000 gallons, which is nearly equal to 17,000,000 gallons for every day in the year; and with this heavy draft on the stored water, the supply had to be limited for several weeks to 70,000,000 per day, while the average daily consumption for eight years past has been more than 80,000,000 gallons.

The drought recurred with even greater severity in 1877. In 1876, the rain-fall in the Croton basin, from April 1, to September 30, was 20 77-100 inches, and during the same period in 1877, it

was but 14 63-100 inches. From June 29, to October 5, 4,344,000,000 gallons of water were drawn from the reservoir and lakes.

In 1878, there were only twenty days from July 27 to 30, and from August 19 to September 4, when the natural flow of the Croton river was insufficient for the daily supply, and during this time, 724,700,000 gallons of water were drawn from the Boyd's Corners Reservoir.

With the completion of the new reservoir on the middle branch of the Croton, and the acquisition of the right and construction of the dams and flumes to draw upon all the available lakes and ponds in the Croton basin, our storage capacity now stands as follows:

	Gallons.
Boyd's Corners Reservoir.....	2,727,000,000
Middle Branch Reservoir.....	4,004,000,000
Lake Mahopac.....	575,000,000
" Kirk.....	565,000,000
" Gleneida.....	165,000,000
" Gilead.....	380,000,000
Barrett's Pond.....	170,000,000
China.....	105,000,000
White.....	100,000,000
Pine.....	75,000,000
Long.....	60,000,000
Peach.....	230,000,000
Cross.....	110,000,000
Lake Waccabuc.....	200,000,000
Lake Tonnetta.....	50,000,000
Haines' Pond.....	25,000,000
Total gallons.....	9,000,000,000

With this amount of stored water we can fill the aqueduct to the extent of its capacity during the severest drought that may occur, and the only way in which the supply can be increased is by additional conduits to bring water into the city.

The future plans for the improvement and increase of the water supply are briefly summarized in the following extracts from the quarterly reports of Mr. Allan Campbell, the Commissioner of Public Works:

REPORT FOR THIRD QUARTER OF 1877.

After careful study, and the experience of the late extraordinary drought, I see no reason to alter the opinion expressed in previous reports, that the Croton system (with such auxiliary supplies as have heretofore and shall hereafter be indicated) is the most economical, simplest and best system, all things considered, which can be adopted.

Amongst other sources of supply which have been suggested, are the Passaic and the Hudson river.

The water-shed of the former river above the Dundee dam, situated five miles below the city of Paterson and at the head of tide-water, has an area of about nine hundred and fifty square miles. The cities of Newark, Jersey City, and Hoboken, take their supply from this river below the Dundee dam, and provisions would have to be made to pass them the quantity required for their use. The water, if taken at the dam, must be pumped into a reservoir, and carried thence across Saddle river and under the Hackensack to a proper point eight miles distant; then pumped into a reservoir, and thence led by pipes under the Hudson river to the reservoir in New York. To provide for an uninterrupted supply from this source, the pipes under the Hackensack and Hudson rivers should be carried through tunnels, that they may be readily reached for repairs.

The water of this stream is contaminated by the refuse of manufactures and the sewerage of Paterson, a city of large and increasing population. Newark, Jersey City, and Hoboken, now complain of the quality of the water obtained from this river in time of drought, and are having examinations made for a different and more pure supply.

To tap the river at such elevation that it may be brought into New York without pumping would necessitate the construction of large storage reservoirs and compensation to the mill owners and cities using the water on the lower part of the river, and it is doubtful whether a grant to divert the water could be obtained.

The water flowing in the Passaic during recent droughts, according to authentic statements, was only one hundred million gallons per day, or about the quantity consumed daily in New York. Considering the large cities in New Jersey to be first supplied, the expense and precarious method required to conduct the water to this city, and other objections which have been mentioned, this plan may be pronounced impracticable.

It has been proposed to pump the water of the Hudson river at Poughkeepsie, to the high ground lying east of the river, and thence carry it by pipes several miles to the headwaters of the Croton. A description and estimate of this plan was published in Poughkeepsie about a year ago, or after the drought of 1876, and contemplated a partial supply to aid the Croton in meeting such deficiencies. Our present system of storage reservoirs in the Croton valley will accomplish the object at far less expense, and with pure water; that of the Hudson at Poughkeepsie being sometimes brackish.

If the Hudson river shall ever be used for the supply of New York, its water must be taken where it is unaffected by the sea, perhaps one hundred to one hundred and twenty miles above the city, and thence conveyed by aqueduct or pipes in the valley of the Hudson itself, to the point of distribution. The cost of such a work over the rough country which borders the Hudson river would be enormous.

There is undoubtedly a great advantage in drawing a supply of water for a large city from a great and never-failing river like the Hudson, its capacity being practically without limit, and if there were no other and more feasible alternative, it might be well to consider this plan, formidable as it may appear. In the far distant future, when New York shall count its population by many millions, and when the Croton with its adjunct, the Housatonic, shall have been taxed to their utmost capacity, it is a satisfaction to know that the great city can never be deficient in its water supply, the Hudson affording a certain resort, though at a great expense.

Another suggestion is that water may be procured from Long Island, by sinking wells in the sand, and conveying the water by pipes under the East river to this city. It has even been asserted that the present supply for Brooklyn is so abundant that a sufficient amount can be spared to supply the lower part of New York, under a pressure of sixty pounds to the square inch. This cannot be true, as during the late drought the Brooklyn Board of City Works was warning its citizens to be sparing of water, the reservoirs being greatly reduced. Even if a supply could be obtained from Long Island, its conveyance by pipes under the East river, in any considerable quantity, would be attended with hazard.

With this notice of suggestions which have been made for improving the water supply of New York, I will now give my views as to the best mode of securing the end proposed:

1st. As to the quantity which the Croton watershed will furnish—From a careful survey made by the Croton Aqueduct Board in 1857-8, it was found that the Croton-watershed embraces an area of 338 square miles. In a report made by the Board to the Common Council, in 1863, the average daily flow of the Croton was stated to be 339,000,000 gallons.

From the spring of 1866, when the storage reservoir at Boyd's Corners was commenced, a rain-gauge has been kept at that point. The elevation is 550 feet above the tide, and the rain-fall at that point may be considered a fair average of the rain-fall in the Croton basin in a period of twelve years.

From the above data, and from daily observations taken at the Croton dam and in the aqueduct, the following table is constructed, showing the actual rain-fall in the Croton basin, the average amount in gallons of the natural flow of the river daily at the dam, the percentage of rain-fall delivered at the dam, and the number of days in each year when no water ran over the dam:

YEAR.	Rain-fall at Boyd's Corners Reservoir.	Average Amount Per Day of Natural Flow of Croton River at Croton Dam.	Percentage of Rain-fall Running in the Stream.	Number of Days when no Water Ran Over Croton Dam.
	Inches.			
1866.....	51.77	441,000,000	51	50
1867.....	50.77	540,000,000	65	..
1868.....	50.33	601,000,000	74	8
1869.....	48.36	457,000,000	58	80
1870.....	44.63	348,000,000	47.5	102
1871.....	48.94	357,000,000	45	37
1872.....	40.74	307,000,000	49	34
1873.....	43.87	444,000,000	67	116
1874.....	42.37	428,000,000	63	83
1875.....	43.66	435,000,000	59	71
1876.....	40.68	368,000,000	56	175
January 1 to November 1, 1877 (10 months).....	36.35	307,000,000*	44	136

* N. B.—The heavy rains of October will largely increase this average for the whole year 1877.

From which it appears that the highest average daily flow in any year was 601,000,000 gallons, the general daily average for the twelve years was 419,000,000 gallons, and the minimum average daily flow 307,000,000 gallons, and allowing 100,000,000 gallons daily to be delivered by the aqueduct (its maximum capacity), then it follows that even in the driest year over 200,000,000 gallons daily run to waste, and that if this were collected and impounded in storage reservoirs, to be delivered as demanded, the Croton basin would supply a population of 3,000,000 in number, allowing a consumption of the large quantity of 100 gallons daily per capita.

It would not be necessary to store all the water flowing in the river, and there would be some loss by evaporation; but, on the other hand, the per capita allowance can, with regulation against waste, be much reduced below 100 gallons daily, and therefore the Croton basin alone may be safely counted on to supply a city of two and a half million inhabitants.

I have made the above statements because false impressions are entertained by some as to the adequacy of the Croton watershed, founded, doubtless, upon the reduced supply during droughts. The facts therein presented demonstrate clearly the error of such opinions, and prove that, by the construction of the proper works from time to time, always, of course, keeping well in advance of actual need, the demands of the city, as it grows in population, can be supplied from this source.

But one artificial reservoir has yet been brought into use, viz., that at Boyd's Corners, having a storage capacity of nearly 3,000,000,000 gallons. Another reservoir of nearly 4,000,000,000 gallons, on the middle branch of the Croton river, has been three years in course of construction, and will be ready for use in January, 1878. As I have several times stated, this reservoir will greatly aid the water supply, but the time, in my opinion, has arrived for commencing a third reservoir, for which a site has been selected on the east branch of the Croton, and plans and surveys are being made in order that this work may be put under contract next season. It must be remembered that we are every year laying additional and larger mains in the city, and the supply at the source must keep pace with the demand in the city. The proposed new reservoir will consume nearly three years in its construction, and will have a capacity of 4,500,000,000 gallons. These three great reservoirs, with the natural lakes for the use of which permanent provision is to be made under the law of last session, added to the natural flow of the Croton, will fill the present aqueduct every day in the year, and thus secure all the benefit which one aqueduct can possibly afford.

2d. As there is but one aqueduct or conduit by which water is brought to the city, it is of the first importance that this work should be maintained in thorough repair, so that it may be filled nearly to its roof, and convey its maximum quantity. The Croton Aqueduct is a noble structure, and for thirty-five years has performed its duty without a breach sufficient to interrupt its current. In tunnels or excavations, where it rests upon natural foundations, it continues almost unimpaired; but in crossing valleys, upon artificial foundations, very slight settlements sometimes occur, causing crack and leaks which can only be temporarily remedied until the water is drawn off, as is done once a year for as thorough repair as is practicable in the short period of three days, beyond which time the supply cannot be interrupted.

Within the past two or three years considerable work has been done towards strengthening the aqueduct in its outer walls, and in improving and perfecting the arch inclosing the water-way. It is proposed to continue this work each year until the aqueduct is rendered as secure as possible, and with this view I have asked the Board of Estimate and Apportionment for a small additional appropriation over and above the ordinary work of maintenance, which I trust will be granted. It is true economy carefully to guard and protect the single conduit by which the city is supplied, as breaches or leaks would entail serious consequences.

3d. Waste of water must be prevented by the use of meters in all large establishments. Within the past year meters have been placed in railroad and omnibus stables. They have also been applied along the water front on docks and piers, where great waste previously existed. There is yet much to be done in this matter, but it is intended to follow it up until all establishments and places of the kind above mentioned are metered. This, with careful inspection of private houses by competent persons, will effect an important saving in the amount of water used; indeed, the steps already taken have had an appreciable effect in accomplishing this most desirable purpose.

4th. For the purpose of ascertaining what supply may be drawn from the Bronx, a careful survey is now in progress, but I am not yet able to state its results. More than fifty years ago, and before it was decided to use the Croton river, examinations were made of the Bronx with the object of supplying the city from its waters.

In 1824 Canvas White, who had been one of the engineers of the Erie Canal, made a survey of this stream, and estimated that by building a dam at the outlet of the Rye ponds in Westchester county, six feet in height, and lowering the outlet two feet, the natural flow of the river could be so far aided as to afford a steady supply of 6,600,000 gallons per day. This quantity was deemed inadequate for a population then comparatively small, but rapidly increasing under the stimulus imparted by the Erie Canal, and its further consideration was abandoned, and the study of the Croton valley taken up.

The circumstances are now entirely altered. Then the Bronx river was thought of as the main source of supply; now, if found available at all, it will be merely as an auxiliary, and for the supply of the annexed district north of the Harlem river, to which extent it would relieve the demand upon the present aqueduct, which is every year approaching nearer and nearer the maximum capacity of that structure. The water should be taken out above White Plains, to avoid the impurities of the numerous villages situated on the Bronx below that place. It could be delivered at some point north of the Harlem river, at an elevation of fifty feet above the present aqueduct, and thus reach the highest ground in the suburban district. The extremely low cost of iron at the present time, as well as other economical considerations, would make an iron pipe of sufficient size the most proper conduit.

The feasibility of this plan will depend upon its cost and the quantity of water which can with certainty be secured. It is very desirable in the present condition of our burdensome debt and taxation to defer as long as possible the large expense of an additional aqueduct, while at the same time it is equally important to maintain a liberal supply of water for the growing population. Now, if the waters of the Bronx and the Rye ponds can be introduced, at a cost commensurate with the quantity delivered, it will just so far aid in securing the object proposed; and this conduit, though comparatively small, will remain a permanent part of the water system of the city. I will present the full results of the survey when the plans and estimates are prepared.

5th. The Housatonic river.—Next to the Croton basin, and as auxiliary thereto, the Housatonic river offers the most interesting and important subject for our consideration.

In my fourth quarterly report for the year 1876, I referred to it as follows: "I have already explained that the Croton river and basin are adequate for the supply of a city of more than two millions of inhabitants, but in investigating this important subject I have been led to look beyond the Croton basin, and to consider what additional supplies may be most feasibly and economically secured for the unfailing and abundant supply of water to this great metropolis.

"My knowledge of the topography of the country immediately north of the Croton valley, obtained from the reconnaissance and surveys made several years ago, induced the belief that the waters of the Housatonic river might be tapped and led by conduit to the headwaters of the Croton. A cursory survey, recently made, establishes the perfect feasibility of this plan at a comparatively moderate cost.

"The Housatonic is a large river, having its source in the Berkshire hills, and its southerly course through the State of Connecticut approaches at a point ten miles north of the head of the Croton, within half a mile of the New York State line. At this point, known as Bull's Falls, a tributary of the Housatonic breaks through the mountain range which divides New York from Connecticut, and opens a way for the introduction of a canal by which the waters of the Housatonic may be led and discharged into the Croton basin.

"By means of this great auxiliary supply, from a large river of the purest quality, the water supply of this great city may be considered assured, even for the distant future. Of course, legislative sanction of the State of Connecticut will be required in perfecting this plan."

In order to obtain accurate information in regard to this project, I propose to have a detailed survey made during the coming season, and plans and estimates prepared and filed in the Department, so as to be available whenever the proper time shall arrive for carrying the work into effect.

From the examination already made, the following information has been obtained: The watershed of the Housatonic, above Bull's Falls, has an area of about 750 square miles, or more than double that of the Croton. From a measurement of the stream, made at a time of very low water, it was found to discharge 200,000,000 gallons daily.

A canal of about twenty-seven miles in length will lead the waters of the Housatonic, by gravity, into the Croton basin, for which canal two lines will require examination.

A short canal of ten miles, commencing near Bull's Falls, would, for a time, accomplish the purpose by raising the water at that point by pumps, to be operated by the water power of the river, which here falls eighty feet in half a mile.

With the large supply which the Housatonic will furnish, added to the drainage of the Croton watershed, it is clear that a population of more than three millions will be liberally provided.

Sixth. High Service.—When the Croton water was introduced into New York, and some years subsequently, the city, as then built, was below the level of the receiving reservoir, and water was delivered to the upper stories of the houses by hydraulic pressure. Since that time the elevated portions of the island have been built upon, where the land is as high as the surface of the park reservoirs. Of course at all those points the water must be raised to the upper stories by pumping, and this was doubtless the original design of the Croton Aqueduct Commission.

In the year 1870 a small reservoir was built near the southern end of High Bridge, into which Croton water is pumped by steam power, the object being to supply the Manhattanville district. There being a surplus beyond the requirements of that immediate neighborhood, it has been distributed to other high points, and so pressing have been the demands for this high-service water, that it is now extended to the extreme limit of its capacity.

Its great value and popularity having been proven, the necessary legislation to authorize the erection of additional pumping power was asked of the last Legislature, but the bill, which passed the Assembly, was not reached in the Senate.

I propose to renew the application at the coming session, and if granted, to proceed next year with the necessary works upon the city lots between Ninety-seventh and Ninety-eighth streets, near Ninth avenue, already set apart for this purpose, and to carry out this most useful improvement.

Seventh. Distribution of Water.—The growth of the city has rendered an increase in the size and arrangements of the distributing mains necessary. The Department is making good progress in this work, and it is proposed to continue it under the authority conferred for that purpose, until the small mains of former years are replaced by large ones on the principal streets and avenues, and in connection therewith to put in a sufficient number of fire-hydrants.

REPORT FOR THE SECOND QUARTER OF 1878.

Supply of Water for the Future.

I have in several of my reports treated very fully of the important question of an abundant supply of water for the future. I will now briefly present some views, derived from our latest investigations:

First.—The present aqueduct is now carrying water up to its fullest capacity, and, from the substantial repairs which have been made upon it during the past two years, the leaks, which had been considerable, have been reduced, so that loss from this cause is comparatively small. Waste in the city has also been much reduced by the introduction of meters on the docks, in stables, and at other places where water is used in larger quantities, and also by inspection in private houses. Notwithstanding this state of things the consumption during the present summer has been greater than the supply, as is evidenced by the fact that the level of the Central Park Reservoir has fallen several inches.

The condition of the water supply is essentially different from what it was last season. Then we were suffering from unprecedented drought, and there was a lack of water at the sources of the Croton. Now the streams and reservoirs, natural and artificial, in the Croton basin are full, and water is now, and for many days during the summer has been, running over the Croton dam into the Hudson river. No draft has yet been made upon the lakes or reservoirs, and, indeed, if the Hudson itself were pouring into the Croton basin, no greater quantity could be delivered daily at the city without additional conduits, the present aqueduct being filled to its utmost capacity. It follows from this state of things, taken in connection with the growth of the city and the rapid extension of water-pipes, that an additional supply of water should be provided without unnecessary delay, by means of an additional conduit, and we are thus brought to the consideration of the best method of solving the problem. It is one which must be met, and though it will entail expense upon the city, I should fail in my duty if I did not, in advance of absolute need, present the true state of the case and propose the remedy.

Second.—If the city were not in its present deplorable financial condition, loaded with an enormous debt, and overburdened with taxation, it would be the part of wisdom to prepare for the construction of a new and large aqueduct from the Croton basin. Such a work would require five years for its completion, and would cost at least twelve millions of dollars. I discard all propositions and suggestions to enlarge the present aqueduct, or to lay mains alongside of it, as impracticable. We cannot run the hazard of severing the single artery on which the very life of the city depends. Any work in such close proximity to it would subject it to such disaster.

Before the lapse of many years a new and large aqueduct must be built from the Croton basin to meet the wants of increasing population, and its capacity should be such that, when added to previously existing conduits, the combined flow of all should be sufficient for a city of three millions of inhabitants. Impressed, however, with the importance of postponing for some years the large outlay required for a new aqueduct, I have carefully considered the feasibility of some other means of providing an additional supply of water at a moderate cost, which shall meet the wants of the city for several years, and until it is better prepared to incur the cost of the greater work. In verbal and written communications to you I have indicated the Bronx and the Rye ponds as the surface from which such auxiliary supply may be obtained. Further study of the question confirms this opinion, which is also sustained by that of the Chief Engineer of the Croton Aqueduct, based upon actual and careful surveys.

The Rye ponds are situated on one of the branches of the Bronx, about five miles northeasterly of White Plains, and have an area of two hundred and nineteen acres. Their waters are pure, and the larger lake of the two is fifty or sixty feet in depth, and two hundred and ninety-one feet above tide. It is proposed to erect a dam of eight feet at the outlet, by which six hundred millions of gallons may be stored. About one mile lower down, and on the main stream, another reservoir of nine hundred million gallons may be formed by a dam of thirty-five feet in height. These lakes, with the natural flow of the stream, will furnish ten millions of gallons daily, or one-ninth of the supply furnished by the Croton Aqueduct. It is practicable, at very small cost, to lead into Rye pond the flood water of Byram river, by which a considerable additional supply may be obtained.

It is proposed to convey the waters of the Bronx by an iron pipe of forty-two inches diameter, and fifteen miles long, to a receiving reservoir near Williams' Bridge, elevated fifty feet above the Croton Aqueduct, whence so much of it as may be required can be distributed to the upper wards, and the remainder discharged into the aqueduct or otherwise conveyed to other parts of the city. It is computed that three million gallons daily will suffice for the present supply of the Twenty-third and Twenty-fourth Wards, leaving seven million gallons to be added to the present supply south of the Harlem river.

The work is estimated to cost one million two hundred and fifty thousand dollars. Iron pipe is now lower than at any previous period, our last purchase having been made at twenty-one dollars per ton. The time is therefore very favorable for such work. The cost per million gallons will not exceed the cost for the same amount by the Croton aqueduct, and considering that this latter work was constructed nearly forty years ago, when labor was cheap, the comparison exhibits the Bronx project in a favorable light. The elevation of the reservoir at Williams' Bridge will furnish water by natural pressure to the high grounds of the annexed district which are destined to be occupied by large and valuable buildings.

The country from which the supply is to be drawn is purely agricultural and the water will be as potable as that of the Croton. About two years will be required to construct this work.

There is no other plan by which an equal quantity of water may be so cheaply and quickly added to our present supply. The present laws, which authorize the expenditure of not exceeding one million of dollars annually for increasing the supply of water, by the issue of bonds, will only need to be supplemented by an ordinance of the Common Council, but if additional legislation is necessary to carry out the work, it can, no doubt, be obtained on application of the city authorities. This work will always remain a valuable part of our water system, and I recommend that early steps be taken to put it in execution.

Third.—For the greater supply of water which will be required in the more distant future by the medium of a new and large aqueduct from the Croton basin, reliance must be had upon the Croton watershed and the Housatonic river. The former, with an area of three hundred and forty square miles, will furnish, if the water be impounded in reservoirs, a supply at the present rate of consumption for more than double the present population. But as it is well not to rely altogether on stored water, my attention, as I have explained in previous reports, has been turned to the Housatonic. A party of engineers is now engaged in making a survey to ascertain the practicability and cost of drawing eighty or one hundred millions of gallons daily from that river, and of leading it to the Croton basin, whence it will flow to the city through the new aqueduct above spoken of. If this project be feasible, an abundant supply of water will, with the two aqueducts and the conduit from the Bronx, be assured for a population of three millions.

I have recently, with the Chief Engineer, made an examination of the Housatonic river, and the three lines of canal which are being surveyed for diverting its waters to the head of the Croton. Which of the three will be preferable can only be ascertained by an instrumental examination, and it is not necessary that I should at this time enter into a minute description of the plan proposed, as this will be done in a special report on the close of the survey and completion of maps and estimates. The water appears to be pure and soft, the very few manufacturing works upon the stream above the point of effluence not being of a character to pollute it. The drainage area above the head of the proposed canal is seven hundred and fifty square miles, or more than double that of the Croton.

The Housatonic being in Connecticut the consent of the Legislature of that State must be obtained for the construction of a canal, and the diversion of any part of the waters of this river. I believe the cost of water-rights would be quite moderate. Although there are falls and rapids on this stream, affording good water-power, very little use has been made of it. At Fall's Village a water-power canal was constructed several years ago, but it remains dry and unused to this day. Water-power, unless situated near great markets, has been in great measure superseded by steam-power. That is to say, the cost of transporting the raw and manufactured materials to and from the water-power, situated inland, exceeds the cost of steam-power, which may be planted on tide water, and close to market.

I shall look with interest to the results of the surveys now in progress, because of their bearing upon one of the most important questions connected with the growth and prosperity of the city. Although it may be some years before the actual work of the contemplated plan is undertaken, it is well to give the subject an early and exhaustive study, so that at the proper time the best mode and plan may be ready for execution.

Fourth.—I would again urge the early commencement of the high-service works at Ninety-seventh street, near Ninth avenue, for which an ordinance is now before the Common Council. The rapid extension of water pipes, by which pressure is reduced, and the erection of buildings on the high grounds in the upper part of the city, make this improvement a necessity. It will cost about two hundred and twenty thousand dollars.

The high-service works and the conduit from the Bronx will together not exceed one million five hundred thousand dollars in cost, a sum comparatively moderate, when we consider the great advantages which will follow from the outlay. In a mere financial view, the expenditure will be reimbursed by water-rents and increased valuation of taxable property.

Revenue.

The following table shows the yearly revenue derived from "Croton water," from its introduction into the city in 1842, to October 1, 1877:

From Oct. 5, 1842, to May 1, 1843	\$32,053 74
" May 1, 1843, " 1, 1844	84,444 68
" " 1, 1844, " 1, 1845	117,227 86
" " 1, 1845, " 1, 1846	163,900 52
" " 1, 1846, " 1, 1847	193,346 24
" " 1, 1847, " 1, 1848	219,416 72
" " 1, 1848, " 1, 1849	250,081 51
" " 1, 1849, Dec. 31, 1849	259,532 97
" Jan. 1, 1850, " 31, 1850	458,951 87
" " 1, 1851, " 31, 1851	458,789 78
" " 1, 1852, " 31, 1852	578,426 48
" " 1, 1853, " 31, 1853	650,021 20
" " 1, 1854, " 31, 1854	703,730 83
" " 1, 1855, " 31, 1855	790,077 70
" " 1, 1856, " 31, 1856	778,292 77
" " 1, 1857, " 31, 1857	823,156 35
" " 1, 1858, " 31, 1858	840,928 08
" " 1, 1859, " 31, 1859	855,261 47
" " 1, 1860, " 31, 1860	868,843 58
" " 1, 1861, " 31, 1861	891,430 81
" " 1, 1862, " 31, 1862	893,896 82
" " 1, 1863, " 31, 1863	982,031 26
" " 1, 1864, " 31, 1864	1,006,191 77
" " 1, 1865, " 31, 1865	1,056,772 49
" " 1, 1866, " 31, 1866	1,125,605 96
" " 1, 1867, " 31, 1867	1,261,600 30
" " 1, 1868, " 31, 1868	1,312,093 05
" " 1, 1869, " 31, 1869	1,315,076 13
" " 1, 1870, Apl. 9, 1870	77,641 95
" Apl. 11, 1870, " 10, 1871	1,296,383 79
" " 11, 1871, " 10, 1872	1,353,591 59
" " 10, 1872, " 30, 1873	1,439,349 39
" " 30, 1873, Dec. 31, 1873	1,386,132 41
" Jan. 1, 1874, Jan. 1, 1875	1,477,277 06
" " 1, 1875, " 1, 1876	1,444,256 71
" " 1, 1876, " 1, 1877	1,478,281 00
" " 1, 1877, " 1, 1878	1,470,329 60
" " 1, 1878, " 1, 1879	1,606,509 29
	\$32,001,535 73

Statement Showing Cost of Croton Water Works.

Total amount expended for works, structures, aqueducts, pipes, etc., etc., connected with the water supply of the City of New York, including maintenance and repairs, from the period of its inception to the first day of January, 1879:

To January 1, 1865	\$20,030,221 93
During the year, 1865	224,337 27
" 1866	442,628 05
" 1867	581,794 80
" 1868	726,437 40
" 1869	894,628 19
" 1870	1,172,078 48
" 1871	2,784,440 72
" 1872	1,836,847 68
" 1873	2,049,850 51
" 1874	1,465,708 03
" 1875	882,777 64

During the year, 1876	\$1,066,645 50
" 1877	859,670 68
" 1878	802,014 58
Total cost	\$35,820,081 46
Total cost	\$35,820,081 46
Total revenue	32,001,535 73
Cost over revenue	\$3,818,545 73

EXHIBIT "A."

Pipes of all Sizes Laid for the Distribution of Croton-water to December 31, 1878.

	48-in.	36-in.	30-in.	24-in.	20-in.	16-in.	12-in.	10-in.	6-in.	4-in.	Total Feet.	Miles.
Previous to Jan. 1, 1860	49,477	44,862	9,742	41,324	14,978	282,782	5,875	937,463	9,472	1,395,975	264.38	
Laid in 1860						6,602		26,331		32,933	6.24	
" 1861						5,205		34,567		39,772	7.53	
" 1862	27,900					3,610		21,713		53,223	10.08	
" 1863						7,550		20,986		28,536	5.41	
" 1864						2,080		14,999		17,079	4.16	
" 1865						6,520		12,938		19,458	3.68	
" 1866					7,050		3,670		11,100	21,820	4.13	
" 1867					1,665		6,276		17,660	25,601	4.85	
" 1868					2,531		8,268		21,453	32,252	6.11	
" 1869					11,300		9,681		18,171	39,152	7.41	
" 1870					10,770		18,500		35,282	65,735	12.45	
" 1871	2,220	3,050			3,557		19,494		33,481	66,144	12.52	
" 1872	82	16,402		174	3,098	72	25,372		52,750	107,381	20.34	
" 1873	17,332	481		1,626	38,132		34,139		57,855	153,032	28.99	
" 1874	9,513	109	2,177		8,059		18,055	754	27,436	69,447	13.15	
" '75, '76	2,032		235		22,108		32,771		45,206	102,352	19.34	
" 1877	9,407				14,998		20,663		34,142	79,210	15.00	
" 1878	6,916	5,880			16,181		35,699		58,405	123,081	23.31	
Total	75,402	75,399	47,274	11,542	180,773	17,130	549,647	6,629	1,481,938	31,339	2,477,323	469.08
Less amount taken up	10,355		5,854				4,100		5,400	3,100	28,809	5.45
Amount now Laid	65,047	75,399	41,420	11,542	180,773	17,130	545,547	6,629	1,476,538	28,239	2,448,514	463.63

Number of Hydrants in the City.

No. 1, 2, and 3 hydrants, 3-inch barrel	3,350
Victor	102
B	811
A	761
Total	5,024

Document "B."

Showing Titles of Appropriations; Amount of Appropriations and Transfers of 1878; Requisitions on 1878 to April 1, 1879; Requisitions on Liabilities of 1878 in Second Quarter, 1879; Balances of 1878, on July 1, 1879; Appropriations and Transfers of 1879; Requisitions, First Quarter, 1879; Requisitions, Second Quarter, 1879; Balances, July 1, 1879; with Titles and Conditions of the "Trust Accounts."

TITLES OF APPROPRIATIONS.	APPROPRIATIONS AND TRANSFERS, 1878.	REQUISITIONS ON 1878 TO APRIL 1, 1879.	REQUISITIONS ON LIABILITIES OF 1878, IN SECOND QUARTER, 1879.	BALANCES OF 1878, ON JULY 1, 1879.	APPROPRIATIONS AND TRANSFERS, 1879.	REQUISITIONS, FIRST QUARTER, 1879.	REQUISITIONS, SECOND QUARTER, 1879.	BALANCES ON JULY 1, 1879.
Aqueduct—Repairs and Maintenance	\$112,000 00	\$111,995 78		\$4 22	\$112,000 00	\$14,514 30	\$24,854 43	\$72,631 18
Aqueduct—Repairs and Maintenance, Salaries				13,760 00		2,257 02	4,550 04	6,946 34
Boulevard, Roads, and Avenues—Maintenance	41,000 00	40,013 12	\$954 97	31 91	41,000 00	4,010 90	11,737 40	15,251 79
Boulevard, Roads, and Avenues—Maintenance, Salaries						687 04	1,044 00	2,268 06
Contingencies—Department of Public Works	2,500 00	2,428 95		71 05	2,500 00	144 05	270 50	2,085 45
Flagging Sidewalks and Fencing Vacant Lots, etc.	1,100 00	1,081 99		18 01	1,100 00		592 79	407 21
Free Floating Baths	5,880 00	5,867 28		12 72	5,880 00	5 20	478 91	9,015 89
Free Floating Baths, Battery					9,500 00	3 64	226 66	9,269 70
Free Floating Baths, Salaries					4,000 00	442 50	630 00	2,867 50
Free Floating Baths, Additional	16,559 27	12,272 45		* 4,446 82	4,446 82	308 00	898 23	3,240 59
Lamps and Gas	498,809 59	498,801 56		8 03	504,000 00	78,715 75	118,516 28	306,767 97
Lamps and Gas, Salaries					6,000 00	904 00	1,252 00	3,844 00
Public Buildings—Construction and Repairs	31,250 00	31,176 52		73 48	33,000 00	2,635 01	6,823 16	23,541 83
Public Buildings—Construction and Repairs, Salaries					2,000 00	307 50	624 00	1,068 50
Public Drinking Hydrants	3,000 00	2,999 22		78	4,000 00	98 98	1,801 49	2,099 53
Removing Obstructions in Streets and Avenues	4,250 00	4,248 23		1 77	1,500 00	121 55	1,090 95	1,090 95
Removing Obstructions in Streets and Avenues, Salaries					2,000 00	345 00	530 00	1,125 00
Repairing and Renewal of Pipes, Stop-cocks, etc.	90,000 00	89,991 05		8 95	62,500 00	11,202 44	20,431 26	30,866 30
Repairing and Renewal of Pipes, Stop-cocks, etc., Salaries					25,000 00	4,296 48	10,212 30	10,491 22
Repaving, under chapter 476, Laws 1875	355,000 00	286,285 67	10,968 33	57,746 00				
Repaving Streets and Avenues, under chapter 476, Laws 1875					300,000 00		7 24	299,992 76
Repaving, under chapter 476, Laws 1875, Salaries					6,000 00	318 79	650 38	5,030 83
Repairs and Renewal of Pavements	172,000 00	171,399 72	387 50	212 78	150,000 00	1,342 93	58,810 60	89,846 47
Roads and Avenues, and Sprinkling	20,000 00	19,988 42		11 58	18,000 00	511 02	5,114 61	12,374 37
Salaries—Department of Public Works	94,250 00	94,164 43		85 57	92,000 00	21,016 46	21,016 47	49,774 07
Sewers—Repairing and Cleaning	60,000 00	59,433 39	500 02	66 59	46,200 00	5,378 81	15,400 51	24,420 68
Sewers—Repairing and Cleaning, Salaries					8,800 00	1,045 50	1,853 00	5,901 50
Street Improvements—For Street Signs, etc.	620 00	548 00		72 00	1,000 00	5 00	223 66	771 34
Supplies for and Cleaning Public Offices	92,250 00	92,207 04		42 96	60,234 00	14,080 47	18,085 12	28,058 41
Supplies for and Cleaning Public Offices, Salaries					15,366 00	2,845 60	5,325 20	7,195 20
Supplying Water to Shipping, etc., Salaries	8,000 00	7,990 00		10 00	8,000 00	1,307 00	2,663 50	4,029 50
Wells and Pumps—Repairing and Cleaning	500 00	458 64		41 36	1,500 00		82 03	1,417 97
Bridge across Fourth avenue, at One Hundred and Sixteenth street					17,500 00			17,500 00
Expenses of Grading, etc., Fort Gansevoort Property, etc.					25,000 00			25,000 00
Totals	\$1,608,968 86	\$1,533,351 46	\$12,810 82	\$62,966 58	\$1,581,306 82	\$169,104 03	\$336,059 87	\$1,076,142 92

* Credited with an amount of Voucher withdrawn, \$160.

TRUST ACCOUNTS.	AMOUNTS AUTHORIZED BY BOARD OF ESTIMATE AND APPORTIONMENT.	AMOUNTS CALLED FOR BY COMMISSIONER OF PUBLIC WORKS.	AMOUNTS EXPENDED TO JANUARY 1, 1879.	AMOUNTS OF REQUISITIONS, FIRST QUARTER, 1879.	AMOUNTS OF REQUISITIONS, SECOND QUARTER, 1879.	TOTAL REQUISITIONS TO JULY 1, 1879.	AMOUNTS TO CREDIT ON JULY 1, 1879.
Additional Alterations of Aqueduct, Ninety-third to One Hundred and Thirteenth street	\$3,550,000 00	\$3,600,000 00	\$3,596,740 09	\$3,089 40		\$3,599,829 49	\$170 51
Additional Alterations of Aqueduct, One Hundred and Eighteenth to One Hundred and Forty-second street	65,165 57	100,000 00	57,515 93			57,515 93	42,484 07
Boulevard, Roads, etc.—Assessment Fund				5,915 89	\$8,034 92	13,950 81	
Croton Water Fund	1,310,000 00	1,310,000 00	1,279,065 79	11,843 18	7,189 50	1,298,098 47	11,901 53
Croton Water-main Fund	3,625,000 00	3,750,000 00	3,702,937 80			3,702,937 80	47,062 20
Croton Water-main Fund, No. 2	1,338,000 00	1,488,000 00	1,140,384 97	18,627 49	60,110 54	1,219,123 00	268,877 00
Meter Stock	11,500 00	25,000 00	10,106 98			10,106 98	14,893 02
Street Improvement Fund				84,419 71	56,031 42	140,451 13	

C. T. McCLENACHAN, First Bookkeeper, D. P. W.

Document "C."

A Statement in detail of Expenditures of the Department of Public Works, for which requisitions were drawn upon the Comptroller, during the Quarter ending June 30, 1879.

APPROPRIATIONS.

Aqueduct—Repairs and Maintenance—

Building brick walls.....	\$142 75
Cement and lime.....	273 10
Coal.....	1,415 90
Incidentals, miscellaneous.....	279 92
Land.....	260 00
Lumber.....	317 76
Oil.....	698 30
Pay-rolls.....	17,916 34
Repairing engine.....	339 06
Repairing gate-houses.....	718 15
Repairing tools.....	77 42
Rubber hose.....	61 20
Sand and stone.....	190 00
Supplies.....	258 70
Taxes.....	456 04
Tools.....	109 79
Wood.....	45 00
Wrought bands.....	1,295 00

Total.....\$24,854 43

Aqueduct—Repairs and Maintenance (Salaries)—

Pay-rolls.....	\$4,556 64
----------------	------------

Boulevard, Roads, etc.—Maintenance—

Coal.....	\$40 75
Gravel.....	874 16
Harness.....	55 00
Horsekeeping.....	9 00
Iron.....	68 27
Lath.....	27 00
Leather.....	18 33
Pay-rolls.....	9,214 99
Rent of offices.....	81 25
Repairing wagon.....	45 00
Repairing sprinklers.....	51 16
Rubber hose.....	191 40
Sand and clay.....	880 00
Supplies.....	25 69
Tools.....	52 92
Trees.....	102 48

Total.....\$11,737 40

Boulevard, Roads, etc.—Maintenance, for 1878—

Sand and clay.....	\$769 72
Screenings.....	185 25

Total.....\$954 97

Boulevard, Roads, etc.—Maintenance (Salaries)—

Pay-rolls.....	\$1,044 00
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Contingencies—Department of Public Works—

Incidentals.....	\$200 00
Traveling expenses.....	70 50

Total.....\$270 50

Flagging and Fencing in front of City Property—

City Prison.....	\$312 80
Market, Clinton.....	95 20
Market, Jefferson.....	28 02
Forty-second street, between First and Second avenues.....	156 77

Total.....\$592 79

Free Floating Baths—

Painting baths.....	\$275 00
Repairing tanks.....	106 49
Services of Architect.....	166 66
Services of Inspector.....	60 00
Supplies.....	10 76
Towing baths.....	86 66

Total.....\$705 57

Free Floating Baths (Salaries)—

Pay-rolls.....	\$690 00
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Free Floating Baths (Additional) for 1878—

Painting baths.....	\$520 00
Repairing tanks.....	191 90
Supplies.....	13 01
Towing baths.....	173 32

Total.....\$898 23

Lamps and Gas—

Crossheads.....	\$279 00
Glass.....	27 50
Lamps.....	1,975 00
Lamp-irons.....	185 00
Lamp-posts.....	2,064 25
Lighting Armory, Third Regiment (Cavalry).....	42 94
" Fifth ".....	87 59
" Seventh ".....	240 54
" Eighth ".....	47 70
" Ninth ".....	476 33
" Eleventh ".....	79 04
" Twelfth ".....	205 20
" Twenty-second Regiment.....	358 91
" Sixty-ninth ".....	86 83
" Seventy-first ".....	150 29
" Battery "B" Artillery.....	5 80
" "K" ".....	10 07
" Sep. Troop "A" Cavalry.....	42 37
" "B" Artillery.....	25 84

Lighting Brown Stone Building.....	29 07
" City Hall.....	560 12
" County Jail.....	505 40
" Court, Marine.....	7 41
" " Special Sessions.....	1 33
" " Second District Civil.....	17 29
" " Fourth ".....	1 90
" " Fifth ".....	5 13
" " Eighth ".....	3 80
" " Ninth ".....	3 80
" " First District Police.....	215 08
" " Second ".....	45 60
" " Third ".....	52 82
" " Fourth ".....	62 78
" " Fifth ".....	16 80

Lamps and Gas—

Lighting Department of Buildings.....	\$7 79
" Engine-house at High Bridge.....	116 20
" Market, Catharine.....	54 72
" " Centre.....	235 41
" " Clinton.....	229 71
" " Essex.....	97 47
" " Fulton.....	33 39
" " Jefferson.....	96 90
" " Tompkins.....	145 16
" " Union.....	86 83
" " Washington.....	524 97
" New Court-house.....	898 89
" Office of Collector of Arrears of Personal Taxes.....	4 75
" " Corporation Attorney.....	48 45
" " Engineer—Boulevard.....	20
" " Receiver of Taxes.....	187 91
" Photometrical Rooms.....	62 39
" Rivington Street Yard.....	3 42
" South Gate-house.....	17 60
" Streets, Central Gas-light Co.....	19,179 53
" " Harlem.....	20,568 42
" " Manhattan ".....	20,253 66
" " Metropolitan ".....	19,300 63
" " New York ".....	10,325 08
" " N. Y. Mutual ".....	2,561 31
" " N. Y. & N. J. Globe Gas-light Co.....	1,698 66
" " Northern Gas-light Co.....	12,319 99
" " Vonkers ".....	576 00
Pay-rolls, Lighters.....	300 00
Rent of Photometrical Rooms.....	162 50
Supplies.....	22 22
Traveling expenses.....	77 50

Total.....\$118,516 28

Lamps and Gas—Salaries—

Pay-rolls.....	\$1,252 00
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Public Buildings—Construction and Repairs—

Armory—Ninth Regiment.....	\$155 19
Avenue, Tenth, and Little West Twelfth street.....	50 25
Beekman street, No. 49.....	16 00
Brown Stone Building.....	120 83
Bureau of Repairs and Supplies.....	208 73
City Arsenal.....	195 00
City Hall.....	1,334 47
City Prison.....	213 93
Clinton street, No. 154.....	37 79
County Jail.....	631 06
Court, First District Civil.....	6 65
" Sixth ".....	57 27
" Third District Police.....	8 10
Court-house, New.....	371 71
" Third District.....	511 33
" Fifth ".....	15 12
" Seventh ".....	30 39
" Tenth ".....	12 43
Dispensary Building.....	3 00
Dog Pound.....	900 00
Grand street, No. 594.....	32 60
Market, Centre.....	14 50
" Clinton.....	275 00
" Essex.....	8 55
" Fulton.....	1,228 48
" Jefferson.....	21 94
" Washington.....	183 23
Norfolk street, No. 25.....	8 18
Register's Office.....	113 03
Rivington Street Yard.....	46 40

Total.....\$6,823 16

Public Buildings—Construction and Repairs (Salaries)—

Pay-rolls.....	\$624 00
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Public Drinking Hydrants—

Altering hydrants.....	\$181 69
Repairing hydrants.....	1,619 80

Total.....\$1,801 49

Removing Obstructions in Streets and Avenues—

Traveling expenses.....	\$62 50
Trucking and labor.....	225 00

Total.....\$287 50

Removing Obstructions in Streets and Avenues (Salaries)—

Pay-rolls, Inspectors.....	\$530 00
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Repairing and Renewal of Pipes, Stop-cocks, etc.—

Bolt ends.....	\$93 76
Cement and lime.....	36 75
Coke.....	25 00
Hydrant boxes.....	250 00
Hydrants.....	806 00
Lumber.....	615 98
Oil.....	72 37
Pay-roll.....	15,744 07
Repairing engine.....	896 33
" hydrants.....	14 50
Rubber hose.....	24 30
Setting hydrant frames.....	111 13
Steel.....	49 80
Stop-cock boxes and covers.....	526 50
Stop-cocks.....	445 00
Tapping and waste cocks.....	633 00
Tools.....	86 77

Total.....\$20,431 26

Repairing and Renewal of Pipes, Stop-cocks, etc. (Salaries)—

Pay-rolls.....	\$10,212 30
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Repaving Streets and Avenues, under Chap. 476, Laws of 1875—

Traveling expenses.....	\$7 24
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Repaving, under Chap. 476, Laws of 1875 (Salaries)—

Pay-rolls.....	\$650 38
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Repaving, under Chap. 476, Laws of 1875, for 1878—

Barclay and Morris streets.....	\$360 83
Irving place and Fifteenth street.....	1,104 04
Fourteenth street, between University place and Ninth avenue.....	1,651 61
Fifth avenue, between Fifty-ninth and Seventy-second streets.....	7,851 85

Total.....\$10,968 33

Repairs and Renewal of Pavements—

Belgian blocks.....	\$7,300 00
Bridge stone.....	759 84
Cart signs.....	80 00
Harness.....	95 00
Pay-roll.....	45,351 00
Relaying pavement.....	1,366 56
Repairing tool-house.....	31 92
Repairing tools.....	510 20
Sand.....	2,937 50
Supplies.....	378 58

Total.....\$58,810 60

Repairing and Renewal of Pavements, for 1878—

Sand.....	\$387 50
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Roads and Avenues and Sprinkling—

Filling.....	\$300 00
Pay-rolls.....	4,546 11
Powder and fuse.....	20 75
Repairing tools.....	132 75
Tools.....	52 50
Traveling expenses.....	62 50

Total.....\$5,114 61

Salaries—Department of Public Works—

Pay-rolls.....	\$21,016 47
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Sewers—Repairing and Cleaning—

Altering basin.....	\$114 40
Basin covers.....	24 15
Cement.....	98 75
Cleaning basins and culverts.....	2,300 00
Lumber.....	155 70
Manhole frames and covers.....	881 57
Pay-rolls.....	6,616 20
Rebuilding basin.....	102 60
Rebuilding sewer.....	960 32
Repairing basin-heads.....	355 45
Repairing basins.....	550 37
Repairing manholes.....	261 70
Repairing sewers.....	3,641 54
Resetting crosswalk.....	13 98
Rubber hose.....	173 65
Tools.....	118 35
Traveling expenses.....	25 78

Total.....\$16,400 51

Sewers—Repairing and Cleaning (Salaries)—

Pay-rolls.....	\$1,853 00
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Sewers—Repairing and Cleaning, for 1878—

Rebuilding basin.....	\$116 38
Rebuilding manhole.....	81 75
Repairing basin.....	78 60
Repairing gas-pipes.....	54 49
Tools.....	168 80

Total.....\$500 02

Street Improvements—For Street Signs, etc.—

Strengthening embankment.....	\$223 66
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Supplies for and Cleaning Public Offices—

Armory 8th Regiment.....	\$14 00
“ 9th “.....	110 50
“ 11th “.....	13 50
“ 12th “.....	42 00
“ Sep. Troop A.....	39 50
Brown Stone Building.....	137 60
Bureau Repairs and Supplies.....	301 58
Chambers street, No. 27.....	34 30
City Hall.....	806 28
County Jail.....	120 25
Court Second District Civil.....	1 07
“ Third “.....	5 25
“ Sixth “.....	53 38
“ Seventh “.....	143 50
“ Eighth “.....	42 96
“ Ninth “.....	74 55
“ First District Police.....	35 05
“ Second “.....	130 50
“ Third “.....	42 50
“ Fourth “.....	3 50
“ Fifth “.....	21 10
“ Common Pleas.....	107 06
“ Marine.....	166 54
“ Special Sessions.....	99 00
“ Superior.....	14 50
“ Supreme.....	17 00
Court-house, New.....	1,711 70
“ Third District.....	18 63
Department of Buildings.....	31 25
“ Finance.....	150 20
“ Public Works.....	254 05
“ Taxes and Assessments.....	78 99
Office Board of Aldermen.....	43 34
“ Assessors.....	68 85
“ Collector Arrears Personal Taxes.....	57
“ Commissioners of Accounts.....	23 00
“ Corporation Attorney.....	22 72
“ Counsel.....	27 00
“ County Clerk.....	120 09
“ District Attorney.....	28 25
“ Mayor.....	224 18
“ Public Administrator.....	16 85
“ Register.....	10 00
“ Surrogate.....	5 48
Pay-rolls.....	12,673 00

Total.....\$18,085 12

Supplies for and Cleaning Public Offices (Salaries)—

Pay-rolls.....	\$5,325 20
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Supplying Water to Shipping, and for Building (Salaries)—

Pay-rolls.....	\$2,663 50
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Wells and Pumps—Repairing and Cleaning—

New pump.....	\$69 23
Repairing pumps.....	12 80

Total.....\$82 03

RECAPITULATION OF APPROPRIATIONS.

Aqueduct—Repairs and Maintenance.....	\$24,854 43
“ “ “ Salaries.....	4,556 64
Boulevard, Roads, and Avenues, Maintenance of.....	11,737 40
“ “ “ “ for 1878.....	954 97
“ “ “ “ Salaries.....	1,044 00
Contingencies—Department of Public Works.....	270 50
Flagging and Fencing in front of City Property.....	592 79
Free Floating Baths.....	705 57
“ “ Salaries.....	600 00
“ “ Additional for 1878.....	898 23
Lamps and Gas.....	118,516 28
“ “ Salaries.....	1,252 00
Public Buildings—Construction and Repairs.....	6,823 16
“ “ “ Salaries.....	624 00
Public Drinking Hydrants.....	1,801 49
Removing Obstructions in Roads and Avenues.....	287 50
“ “ “ Salaries.....	530 00
Repairing and Renewal of Pipes, Stop-cocks, etc.....	20,431 26
“ “ “ “ Salaries.....	10,212 30
Repaving Streets and Avenues, under Chapter 476, Laws 1875.....	7 24
Repaving, under Chapter 476, Laws 1875, for 1878.....	10,968 33
“ “ “ Salaries.....	650 38
Repairs and Renewal of Pavements.....	58,810 60
“ “ “ for 1878.....	387 50
Roads and Avenues, and Sprinkling.....	5,114 61
Salaries—Department of Public Works.....	21,016 47
Sewers—Repairing and Cleaning.....	16,400 51
“ “ “ for 1878.....	500 02
“ “ “ Salaries.....	1,853 00
Street Improvements—For Street Signs, etc.....	223 66
Supplies for and Cleaning Public Offices.....	18,085 12
“ “ “ Salaries.....	5,325 20
Supplying Water to Shipping and for Building Purposes—Salaries.....	2,663 50
Wells and Pumps—Repairing and Cleaning.....	82 03

Total.....\$348,870 69

FUNDS AND TRUST ACCOUNTS.

CROTON WATER FUND.

Drawing implements.....	\$58 40
Horsekeeping.....	120 00
Land purchased.....	55 00
Pay-rolls.....	4,599 47
Plants.....	75 00
Rent of mill seat.....	375 00
“ office.....	65 00
Services of Expert.....	352 50
“ Legal.....	1,291 81
“ of Witness.....	180 00
Traveling expenses.....	8 32

Total.....\$7,189 50

CROTON WATER MAIN FUND.

Building foundation, Engine-house.....	\$4,922 65
Cast iron water-pipe.....	17,073 26
Changing service taps.....	402 42
Horsekeeping.....	87 65
Hydrant boxes.....	265 00
Laying Croton-mains.....	10,490 91
Lead.....	888 73
Pay-rolls.....	19,030 40
Repairing gas-mains.....	158 83
“ service pipe.....	9 72
“ wagon.....	130 85
Stop-cock boxes and covers.....	361 75
Stop-cocks and hydrants.....	6,157 50
Supplies.....	36 25
Traveling expenses.....	94 62

Total.....\$60,110 54

STREET IMPROVEMENT FUND.

Crosswalks—	
Fourth avenue at intersection One Hundred and Tenth to One Hundred and Fourteenth street, P. J. Masterson.....	\$200 00
Curb, Gutter and Flagging—	
Forty-fifth street, between First and Second avenues, G. Palmer.....	240 52
Fencing—	
Between Sixty-ninth and Seventieth streets and Lexington and Fourth avenues, Michael Mahoney.....	\$119 19
Forty-fourth street, between Tenth and Eleventh avenues, Michael Mahoney.....	17 71
East side Madison avenue, between Eightieth and Eighty-first streets, Michael Mahoney.....	156 69
East side Sixth avenue, between One Hundred and Twenty-fourth and One Hundred and Twenty-fifth streets, Michael Mahoney.....	92 80
Southwest corner Seventy-fourth street and Fourth avenue, R. A. Cunningham.....	73 00
Flagging—	
East side Madison avenue, between Eightieth and Eighty-first streets, J. S. Masterson.....	\$152 71
West side First avenue, between Fifty-ninth and Sixtieth streets, L. Rock.....	54 00
North side Fifty-first street, between Broadway and Eighth avenue, J. S. Masterson.....	29 16
North side Sixtieth street, between Boulevard and Ninth avenue, James Reilly.....	553 17
North side Fifty-ninth street, between Madison and Fifth avenues, T. J. Reilly.....	341 10
North side Seventy-second street, between Lexington and Third avenues, J. S. Masterson.....	298 82
South side Eighty-fifth street, one hundred feet west of Lexington avenue, J. S. Masterson.....	63 86
Paving—	
Fifty-third street, between Broadway and Seventh avenue, Thomas Gearty.....	\$773 22
Seventy-fourth street, between Avenue A and East river, Denis Egan.....	2,462 01
Eighty-first street, between Fourth and Fifth avenues, D. McGrath.....	3,022 97
One Hundred and Fourteenth street, between Second and Fourth avenues, W. A. Cumming.....	512 80
One Hundred and Twentieth street, between First avenue and Harlem river, James Reilly.....	416 40
Receiving Basins—	
First avenue, northwest corner of Extra place, Charles Devlin.....	\$109 50
First avenue, northeast and northwest corners of Sixty-first street, T. L. Butler.....	7 80
Tenth avenue, northwest corner of Bloomfield street, Charles Devlin.....	288 80
Madison avenue, northwest corner of One Hundred and Tenth street, R. A. Cunningham.....	10 00
Avenue A, southwest corner of Fifty-fourth street, P. T. Masterson.....	267 45

683 55

Regulating, Grading, etc.—	
Madison avenue, between Ninety-ninth and One Hundred and Fifth street, J. Slattery.....	\$4,016 25
Ninth avenue, between Sixty-third street and Boulevard, J. D. Crimmins.....	583 35
Forty-second street, between Second avenue and East river, Thomas Connell.....	1,295 00
Seventy-sixth street, between First avenue and Avenue A, J. Slattery.....	133 75
Ninety-ninth street, between First and Third avenues, J. D. Crimmins.....	7,849 29
	\$13,877 64
Sewers—	
New avenue, west of Morningside Park, James Everard.....	\$1,655 68
Eleventh avenue, between Sixtieth and Sixty-fourth street, J. H. McCabe.....	415 20
Twelfth avenue, between One Hundred and Thirtieth and One Hundred and Thirty-first streets, W. E. Dean.....	197 80
Ann street, between William and Gold streets, F. P. Nesbit.....	46 40
Forty-fourth and Forty-fifth streets and Hudson river, T. Smith.....	3,738 22
Ninety-fifth street, between Third and Lexington avenues, J. B. Healy.....	3,247 07
Ninety-ninth street, between Boulevard and Tenth avenue, F. Stollmeyer.....	53 00
One Hundred and Nineteenth street, between Fifth avenue and Summit, J. H. McCabe.....	1,834 45
One Hundred and Nineteenth street, between Fourth and Fifth avenues, J. G. Smith.....	405 00
One Hundred and Thirty-second and One Hundred and Thirty-third streets, between Sixth and Seventh avenues, Devlin & McKim.....	271 60
	11,864 42
Pay-rolls, Engineers, etc., Sewers.....	13,707 02
Inspectors, Sewers.....	2,858 00
" Paving.....	168 00
" Regulating, Grading, etc.....	2,158 00
Supplies.....	242 25
Surveyors.....	892 41
Total.....	\$56,031 42

STREET IMPROVEMENTS ABOVE FIFTY-NINTH STREET.

Boulevard Planting—	
Pay-rolls.....	\$66 42
Boulevard and Eleventh avenue, Regulating, Grading, etc.—	
Pay-rolls.....	\$629 20
Regulating, grading, etc.....	5,772 73
	6,401 93
Morningside avenue, West—	
Pay-rolls.....	\$1,566 57
Total.....	\$8,034 92

GENERAL SUMMARY.

Appropriations.....	\$348,870 69
Trust Accounts—	
Croton Water Fund.....	7,189 50
Croton Water Main Fund.....	60,110 54
Street Improvement Fund.....	56,031 42
Street Improvements, above Fifty-ninth street.....	8,034 92
	131,366 38
Grand Total.....	\$480,237 70

Document "D."

Contracts Made during the Three Months ending June 30, 1879.

DATE.	NATURE AND LOCATION OF WORK.	CONTRACTOR.	SURETIES.	ESTIMATED COST.
1879.	<i>Sewers.</i>			
Apr. 11	Sewer in One Hundred and Fifteenth street, between Fourth and Madison avenues.....	Frank Stollmeyer, 22 E. 75th street.....	David Babcock, 16 Broadway..... Henry Stollmeyer, 22 E. 75th street.....	\$1,741 30
" 12	Sewer in Second avenue, between Seventy-fifth and Seventy-sixth streets.....	James Baird, 410 E. 58th street.....	William Baird, 310 E. 57th street..... Matthew Baird, 306 E. 57th street.....	2,310 00
" 12	Sewer in Eighty-third street, between Tenth avenue and Boulevard.....	James Baird, 410 E. 58th street.....	William Baird, 310 E. 57th street..... Matthew Baird, 306 E. 57th street.....	2,123 75
" 21	Sewer in Seventy-third street, between Eighth and Tenth avenues.....	John G. Smith, 423 W. 48th street.....	Noah A. Childs, 152 E. 63d street..... L. W. Johnson, 414 W. 34th street.....	13,745 20
" 29	Sewer in One Hundred and Seventh street, between Fourth and Fifth avenues.....	Patrick Mulholland, 1339 Third avenue.....	E. C. Sheehy, 1453 Third avenue..... Patrick Sheehy, 251 E. 83d street.....	3,619 30
May 26	Sewer in One Hundred and Twenty-ninth street, between Seventh and Eighth avenues.....	John C. Dowling, 83d st. and 1st ave.....	F. McCabe, 725 Lexington avenue..... P. Sheehy, 251 E. 83d street.....	1,231 00
" 26	Sewer in One Hundred and Twenty-eighth street, between Second and Third avenues.....	John C. Dowling, 83d st. and 1st ave.....	F. McCabe, 725 Lexington avenue..... P. Sheehy, 251 E. 83d street.....	1,626 00
June 2	Sewer in Lexington avenue, between One Hundred and Third and One Hundred and Fourth streets.....	Edward Bradburn.....	Bernard Maloney, 123 E. 116th street..... Tim Donohue, 412 E. 114th street.....	1,332 50
" 16	Sewer in Sixty-ninth street, between Boulevard and Ninth avenue.....	Thomas L. Butler and Thomas J. Reilly.....	Thomas O'Reilly, 1001 First avenue..... John Davidson, 128 E. 52d street.....	3,560 00
May 21	Extension of sewer at the foot of Houston street, with alterations and improvements to existing sewers and appurtenances in Sewerage District No. 4.....	James Baird, 410 E. 58th street.....	William Baird, 310 E. 57th street..... Matthew Baird, 306 E. 57th street.....	18,940 00
				\$50,229 05
<i>Regulating and Grading Contracts.</i>				
May 27	Regulating, grading, etc., Seventieth street, from Eighth to Tenth avenues.....	John Brady, 288 S. 2d st., B'klyn. E. D.....	James A. Coleman, 200 W. 26th street..... John H. Kendall, 23 Washington place.....	\$18,305 00
June 12	Regulating, grading, etc., Sixty-eighth street, from Third avenue to East river.....	John Slattery, 788 Fourth avenue.....	James Slattery, 207 W. 57th street..... William Hullivan, 349 W. 53d street.....	1,570 00
				\$19,875 00
<i>Paving.</i>				
June 27	Regulating, grading, setting curb stones, flagging and paving, with trap-block pavement, the block bounded by Gansevoort street, Little West Twelfth street, Washington street, West street, and Tenth avenue.....	John Brady, 288 S. 2d st., B'klyn. E. D.....	James A. Coleman, 200 W. 26th street..... John H. Kendall, 23 Washington place.....	\$24,263 30
" 29	Regulating, grading, setting curb stones, flagging and paving Water street, between Corlears and East streets, with granite pavement.....	James Pollock, 239 E. 11th street.....	William A. Cumming, 5 Dey street..... James Sinclair, 413 E. 29th street.....	2,069 68
" 26	Paving One Hundred and Fourth street, between Second and Third avenues, with Belgian pavement.....	Denis McGrath, Weehawken, N. J.....	John H. Borsennecker, 552 Eleventh avenue..... James Slattery, 207 W. 57th street.....	2,765 08

DATE.	NATURE AND LOCATION OF WORK.	CONTRACTOR.	SURETIES.	ESTIMATED COST.
1879.	<i>Paving intersections of Fourth avenue with Eighty-third, Eighty-fourth, Eighty-fifth, and Eighty-sixth streets, with Belgian pavement.....</i>			
June 26		Denis McGrath, Weehawken, N. J.....	John H. Borsennecker, 552 Eleventh avenue..... James Slattery, 207 W. 57th street.....	\$3,635 88
				\$32,733 94
<i>Awarded under Chapter 476, Laws of 1875.</i>				
Apr. 3	Paving Vesey street, from Broadway to West street, with granite pavement.....	John F. Broderick, 153 E. 87th street.....	Bernard Maloney, 123 E. 116th street..... Charles Glaser, 180 E. 104th street.....	\$10,665 50
<i>Croton Water Pipe Contracts.</i>				
Apr. 9	Laying Croton-mains in One Hundred and Seventy-seventh, Seventy-sixth, Seventy-third, One Hundred and Fifty-second, One Hundred and Eighth, One Hundred and Forty-sixth, One Hundred and Nineteenth, Seventy-ninth, One Hundred and Fifty-third, and Ninety-ninth streets.....	John Cornwell, 2101 Madison avenue.....	George Borstman, 309 E. 25th street..... Peter M. Wilson, 318 W. 15th street.....	\$5,382 70
" 21	Laying Croton-mains from High-service Reservoir over the High Bridge and along the line of the Aqueduct and McComb's Dam road to Kingsbridge road.....	John P. Cumming, Jr., Inwood.....	Wm. G. Spear, 220 E. 118th street..... Thomas Bailey, 152d st. and 10th ave.....	7,615 00
" 26	Laying Croton-mains in Ninety-eighth street, Eighth avenue, Ninth avenue, Sixth avenue, and Lexington avenue.....	Matthew Baird, 306 E. 57th street.....	William Baird, 310 E. 57th street..... Charles R. Parrott, 727 Lexington avenue.....	15,964 00
June 14	Laying Croton-mains in Eighty-fifth street, Boulevard, and Avenue A.....	John Cornwell, 2101 Madison avenue.....	George Borstman, 309 E. 25th street..... Peter M. Wilson, 318 W. 15th street.....	3,517 70
				\$32,479 40
<i>Miscellaneous.</i>				
Apr. 17	Construction of retaining walls, arch steps, railing, and for the filling and grading necessary for the support of a forty-foot roadway in Forty-second street, between First and Second avenues.....	Edward Freely, 209 Van Buren street, Brooklyn.....	Charles H. Field, 957 Second avenue..... M. B. Flynn, 622 E. 114th street.....	\$30,834 00
May 6	One floating swimming bath.....	William F. Morgan, 73 Broadway.....	Gottlob Bollet, 168 Allen street..... John D. Hansen, 72 Second street.....	6,873 00
" 19	Furnishing all the materials, building and putting up two pumping engines and boilers, with the necessary water and steam connections and appurtenances, in building to be erected between Ninety-seventh and Ninety-eighth streets, 100 feet west of Ninth avenue.....	H. R. Worthington, 239 Broadway.....	D. S. Hines, 239 Broadway..... W. A. Perry, 239 Broadway.....	64,300 00
June 19	Building boiler and engine-house, chimney vaults, etc., on lot situated between Ninety-seventh and Ninety-eighth streets, 100 feet west of Ninth avenue.....	D. C. Weeks.....	Valentine Cook, 214 E. 37th street..... Frank M. Weeks, Walton av., bet. 162d and 163d streets.....	45,771 00
" 14	Sodding the top and face of the dam and the ground below the dam of the New Reservoir, on the middle branch of the Croton river, in the town of South East, Putnam Co., N. Y.....	William B. Jackson, 48 Dey street.....	John McNamee, 477 Kent av., B'lyn..... Manus McNulty, 26 Downing street.....	4,757 50
				\$152,535 50
" 12	Regulating, grading, setting curb and gutter stones and flagging Elm street, between Pearl and Worth streets.....	John B. Healy, 246 E. 105th street.....		\$306 88
May 21	Setting curb and gutter stones and flagging Forty-fifth street, between First and Second avenues.....	Gilbert Palmer, 49 E. 78th street.....		278 37
Apr. 1	Flagging, full width, north side of Seventy-second street, from Lexington to Third avenue.....	John S. Masterson, 127th st. and 7th ave.....		309 92
" 1	Flagging south side of Eighty-fifth street, 100 feet west of Lexington avenue.....	John S. Masterson, 127th st. and 7th ave.....		67 20
" 1	Flagging east side of Madison avenue, between Eightieth and Eighty-first streets.....	John S. Masterson, 127th st. and 7th ave.....		159 04
" 1	Flagging north side of Fifty-first street, from Broadway to Eighth avenue.....	John S. Masterson, 127th st. and 7th ave.....		30 00
May 19	Flagging, full width, west side of First avenue, between Fifty-ninth and Sixtieth streets.....	Lawrence Rock, 459 W. 40th street.....		54 00
" 19	Fencing vacant lots on the southeast corner of Seventy-fourth street and Fourth avenue.....	R. A. Cunningham, 343 E. 16th street.....		70 35
" 15	Sewer in One Hundred and Fourth street, from 650 feet east of Tenth avenue to 75 feet west of Ninth avenue.....	John B. Healy, 246 E. 105th street.....		762 75
" 17	Receiving-basin on southwest corner Ninety-second street and Eighth avenue.....	John Mulholland, 73d st., 1st & 2d aves.....		385 00
				\$2,423 51

RECAPITULATION.

Ten sewer contracts.....	\$50,229 05
Two regulating and grading contracts.....	19,875 00
Four paving contracts.....	32,733 94
One paving (under chapter 476, Laws of 1875).....	10,665 50
Four Croton water pipe contracts.....	32,479 40
Six miscellaneous contracts.....	152,535 50
Ten special contracts.....	2,423 51
Thirty-seven contracts.....	\$300,941 90

Contracts Completed during the Three Months ending June 30, 1879.

DATE.	NATURE AND LOCATION OF WORK.	COST.
1879.	<i>Flagging.....</i>	
April 5	West side of Fifty-ninth street, between Madison and Fifth avenues.....	\$371 09
" 23	In Forty-fourth and Forty-fifth streets, at North river, with alterations to existing sewers in Sewerage District No. 2.....	11,007 22
" 23	On the northwest corner of First street and Extra place.....	142 30
" 23	On southwest corner Fifty-fourth street and Avenue A, and on northwest corner of Fifty-fifth street and Avenue A.....	422 25
May 6	Paving.....	953 42
" 7	Sewer.....	2,397 25
" 13	Receiving-basins.....	417 00
" 21	Fencing vacant lots.....	143 84
" 21	Paving.....	3,612 78
" 24	Flagging.....	785 32
" 24	Fencing vacant lots.....	113 09
June 4	Paving.....	3,417 87

Document "F."

DEPARTMENT OF PUBLIC WORKS,
CHIEF ENGINEER'S OFFICE, CITY HALL,
NEW YORK, January 23, 1878.

Hon. ALLAN CAMPBELL, Esq., Commissioner of Public Works:

SIR—In accordance with your instructions a party was organized and placed in the field in September last, for the purpose of making a careful and thorough survey of the Bronx river, with the object of ascertaining its capabilities for furnishing an additional supply of pure and wholesome water, and the practicability of bringing into the city such supply, and the cost of the same. The country below White Plains through which this river flows is rapidly filling with inhabitants, large and growing villages occupying the lands on each side. It was therefore deemed advisable that the surveys and estimates should be made in reference to taking the waters above White Plains, the river below that village being liable to pollution.

The small streams which form the Bronx river take their rise in the towns of New Castle, North Castle, and Mount Pleasant, Westchester County. They head in the ridges which divide their waters from those of the Croton on the north, the Sawmill river on the west, and the Byram river on the east. These flowing southward to the neighborhood of Kensico there receive the stream which forms the outlet of the Rye ponds. These ponds or lakes lie about one mile south-east of Kensico, the larger covering an area of 186 acres and the smaller 34 acres. The elevation of the large pond is 291 feet above tide and two feet above the smaller and flowing into it.

Upon a preliminary examination of the river two points were selected as the most feasible for locating dams, the first being about one-quarter of a mile east of Kensico Station on the Harlem Railroad, and the other at the outlet of Little Rye pond.

A weir was placed in the river at the proposed site of the dam and another at the outlet of Little Rye pond. The depth of water on these was observed daily during an unprecedented drouth to the 5th October, when a heavy rain fell. The amount of water passing daily in the Bronx at this time was 1,006,992 gallons, and flowing out of Rye pond was 599,040 gallons. The storm of the 5th October carried away the weir which was again rebuilt after the freshet, and there was found 8,028,720 gallons flowing in the Bronx, and from the Rye ponds 923,040 gallons. There is now an average of 23,338,000 gallons passing the point selected for the dam. To procure proper data to estimate the amount of water that could be made available, a survey was made of the watershed of the river above the proposed site of the dam, as also of that part passing through the Rye ponds. It was found that the watershed of these lakes was three square miles and that of the river above the proposed dam 13 square miles. The nearest point where reliable observation of the rain-fall had been taken was at White Plains, where Professor Willis of the Alexander Institute has kept a record for the past five years, being for 1873 to 1877, inclusive. These observations give the average annual rain-fall at 56.67 inches.

Assuming that 45 per cent. of the rain-fall runs into the stream (the lowest percentage we have of record on the Croton) we have an average daily flow of over 15,000,000 gallons.

The character of the surface and soil of the watershed of the Bronx river, the ground being generally rough and precipitous, requires that large storage capacity be provided to secure a daily supply of 10,000,000 gallons. The effect of storing the water is to greatly improve the quality and by exposure to the air to greatly decrease the amount of organic matter.

It is proposed to build a dam at the outlet of Little Rye pond, raising the water 8 feet over this pond and 6 feet over the large one. The area of these ponds is 219 acres and by the dam will be increased to 280. The available capacity of this lake as a reservoir will be 575,000,000 gallons.

At the point selected for a dam on the Bronx, near Kensico, the elevation is 200 feet above tide. It is proposed to build a dam 35 feet high, and take the water out at an elevation of 210 or 10 feet above the bottom. This dam will flood 188 acres and the available capacity will be 904,000,000 gallons, which with the 575,000,000 gallons stored in the Rye ponds it is estimated will, with the natural flow, furnish a daily supply of 10,000,000 gallons.

The ground for a masonry conduit was found not favorable, and the estimate is based upon cast-iron pipes 42 inches diameter. Near Williams' Bridge favorable ground is found for a distributing reservoir. The distance from the dam to the reservoir is 80,300 feet or 15.2 miles. The surface of the water in this reservoir will be 180 feet above tide, or 50 feet higher than the water in the aqueduct near Jerome Park, and will supply the high grounds in the new wards south of Williams' Bridge. The estimates are for a reservoir that will hold 60,000,000 gallons. Two million gallons per day will at present fully supply the new wards and the eight millions additional, brought in from the Bronx, can be turned into the Croton Aqueduct, distant about 4,000 feet west from this reservoir, until the demand in the new wards shall equal this supply from the Bronx river.

WATER RIGHTS.

There are nine dams on the river, each of which will be effected by the diversion of the water. None of them have large storage capacity. Assuming that we divert 10,000,000 gallons daily, and that this water could be used 12 hours per day in the mills, and that the water wheels would give 70 per cent. of the power on the shaft, it would necessitate 54 horse power to be supplied by steam. Most of the mills have steam engines, and the cost of the increased use of them may be put down as not exceeding \$100 per horse power per annum, including repairs and maintenance. This would give \$5,400 per annum, and capitalized at six per cent., would be \$90,000.

Estimated cost of Lake reservoir, dam, lands, water-rights, conduit, distributing reservoir, near Williams' Bridge and connection with the Croton aqueduct:

Rye Ponds Reservoir.....	\$16,550 00
Dam near Kensico, including change of roads.....	152,490 00
Conduit, including right of way.....	667,195 00
Distributing reservoir near Williams' Bridge.....	154,675 00
Connection with Croton Aqueduct.....	36,825 00
Water rights on river.....	90,000 00
	<u>\$1,117,735 00</u>

Add for superintendence and contingencies 10 per cent.....

111,774 00

\$1,229,509 00

This estimate of cost is based upon the present low prices, and the whole work could now be put under contract to good and responsible contractors within the foregoing estimate.

In addition to the benefit that New York will derive from obtaining a further supply of water from a source away from and independent of the Croton, will be the great advantage of this delivery fifty feet higher than can be delivered from the Croton Aqueduct, thus furnishing water to much of the district that now could only be supplied by pumping from the present aqueduct.

Very respectfully yours,

JOHN C. CAMPBELL,
Chief Engineer Croton Aqueduct.

NOTE.—Since the above report was made, it has been deemed proper to increase the height of the dam, and capacity of the storage reservoir at Kensico, and to increase the size of the main from 42 inches to 48 inches in diameter, by which the estimated cost is increased to \$1,500,000.

The following is the revised Engineer's estimate in detail:

Document "G."

DEPARTMENT OF PUBLIC WORKS,
CHIEF ENGINEER'S OFFICE, CITY HALL,
NEW YORK, June 28, 1879.

ALLAN CAMPBELL, Esq., Commissioner of Public Works:

SIR—According to your instructions a party was organized May 8, 1879, under T. A. Emmet, Assistant Engineer, to make the necessary surveys of the Byram river, to ascertain the area of its watershed and the practicability of diverting a portion of the waters of same into the Bronx river.

The surveys have so far progressed that it is assured that the waters of the Byram can be diverted into Bronx watershed.

After a personal examination of the several routes, locations, and of the water powers on the Byram from its sources to Long Island sound, I present herewith an estimate of the amount of water to be obtained, cost of diverting same, and also of the cost of the necessary works, etc., to obtain the waters of the Bronx and Byram rivers combined, as a further supply for the City of New York, and connecting same with the present distribution of Croton water.

BYRAM RIVER.

The Byram river has its headwaters in the State of New York, Wampus and Byram ponds forming the headwaters of the two main streams which unite after flowing about five (5) miles (near the Connecticut State line), then the river flows through the State of Connecticut to Long Island sound; at Portchester its watershed adjoins that of the Bronx on the west, and the water of same can be

diverted in the State of New York by means of a tunnel and open cut through the dividing ridge into Bear Gutter creek, one of the tributaries of the Bronx river.

The other practicable means of diverting the water is by way of open cut and tunnel through Tamarack Swamp. This route is two-thirds in Connecticut and one-third in New York. The valley of the Byram in the State of New York is a good farming country, and is analogous to that of the Croton. There are no factories or large towns to pollute the waters of same, and from facts obtained at Woolen Mill, at Glenville, it is very soft and pure.

Water shed of Byram river from its sources to the Connecticut State line.....9.33 square miles.
Watershed from sources to the best location for a dam 1,100 feet from State line.....8.66 "

EXPOSED WATER SURFACE.

Byram pond.....	160 acres.
Wampus pond.....	50 "
Byram and Wampus rivers.....	75 "
Dam and reservoir proposed.....	75 "
Total.....	360 acres, say 0.66 square miles.

Leaving 8 square miles watershed.

If Croton watershed of 338 square miles and
Exposed water surface of 13 square miles.

325 square miles, will furnish 250,000,000 gallons per day with 40,000,000,000 gallons of storage water, taking the year 1876 as a basis (the driest year known in the Croton basin), the Byram will furnish six million gallons per day, with 1,000,000,000 gallons of storage water.

Three of the mills on the river below, some years ago joined together and made a storage reservoir of Byram pond by building a dam near the outlet and buying the land adjacent to be overflowed by water. Area of the pond (160 acres), and the depth that the water can be drawn (13 feet), it has 550,000,000 gallons stored in same, and from the best information that can be obtained it will fill every year.

There are seven (7) water and mill rights on the river between the Connecticut State line and the sound at Portchester.

Six (6) of these water and mill rights are situated in the State of Connecticut.

First Water-right south of Connecticut line; owner, Anna Sherwood; mill all gone to pieces; dam most gone; no pondage; fall, 12 feet.

There being no improvements nor any work going on it is a water-right only, and is worth, say.....\$4,000 00

Second Water-right below State line; owner, Ernestine Pickhart and heirs; mill all gone to pieces; dam has been kept in fair repair; fall, 14 feet.

There being no mill nor any work in active operation, is worth for water-right, say.. \$5,000 00
Value of dam.....2,500 00

Total.....\$7,500 00

Both of the mills being just below where the water will be diverted, and no other stream flowing in the river, all of their water rights must be bought out.

Third Water-right below State line; owner, Josiah Wilcox; frame mill in fair order; dam in good order; running steadily on tool and carriage hardware; no steam power; fall, 20 feet; owns one-fifth interest in Byram pond.

There being no tributaries coming into the river between this mill and the State line, all of his power will have to be replaced.

Six (6) million gallons of water per day is equal to 2-horse power per foot fall, 20 feet fall, equals 40-horse power.

Engine and boiler house.....	\$1,500 00
40-horse power engine and boiler.....	4,000 00
Belting and shafting.....	1,000 00
4 lbs. coal per hour, per horse power, for 12 hours, and for 300 days, equals 288 tons, at \$6.....	\$1,728 00
Engineer and fireman (1 man), at \$2 per day, 320 days.....	640 00
Oil, waste, etc., at \$1 per day, 300 days.....	300 00
Repairs, 10 per cent of costs.....	400 00
	<u>\$3,068 00</u>

Total capitalized, at 6 per cent.....51,000 00

Total.....\$57,500 00

Fourth Water-right below State line; owner, — Reynolds; old grist mill in fair order (frame); new woolen and felt mill (frame); dam in fair order; a large tributary stream combines with the Byram, just above this mill; good pondage; no steam power; mill runs regularly; fall, 14 feet; 6 million gallons per day equals 2-horse power per foot fall, 14 feet fall, equals 28-horse power.

Engine and boiler house.....	\$1,000 00
28-horse power engine and boiler.....	2,500 00
Belting and shafting.....	1,000 00
4 lbs. coal per hour, per horse power, for 12 hours, for 300 days, equals 202 tons, at \$5.....	\$1,010 00
Engine, etc., at \$2 per day, 300 days.....	600 00
Oil, waste, etc.....	200 00
Repairs, 10 per cent of cost.....	250 00
	<u>\$2,060 00</u>

Capitalized at 6 per cent.....34,000 00

Total.....\$38,500 00

Fifth Water-right below State line; owner, W. J. Tingle; large brick woolen factory; good masonry dam; small pondage; steam engine and boiler as an auxiliary; 110-horse power; runs steadily and uses more power than water; furnishes 6 months in the year; fall, 35½ feet; owns two-fifths of Byram pond; 6 million gallons per day and 35½ feet fall, equals 71-horse power.

Engine and boiler house.....	\$2,500 00
Engine and boiler, 71-horse power.....	5,000 00
Belting and shafting.....	1,000 00
3½ lbs. coal per hour, per horse power, 12 hours, for 300 days, equals 448 tons, at \$5.....	\$2,240 00
Engine, etc., at \$2.50 per day, 300 days.....	750 00
Oil, waste, etc.....	350 00
Repairs, etc., 10 per cent of cost.....	500 00
	<u>\$3,840 00</u>

Capitalized at six per cent.....64,000 00

Total.....\$72,500 00

Sixth Water-right below State line; owners, Russell, Birdsall & Ward; large brick bolt works in good order; first-class masonry dam; no steam power; runs steadily and has two days' pondage; fall, 40½ feet; owns two-fifths of Byram Pond; six million gallons and 40½ feet fall equals 81 horse power.

Engine and boiler house.....	\$5,000 00
Engine and boiler, 81 horse power.....	6,000 00
Belting and shafting.....	1,200 00
3½ lbs. coal per hour, per horse power, 12 hours, 300 days, equals 513 tons, at \$4.75.....	\$2,437 00
Engineer and fireman, at \$2.50 per day, 300 days.....	750 00
Oil, waste, etc.....	400 00
Repairs, etc., ten per cent. of cost.....	600 00
	<u>\$4,187 00</u>

Capitalized at six per cent.....69,783 00

Total.....\$81,983 00

Seventh Water-right below State line at Portchester; owner, William Greaves; can run only when tide is low; fall, seven feet; old frame grist mill in State of New York; dam in fair order; large pondage; no steam power; six million gallons and seven feet fall equals fourteen horse-power.

Engine and boiler house	\$1,000 00
Engine and boiler, 14 horse power	1,500 00
Belting and shafting	500 00
4 lbs. coal per horse power, per hour, 12 hours, 300 days, equals 101 tons, at \$4.	\$404 00
Engineer and fireman	500 00
Oil, waste, etc.	200 00
Repairs, ten per cent. of cost	150 00

Capitalized at six per cent.	20,900 00
Total	\$23,900 00

Dam across Byram river, about 1,100 feet north of State line; 700 feet long; 15 feet high.

75 acres of land, at \$2.50	\$18,750 00
3,000 cubic yards masonry, at \$7	21,000 00
8,000 cubic yards embankment and excavation, at 50 cents	4,000 00
Gates, house, etc.	5,000 00
Total	\$48,750 00

Storage capacity, 180,000,000 gallons.

Open cut and tunnel from dam (through Tamarack Swamp) to Rye pond, 11,600 feet.

600 cubic yards tunnel excavation, at \$6	\$3,600 00
200 cubic yards masonry in tunnel, at \$10	2,000 00
31,200 cubic yards excavation and embankment, at 50 cents	15,600 00
15,600 cubic yards of masonry, at \$5	78,000 00
10 acres of land, at \$300	3,000 00
Total	\$102,200 00

Open cut and tunnel through to Bear Gutter Creek—all in New York; tunnel, 2,600 feet; open cut, 1,200 feet.

4,333 cubic yards tunnel excavation, at \$6	\$25,998 00
2,166 cubic yards masonry (tunnel) at \$10	21,660 00
5,330 cubic yards excavation, at 40 cents	2,132 00
1,800 cubic yards masonry, at \$5	9,000 00
1,800 cubic yards dry wall, at \$2.50	4,500 00
10 acres of land, at \$250	2,500 00
Cleaning out Bear Gutter Creek	7,500 00
Total	\$73,290 00

Storage Reservoir at Byram Pond, owned one-fifth by Joseph Wilcox, two-fifths by W. J. Tingle, two-fifths by Russell, Birdsall & Ward; surface area, 160 acres; can be drawn down thirteen feet; capacity, 550,000,000 gallons; at \$160 per million gallons, the cost of the new reservoir on Midah Branch

SUMMARY.

Dam across Byram river	\$48,750 00
Tunnel, etc., to Bear Gutter creek	73,290 00
Storage Reservoir at Byram pond	88,000 00
First War-right in Connecticut	4,000 00
Second " "	7,500 00
Third " "	57,500 00
Fourth " "	38,500 00
Fifth " "	72,500 00
Sixth " "	81,983 00
Seventh " "	23,900 00
	\$495,923 00
Add ten per cent. for engineering and contingencies	49,592 00
Total cost to divert the Byram river, 730,000,000 gallons of stored water	\$545,515 00

THE BRONX RIVER.

13.33 square miles water-shed.
Exposed water surface.

Rye ponds	290 acres.
River, etc.	40 "
Reservoir at Kensico	250 "
Reservoir at Williams' Bridge	15 "
Total	595 acres = 0.93 square miles.

Leaving 12.40 square miles.

Taking Croton river as a basis same as in calculation for the Byram river, 12.40 square miles will furnish per day 9,500,000 gallons, and will require 1,520 million gallons of water stored.

There being no favorable location on the Byram river for storage reservoirs, it will be the most economical to increase the storage on the Bronx by raising the dam at the outlet of Rye ponds five feet, and the dam on the Bronx near Kensico, ten feet, and the following estimates of cost are based on thus increasing the storage on the Bronx, substituting a 48-inch pipe in place of a 42-inch pipe, so as to carry 16 to 22 million of gallons per day, and also increasing the capacity of the reservoir at Williams' Bridge from 60 to 100 million gallons.

DAM AND RESERVOIR AT RYE PONDS.

100 acres of land overflowed by dam thirteen feet above present level of ponds, at \$200	\$20,000 00
100 cubic yards rock excavation, at \$2	200 00
4,500 cubic yards excavation and embankments, at 50 cents	2,250 00
1,500 cubic yards masonry, at \$7	10,500 00
30 pipes and stop-cocks	1,500 00
Cleaning out stream between Rye ponds and Kensico	7,500 00
	\$41,950 00

DAM AND RESERVOIR AT KENSICO (45 feet high).

300 acres of land, at \$250	\$75,000 00
Former estimate, \$92,490.00 + 25 per cent. for increased height	115,612 00
	190,612 00

CONDUIT.

80,000 lineal feet 48-inch pipe, 28,000 tons, at \$30	\$840,000 00
200 tons special, at \$50	10,000 00
Hauling and laying do., at \$2 per foot	160,000 00
2 48-inch stop-cocks and gearing	4,000 00
24 air-cocks and blow-outs, at \$100	2,400 00
42 acres of land, 33 feet wide, for same, at \$500	21,000 00
	1,037,400 00

RESERVOIR AT WILLIAMS' BRIDGE.

Capacity, 100 million gallons.	
Former estimate, \$140,675,000, add 30 per cent. for extra size equals	\$182,877 00
20 acres of land, at \$1,000	20,000 00
	202,877 00

CONNECTION WITH CROTON AQUEDUCT.

4,300 lineal feet 36-inch pipe, 860 tons, at \$30	\$25,800 00
100 tons special, at \$50	5,000 00
750 cubic yards rock excavation, at \$2	1,500 00
7,000 cubic yards earth excavation, at 30 cents	2,100 00
4,400 lineal feet 36-inch pipe to haul and lay, at \$1.50	6,600 00
House and connecting with aqueduct	3,000 00
	\$44,000 00

Water-rights and substituting steam for water power on Bronx	257,000 00
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Total	\$1,773 839 00
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Connecting Williams' Bridge Reservoir with present distribution in the Twenty-third and Twenty-fourth Wards—

9,000 feet 36-inch pipe, 1,800 tons, at \$30	\$54,000 00
100 tons special, at \$50	5,000 00
Laying and hauling, at \$1.50 per foot	13,500 00
	72,500 00

The capacity of the pipes across Manhattan valley and the present construction of the gate-houses at each end necessitates, in order to carry this increased volume of water, the laying of a new 48-inch pipe across the valley, and rebuilding the gate-house.

ESTIMATED COST.

12,500 cubic yards earth excavation, at 30 cents	\$3,750 00
11,000 cubic yards rock excavation, at \$2.50	27,500 00
500 cubic yards brick masonry, at \$12	6,000 00
2,000 cubic yards rubble and concrete masonry, at \$8	16,000 00
160 cubic yards cut-stone masonry, at \$70	11,200 00
Gates and fixtures	9,000 00
Pipes and special castings	61,000 00
Laying pipes	10,000 00
New houses over gates	30,000 00
Changes at Forty-second street	2,500 00
Cleaning up and fencing around lots	7,000 00
Sewer (3 by 4 feet), from Manhattan street street to One Hundred and Thirty-fifth street, 2,400 feet, at \$8	19,200 00
	203,150 00

Add 5 per cent. for engineering and contingencies	\$2,049,489 00
	102,475 00

Total	\$2,151,964 00
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SUMMARY.

Of the estimates of 1877 and 1879, as to a supply of water from the Bronx river, the estimate of 1879 includes increased pondage and size of pipe conduit so as to carry the waters of Byram river also.

	Estimate, 1877.	Estimate, 1879.
Land and dam at Rye ponds	\$16,550 00	\$41,950 00
Land and dam at Kensico	152,490 00	190,612 00
Land and conduit pipe	667,195 00	1,037,400 00
Reservoir at Williams' Bridge	154,675 00	202,877 00
Connection with Croton Aqueduct	36,825 00	44,000 00
Water-rights on river	90,000 00	257,000 00
	\$1,117,735 00	\$1,773,839 00

Ten per cent. for engineering and contingencies	111,774 00
	\$1,229,509 00

Connecting Williams' Bridge Reservoir with the present distribution of the Twenty-third and Twenty-fourth Wards	72,500 00
For change of gate-houses and new 48-inch main across Manhattan Valley	203,150 00
Add five per cent. for engineering and contingencies	102,475 00
	\$2,151,964 00

BYRAM RIVER.

Dam across Byram river	48,750 00
Tunnel, etc., to Bear Gutter creek	73,290 00
Byram pond	88,000 00
Water-rights on Byram river	285,883 00
Add ten per cent. for engineering, etc.	49,592 00
Total	\$2,697,479 00

SUMMARY.

Byram river water-rights and powers	\$545,515 00
Pipe, reservoir and connection with aqueduct, and water-rights and powers	\$1,773,839 00
Connecting Williams' Bridge Reservoir with present distribution in Twenty-third and Twenty-fourth Wards	72,500 00
New gates and house and new 48-inch pipe at Manhattan Valley	203,150 00
	\$2,049,489 00
Add five per cent for engineering and contingencies	102,475 00
	2,151,964 00
	\$2,697,479 00

Total for the Bronx and Byram combined say \$2,750,000.

Under the estimate for the Byram and Bronx rivers combined we will have the following

STORAGE CAPACITY.

Byram pond	550,000,000 gallons.
Byram Dam and Reservoir	180,000,000 "
Rye ponds	1,050,000,000 "
Kensico Dam and Reservoir	1,620,000,000 "
Williams' Bridge Reservoir	100,000,000 "
Total	3,500,000,000 "

Required for 6,000,000 gallons per day from Byram	1,000,000,000 gallons storage.
Required for 9,500,000 gallons per day from Bronx	1,520,000,000 "

Total storage required	2,520,000,000 gallons.
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With the increased storage of 3,500,000,000 gallons it gives an average supply of 20,000,000 gallons per day.

Croton watershed and the Cochituate watershed have averaged more than 1,000,000 gallons per square mile per day for a number of years.

So that the Byram and Bronx rivers, with a water-shed available of twenty-two square miles, should furnish, with the large storage contemplated, easily 20,000,000 gallons per day.

Respectfully yours,
G. W. BIRDSALL,
First Ass't Engineer Croton Aqueduct, in Charge of Bureau.

Fall of Rain and Snow at White Plains.

	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Total inches.
1873.....	4.6	3.5	1.7	3.1	2.9	0.2	3.7	8.3	2.5	2.5	2.5	3.3	38.8
1874.....	9.0	4.6	6.2	4.9	5.8	2.0	8.4	4.7	7.0	1.9	3.3	2.5	60.3
1875.....	2.9	3.4	9.9	10.0	2.6	3.5	11.2	8.1	2.5	2.6	3.1	4.0	63.8
1876.....	4.5	8.1	13.6	3.9	2.9	2.9	3.2	2.8	5.7	1.6	4.2	10.6	63.5
1877.....	6.2	2.0	7.8	3.4	1.1	1.8	2.2	5.6	2.2	18.9	8.95	1.8	61.95
1878.....	11.1	3.6	4.5	2.2	4.8	4.4	2.9	3.4	5.1	3.6	9.5	9.4	64.5

Rain-fall on the Byram River, at Wilcox Mill, Three Miles South of the Connecticut State Line.

1875.....	42.60 inches.
1876.....	41.20 "
1877.....	45.59 "
1878.....	48.30 "

Document "H."

REPORT ON SURVEYS FOR DIVERTING A PORTION OF THE WATERS OF THE HOUSATONIC TO THE CROTON BASIN.

To GEORGE W. BIRDSALL, First Assistant Engineer in Charge of Croton Bureau :

DEAR SIR—I beg to present herewith my final report on the surveys made by me during the past season for the purpose of determining the feasibility of diverting a portion of the waters of the Housatonic river to the Croton basin, to the extent of 100 million gallons daily.

It was believed that the Housatonic river would furnish an inexhaustible supply, and that it could be conveyed to the Croton valley at a moderate cost, and thus reinforced the Croton would be able to supply the City of New York, although its population should be doubled in number.

The Housatonic river rises in Berkshire county, Mass. It is formed by the confluence of several small streams which unite near Pittsfield, and flow southerly through the State of Connecticut and empties into Long Island Sound a short distance east of Bridgeport. As a general rule the Housatonic valley is rugged in the extreme. Near the headwaters the valleys are more open, but on the main stream the valley is narrow and the mountain sides steep and rocky. It has a number of falls and rapids which make it available for mill purposes. The geological structure of the valley of the Housatonic is varied. Near its headwaters limestone and granite are mixed up promiscuously, one stream being found to be "hard" and a neighboring one "soft."

In the State of Connecticut the hills on the east are for the most part limestone, while those on the west are of granite formation. I have collected a number of specimens of rock to show this rather peculiar characteristic.

To determine the capability of the river to furnish the required amount of water I made a large number of gaugings. A gauge was kept at Kent, from May 22 to November 1 (see Schedule "N"), also one at West Cornwall for the same length of time. I also gauged the river by cross-sections and velocity a number of times near Fall's Village. The drainage area, obtained from the best published maps, above these several points is as follows: Above Fall's Village, 631 square miles; above West Cornwall, 799 square miles; and above Bull's Bridge, 799 square miles. The results at West Cornwall are not considered reliable on account of the leaky condition of the dam, and from the fact that during the latter part of the season "flash-boards" were placed upon the dam, over and under which the water flowed, rendering the readings of the gauge no index of the amount of water in the river. The records at Kent Dam I consider reliable, and the calculation of quantities, as shown by them, and the different formulae employed, are found in Schedule "L."

The average flow during the season may be stated at 300,000,000 gallons daily, and the minimum at 170,000,000 gallons. The value of these waters for domestic purposes will be determined by analysis by Professor Chandler, to whom a sample has been sent for that purpose.

To fix the dimensions of a canal or conduit to convey this large volume of water, and its gradients, was a problem of some intricacy. Experience in other similar works induced the adoption of an open canal, trapezoidal in section, with a water area of 80 square feet, and a grade of 1 foot per mile, which it was believed would produce a current of about 2 miles per hour. The verification of this result, and the various formulae used, will be found in Schedule "M."

A previous study of the topography of this section had induced the belief that the project of "tapping" the Housatonic could be successfully accomplished at three points, viz.: near Fall's Village, at West Cornwall, and Bull's Bridge. All of these lines would reach the Croton at its headwaters near Pawling. To determine which route was the most practicable, and to work out the minor details as to choice of ground, heights and distances, etc., was the object of this instrumental survey.

The Fall's Village route begins on the Housatonic a short distance north of Fall's Village, and immediately south of the dam of the Housatonic Railroad Company. We began our survey for the canal at an elevation of 622 feet above tide (which had been previously established by a transfer of levels from the Croton river). From the initial point the line follows down the valley of the Housatonic river to the valley of Salmon brook, a tributary of the Housatonic river, thence westerly, up the valley of Salmon brook, to Limerock, whence, crossing this stream, it proceeds still westerly across the dividing ridge to the headwaters of the Sharon brook of Weebutuck.

In passing this ridge a tunnel will be required. After a thorough examination, the shortest line for this tunnel was found to be 2½ miles long.

From the western end of this tunnel, natural watercourses can be used for more than 8 miles by expending a comparatively small sum for straightening and widening. This route is then by the outlet of Long Pond, so called, to Mudge Pond, and by the outlet of Mudge Pond, called Sharon Brook or the Weebutuck, to a point near Leedsville, crossing from the State of Connecticut to the State of New York about half-way between Mudge Pond and Leedsville. There the elevation is 460 feet above tide, and it becomes necessary to leave the stream and construct an artificial channel in order to overcome the summit at Pawling.

The route from here therefore follows the hillsides, with a descending grade of one foot per mile. It runs along the westerly side of the valley of the Weebutuck to a point near South America, where it was necessary to swing around to the westward and cross Wassaic creek (which here joins the Weebutuck, forming the Ten Mile river) and the Harlem railroad. The profile of our line just east of this crossing shows heavy cutting; this arises from crossing several high gravel knolls which lie at the base of the mountain, dividing the valley of the streams just mentioned, and in the triangle formed by their junction.

The height of our grade above Wassaic creek was 38 feet, and above the Harlem Railroad 15 feet.

From this point the line runs down the valley of the Ten Mile and up the Swamp river to Pawling, where it joins the headwaters of the Croton. From the crossing of the Harlem Railroad near Wassaic to Pawling the line lies to the westward of that road, and varying from a few feet to two miles distant from it. For much of this distance it is upon tolerably smooth ground, while some very rough hillsides and deep ravines were encountered. Among these I might mention Stone Church creek near Dover Plains, a long stretch of almost perpendicular rock, about 1½ miles south of Dover Plains, a deep ravine near the old furnace west of Dover Furnace, and Burton's Brook, west of South Dover.

The distances on this route were as follows:

Fall's Village to eastern end of tunnel.....	4.87 miles.
Tunnel.....	2.50 "
Western end of tunnel to State line.....	4.94 "
State line to Leedsville.....	3.50 "
Leedsville to Pawling.....	25.32 "
Total length of line.....	41.13 miles.
By natural water-courses.....	8.44 miles.
By artificial channel.....	32.69 "

The other routes, viz.: to Bull's Bridge and West Cornwall, are upon the same ground as far as Bull's Bridge, where they reach the Housatonic at a distance of about 11 miles from Pawling, whence the Cornwall route bears northward along the western slope of the valley of the Housatonic. These routes may therefore be described as one.

Commencing at a point of the Fall's Village line near Pawling, it crosses to the east side of the Swamp river, and continuing for a short distance along this valley it bears still more to the eastward, and crosses the Harlem Railroad seven feet below the track. Thence we proceed in a northerly direction, being at times quite near the railroad, to a point near South Dover, whence, turning to the east again, the line crosses the dividing ridge between the valleys of the Swamp and Ten Mile rivers, and by a deep cutting reaches the latter stream at a distance of 8.1 miles from Pawling.

The profile of this portion of the route shows some deep cutting and other heavy work. This becomes necessary, because all the streams are flowing northwest into the Swamp river, and in following a grade line of one foot per mile, we are continually obliged to bear eastward, crossing these ravines diagonally towards the base of the main range of hills.

The passage of the Ten Mile river is effected by a bridge of 1,000 feet in length, and 126.5 feet above the stream, thence the line follows down the valley of the Ten Mile to Bull's Bridge, crossing in that distance two wide and deep ravines, the first being 850 feet between grade points and 37.5 feet deep at its deepest point, and the second having a span of 700 feet from grade to grade, and 98 feet deep at its lowest point.

In reaching Bull's Bridge two alternate lines were examined. The first was run on the south side of the Ten Mile river from South Dover to a point opposite Bull's Bridge, terminating in a small reservoir or basin which will receive its supply of water by pumping from a canal to be constructed from the head of the falls at Bull's Bridge to and across the Ten Mile river at this point. This line is alternate to the line to Bull's Bridge only, for the conveyance of water from the Housatonic by the plan of pumping and gravitation combined, and will be spoken of hereafter, and is called the Duell Hollow route.

The second alternate line was run from a point on the north side of the Ten Mile river to and around a sheet of water called Ellis Lake, to avoid crossing the two ravines heretofore spoken of. This line is alternate to the direct route to Bull's Bridge, as well as the Cornwall route, and is called the Ellis Lake route.

From Bull's Bridge the Cornwall route bears to the northward along the west side of the Housatonic valley, being at this point 110 feet above the water.

The mountain upon which the line is located is extremely steep and rocky, involving great expense in building the canal from Bull's Bridge to Kent.

Near Kent the line crosses the valley of Macedonia brook, a wide and deep ravine, 1,700 feet from grade to grade, and 99 feet deep at its lowest point. The nature of the ground from here to the end of this line, near West Cornwall, improves as we approach the bottom of the valley, and is without any special engineering difficulties.

The length of this line by the direct route to Bull's Bridge, and thence to West Cornwall, is 26.8 miles, and the elevation above tide at that point is 462 feet. The proposed dam at this point for turning water into the canal is ten feet above average water level, and 467 feet above tide.

The line of the conduit between Pawling and Bull's Bridge having been fully described as far as this high ground above Bull's Bridge, it is only necessary to speak of the means of raising the water to this height, whence it may flow by gravity to Pawling. To accomplish this I propose a dam at the head of Bull's Falls, eight feet high, thence the water to be led in a canal to pumping works at the foot of the hill, whence it can be driven through a force-main to a small basin on the heights, connecting with the canal and 109 feet above the level of the water in the dam. By the alternate route via Duell Hollow, the water would be taken from the dam at the head of the falls and conveyed across the Ten Mile river to pumping works on the south side of that stream, where it would be necessary to raise the water 112 feet to the small reservoir at the end of the canal. This route is 14.77 miles long, being about three miles longer than the direct line to Bull's Bridge, but it avoids the expensive bridging of the Ten Mile river and the two ravines spoken of, as the canal from the head of the falls can be carried across to the south side of the Ten Mile river, at a height of sixty-eight feet above the water, against 126.5 at the upper crossing.

Of the two plans for the conveyance of the water of the Housatonic by gravity the canal from Fall's Village is the longer and more expensive.

The dam across the Housatonic is less expensive, however, at this point than at either of the other points on the river chosen for that purpose. It is to be built upon the rocks at the head of the falls, it is five feet high, constructed of solid masonry, with an embankment behind it and an apron supported on a stone-filled crib in front. The first serious obstacle is the tunnel near Sharon. This cannot be less than two and a half (2.5) miles long, and requires four shafts sunken to the grade of the tunnel and varying from 176 feet to 228 feet deep.

The tunnel once constructed, streams flowing southward afford at once a conduit ready made which can be rendered available at very little expense to Leedsville, where an elevation is reached which requires an artificial conduit to be constructed to reach the summit at Pawling. At this point of divergence it would be necessary to build a dam across the Weebutuck to turn the water into the canal. In view of the fact that this is a considerable stream having a drainage area of about forty square miles, and that the minimum flow of the Housatonic is only 170 million gallons per diem, and that the proposed diversion of 100 million gallons would be most necessary when the river is at its lowest stage, and thereby the loss to mill-owners most severely felt, it seems to me that a dam at this point sufficiently high to catch the drainage of the Weebutuck would be a valuable adjunct to the system, and would greatly relieve the drain on the river during the dry months of summer. In fact, it might be worth considering whether the addition of this stream to the Croton would not be of sufficient importance to merit attention. Draining as it does about forty square miles, this amount of territory, nearly equal to the drainage area of Boyd's Corners and Middle Branch Reservoirs together, could be added to the Croton basin by a canal of twenty-five miles in length, costing not over \$1,000,000.

Between the point of divergence from the Weebutuck and Pawling, the principal structures to be erected are, an iron bridge carrying an aqueduct designed to be constructed of the same material, over Wassaic creek and the Harlem Railroad, a distance of 400 feet, an arch culvert over Stone Church creek near Dover Plains, of thirty feet span, also one of the same span over old Furnace creek, near Dover Furnace, and one of twenty-feet span over Burton's Brook. With the exception of these important works no serious difficulties are met with upon this line.

Streams, the beds of which are far enough beneath the grade of the canal, are carried under it by culverts, and streams above or about the grade are to be allowed to flow into it, a waste weir being provided on the opposite side to allow surplus water to pass over. These streams would in some degree act as feeders to this canal.

The nature of the soil is such that it is probable that a large amount of puddling will be required to make the canal water-tight. The cost of constructing the canal by this route is estimated at \$2,188,688.45.

The items which make up this sum are enumerated in Schedule "A."

On the West Cornwall route the principal points which require mention are four aqueducts across streams and ravines, and the heavy side hill work between Bull's Bridge and Kent. For the distance of about four miles northward from Bull's Bridge the grade line of the canal lies upon the mountain side, from 100 to 110 feet above the water, along steep bluffs and perpendicular crags. At other points the ground is covered with immense boulders. A canal cannot be constructed upon such ground as this without great expense for excavation and retaining walls.

The plan proposed for the aqueduct crossing the Ten Mile river and other streams and ravines is a wrought iron flume or trough, 16 ft. x 6 ft., supported by a truss bridge with spans of 100 feet each. This bridge in turn is to be supported upon wrought iron trestle piers built upon stone foundation. A structure of this sort is believed to be a safe and economical method of carrying the canal across these streams. These four aqueducts have an aggregate length of 3,200 feet and, exclusive of masonry, are estimated to cost \$352,000, a sum greater than the cost of Sharon tunnel.

The dam at West Cornwall for turning the water into the canal will be ten feet high with an overfall of 300 feet in width and an elevation of 467 feet above tide. Like plans for other dams on the Housatonic, it is to be built of masonry with a heavy embankment behind it, and a stone filled crib supporting an apron in front, and, including gate-houses, gates, etc., is estimated to cost about \$100,000. The total cost of the canal by this route is estimated at \$1,894,209.47, the items of which are found in Schedule "B."

Of the two gravity routes, the Fall's Village line is the longer and the more expensive, there being 32.6 miles of canal (inclusive of 2.5 miles tunnel) to build, against 26.8 miles on the other route, an excess of nearly six miles. This is partly compensated for by the fact that the line is upon solid ground with no large bridges to watch and repair, and with the additional advantage of catching the flow of the Weebutuck which I have before alluded to. The question of maintenance will probably have the greatest influence in deciding the question as to which of these lines is the most feasible.

In regard to the plan of pumping the water of the Housatonic at Bull's Bridge to the elevation of the canal, and the conveyance thence by gravity, the only question to be discussed is the means of elevating it to the height of this canal. The dam across the river, the canal leading to the pump wells and the necessary machinery form a large part of the expense of this plan.

To raise this large volume of water by pumps run by water-power, and thus utilize the fall and force of the river, would seem to be at once a cheap and available plan for raising the water to the required height. Unfortunately the measurement of the flow of the river shows that it could not be relied upon to furnish power and at the same time to suffer the loss of 100,000,000 gallons daily.

It would require 350,000,000 gallons to be used as power with a head of 45 feet to raise 100,000,000 gallons 109 feet. The river only furnishes this amount at times of high water, whence it is plain that the idea of pumping by water-power must be abandoned, and recourse must be had to steam. It is estimated that it will require at least five pumps of four feet diameter, with all the necessary engines, boilers, etc. In addition to this it will require four lines of four-foot pipes for

force mains. The cost of these works is estimated at \$787,000, and the daily expense of running the same at \$1,000, which capitalized represents a sum of over \$5,000,000.

The total cost of the canal by this route and plan is stated in Schedule "C" at \$1,890,000.95. If the route via Duell Hollow were selected the cost, the items of which appear in Schedule "D," would be \$1,671,150.94.

The Ellis Lake route, so called, is estimated to cost, as appears in Schedule "E," \$1,762,852.06.

By inspection of Schedule "F," we find that if this alternate line via Ellis Lake were applied to the West Cornwall route, the cost of that line would be \$1,796,872.99.

Although the first cost of constructing the line to Bull's Bridge and erecting the necessary pumps and machinery is smaller than either of the gravity routes, yet the great cost of maintaining these works as compared with the small cost of keeping a canal in repair, naturally suggests that one or the other of the gravity routes be selected as the most feasible.

All the lines for the proposed canal reach the east branch of the Croton at Pawling, where it takes its rise. For many miles it is a very small stream, and to devise a plan for enabling it to carry one hundred million gallons in addition to its present volume without overflow was another object of my survey.

A careful examination of this stream from the neighborhood of Brewsters to Pawling showed that it would be necessary to remove boulders and cut out certain reefs of rock and dredge the bottom of mud and hardpan and straighten its serpentine channels in many places.

The estimated cost of this work is \$81,312.

I submit herewith a profile of the several lines and numerous maps showing the location of these lines and the topography of the adjoining country, also plans of dams, bridges, and culverts.

I also submit a statement of the mills and mill-powers on the Housatonic river, from Fall's Village southward to its mouth, all of which would be more or less affected by the diversion of the waters of that stream.

The amount of damage sustained by each is stated in accordance with awards of damages on other streams made under similar circumstances.

All of which is respectfully submitted.

HORACE LOOMIS,
Assistant Engineer Department Public Works.

Dated New York, April 2, 1879.

SCHEDULE "A."

Fall's Village Line.

Quantities.		
440,682	lineal feet of fencing, at 25c.	\$110,170 50
329	acres of land, at \$200.	65,800 00
7.8	developed mill powers, at \$10,000.	185,000 00
21.4	undeveloped " " " " " "	5,000 00
555,364	cubic yards earth excavation, at 50c.	277,682 00
208,544	" " " " " " " "	312,816 00
110,711	" " " " " " " "	110,711 00
756	feet of bridge for road crossings, at \$10.	7,560 00
412	" " " " " " " "	20,600 00
44,395	cubic yards of earth in widening Sharon brook, at 50c.	22,197 50
75,339	" " " " " " " "	75,339 00
1,991	" " " " " " " "	5,973 00
71,552	" " " " " " " "	214,656 00
4,140	" " " " " " " "	24,840 00
668	" " " " " " " "	6,680 00
20,794	" " " " " " " "	124,764 00

Dams—Fall's Village and Leedsville.

758	cubic yards of cut stone masonry, at \$40.	30,320 00
1,021	" " " " " " " "	20,420 00
422	" " " " " " " "	2,110 00
1,422	" " " " " " " "	1,422 00
1,055	" " " " " " " "	10,550 00
4,704	" " " " " " " "	2,352 00
1,199	square yards paving back of dam, at \$1.50.	1,798 50
18,482	feet of timber in apron, at \$40 per M.	739 28
	Gate-houses, gates, hoisting-gear, etc.	20,000 00
47,888	cubic yards in tunnel and shafts, at \$7.	335,216 00

For engineering and contingencies add 10 per cent. \$1,989,716 78

Total..... \$2,188,688 45

SCHEDULE "B."

West Cornwall Line (direct).

Quantities.		
215	acres of land, at \$200.	\$43,000 00
5.8	developed mill powers, at \$10,000.	58,000 00
2.4	undeveloped mill powers, at \$5,000.	12,000 00
408,393	cubic yards of earth excavation, at 50c.	204,196 50
130,997	" " " " " " " "	196,450 50
95,969	" " " " " " " "	47,984 50
100,960	" " " " " " " "	100,960 00
284,000	lineal feet of fencing, at 25c.	71,000 00
4,278	" " " " " " " "	8,102 27
41,464	cubic yards of dry masonry, culverts, slope walls, etc., at \$3.	124,482 00
2,167	" " " " " " " "	13,002 00
9,467	" " " " " " " "	94,670 00
22,197	" " " " " " " "	133,182 00

Dam at West Cornwall.

919	cubic yards of cut stone masonry, at \$40.	36,760 00
1,957	" " " " " " " "	39,120 00
744	" " " " " " " "	3,720 00
2,168	" " " " " " " "	2,168 00
773	" " " " " " " "	3,865 00
2,778	" " " " " " " "	1,389 00
1,667	square yards of paving back of dam, at \$1.50.	2,500 50
19,860	feet of timber in apron, at \$40 per M.	794 40
	Gates, gate-houses, and hoisting-gear.	10,000 00
3,200	lineal feet of bridge over Ten Mile and other rivers, at \$110.	352,000 00
648	" " " " " " " "	6,480 00
75,339	cubic yards of earth excavation, strengthening Croton, at \$1.	75,339 00
1,991	" " " " " " " "	5,973 00

For engineering and contingencies add 15 per cent. \$1,647,138 67

Total..... \$1,894,209 47

SCHEDULE "C."

Bull's Bridge Line (direct).

Quantities.		
100	acres of land, at \$200.	\$20,000 00
4.4	developed mill power, at \$10,000.	44,000 00
2.4	undeveloped mill power, at \$5,000.	12,000 00
240,654	cubic yards of earth excavation, at 50c.	120,327 00
23,942	" " " " " " " "	35,913 00
111,794	" " " " " " " "	55,897 00

49,965	cubic yards of puddle lining, at \$1.	\$49,965 00
6,454	" " " " " " " "	4,840 50
4,278	lineal feet of new road, at \$10,000 per mile.	8,102 27
400	" " " " " " " "	4,000 00
4,106	cubic yards of dry masonry, culverts, slope walls, etc., at \$3.	12,318 00
1,169	" " " " " " " "	7,014 00
6,569	" " " " " " " "	65,690 00
4,617	" " " " " " " "	27,702 00
75,339	" " " " " " " "	75,339 00
1,991	" " " " " " " "	5,973 00
2,000	lineal feet of bridge over Ten Mile river, etc., at \$110.	220,000 00
118,332	" " " " " " " "	29,583 00

Dam.

814	cubic yards of cut-stone masonry, at \$40.	32,560 00
1,144	" " " " " " " "	22,880 00
955	" " " " " " " "	4,775 00
789	" " " " " " " "	789 00
896	" " " " " " " "	2,688 00
788	" " " " " " " "	7,880 00
2,092	" " " " " " " "	1,046 00
1,350	square yards of paving back of dam, at \$1.50.	2,025 00
17,740	feet of timber in apron of dam, at \$40 per M.	709 60
	Gate-houses, gates, and hoisting-gear.	10,000 00

Reservoir.

192	cubic yards of earth excavation, at 50c.	96 00
192	" " " " " " " "	288 00
17,699	" " " " " " " "	8,849 50
2,131	" " " " " " " "	2,131 00
4,192	square yards of paving slopes, at \$1.50.	6,288 00
176	cubic yards of cement masonry, inlet of pipes, at \$10.	1,760 00
5	sets of pumping engines, pumps, etc., at \$100,000.	500,000 00
	Pumping houses.	100,000 00
4	lines of 4-feet pipes, force mains.	187,500 00
13,631	cubic yards of earth excavation for pipes, at 50c.	6,815 50
13,631	" " " " " " " "	20,440 50

For engineering and contingencies add 10 per cent. \$1,718,190 87

Total..... \$1,890,000 95

SCHEDULE "D."

Bull's Bridge Line (via Duell Hollow).

Quantities.		
119	acres of land, at \$200.	\$23,800 00
4.4	developed mill power, at \$10,000.	44,000 00
2.4	undeveloped mill power, at \$5,000.	12,000 00
167,220	cubic yards of earth excavation, at 50c.	83,610 00
57,971	" " " " " " " "	86,956 50
71,161	" " " " " " " "	35,580 50
60,505	" " " " " " " "	60,505 00
3,278	lineal feet of new road, at \$10,000 per mile.	6,208 33
468	" " " " " " " "	4,680 00
157,584	" " " " " " " "	39,396 00
75,339	cubic yards of earth excavation, straightening Croton river, at \$1.	75,339 00
1,991	" " " " " " " "	5,973 00
11,821	" " " " " " " "	35,463 00
976	" " " " " " " "	5,856 00
5,314	" " " " " " " "	31,884 00
755	" " " " " " " "	7,550 00
7,072	" " " " " " " "	42,432 00

Dam.

814	cubic yards of cut stone masonry, at \$40.	32,560 00
1,144	" " " " " " " "	22,880 00
925	" " " " " " " "	4,625 00
789	" " " " " " " "	789 00
896	" " " " " " " "	2,688 00
788	" " " " " " " "	7,880 00
2,092	" " " " " " " "	1,046 00
1,350	square yards of paving back of dam, at \$1.50.	2,025 00
17,740	feet of timber in apron, at \$40 per M.	709 60
	Gates, gate-houses, hoisting-gear, etc.	10,000 00
	Reservoir—Pumps, pump-houses, force-mains.	832,792 20

For engineering and contingencies add 10 per cent. \$1,519,228 13

Total..... \$1,671,150 94

SCHEDULE "E."

Bull's Bridge Line (via Ellis Lake).

Quantities.		
113	acres of land, at \$200.	\$22,600 00
4.4	developed mill power, at \$10,000.	44,000 00
2.4	undeveloped mill power, at \$5,000.	12,000 00
187,132	cubic yards of earth excavation, at 50c.	93,566 00
32,249	" " " " " " " "	48,373 50
64,408	" " " " " " " "	32,204 00
60,218	" " " " " " " "	60,218 00
1,028	lineal feet of bridge over the Ten Mile river, at \$110.	113,080 00
468	" " " " " " " "	4,680 00
149,732	" " " " " " " "	37,433 00
75,339	cubic yards of earth excavation, straightening Croton river, at \$1.	75,339 00
1,991	" " " " " " " "	5,973 00
14,356	" " " " " " " "	43,068 00
2,327	" " " " " " " "	13,962 00
3,748	" " " " " " " "	37,480 00
2,523	" " " " " " " "	1,261 50
6,560	" " " " " " " "	39,360 00
	Quantities in dam same as Schedule "D"	85,202 60
	Reservoir—Pumps, pump-houses, force-mains, etc., same as Schedule "C"	832,792 20

For engineering and contingencies add 10 per cent. \$1,602,592 80

Total..... \$1,762,852 08

SCHEDULE "F."

West Cornwall Line (via Ellis Lake).

236	acres of land, at \$200.	\$47,200 00
5.8	developed mill power, at \$10,000.	58,000 00
2.4	undeveloped mill power, at \$5,000.	12,000 00

482,134	cubic yards of earth excavation, at 50c.	\$241,067 00
133,769	rock excavation, at \$1.50.	200,653 50
91,357	borrowed embankment, at 50c.	45,678 50
111,213	puddle lining, at \$1.	111,213 00
2,232	lineal feet of bridge over Ten Mile river and Macedonia creek, at \$110.	245,520 00
720	road crossing, at \$10.	7,200 00
3,668	new road, at \$10,000 per mile.	6,947 00
311,400	fencing, at 25c.	77,850 00
75,339	cubic yards of earth excavation, widening Croton river, at \$1.	81,312 00
1,991	rock excavation, widening Croton river, at \$3.	163,947 00
54,649	dry masonry, culverts, slope walls, etc., at \$3.	23,316 00
3,886	cement rubble in waste weirs, etc., at \$6.	66,460 00
6,646	abutments and piers of bridges, at \$10.	144,840 00
24,140	cement lining of rock excavation, at \$6.	100,316 90
Quantities in dam same as Schedule "B"		
		\$1,633,520 90
Add for engineering and contingencies 10 per cent.		163,352 09
Total.		\$1,796,872 99

SCHEDULE "K."

Record of Water Power on the Housatonic River, Birmingham to Fall's Village.

LOCATION.	Head.	Kind of Wheel.	Size of Wheel.	Horse Power.	Mill Powers Destroyed.	Value of Mill Powers Destroyed.	REMARKS.
Birmingham	22	Turbine	6' 10"	2,500	4.4	\$44,000	A mill power estimated at 30 cubic feet of water per second for 24 hours with 25' head. Developed, valued at \$10,000. Undeveloped, " 5,000.
Bull's Bridge	12	Turbine	6' 10"	160	2.4	12,000	Blast Furnace; power not now in use.
Kent	7	Undershot	18 x 9	25			Blast Furnace.
"	7	Flutter	3' 6"	10			"
"	8	Turbines	4'	40			Grist Mill.
"	7	Snail	3' 6"	10	1.4	14,000	Saw Mill (not in use).
West Cornwall	10	Turbines	3'	100	2.0	20,000	Shear Works use 150 inches of water in each wheel.
Fall's Village	95				19	95,000	Water Power Company; canal not in use and no mills upon it.
"	13	Parker		50			Housatonic Railroad Company's Repair Shop located above the proposed dam at Fall's Village.
"	13	Turbine		80			
							\$185,000

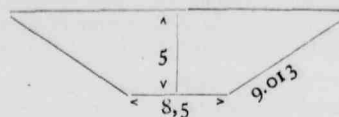
SCHEDULE "L."

Calculations of Flow of Water in Housatonic River—Data taken at Kent Dam.

DATE.	FORMULA.	GALLONS IN 24 HOURS.
May 22d to August 21st.	Trautwine $\phi = L \times H \times V \times C$ (taking dam in sections).	328,548,960
	Trautwine $\phi = L \times H \times V \times C$ (using total length and average head).	350,485,823
	Eytillwine $\phi = 3.4 L \sqrt{H^3}$.	373,299,840
	Francis $\phi = 3.01208 L \sqrt{H^3}$.	331,012,533
Sept. 6th to Nov. 1st.	Trautwine $\phi = L \times H \times V \times C$ (taking dam in sections).	306,737,280
	Trautwine $\phi = L \times H \times V \times C$ (using total length and average head).	289,554,695
	Eytillwine $\phi = 3.4 L \sqrt{H^3}$.	298,358,640
	Francis $\phi = 3.01208 L \sqrt{H^3}$.	264,542,548
June 25th.	Trautwine $\phi = L \times H \times V \times C$ (taking dam in sections).	445,474,080
	Trautwine $\phi = L \times H \times V \times C$ (total length and average head).	470,964,991
	Eytillwine $\phi = 3.4 L \sqrt{H^3}$.	498,927,600
	Francis $\phi = 3.01208 L \sqrt{H^3}$.	441,525,903
August 21st.	Trautwine $\phi = L \times H \times V \times C$.	174,039,840
	Eytillwine $\phi = 3.4 L \sqrt{H^3}$.	179,632,080
	Francis $\phi = 3.01208 L \sqrt{H^3}$.	155,987,739
July 10th.	Trautwine $\phi = L \times H \times V \times C$ (by sections).	273,456,000
May 22d to June 17th.	Trautwine $\phi = L \times H \times V \times C$ (by sections).	531,107,280
May 22d to Nov. 1st.	Average by five methods above.	320,269,471

SCHEDULE "M."

Calculations by Various Formula of Velocity and Corresponding Flow of Water in Proposed Canal.

Area = $s = 80$ sq. ft.

C = Wet perimeter = 26.526 feet.

$$\frac{s}{c} = 3.015 \quad t = 5280 \quad h = 1 \quad i = \frac{1}{5280} \quad \sqrt{\frac{2g}{m}} = 64.87.$$

AUTHORITY.	FORMULA.	VELOCITY IN FEET PER SECOND.	GALLONS IN 24 HOURS.
Du Briat	$v = \frac{88.51 (r^{\frac{1}{2}} - .03)}{(\frac{1}{i})^{\frac{1}{2}} - h y p \log (\frac{1}{i} + 1.6)^{\frac{1}{2}} - .084 (r^{\frac{1}{2}} - .03)}$	2.065	107,049,600
Fanning	$v = (\frac{2g}{m} \times r \times i)^{\frac{1}{2}}$	1.544	80,040,960
Eytillwine	$v = (8975.43 r i + .011589)^{\frac{1}{2}} - .1089$	2.158	111,870,720
Girard	$v = (10567.8 r i + 2.67)^{\frac{1}{2}} - 1.64$	1.311	67,962,240
Prony	$v = (10607.02 r i + .0556)^{\frac{1}{2}} - 2.36$	2.236	115,914,240
D'Aubuisson	$v = (8976.5 i r + .012)^{\frac{1}{2}} - .109$	2.157	111,818,880
Neville	$v = 140 (r i)^{\frac{1}{2}} - 11. (r i)^{\frac{1}{2}}$	2.42	125,452,800
Leslie	$v = \frac{100 \sqrt{r}}{\sqrt{\frac{i}{h}}}$	2.389	123,845,760
Pole	$v = (10000 \frac{h s}{l c})^{\frac{1}{2}}$	2.389	123,845,760
Beardmore	$v = 100 \sqrt{r i}$	2.389	123,845,760
Darcy & Bazin	$v = r (\frac{1000 \times i}{.08534 r + 3.5})^{\frac{1}{2}}$	1.682	87,194,880
M. Hagen	$v = 4.39 \sqrt{r \times (\frac{1}{i})^{\frac{1}{2}}}$	1.829	94,815,360

SCHEDULE "N."

Table of Rain Fall and Gauge on Dam at Kent—Depth of Water at Gauge on Dam.

MAY.

Rain Fall during month, 1.24 inches.

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	17½	14½	13½	12½	12	11¾	11½	10¾	10¾	14

JUNE.

Rain Fall during Month, 2.87 inches.

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
14¾	13¾	11	10	10¾	10¾	10	10	17	17½	16¾	15½	14¾	12¾	11¾	11	10	9½	9½	9½	9½	9½	12½	12½	12	11	11	13	12½	11

JULY.

Rain Fall during Month, 4.40 inches.

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
9	8	8	8	8½	8¾	8	7	6½	8	8¼	8½	9	9¼	8	7	7	7	7	6½	6½	8¼	8½	8½	8½	6½	6¾	6¾	6½	6½	7¾

AUGUST.

Rain Fall during Month, 2.06 inches.

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
10	10¾	10¾	11¾	12¾	12¾	10¾	10	9½	10	9	8	7¾	8½	7¾	7¾	6¾	6¾	6¾	6¾	6¾	6¾	6¾	6¾	6¾	6¾	6¾	6¾	6¾	6¾	6¾

SEPTEMBER.

Rain Fall during Month, 3.80 inches.

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
..	..	..	..	7½	7½	7	6¾	6¾	5½	4½	4½	4¾	5½	5½	5	5	5	5	5	4¾	4¾	4	4¾	4¾	5	4¾	4	4	4

OCTOBER.

Rain Fall during Month, 3.80 inches.

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
4	4	3½	4	4	4	4	4	4	5	5¾	6	5¾	4¾	3½	3¾	4¾	4¾	7¾	8¾	7¾	6¾	7¾	9¾	9¾	7¾	7	6	6	7	7

Observer of Rain Fall, Miss M. E. Lyman.

Keeper of Gauge on Dam, Benjamin Benedict.

August 21st to September 6th, no readings of Gauge taken on account of repairs to Dam.

Length of Dam, 284.5 feet.

Document "I."

To GEORGE W. BIRDSALL, First Assistant Engineer in Charge of Croton Aqueduct Bureau:

DEAR SIR—Having determined, by gauging and other measurements, the quantity of water to be obtained from the Housatonic, it was quite as necessary to determine its quality, and thereby its value for domestic and other uses to which it would be put as a part of the water supply of New York.

A sample of its waters, taken from Fall's Village, was submitted to Prof. Chandler for analysis. The results, accompanied by an analysis of Croton water by way of comparison are as follows—One U. S. gallon, of 231 cubic inches, contains:

	Housatonic.	Croton.
Chloride of sodium.....	0.2019 grains.	0.284 grains.
Sulphate of potash.....	0.1300 "	0.205 "
" soda.....	0.1842 "	0.024 "
" lime.....	0.0489 "	0.024 "
Carbonate of lime.....	3.0362 "	1.698 "
" magnesia.....	1.5430 "	0.935 "
Alumina and oxide of iron.....	0.0816 "	0.058 "
Silica.....	0.5540 "	0.222 "
Organic and volatile matter.....	0.5832 "	0.874 "
Total solids.....	6.3630 "	4.324 "
Hardness.....	3.6 degrees.	2.5 degrees.
Free ammonia.....	0.0210	0.0700
Allumina ammonia.....	0.0674	0.2450

This analysis shows that the water of this river compares favorably with that of the Croton, the Hudson, and many other streams which have been used to supply cities and towns.

It possesses only one degree of hardness more than the Croton—about the same as the Hudson—and can in no wise be called "hard," as water does not reach that state until it contains at least seven degrees of hardness.

In addition to this analysis it was thought best to make an examination of the stream above the point at which it was proposed to divert its waters, and note any sources of pollution which might be found to exist, in the way of refuse from manufactories, sewage of towns, or other causes.

In the State of Connecticut there is no manufacturing or other causes of impurity to the river, and at Fall's Village, the most northerly point selected for diverting the water, there were no impurities in it apparent to the touch, taste, or smell.

At Great Barrington, in the State of Massachusetts, seventeen miles north of Fall's Village, I found the first manufactory on the river, a woolen mill, and from this point to the headwaters mills and manufactories are found at short intervals, there being fifty-one in all. They are principally woolen, paper, and cotton mills, and they use the water in the various operations carried on in them, and discharge their waste matter into the river. The apparent effect did not extend beyond one and one-half to two miles below each mill, and in many cases only a few yards. The distance in which a rapid stream will clarify itself is variously stated by good authority to be from two to ten miles.

Dr. H. Letheby, a distinguished London physician, states "That sewage (the most dangerous pollution) when it is mixed with twenty times its volume of running water, and has flowed a distance of ten or twelve miles, is absolutely destroyed; the agents of destruction being infusorial animals, aquatic plants and fish, and chemical oxidation."

In regard to the effect upon streams of the refuse of manufactories, gas-works, etc., I take the liberty of quoting the language of Dr. Chandler, the distinguished chemist, and President of the Board of Health of this city, who has kindly furnished the foregoing analysis of Housatonic water. In his report upon "sanitary chemistry of waters," he says:

"It is often suggested that the waters of our rivers are liable to become polluted to a dangerous degree by refuse chemicals from paper factories, woolen mills, print works, and chemical works. While this may undoubtedly be true in some densely populated portions of England, where the factories are numerous and the streams very small, I do not think that for years to come this source of pollution need be feared in this country. Our rivers are too large and our factories too much scattered; and the importance of turning all waste products to account is made imperatively necessary by the sharp competition which prevails among manufacturers. This latter point is well illustrated by our gas companies, who now derive an important revenue from the sale of their coal-tar and ammonia water, offensive products which they formerly allowed to run to waste. The waste products of our most important industries are entirely harmless when diluted with large volumes of water. They consist chiefly of sulphuric and hydro-chloric acids, lime, potash, soda, iron, and alumina, salts, chloride of lime, exhausted dye-woods, and soap-suds used in scouring wool."

"The most powerful form, when mingled, harmless salts, carbonates, sulphates, and chlorides, which are normal constituents of all river waters. The action of many of these products, if appreciable at all, will be to purify the waters, by oxidizing or precipitating the matter derived from sewage."

It is therefore plain that no defilement can result to the waters of the Housatonic at Fall's Village from factory or other refuse discharged into the river at a point at least seventeen miles distant. The result of the analysis is abundant proof of this. If we consider that from this point the water is designed to be carried forty-one miles in an open canal, and thence thirty-five miles by the Croton river before it reaches the aqueduct, there can be no doubt that the water of this river will be a valuable addition to the Croton, and eminently fit to form part of the water supply of New York.

All of which is respectfully submitted.

HORACE LOOMIS,

Assistant Engineer, Department Public Works.

Dated New York, April 21, 1879.

Document "J."

155 CONGRESS STREET, BROOKLYN, August 1, 1878.

JOHN C. CAMPBELL, Esq., Chief Engineer Croton Aqueduct:

SIR—I had the honor to receive from you a communication of date June 11th, requesting me "to examine the present system of distribution of the Croton water, in reference to changing the plan, by dividing the city into separate districts, to be supplied by independent mains, and especially in reference to supplying the district south of Houston street, with a view to restoring the pressure in the lower wards to what it was when the Croton water was first introduced, and to report upon the same."

The system of distribution in this city is unexceptionally intricate, rendered so measurably by the divided responsibility in the earlier years of the administration of the Water Department, for the location and dimensions of pipes; and no experiments or observations which we are able to make on the supply mains, within a reasonable time, can indicate more than the transient and varying pressure which the service pipes are undergoing at all times, and which, to be of any benefit towards indicating the sources of existing troubles of water supply, or their remedy, should have been undertaken some years ago, and continued at intervals, and extended over the various levels of the territory supplied by water, and recorded for comparison whenever the question of new mains came up for consideration. Nor is there any reliable formula for calculating the service head at all times in different parts of the city, owing to the complicated and irregular action going on within the pipes, from the continued accidents of location, construction, and operation, and almost wholly removed from direct observation, hence their determination must be almost entirely a matter of judgment merely.

Failing the requisite data therefore, I have refrained from attempting anything like an analysis of the movement of the water in your pipes, either as it now is, or what I would suggest it should be; that may well be left to maturer study in your own office; but I have after a careful examination of the locality, and a consideration of all the data in my possession, given my opinion in general of the present needs of your water service, confining myself to the spirit of your instructions, and beg leave to submit the following:

In reference to restoring the lost head in the lower part of the city, I would state that undoubtedly the same pressure could be had now in the lower wards as formerly, when the circumstances attending the use of the water—in that district rendered similar to what it then was—and were no paramount objections from other and rival interests existing thereto, we will endeavor to show the circumstances governing the pressure there in 1842, by the aid offered by the meagre reports of the Water Department of that date; precision in this is not attainable, but is of little consequence, as experiments made in later years on the mains then in use furnish us with all the general information requisite for our present purpose.

It is unavoidable that reference should be had in explaining the present condition of things to what was anticipated they would be at this time, when the works were first opened for use, and in view of which it was believed that ample provision had been made. No apology, therefore, is needed for the introduction of many facts and figures of an old date, and with which you are very familiar.

In the semi-annual report of the Water Commissioners made to the Board of Aldermen, January, 1838, the Chief Engineer Mr. John B. Jervis, in his report of December, 1837, explains the characteristics of the work then in progress, and its dimensions as designed: "Capacity of Receiving Reservoir, 150 million gallons; top water level, 119 feet above mean tide; Distributing Reservoir, 20 million gallons, top water 115 feet; three lines of 36-inch pipe mains, projected between the reservoirs, distance apart, 10,710 feet, and two of the lines laid ready for operation. The population below Fourteenth street estimated at 300,000, and the same density of settlement extending to One Hundred and Sixth street, estimated as giving a population of 1,250,000 which, with the liberal provision of 30 gallons per head, it was estimated would require 37,500,000 gallons daily. Flow of the Croton (with the storage of the lake) estimated at 35,000,000 daily; any further amount of water needed could be had by storage on the Croton river shed. The full capacity of the aqueduct (inferred from data given at about 60,000,000), it was estimated, would be reached in 60 years (A. D. 1900), and that 700,000 people would ultimately derive their supply of water from the Distributing Reservoir."

The water was introduced into the city in 1842, when the supply was confined to the discharge from two 36-inch mains from the Distributing Reservoir, with, we may presume, a full head.

In 1858 these two pipes were experimented on and found to deliver (see report on the position of the Prospect Hill Engine-house, Brooklyn, by I. P. Kirkwood) 19½ millions gallons in 24 hours. The pipes had been laid without protection, and had become much tuberculated; this and the increased head during the earlier years, justifies the opinion that in 1842 these mains could discharge below Fourteenth street over 21 millions U. S. gallons daily, which, with the estimated population then of 300,000, gives 70 gallons per head as the capacity of the works. But on the first introduction of the water, and before the complete extension of the service pipes, or the demand for shipping or manufactures had obtained, and before the unlimited waste of water had become to be regarded as one of the inherent rights of the taxpayers, and while indeed pure water on any floor of a house was yet regarded as a luxury to be thankful for, it is not likely that the daily demand for water had reached the one-half of this. In the law governing the flow of water in pipes under a constant head, velocity and pressure bear an inverse ratio to each other, as the velocity is diminished, the pressure is increased, and the reverse; and reducing the draught upon the pipes one-half, would diminish, of course, the velocity in the same ratio, and in consequence increase the pressure. The supply at that time was, as we have seen, so much in excess of the draught upon the pipes, that a higher head on the service was at all times attainable than was necessary, which in consequence led to increased waste; as with a constant head, the discharge varies with the velocity, and the velocity varies as $\sqrt{\text{head}}$, if the discharge is lessened one-half, it will require but one-quarter of the head to effect it. The consumption varied probably from one-quarter to one-half of the capacity of the pipes, and the water could be delivered upon any floor of any house below Thirtieth street; and the jet in the park fountain rose, as we recollect it, at times (for it was even then variable) from 50 to 60 feet. Such was the condition of things then in 1842. A population of 300,000 was supplied by two 36-inch mains, which were capable of delivering at Houston street considerable over 21 millions of gallons per diem. With the causes which led to the rapid increase in the demand for water, and the effort made to control it within reasonable limits, it is unnecessary for me to enlarge, it soon became a crying evil, and one of constant reference in the reports of the Water Department, so soon, or even before, the organization of the Croton Department brought the extension of the distribution within their control.

In 1849, or but seven years after the introduction of the water, attention is called by the Commissioners to the enormous waste in the city, and they stated in their report that the consumption then is "72 gallons (U. S.) over the entire area of the city daily, per head of the population," or nearly the whole volume of the Croton river. A new 36-inch main had been laid from the receiving reservoir down Third avenue, and Commissioners, calling for appropriation for the purpose of connecting this main with the distributing reservoir, down Forty-second street, state that "this improvement, with a connection on Fifth avenue, between Fortieth and Forty-second streets, will effectually silence all complaints of want of water in the upper stories of buildings."

From the data given and the census returns, it will appear that the consumption of water had risen to a daily total of about 30,000,000 gallons.

But in 1851, when urging the importance of a new receiving reservoir, Commissioners quote from their Report of 1850, and state "that the last drop of water which the works in their present condition can supply is now daily delivering in the city" (this refers to needed improvements on the line of aqueduct proper). If this was so (of which there can be no doubt), then the city, with a population of about 500,000, was using all the water which had been provided for two and a half times that number, and if it had been proposed then to preserve the original head in the lower wards, the answer would doubtless have been that the new receiving reservoir would effect that result. At all events, it would have appeared very apparent that the head could not be maintained below unless at the expense of the upper part of the city, then rapidly improving.

In the Report of Commissioners, January, 1851, they say "that for the last two years each inhabitant within the water district has a daily supply of nearly 90 gallons," and that when the improvements projected at the High Bridge are effected, "all the water which the conduit can carry will be delivered." Previous to this, in 1849, a 30-inch main was laid from the receiving reservoir in Third avenue, supplying the eastern side of the city, and the water rose in consequence in the distributing reservoir, in 1850, 5 feet 7 inches, and then commenced falling until, in 1855, it averaged 6 feet 8 inches less than in 1850. In 1855, a similar main was laid in Eighth avenue from the receiving reservoir, which increased the average depth in the distributing reservoir for 1856 but 1 foot. Notwithstanding improvement in the introduction of pipes in the distribution, the complaints of deficiency of water continued to increase, and in January, 1857, Water Commissioners report "that without a large and permanent addition to the supply, the distributing reservoir will be drawn down so low as to be rendered ineffectual to a large extent," and preparations were made for commencing work on the new receiving reservoir, which was completed and water let in, August, 1862. Meanwhile, an additional 4-foot main had been laid between the reservoirs (Fourth avenue to Thirty-eighth street), and in the report of Commissioners for 1863 they state "that instead of a storage of about 195,000,000 gallons from all sources (all they could previously command), they now have on hand upwards of 1,200,000,000 gallons, independent of any contingency on the line of aqueduct, and that, by careful gaugings, the amount consumed in the city reached 52,500,000 gallons daily," and urge the importance of a storage reservoir on the Croton river shed. Notwithstanding the improvement in the distributing reservoir was not apparent by this accession of water, still the demand continued to increase, and kept in advance of the supply, and Commissioners seriously set themselves to consider the causes for this enormous, and what was properly considered unnecessary, waste of water, and the best means for meeting it, all their efforts hitherto having proved of no avail toward lessening it to any extent. Engineers were employed to examine and report upon the system of distribution, and the result was embodied in the Commissioners' Report of 1864, and which we will briefly notice. In 1849, the mains supplying the water district were confined to three, viz.: two 36-inch pipes between the reservoirs, and continued, the one down Fifth avenue to Broadway and Houston street, the other down Fifth avenue and Fourteenth street, through Avenue A, to Houston street, where they were connected by a 20-inch pipe, and a 30-inch main down Third avenue to Fourteenth street, connecting with one of the above, so that for the supply at Fourteenth street there were three mains, having an aggregate area of 19 square feet. By the census returns of that year the population below Fourteenth street was 420,000, and the whole city 726,000.

The supply mains at that date are shown as follows:

At the crossing of Seventy-fifth street, 5 mains, area 36.52 square feet.	
" " Thirty-fifth street, 4	24
" " Twenty-fifth street 4	21.16
" " Fourteenth street, 3	19
" " Thirteenth street, 3	14.19
" " Houston street, 2	8.05

It was remarked that at Houston street the area of mains was reduced to one-third of the area of those crossing Thirty-fifth street, and the supply of water at Fortieth street was assumed to be as follows:

Eighth avenue, 30-inch pipe.....	9,000,000 gallons daily.
Fifth avenue, 36 ".....	14,000,000 "
Fifth avenue, 36 ".....	14,000,000 "
Fourth avenue, 48 ".....	7,000,000 "
Third avenue, 30 ".....	10,000,000 "

Total..... 54,000,000

of which it was estimated that one-half or over 26,000,000 gallons was consumed below Houston street, and assuming that the day flow equals 1.33 of the average consumption of the 24 hours, the 36-inch main when it crosses Thirty-ninth street was estimated to have a velocity of 3.91 feet per second, and to this extreme velocity was attributed the loss of head of 46 feet at Canal street, and they concluded that a velocity of 2 feet per second (the mains being increased to that extent), would secure a fair pressure of water throughout the city.

In addition to additional mains, it was recommended that the mains should be connected at shorter intervals than had been the practise heretofore, and that the smaller supply pipes should connect with the mains also at shorter intervals.

It is believed that the latter two recommendations have been carried out to a large extent. Great improvements have been effected within a few years past in the distribution, by connecting dead ends and otherwise promoting the circulation, and I am unable to suggest any improvements

in this respect with reference to the mains. By comparing the table on the previous pages with the present condition of the piping, we have as follows:

	1864.		1878.	
	NO. OF MAINS.	AREA IN SQUARE FEET.	NO. OF MAINS.	AREA IN SQUARE FEET.
Crossing of Seventy-fifth street.....	5	36.52	7	61.6
Crossing of Twenty-fifth street.....	4	23.95	6	30.40
Crossing of Thirty-fifth street.....	4	21.16	6	30.40
Crossing of Fourteenth street.....	3	19.	6	27.66
Crossing of Thirteenth street.....	3	14.19	6	27.66
Crossing of Houston street.....	2	8.05	4	19.02

The report of 1864 calls attention to the fact that the area of the mains was reduced at Houston street to one-third of that of the mains crossing Thirty-fifth street.

By the above table it will be seen that the combined areas of the great supply mains are some 62 per cent. greater than they were in 1864, and the area of the mains at the crossing of Houston street is two-thirds of that at crossing of Thirty-fifth street, instead of being only one-third as they then were, and the area of mains at Houston street are now 30 per cent. of the great main at crossing of Seventy-fifth street, instead of 22 per cent., as in 1864.

While the circumstances are so far changed that the bulk of the population instead of being below, is now above Houston street, in other words, while the aggregate area of the great supply mains have been increased in a greater ratio than the increase in the population, those supplying the district below Houston street have been doubled in area within the last twelve years. Yet the total water consumed daily below Houston street is but little if any in excess of what it then was, whilst the total consumption above is now double what it is below, as will be shown further on.

In view of all the evidence I have been able to collect I cannot see that it is desirable to increase the mains at Houston street to the extent recommended in Commissioners' Report of 1864, viz., to the same or greater area than now at crossing of Thirty-fifth street, on the contrary, I believe them to be of ample dimensions now for the proper service of the lower wards. Were your water supply sufficient to preserve a proper head there, when drawing in the upper part of the city, and the operation of the three-foot main laid in 1871 to Chambers street, when allowed full action, is an evidence that no additional mains would bring any improvement without a large increase in your water supply; and to make a distinct district of the territory below Houston street, would, while it might restore a portion of the lost head there, be at the expense of the better part of the city occupied as residences.

The resident population below Houston street may be estimated at 290,000, and estimating the floating population, with the shipping, manufactures, and in the localities where small villages congregate, at 90,000 in the day time, and the day population may be taken at 380,000—allowing the resident population above to be 720,000—and the floating population at one-half of that below, which is a fair estimate, and you are supplying water now to 1,145,000 people in the day hours.

From experiments on the mains corner of Canal street and Broadway, and at Tompkins square, giving the loss of head in feet in the day and night hours, we get the following data:

	CANAL STREET.		TOMPKINS SQUARE.	
	DAY.	NIGHT.	DAY.	NIGHT.
July, 1858.....	52.5	....	44.	....
July, 1864.....	46.	15.	....	....
July, 1878.....	50.7	29.25	40.6	25.2

Assuming that the loss of head to average 44 feet on these mains at Houston street, and using the formula devised by Mr. Kirkwood, from experiments (here, in Jersey City, and Brooklyn, from the discharge of mains within the influence of city distribution), and we have as the discharge of the 36-inch main for 24 hours 13,724,760 gallons; as the 36-inch main of 1871 is disconnected with the distribution above, its discharge would be greater, but taking all the deficiencies in the other two pipes into consideration, and it may be fairly assumed that the three mains (36-inch pipes), can deliver at Houston street 41,000,000 gallons daily. But this does not represent the actual state of things, for the draught on the old 36-inch pipes above Houston street is probably greater than formerly, and thus tending to vitiate the result of any calculation founded on formula deduced from their previous discharge, yet this is to a certain extent counterbalanced by the accessions from cross-connections not existing formerly. The demand for water above, however, has so increased that it becomes necessary to throttle the new 36-inch main at Fourth street and Fourth avenue, in order to keep up the supply above; hence diminishing its flow materially, possibly a half or even more, leaving the actual delivery of the three mains but about 32,000,000 gallons for a day, for population of 380,000, or 84 gallons per head, and upon the supposition that ninety millions is the daily consumption of the entire population of this city, leaves 58,000,000 gallons for the population of 720,000 above Houston street, or less than 80 gallons per head.

This cannot be offered with any claim for accuracy, owing to the irregularity in the data upon which the calculations rest, yet we believe it indicates pretty fairly at present the local consumption of water in your city.

In 1864 it was estimated that one-half of your entire delivery into the city, or 26½ million gallons, was given below Houston street, and this was previous to laying the 36-inch main to Chambers street, in 1871, thus showing conclusively that, although the resident population has not increased, probably fallen off, still the actual amount of water delivered below this street is fully up to what it then was, but instead of representing one-half of the total delivery into the city, as it then did, it now constitutes but one-third of it. The demand above, as we have seen, now largely predominating and controlling the supply below. No arrangement of mains or pipes therefore, can be expected to give an increased pressure in the lower wards, without abstracting from your present means of supply in the upper part of the city.

It is true that the draught upon your supply in the lower wards, as shown above, is so much diminished at night that the pressure is increased during those hours, and by taking advantage of that fact, reservoirs established in this quarter of the city could be filled by this increase at night, thus tending to equalize the day flow with an increase of pressure over the present service. This, with an independent main from the reservoir, and shutting off the service from above Houston street, would seem to offer some improvement on the present state of things, but this is by no means a restoration to its original condition, as is evidenced by the fact that the private cisterns which necessity has introduced into this portion of the city, in order to secure a day pressure, represents the action of these proposed reservoirs, and you have a measurably independent 36-inch main, but they prove entirely inadequate to accomplish more than to insure a supply on the second floor of buildings when the day flow is already obtained on the first floor.

In other words, that the upper part of the city, on a higher level, may receive its necessary supply on the lower floors of dwellings, the residents of the lower wards must be denied the luxury of wasting water under an unnecessarily high head.

With reference to distinct districts, the only city of any magnitude that I am aware of, where the system is carried out, is London. Paris it is true is divided into two distinct districts, but this, as in several smaller localities, arises from the different and varying elevations of the several sources of supply. But the circumstances which have led to the division in London, are entirely dissimilar to what they would be in New York.

The area of London is nearly 130 square miles, and is supplied by eight private water companies, whose pipes are necessarily entirely distinct; which fact arises from the growth of the city gradually calling for an increase in the water supply, which no single company could meet; whereas in New York, the scheme of supply was from the first to provide at the expense of the city, for all the water which the island of Manhattan, or 22 square miles would need for a century to come, or until the city had absorbed the entire territory, and the shape of the island, and the direction from whence the supply was derived, led to the disposition and size of the mains as we find them. Had the work been projected originally in view of the island being divided into districts, unless great expense had been incurred, it would have tended to retard and hamper the increase of the city, as the population would not have extended into a district until it had been provided with all the needed water facilities for its entire area in advance. Any present division into independent districts (except such a natural division for instance as making the summit at Eighty-first street the dividing line between a northern and southern district), besides being attended with great expense in first cost, and additional complications of working, would result in no improvement of any moment, unless it were accompanied by a large increase in your water supply, by the construction of an additional conduit, when no such change would be called for.

That this construction of a new conduit has become a matter of immediate necessity admits of no manner of doubt. You are running the present conduit under a pressure which it was never designed to sustain, and which nothing but necessity can justify; and until you can furnish additional water on a broad scale, not only will there be a deficiency in the pressure of the lower wards, but an interruption to your entire supply will at all times be imminent.

(Signed)

Respectfully submitted,

J. W. ADAMS.

Document "K."

DEPARTMENT OF PUBLIC WORKS,
WATER PURVEYOR'S OFFICE, No. 4 CITY HALL,
NEW YORK, July 8, 1879.

Hon. ALLAN CAMPBELL, Commissioner of Public Works:

SIR—I have the honor to report to you the transactions of this Bureau for the months of April, May, and June, 1879.

REPAIRING PIPES, STOP-COCKS, ETC.

There have not been during the quarter any serious breaks along the line of pipes, and all complaints of leaks in the mains and other irregularities have received prompt attention. The usual force of three companies has been kept constantly employed.

REPAIRS TO STREET PAVEMENTS.

During the latter part of April the repair gangs were organized and started in the work of repairing the street pavements, and much good work has since been accomplished. A wise expenditure of the moneys of the appropriation has been and is being made in the work of renewing the whole of the pavement in certain short blocks by special contract. Elm street, between Pearl and Duane streets; Jefferson street, between Water and South streets, and Forty-third street, between Fifth and Madison avenues, have been thus repaved. Several others are now under way, and will soon be completed. As there are many miles of the old cobble pavement still remaining in the city, and in view of the fact that the work of repaving progresses so slowly, it was thought advisable to relay certain of the cobble-paved streets by special contract. The pavement in Thames street has thus been relaid, and an order given for the relaying of the cobble in Eighteenth street, between Broadway and Fourth avenue.

The pavements in the city are in better condition now than they have been at this time in several years.

PLACING LARGE HYDRANTS, ETC.

A small force has been engaged in placing large hydrants, as required by the Fire Department, and in repaving over Croton water mains.

REPAIRING SIX-FOOT PIPES.

This work was continued until the middle of May, when it was completed, and the men employed thereon were put to work placing large hydrants down town.

REPAVING UNDER CHAPTER 476, LAWS OF 1875.

The failure of the passage of the resolution in the Board of Aldermen authorizing the repaving of certain streets has prevented any new work under this head.

Of the contracts let last year two were uncompleted, one of which (Second avenue, between Twenty-third and Forty-second streets), was suspended by reason of the frost, and is now delayed by construction of the Metropolitan Elevated Railroad. Work on the other (Vesey street, from Broadway to West street), was begun May 13, and is now very nearly finished.

BOULEVARDS, ROADS, AND AVENUES, MAINTENANCE OF.

For a report of the transactions of this Bureau, under the above head, I would respectfully refer you to the enclosed statement of Mr. Joseph K. Choate, Engineer in Charge.

Number of men employed under charge of Bureau of Water Purveyor during the months of April, May and June, 1879, paid from different appropriations, with amounts of pay-rolls:

MONTHS, 1879.	REPAIRING AND RENEWAL OF PIPES, STOP-COCKS, ETC.		CROTON WATER MAIN FUND, No. 2.		REPAIRS AND RENEWAL OF PAVEMENTS.		AQUEDUCT, REPAIRS AND MAINTENANCE.	
	No. Men.		No. Men.		No. Men.		No. Men.	
April.....	57	\$3,700 06	42	\$2,214 70	296	\$11,041 40	23	\$1,157 05
May.....	60	3,936 69	53	3,090 22	496	24,141 82	13	563 12
June.....	59	3,701 70	115	5,885 42	445	21,420 15	..	.....
Totals.....	176	\$11,338 45	210	\$11,190 34	1,237	\$56,603 37	36	\$1,721 07

RECAPITULATION.

Amounts of pay-rolls for April, May, and June, 1879:

Repairing and Renewal of Pipes, Stop-cocks, etc.....	\$11,338 45
Croton Water Main Fund, No. 2.....	11,190 34
Repairs and Renewal of Pavements.....	56,603 37
Aqueduct, Repairs and Maintenance.....	1,721 07
Total.....	\$80,853 23

Number of vault permits issued during the quarter was thirty-seven (37).

Amount received for vault permits for the same period was nine thousand seven hundred and ten and 84-100 dollars (\$9,710.84.)

Respectfully,

DANIEL O'REILLY, Water Purveyor.

DEPARTMENT OF PUBLIC WORKS,
BUREAU OF WATER PURVEYOR,
NEW YORK, July 1, 1879.

DANIEL O'REILLY, Esq., Water Purveyor:

SIR—In accordance with your instructions, I respectfully submit the following report of the work done during the past three months within the jurisdiction of the Bureau of Water Purveyor, under the immediate care of the engineer in charge of roads and avenues.

The appropriation for the maintenance during 1879 of all macadamized and gravel boulevards, streets, and avenues, is

For labor, materials, etc.....	\$31,000 00
For supervision (salaries).....	4,000 00
Total.....	\$35,000 00

Amount expended to April 1.....	\$5,699 17
Amount expended from March 31 to July 1.....	12,735 87

18,435 04

Unexpended balance.....	\$17,564 96
-------------------------	-------------

The expenses for the past three months are specified as follows:

Sprinkling.....	\$3,073 97
Cleaning roads and gutters.....	2,558 49
Spreading material for road surfacing.....	566 64
Repairing roads.....	517 96
Cleaning basins.....	134 27
Repairing monitors, etc.....	551 87
Material.....	3,480 11
General expenses, including supervision, foreman's time, watchman, repairing tools, etc., maintaining trees, and other necessary expenses.....	1,852 56
Total.....	\$12,735 87

The labor was thus distributed with reference to the various boulevards:

Avenue St. Nicholas, One Hundred and Tenth to One Hundred and Twenty-fifth street.....	\$481 28
Avenue St. Nicholas, One Hundred and Twenty-fifth to One Hundred and Fifty-fifth street.....	835 06
Boulevard, south of Manhattan street.....	1,149 39
Boulevard, north of Manhattan street.....	339 37
Sixth avenue, One Hundred and Tenth street, north.....	660 10
Seventh avenue, One Hundred and Tenth street, north.....	1,183 20
Fifth avenue, Fifty-ninth to Seventy-second street.....	660 18
Fifth avenue, One Hundred and Twenty-fourth to One Hundred and Thirtieth street.....	372 71
Other streets and avenues.....	1,450 52

Total \$7,131 81

The macadamizing of Fifth avenue, Fifty-ninth to Seventy-second street, was completed April 5, 1879, 15,600 square yards of pavement having been laid since the commencement of the work; 2,805 square yards were finished, and the following amounts paid during this quarter:

To M. A. Kellogg, contractor.....	\$7,851 85
J. R. Byron.....	3,065 73
Supervision (Engineer's Inspector, etc.).....	54 58

Total \$10,972 16

Avenue St. Nicholas, from One Hundred and Tenth to One Hundred and Fifty-fifth street, and Seventh avenue, from One Hundred and Tenth street to the Harlem river, have each received a coating of sand and clay, similar to that used upon Sixth avenue last year with such success.

These avenues have all the qualities of earth roads, and judging from the concentration of the driving public upon them, are thoroughly appreciated, and even more of a success than last year.

All of the elm and maple trees on the various boulevards which have been paid for in full and taken off the hands of the contractor who planted them, have been thoroughly cultivated around and the roots drenched with water, pruned, etc., and are generally in a vigorous and healthy condition.

The present force consists of 2 foremen, 3 skilled laborers, 35 laborers, 1 blacksmith, 1 carpenter, 1 watchman, 7 carts, 19 two-horse teams.

Respectfully submitted,

JOSEPH K. CHOATE, Assistant-Engineer.

Document "L."

DEPARTMENT OF PUBLIC WORKS,
BUREAU OF STREET IMPROVEMENTS, ROOM 11, CITY HALL,
NEW YORK, July 11, 1879.

Hon. ALLAN CAMPBELL, Commissioner of Public Works:

SIR—In compliance with your instructions, I beg to hand you herewith a report of the transactions of the Bureau of Street Improvements for the quarter ending June 30, 1879.

Respectfully,

GEO. A. JEREMIAH,
Sup't Street Improvements.

Statement of Works in Progress in the Bureau of Street Improvements on the 30th day of June, 1879.

LOCATION OF WORK.	CONTRACTOR.	SURVEYOR.	INSPECTOR.	CONTRACT TIME.	ESTIMATED COST.	AMOUNT EARNED.	AMOUNT RETAINED.	AMOUNT PAID.	REMARKS.
Regulating, grading, curb, gutter, and flagging— Madison avenue, Ninety-ninth street to One Hundred and Fifth street.....	John Slattery.....	F. M. Leonard.....	P. H. Kedney.....	400 days...	\$47,205 13	\$14,175 00	\$4,252 50	\$9,922 50	
Twelfth avenue, One Hundred and Thirtieth street to One Hundred and Thirty-third street.....	Peter T. Masterson.....	E. E. McLean.....	W. L. Demarest.....	30 days...	3,212 70	.....	.....	.....
Forty-second street, Second avenue to East river.....	Thomas Connell.....	E. E. McLean.....	J. H. Kortright.....	270 days...	15,859 00	14,769 80	4,430 94	10,338 86	
Sixty-sixth street, Eighth avenue to Boulevard.....	John Mulholland.....	F. M. Leonard.....	John Maguire.....	300 days...	14,372 76	1,523 00	456 90	1,066 10	
Seventieth street, Eighth avenue to Tenth avenue.....	John Brady.....	M. Lovell.....	J. J. Fitzgerald.....	300 days...	18,305 00	.....	.....	.....
Ninety-third street, Second avenue to East river.....	Michael Maguire.....	W. M. Dean.....	Suspended.....	60 days...	4,100 00	.....	.....	.....	Work suspended temporarily.
One Hundred and Second street, Fifth avenue to Harlem river.....	Joseph Walsh.....	W. V. Smith.....	M. J. Bannon.....	400 days...	42,421 00	.....	.....	.....
One Hundred and Third street, First avenue to Fifth avenue.....	John C. Dowling.....	W. V. Smith.....	W. F. McManus.....	600 days...	29,360 00	15,848 50	4,754 55	11,093 95	
One Hundred and Sixth street, Madison avenue to Fourth avenue.....	Edward Bradburn.....	W. M. Dean.....	J. W. Hazlett.....	300 days...	4,206 20	.....	.....	.....
Special Contract— Elm street, Pearl street to Worth street.....	John B. Healy.....	E. E. McLean.....	Not yet appointed.....	20 days...	306 88	.....	.....	.....
Boulevards and avenues— Eleventh avenue, One Hundred and Fifty-fifth street to Kingsbridge road.....	Michael Noonan.....	Joseph K. Choate.....	John L. Florence.....	300 days...	65,523 20	12,979 35	3,893 80	9,085 55	
Gansevoort Market property— Gansevoort street, Little West Twelfth street and Washington street.....	John Brady.....	H. Loomis.....	M. McDonnell.....	100 days...	24,263 30	.....	.....	.....
Repairing Walls, Arch, etc.— Forty-second street, Second avenue to East river.....	Edward Freel.....	M. Betts.....	Ralph Ellis.....	100 days...	30,834 00	.....	.....	.....
Total.....					\$299,969 17	\$59,295 65	\$17,788 69	\$41,506 96	

Works declared Abandoned and to be Relet.

Regulating, grading, curb, gutter, and flagging— Sixty-second street, Tenth avenue to Eleventh avenue.....	John Wyberd.....	T. & J. Slater.....	Suspended.....	9 months.	\$7,967 91	\$3,034 84	\$910 45	\$2,124 39	
Seventy-first street, Fifth avenue to East river.....	Herman Polye.....	G. B. Melendy.....	Suspended.....	4 months.	24,907 80	14,345 00	4,303 50	10,041 50	
Total...					\$32,875 71	\$17,379 84	\$5,213 95	\$12,165 89	

Old Contracts Abandoned and Suspended.

Fourth avenue, Fifty-eighth street to Seventy-first street.....	P. Farley.....	R. Foley.....	Suspended.....	2 years ..	\$48,185 82	\$42,232 65	\$12,669 76	\$29,562 89	
Eighty-first street, Second avenue to East river.....	M. J. Bannon.....	F. E. Towle.....	Suspended.....	200 days...	16,208 90	3,840 00	1,152 00	2,688 00	
Total...					\$64,394 72	\$46,072 65	\$13,821 76	\$32,250 89	

Statement showing the amount of Work done during the months of April, May, and June, 1879.

Earth excavation.....	Cubic yards.....	7,548
Rock.....	".....	8,400
Filling furnished.....	".....	33,641
Curb-stones set.....	Lineal feet.....	571 1/2
Curb and gutter stones set.....	".....	1,411
" " reset.....	".....	217 1/2
Flagging laid.....	Square feet.....	20,475 1/2
" relaid.....	".....	2,133 1/2
Picket fence built.....	Lineal feet.....	1,541
Dry rubble retaining wall built.....	Cubic yards.....	400
12-inch vitrified pipe laid.....	Lineal feet.....	353
15-inch ".....	".....	50
18-inch ".....	".....	88
Manholes built.....	".....	2
Receiving-basins built.....	".....	3

Works Completed.

Regulating, grading, etc.— Ninety-ninth street, from First to Third avenue.....	\$15,131 11
Ninth avenue, from Sixty-third street to Boulevard.....	788 11
Total.....	\$15,919 22
Curb, gutter, and flagging— Forty-fifth streets, between First and Second avenues.....	252 89
Flagging— East side of Madison avenue, between Eightieth and Eighty-first streets.....	\$167 40
West side of First avenue, between Fifty-ninth and Sixtieth streets.....	55 50
North side of Fifty-first street, from Broadway to Eighth avenue.....	34 39
North side of Fifty-ninth street, from Madison to Fifth avenue.....	371 09
North side of Sixtieth street, from Boulevard to Ninth avenue.....	785 32
North side of Seventy-second street, from Lexington to Third avenue.....	340 21
South side of Eighty-fifth street, 100 feet west of Lexington avenue.....	70 49
Total.....	1,824 40
Fencing vacant lots— East side of Madison avenue, Eightieth and Eighty-first streets, and Eightieth street, between Madison and Fourth avenues.....	\$189 47
East side of Sixth avenue, from One Hundred and Twenty-fourth to One Hundred and Twenty-fifth street.....	113 09
Block bounded by Sixty-ninth and Seventieth streets and Lexington and Fourth avenues.....	143 84
Forty-fourth street, from Tenth to Eleventh avenue.....	21 79
Southwest corner of Seventy-fourth street and Fourth avenue.....	85 31
Total.....	553 50
Total.....	\$18,550 01

Amount of Vouchers Drawn.

On account of Regulating, Grading, etc.....	\$18,431 26
" Boulevard and Avenues.....	7,744 63
" Street Improvement Fund—For Street Signs, etc.....	223 66
" Flagging Sidewalks and Fencing Vacant Lots in front of City Property.....	592 79
" Salaries—Department of Public Works.....	124 80
Total.....	\$27,117 14

Laboring Force employed on Morningside Avenue, West.

One (1) Foreman; one (1) Stone Mason; one (1) Blaster; ten (10) Laborers.

GEO. A. JEREMIAH,
Superintendent of Street Improvements.

Document "M."

DEPARTMENT OF PUBLIC WORKS,
BUREAU OF SEWERS, ROOM NO. 21, CITY HALL,
NEW YORK, July 2, 1879.

Hon. ALLAN CAMPBELL, Commissioner of Public Works:

SIR—In compliance with your instructions, I beg leave to hand you herewith a report of the transactions of this Bureau for the quarter ending June 30, 1879, showing the total length of the sewerage in the city, with the number of receiving-basins built up to this time.

Respectfully,

STEVENSON TOWLE,
Engineer in Charge of Sewers.

REPORT OF THE TRANSACTIONS OF THE BUREAU OF SEWERS FOR THE QUARTER ENDING JUNE 30, 1879.

Credits to General Fund— Amount received for 343 permits for sewer connections.....	\$6,166 37
Vitrified Stoneware Pipe— Amount received for pipe sold to contractors and credited to Street Improvement Fund.....	\$281 80
Engineers' Fees— Amount of Engineers and Surveyors fees assessed on property benefited, charged in assessment lists, and credited to Street Improvement Fund.....	\$514 00
Sewer Repair Stock— Unexpended balance March 31, 1879.....	\$563 03

JAMES J. MOONEY,
Superintendent of Streets.

NAME OF PARK OR PLACE.	No. of Lamps Lighted.	No. of Lamps Unlighted.	Total.
Battery Park.....	130	97	227
Bowling Green.....	5	..	5
City Hall Park.....	78	41	119
Fountain, City Hall Park.....	..	20	20
Five Points Plaza.....	6	5	11
Franklin Statue, 4 lamps, 2 burners each.....	8	..	8
Park Junction, Grand street and East Broadway.....	..	5	5
Washington Park.....	96	89	185
Union Park.....	29	23	52
Madison Park.....	67	39	106
Worth Monument.....	4	..	4
Worth Monument Plaza.....	5	..	5
Candelabra, Fifth avenue and Twenty-third street, 8 6-foot burners.....	16	..	16
Candelabra, Fifth avenue and Twenty-fourth street, 8 6-foot burners.....	16	..	16
Lincoln Statue.....	2	..	2
Washington Statue, 2 3-foot burners each.....	6	..	6
Jackson Square.....	3	3	6
Tompkins Park.....	13	146	159
Cooper Institute Park.....	1	..	1
Murray Hill Parks, Fourth avenue.....	2	24	26
Reservoir Park.....	20	67	87

NAME OF PARK OR PLACE.	No. of Lamps Lighted.	No. of Lamps Unlighted.	Total.
Central Park, Eighth avenue entrance.....	17	16	33
" Fifth avenue entrance.....	19	13	32
" Transverse road No. 1.....	17	14	31
" " No. 2.....	14	21	35
" " No. 3.....	20	20	40
" Mount St. Vincent.....	5	..	5
" One Hundred and Tenth street and Sixth avenue entrance.....	1	..	1
" One Hundred and Tenth street and Seventh avenue entrance.....	1	..	1
Harlem Bridge, 14 6-foot burners.....	28	..	28
Central Bridge.....	8	..	8
Total.....	637	643	1,280

For lighting the foregoing lamps contracts have been made by the Department of Parks for the eight months ending December 31, next, with the New York Mutual Gas-light Company, at \$6.66 each lamp; with the Metropolitan Gas Company, at \$13, and with the Harlem Gas Company, at \$11.80; these contracts having been executed prior to the passage of the act before referred to. For the lamps on the parks and places south of Grand street, no contracts have been made, but these lamps were lighted by the New York Gas-light Company on orders issued by the Department of Parks, from month to month, at the rate of eighteen dollars per annum. On your communicating with this company in regard to the matter, it has agreed to light these lamps at the rate fixed in our contracts for the street lamps, which is twelve dollars per annum.

It will be seen that while the Department of Parks had six hundred and thirty-seven lamps lighted, there were six hundred and forty-three unlighted. The extinguishing of so many lamps on the several parks left these places in a darksome and uninviting state, and it is necessary that a number of the lamps should be relighted in order that these resorts may be rendered agreeable and secure during these sultry summer evenings. I shall, therefore, with your approval, order the relighting of lamps at important points in the several parks after examining the same and ascertaining their weak spots.

Yours respectfully,

S. McCORMICK,
Superintendent of Lamps and Gas.

EXHIBIT "A."

Statement showing the Amounts on Vouchers drawn for Gas to the various Public Markets, Armories, Offices, etc., and for Fitting-up, Repairing, and Lighting the Public Lamps, etc., for the Quarter ending June 30, 1879.

Washington Market.....	\$489 63
Catharine Country Market.....	29 83
Catharine Meat Market.....	20 90
Fulton Meat Market.....	117 42
Fulton Country Market.....	264 10
Essex Market.....	88 35
Centre Market.....	211 66
Clinton Market.....	204 25
Union Market.....	67 45
Tompkins Market.....	120 84
Jefferson Market.....	87 02
First District Police Court.....	209 19
Second District Police Court.....	34 77
Third District Police Court.....	44 27
Fourth District Police Court.....	51 30
Fifth District Police Court.....	12 00
Court of Special Sessions.....	1 33
Second District Civil Court.....	15 39
Fourth District Civil Court.....	2 09
Fifth District Civil Court.....	3 61
Sixth District Civil Court.....	19
Eighth District Civil Court.....	3 80
Ninth District Civil Court.....	2 80
Marine Court.....	6 84
Court Room, Brown Stone Building.....	28 88
New Court-house.....	856 52
City Hall.....	512 05
Receiver of Taxes' Office.....	150 86
Arrears of Personal Taxes Office.....	3 99
Corporation Attorney's Office.....	44 84
Pipe Yard, Rivington street.....	2 66
Department of Buildings.....	6 84
County Jail.....	460 18
South Gate-house.....	9 60
Engineer of Boulevards' Office.....	20
Engine-house, High Bridge.....	104 80
Photometrical Room, Grand street.....	32 81
Photometrical Room, Seventy-ninth street.....	27 63
Armory, Fifth Regiment.....	62 70
Armory, Seventh Regiment.....	170 81
Armory, Eighth Regiment.....	38 70
Armory, Ninth Regiment.....	372 02
Armory, Eleventh Regiment.....	64 03
Armory, Twelfth Regiment.....	173 09
Armory, Twenty-second Regiment.....	330 60
Armory, Sixty-ninth Regiment.....	67 45
Armory, Seventy-first Regiment.....	128 82
Armory, Third Regiment, Cavalry.....	32 30
Armory, Separate Troop "A," Cavalry.....	39 33
Armory, Separate Troop "B," Cavalry.....	17 29
Armory, Battery "B," Artillery.....	6 46
Armory, Battery "K," Artillery.....	8 74
Public Bath, Gouverneur slip.....	6 46
Public Bath, Fifth street, East river.....	7 22
Public Bath, Bethune street.....	7 60
Public Bath, Thirty-seventh street, East river.....	6 53
Public Bath, Thirty-fifth street, North river.....	6 52
Public Bath, One Hundred and Fourteenth street, East river.....	4 40
Lighting Public Markets (pay-rolls).....	285 00
Cleaning Photometrical Room (pay-rolls).....	15 00
Lamp-posts.....	1,329 25
Lamp-posts, Twenty-third and Twenty-fourth Wards.....	369 50
Street-lamps.....	1,500 00
Boulevard lamps.....	200 00
Cross-heads.....	186 00
Lamp-irons.....	185 00
Glass.....	27 50
Tape line and divider.....	2 00
Supplies for Photometrical Rooms.....	179 72
Lamp maps.....	12 00
Traveling expenses.....	78 50
Photometrical Room, Grand street, rent.....	87 50
Photometrical Room, Seventy-ninth street, rent.....	75 00
Fitting up new lamps.....	304 00
Fitting up new lamps, Twenty-third and Twenty-fourth Wards.....	490 00
Resetting and repairing lamp-posts.....	1,450 00
Resetting and repairing lamp-posts, Twenty-third and Twenty-fourth Wards.....	114 00
Lighting public lamps.....	72,893 76
Lighting public lamps, Twenty-third and Twenty-fourth Wards.....	31,471 52
Total.....	\$117,197 21

EXHIBIT "B."

Summary of the Appropriation for "Lamps and Gas for 1879," showing the Balance against which no Vouchers have been drawn, with the Amount of Liabilities against the Appropriation, for the Quarter ending June 30, 1879.

Amount appropriated for Lamps and Gas, for 1879.....		\$524,000 00
Amount of vouchers drawn during quarter ending March 31.....	\$82,030 85	
Amount of vouchers drawn during quarter ending June 30.....	117,197 21	
		<u>199,228 06</u>
Balance against which no vouchers have been drawn.....		\$324,771 94
Deduct amount transferred by Board of Apportionment to appropriation "Aqueduct, Repairs and Maintenance of, 1879," June 14.....		<u>20,000 00</u>
		<u>\$304,771 94</u>

LIABILITIES.

New York Gas-light Co., lighting public lamps, month of June.....	\$3,547 40
Manhattan Gas-light Co., lighting public lamps, month of June.....	7,247 72
Metropolitan Gas-light Co., lighting public lamps, month of June.....	6,279 27
Harlem Gas-light Co., lighting public lamps, month of June.....	6,678 47
N. Y. Mutual Gas-light Co., lighting public lamps, month of June.....	903 41
Central Gas-light Co., lighting public lamps, month of June.....	6,280 88
Northern Gas-light Co., lighting public lamps, month of June.....	4,111 27
Yonkers Gas-light Co., lighting public lamps, month of June.....	180 00
E. P. Gleason Manufacturing Co., lamp-posts, etc., for Mayor's residence	180 00
M. Dripps, map of Harlem district..	210 00
Gilbert Palmer, gas-mains, etc., for Gansevoort square.....	450 00
Hotchkiss, Field & Co., 50 lamp-posts.....	416 25
Bartlett Lamp Manufacturing Co., 200 Boulevard lamp-irons.....	120 00
Alex. Brandon, 150 street-lamps.....	450 00
E. G. Hilton, 50 lamp-posts for Twenty-third Ward.....	309 50
E. P. Gleason Manufacturing Co., 100 street-lamps for Twenty-third and Twenty-fourth Wards.....	300 00
	<hr/>
	37,784 17
Balance available June 30.....	\$266,987 77

EXHIBIT "C."

Summary of the Appropriation for "Salaries—Lamps and Gas, for 1879," showing the Balance against which no Vouchers have been drawn, for the Quarter ending June 30, 1879.

Amount appropriated for "Salaries—Lamps and Gas, for 1879".....		\$6,000 00
Amount of vouchers drawn during the quarter ending March 31.....	\$1,304 00	
Amount of vouchers drawn during the quarter ending June 30.....	1,352 00	
		<u>2,656 00</u>
Balance available June 30.....		\$3,344 00

EXHIBIT "D."

Summary of the "Lamp Account," showing the number of New Lamps Lighted, Old Lamps Relighted, and the number Discontinued by each Gas Company, during the Quarter ending June 30, 1879.

NEW YORK GAS-LIGHT COMPANY.	
Number of lamps burning March 31, 1879.....	3,231
Number of new lamps lighted during the quarter.....	14
Number of old lamps relighted during the quarter.....	4
	<u>3,249</u>
Less lamps discontinued during the quarter.....	8
Number of lamps burning June 30, 1879.....	3,241
MANHATTAN GAS-LIGHT COMPANY.	
Number of lamps burning March 31, 1879.....	6,656
Number of new lamps lighted during the quarter.....	25
Number of old lamps relighted during the quarter.....	4
	<u>6,685</u>
Less lamps discontinued during the quarter.....	4
Number of lamps burning June 30, 1879.....	6,681
METROPOLITAN GAS-LIGHT COMPANY.	
Number of lamps burning March 31, 1879.....	3,980
Number of new lamps lighted during the quarter.....	21
Number of old lamps relighted during the quarter.....	2
	<u>4,003</u>
Less lamps discontinued during the quarter.....	5
Number of lamps burning June 30, 1879.....	3,998
NEW YORK MUTUAL GAS-LIGHT COMPANY.	
Number of lamps burning March 31, 1879.....	587
Number of new lamps lighted during the quarter.....	..
Number of old lamps relighted during the quarter.....	..
	<u>587</u>
Less lamps discontinued during the quarter.....	..
Number of lamps burning June 30, 1879.....	587
HARLEM GAS-LIGHT COMPANY.	
Number of lamps burning March 31, 1879.....	3,860
Number of lamps transferred from the N. Y. and N. J. Globe Gas-light Co....	510
Number of new lamps lighted during the quarter.....	29
Number of old lamps relighted during the quarter.....	4
	<u>4,403</u>
Less lamps discontinued during the quarter.....	26
Number of lamps burning June 30, 1879.....	4,377
CENTRAL GAS-LIGHT COMPANY.	
Number of lamps burning March 31, 1879.....	1,704
Number of new lamps lighted during the quarter.....	41
Number of old lamps relighted during the quarter.....	6
	<u>1,751</u>
Less lamps discontinued during the quarter.....	2
Number of lamps burning June 30, 1879.....	1,749
NORTHERN GAS-LIGHT COMPANY.	
Number of lamps burning March 31, 1879.....	1,000
Number of new lamps lighted during the quarter.....	10
Number of old lamps relighted during the quarter.....	..
	<u>1,010</u>
Less lamps discontinued during the quarter.....	..
Number of lamps burning June 30, 1879.....	1,010
YONKERS GAS-LIGHT COMPANY.	
Number of lamps burning March 31, 1879.....	72
Number of new lamps lighted during the quarter.....	..
Number of old lamps relighted during the quarter.....	..
	<u>72</u>
Less lamps discontinued during the quarter.....	..
Number of lamps burning June 30, 1879.....	72
Total number of lamps burning June 30, 1879.....	21,715

RECAPITULATION.

Number of lamps burning March 31, 1879.....	21,600
Number of new lamps lighted during the quarter.....	140
Number of old lamps relighted during the quarter.....	20
	160
Less lamps discontinued during the quarter.....	45
Total number of lamps burning June 30, 1879.....	21,715

EXHIBIT "E."

Statement showing the Illuminating Power of the Gas supplied by the several Gas-light Companies during the quarter ending June 30, 1879, as shown by the Daily Observations at the Photometrical Rooms of the Department of Public Works.

FOR WHAT TIME.	NEW YORK GAS CO.			MANHATTAN GAS CO.			NEW YORK MUTUAL GAS CO.			METROPOLITAN GAS CO.			HARLEM GAS CO.		
	ILLUMINATING POWER IN CANDLES.			ILLUMINATING POWER IN CANDLES.			ILLUMINATING POWER IN CANDLES.			ILLUMINATING POWER IN CANDLES.			ILLUMINATING POWER IN CANDLES.		
During the Week Ending.	Lowest.	Highest.	Average.	Lowest.	Highest.	Average.	Lowest.	Highest.	Average.	Lowest.	Highest.	Average.	Lowest.	Highest.	Average.
April 5...	16.13	17.09	16.64	16.50	17.30	16.87	18.48	19.27	18.85	16.70	17.19	16.97	16.73	17.03	16.90
" 12...	16.34	17.11	16.76	16.19	17.41	16.85	18.38	19.29	18.34	17.13	16.74	15.92	16.70	16.30	16.30
" 19...	16.76	17.24	16.97	16.74	17.35	17.03	18.48	19.02	18.65	16.05	16.57	16.32	16.03	16.77	16.34
" 26...	16.72	17.09	16.87	17.00	17.29	17.14	18.59	18.92	18.70	16.86	17.01	16.90	16.58	16.96	16.79
May 3...	16.67	16.89	16.77	17.07	17.59	17.28	18.40	19.27	18.76	16.21	16.72	16.54	16.46	16.66	16.56
" 10...	16.44	16.99	16.82	17.20	17.68	17.36	18.00	19.18	18.76	16.67	17.22	16.89	16.62	16.91	16.78
" 17...	16.52	16.92	16.74	16.87	17.30	17.18	18.39	19.23	18.76	16.82	17.31	15.92	17.03	16.60	16.60
" 24...	15.59	16.58	16.26	16.68	17.91	17.22	18.01	19.32	18.55	16.80	17.59	17.08	15.49	16.32	15.84
" 31...	15.80	16.24	15.88	16.88	17.07	16.93	18.32	18.90	18.52	17.05	17.70	17.24	14.84	16.60	15.63
June 7...	15.82	16.44	16.13	15.88	16.86	16.62	17.86	18.85	18.24	17.21	17.62	17.41	16.36	17.71	17.01
" 14...	16.65	17.07	16.87	16.86	17.32	17.09	17.75	18.35	18.05	17.55	18.32	17.87	16.17	16.95	16.59
" 21...	16.52	17.22	16.93	16.95	17.57	17.23	17.76	18.47	18.14	18.39	18.37	18.43	16.08	16.47	16.32
" 28...	16.49	17.27	16.89	16.93	17.55	17.14	17.71	18.57	18.04	17.98	19.02	18.58	16.03	17.18	16.58
Dist'ce from Gas Works	2 4-100 Miles.			1 83-100 Miles.			1 79-100 Miles.			3 33-100 Miles.			1 75-100 Miles.		

Document "P."

CITY OF NEW YORK, DEPARTMENT OF PUBLIC WORKS,
BUREAU OF REPAIRS AND SUPPLIES,
SUPERINTENDENT'S OFFICE, CITY HALL, ROOM 18,
NEW YORK, July 16, 1879.

ALLAN CAMPBELL, Esq., Commissioner of Public Works:

SIR—In compliance with your request, I herewith submit a report of the transactions of this Bureau for the three months ending June 30, 1879.

The exhibits marked "A," "B," and "C," hereto annexed, show the number and amount of certified vouchers drawn during the three months, also the condition of the appropriations upon which they have been drawn and where the money has been applied.

The principal items of work done are as follows:

Repairing and restoring part of the brown-stone ashlar on front and the brown-stone stoop in rear of City Hall, and painting, kalsomining, etc., in Mayor's Clerk's office, in Permit Bureau, and in office of Chief Clerk of Department of Public Works. Building an iron fence on rear wall of County Jail, repairing wall where hole was cut, and lining the spot with boiler iron; also repairing and altering the plumbing.

Fulton Market caught fire twice during the quarter, on April 16th and on May 31st, necessitating an expense for repairs of nearly \$2,000. A new felt and gravel roof was put on part of the market, and the brick building on the west side was lowered to a height of one story and a new roof put on it. A new felt and gravel roof was put on part of Clinton Market; several iron gratings at Essex Market were repaired, and the gutters and leaders of Union Market were repaired and painted.

Five reflectors were put in City Arsenal, corner of White and Elm streets, for Third Regiment Cavalry.

The building on southeast corner of Tenth avenue and Little Twelfth street was repaired and newly roofed.

Glass dials and arrangements for illuminating them at night are being put in the clock on Third District Court-house, some painting and kalsomining was done in this building, the slate roof was repaired and part of it rendered with hair mortar.

The Dog Pound was rebuilt on a site near the old one.

The room of Clerk of Court of Special Sessions in City Prison Building, was painted and kalsomined and fitted up with cases for records and books.

The work of building a partition, kalsomining and painting in First District Civil Court is still in progress.

Forty-two closets or lockers were built in building Nos. 139 to 143 West Twenty-third street, for Battery K.

The work of fitting up offices for Commissioner of Jurors, in addition to New Court-house is in progress. Venetian blinds were fitted in windows of office of Collector of Assessments, in same building.

New carpets were furnished the Mayor's Clerk's office, County Clerk's office, Permit Bureau, Ninth District Civil Court, Court of Special Sessions, Seventh District Civil Court, and office of Chief Clerk Department of Public Works.

The awnings of the various buildings have been repaired and put up where required, and several new awnings made.

Ice for water-coolers is being taken as usual during warm weather.

A quantity of law books were furnished.

The Public Baths were repaired and painted and tanks caulked and were towed to their summer stations.

A contract was entered into for the construction of a new bath to be located at the Battery. This bath is about finished and will be in position in a day or two.

The work of keeping the buildings and offices clean progressed favorably during the quarter.

Respectfully,

THOMAS KEECH,

Superintendent of Repairs and Supplies.

EXHIBIT "A,"

Showing the Number and Amount of Vouchers drawn on account of the Appropriations therein named, from April 1, 1879, to June 30, 1879, inclusive.

TITLE OF APPROPRIATION.	NUMBER OF VOUCHERS.	AMOUNT.
Supplies for and Cleaning Public Offices.....	62	\$13,714 54
Salaries—Supplies for and Cleaning Public Offices.....	3	3,887 40
Public Buildings—Construction and Repairs.....	53	6,254 77
Salaries—Public Buildings—Construction and Repairs.....	3	468 00
Free Floating Baths.....	4	475 65
Salaries—Free Floating Baths.....	2	457 50
Additional Free Floating Baths.....	6	898 23
Free Floating Baths—For Bath at Battery.....	1	60 00
Totals.....	134	\$26,216 09

EXHIBIT "B,"

Showing the Amount of Expenditures for which Certified Vouchers have been drawn on account of the several Appropriations therein named, and also showing the Buildings, Courts, Departments, etc., to which the same has been charged, from April 1, 1879, to June 30, 1879, inclusive.

NAMES OF BUILDINGS, COURTS, DEPARTMENTS, ETC.	Supplies for and Cleaning Public Offices.	Salaries—Supplies for and Cleaning Public Offices.	Public Buildings—Construction and Repairs.	Salaries—Public Buildings—Construction and Repairs.	Free Floating Baths.	Salaries—Free Floating Baths.	Additional Free Floating Baths.	Free Floating Baths—For Bath at Battery.	TOTALS.
First District Police Court	\$25 05	.....	.....	.....	.....	.....	.....	.....	\$25 05
Second " "	31 75	.....	.....	.....	.....	.....	.....	.....	31 75
Third " "	42 50	.....	\$8 10	.....	.....	.....	.....	.....	50 60
Fourth " "	3 50	.....	.....	.....	.....	.....	.....	.....	3 50
Fifth " "	21 10	.....	.....	.....	.....	.....	.....	.....	21 10
First District Civil Court	.....	.....	6 65	.....	.....	.....	.....	.....	6 65
Third " "	5 25	.....	.....	.....	.....	.....	.....	.....	5 25
Sixth " "	53 38	.....	57 27	.....	.....	.....	.....	.....	110 65
Seventh " "	140 50	.....	.....	.....	.....	.....	.....	.....	140 50
Eighth " "	42 96	.....	.....	.....	.....	.....	.....	.....	42 96
Ninth " "	74 55	.....	.....	.....	.....	.....	.....	.....	74 55
Special Sessions Court	99 00	.....	.....	.....	.....	.....	.....	.....	99 00
Supreme Court	17 00	.....	.....	.....	.....	.....	.....	.....	17 00
Superior Court	14 50	.....	.....	.....	.....	.....	.....	.....	14 50
Marine Court	154 54	.....	.....	.....	.....	.....	.....	.....	154 54
Washington Market	.....	.....	145 80	.....	.....	.....	.....	.....	145 80
West Washington Market	.....	.....	37 43	.....	.....	.....	.....	.....	37 43
Jefferson Market	.....	.....	21 94	.....	.....	.....	.....	.....	21 94
Clinton " "	.....	.....	275 00	.....	.....	.....	.....	.....	275 00
Fulton " "	.....	.....	1,228 48	.....	.....	.....	.....	.....	1,228 48
Essex " "	.....	.....	8 55	.....	.....	.....	.....	.....	8 55
Centre " "	.....	.....	14 50	.....	.....	.....	.....	.....	14 50
Executive Department	224 18	.....	.....	.....	.....	.....	.....	.....	224 18
Legislative " "	23 34	.....	.....	.....	.....	.....	.....	.....	23 34
Law " "	44 00	.....	.....	.....	.....	.....	.....	.....	44 00
Finance " "	127 10	.....	.....	.....	.....	.....	.....	.....	127 10
Department of Buildings	31 25	.....	.....	.....	.....	.....	.....	.....	31 25
Department of Taxes and Assessments	97 99	.....	.....	.....	.....	.....	.....	.....	97 99
Department of Public Works	254 05	.....	.....	.....	.....	.....	.....	.....	254 05
Bureau of Repairs and Supplies, D. P. W.	301 58	.....	208 73	.....	.....	.....	.....	.....	510 31
Bureau of Repairs & Supplies, D. P. W., Pay-rolls	9,476 00	3,887 40	.....	\$468 00	.....	.....	.....	.....	13,831 40
Commissioners of Accounts	23 00	.....	.....	.....	.....	.....	.....	.....	23 00
District Attorney	28 25	.....	.....	.....	.....	.....	.....	.....	28 25
County Clerk	122 19	.....	.....	.....	.....	.....	.....	.....	122 19
Register	10 00	.....	.....	.....	.....	.....	.....	.....	10 00
Surrogate	5 48	.....	.....	.....	.....	.....	.....	.....	5 48
City Hall	806 28	.....	844 83	.....	.....	.....	.....	.....	1,651 11
New Court-house	958 70	.....	292 96	.....	.....	.....	.....	.....	1,251 66
Brown Stone Building	137 60	.....	120 83	.....	.....	.....	.....	.....	258 43
Hall of Records	.....	.....	113 03	.....	.....	.....	.....	.....	113 03
Third District Court-house	18 63	.....	511 33	.....	.....	.....	.....	.....	529 96
Fifth " "	52 91	.....	.....	.....	.....	.....	.....	.....	52 91
Seventh " "	3 00	.....	36 39	.....	.....	.....	.....	.....	39 39
Tenth " "	.....	.....	12 43	.....	.....	.....	.....	.....	12 43
Free Floating Baths	.....	.....	.....	.....	\$475 65	\$457 50	\$898 23	\$60 00	1,891 38
County Jail	118 15	.....	631 06	.....	.....	.....	.....	.....	749 21
City Arsenal	.....	.....	195 00	.....	.....	.....	.....	.....	195 00
City Prison	.....	.....	213 93	.....	.....	.....	.....	.....	213 93
Dog Pound	.....	.....	900 00	.....	.....	.....	.....	.....	900 00
Dispensary Building	.....	.....	3 00	.....	.....	.....	.....	.....	3 00
Rivington Street Yard	.....	.....	46 40	.....	.....	.....	.....	.....	46 40
27 Chambers street	.....	.....	32 60	.....	.....	.....	.....	.....	32 60
534 Grand street	.....	.....	16 00	.....	.....	.....	.....	.....	16 00
49 Beekman street	.....	.....	8 18	.....	.....	.....	.....	.....	8 18
25 Norfolk street	.....	.....	.....	.....	.....	.....	.....	.....	.....
Building southeast corner of Tenth avenue and Little Twelfth street	.....	.....	56 25	.....	.....	.....	.....	.....	56 25
Eighth Regiment	14 00	.....	.....	.....	.....	.....	.....	.....	14 00
Ninth " "	110 50	.....	155 19	.....	.....	.....	.....	.....	265 69
Eleventh " "	13 50	.....	.....	.....	.....	.....	.....	.....	13 50
Totals.....	\$13,714 54	\$3,887 40	\$6,254 77	\$468 00	\$475 65	\$457 50	\$898 23	\$60 00	\$26,216 09

EXHIBIT "C,"

Showing the condition of the Appropriations of 1879, and Special Fund upon which Vouchers have been drawn, from April 1, 1879, to June 30, 1879, inclusive.

Supplies for and Cleaning Public Offices—	
Balance March 31, 1879.....	\$41,782 95
Vouchers drawn.....	13,714 54
	\$28,068 41
Liabilities, estimated.....	4,096 93
Available balance.....	\$23,971 48
Salaries—Supplies for and Cleaning Public Offices—	
Balance March 31, 1879.....	\$11,082 60
Vouchers drawn.....	3,887 40
Available balance.....	\$7,195 20
Public Buildings—Construction and Repairs—	
Balance March 31, 1879.....	\$29,796 60
Vouchers drawn.....	6,254 77
	\$23,541 83
Liabilities, estimated.....	7,144 35
Available balance.....	\$16,397 48
Salaries—Public Buildings—Construction and Repairs—	
Balance March 31, 1879.....	\$1,536 50
Vouchers drawn.....	468 00
Available balance.....	\$1,068 50
Free Floating Baths—	
Balance March 31, 1879.....	\$9,491 54
Vouchers drawn.....	475 65
	\$9,015 89
Liabilities, estimated.....	859 19
Available balance.....	\$8,156 70
Salaries—Free Floating Baths—	
Balance March 31, 1879.....	\$3,325 00
Vouchers drawn.....	457 50
	\$2,867 50
Liabilities.....	770 00
Available balance.....	\$2,097 50

Additional Free Floating Baths—	
Balance March 31, 1879.....	\$4,128 82
Vouchers drawn.....	898 23
	<hr/>
	\$3,230 59
Liabilities, estimated.....	3,159 82
	<hr/>
Available balance.....	\$70 77
Free Floating Baths—For Bath at Battery—	
Balance March 31, 1879.....	\$9,329 70
Vouchers drawn.....	60 00
	<hr/>
	\$9,269 70
Liabilities, estimated.....	6,973 00
	<hr/>
Available balance.....	\$2,296 70

Document "Q."

DEPARTMENT OF PUBLIC WORKS,
BUREAU OF STREET INCUMBRANCES, ROOM 13, CITY HALL,
NEW YORK, July 16, 1879.

Hon. ALLAN CAMPBELL, Commissioner of Public Works:

SIR—Herewith report of the operations of this Bureau for the quarter ending June 30, 1879 (months of April, May, and June).

Number of complaints received against obstructions and incumbrances on streets and sidewalks, in each of which an official notice was served on the offending party for the removal or discontinuance of the same.....	685
Number of removals to the Corporation Yard or other suitable place of merchandise, trucks, wagons, stands, etc.....	40
Expense of such removals (including 478 loads of stone, dirt, rubbish, etc., from various parts of the city).....	\$407 05
Total expenses for the quarter.....	957 05

Received from owners of articles seized for their redemption.....	\$18 50
Received from sale at Corporation Yard.....	66 60

Total..... \$85 10
—which amount was paid over to the City Chamberlain.

Number of Builders' permits issued.....	2,226
“ permits to cut down trees.....	5
“ special permits.....	152
“ notices to repair sidewalks.....	514
“ notices to replace vault covers.....	4

Respectfully submitted,

THOMAS F. HART,
For Superintendent of Incumbrances.

Document "R."

NEW YORK, June 30, 1879.

Hon. ALLAN CAMPBELL, Commissioner of Public Works:

SIR—I herewith transmit statement of moneys received for water rents, penalties, and taps for the quarter ending June 30, 1879:

	Principal.	Penalties.	Taps.
April.....	\$33,086 39	\$618 90	\$748 00
May.....	205,397 40	416 65	1,038 00
June.....	236,647 41	308 85	858 50
	<hr/>	<hr/>	<hr/>
	\$475,131 20	\$1,344 40	\$2,644 50
Total.....		\$479,120 10	

Respectfully submitted,

J. H. CHAMBERS, Water Register.

POLICE DEPARTMENT.

The Board of Police met on the 22d day of August, 1879.
Present—Messrs. MacLean, French, and Morrison, Commissioners.
Resolved, That Commissioner MacLean be appointed to act as President until the stated meeting of the Board, August 29, 1879.

Leaves of Absence Granted.

Captain Thomas Byrnes, Fifteenth Precinct, five days.
“ Alex. S. Williams, Twenty-ninth Precinct, ten days.

Leaves of Absence Granted under Rule 564—Approved.

- August 16. Patrolman John W. Elder, First Precinct, half day.
18. “ Daniel O’Conner, Nineteenth Precinct, half day.
19. “ W. A. Smith, Thirty-third Precinct, one day.
20. “ Michael Johnston, Tenth Precinct, half day.
20. Sergeant Wm. W. Sullivan, Twelfth Precinct, two days.
21. Patrolman Daniel W. Sullivan, Twenty-third Precinct, half day.
21. “ William H. Taylor, Eleventh Precinct, two and a half days.
22. Roundsman William H. Hasson, Second District, two and a half days.

Parades Approved.

New York Turner Cadet Corps, August 22. Street drill.
Normal Lodge, F. & A. M., August 17. Funeral.
Kolte's Post, G. A. R., August 18. Funeral.
Germania Schutzen Bund, August 19. Parade.
Citizens' Corps of Troy, August 20. Parade.
German-American Sharpshooters, August 22. Parade.
Bavarian Festival Society, August 25. Parade.
St. Francis Society, August 18. Picnic.
Wilhelm Sohn K. U. Verein, August 18. Picnic.
Lowenthal's German Schools. August 20. Picnic.
Mount Olivet Baptist Sunday School, August 21. Picnic.
Moltke K. U. Verein, September 1. Picnic.
Rheinisch Sharpshooters, August 18. Target excursion.
Bloomingdale Gardeners Horse Troop, August 20. Target excursion.
Deutsch-American Schutzen Corps, August 25. Target excursion.
Report of the Superintendent, relative to the enforcement of the Excise Law on Sunday, 17th instant, was ordered on file.
Report of the Superintendent, relative to Patrolman Thomas Hogan, Twenty-first Precinct, was ordered on file.

Death reported.

Doorman Michael Dore, Eighteenth Precinct, at 6 A. M., 19th instant.
Report of the Superintendent, on petition of Patrolman John Reilly, Thirty-third Precinct, for full pay while sick, was ordered on file.

SUPREME COURT.

The People, ex rel. Charles O. Dooley }
against } Writ of Prohibition.
The Board of Police.

Resolved, That the papers in the above case be referred to the Counsel to the Corporation with request that proceedings to vacate the writ be taken without delay.

SUPREME COURT.

The People, ex rel. Patrick W. Devitt, }
against } Writ of Certiorari.
The Board of Police.

Resolved, That the papers in this case be referred to the Counsel to the Corporation to make proper return.

Communication from D. A. Levien, Jr., demanding \$64.64, for costs in the case of Charles O. Dooley, was referred to the Treasurer with power.

Communication from the Comptroller, transmitting copy of resolutions of Board of Estimate and Apportionment, calling for the Departmental Estimate for 1880, was referred to the Treasurer.

Communication from Samuel Whitechurch, Secretary Taxpayers' Central Committee, relative to obstructions in Second avenue, caused by materials of Elevated Railroad, was referred to Commissioner MacLean, with power.

Applications ordered on file:
Patrolman Daniel Brooks, Twenty-seventh Precinct, for promotion.

Dr. John G. Shumway, for appointment as Police Surgeon.

On reading report of the Superintendent, it was

Resolved, That full pay be allowed to Patrolman James H. Johnson, Thirteenth Precinct, while sick, from April 3, to May 19, 1879.

On reading report of the Board of Surgeons, it was

Resolved, That Patrolman William H. Rhodes, Twenty-sixth Precinct, be allowed full sick pay while sick.

Resolved, That in the preparation of the abstract of the minutes of meetings of the Board for publication in the CITY RECORD, the Chief Clerk be directed to record hereafter the names of those voting aye or nay on all questions where the roll is called.

Resolved, That Roundsman William F. Cosgrove, First Inspection District, be granted permission to receive a reward of \$35 (subject to the deduction under the rule) for the arrest and conviction of a counterfeiter.

Resolved, That Patrolman Patrick Ryan, Third Court, be and is hereby transferred to the Twenty-ninth Precinct.

Resolved, That Patrolman John Wiegand, Twenty-ninth Precinct, be and he is hereby detailed for duty in the Bureau of Street Cleaning.

Judgments—Fines imposed.

Patrolman Patrick Masterson, Tenth Precinct, five days' pay.
“ Thomas J. Crystal, Tenth Precinct, five days' pay.
“ John McEvoy, Sixteenth Precinct, two days' pay.
“ John Johnston, Sixteenth Precinct, five days' pay.
“ Patrick W. Reilly, Nineteenth Precinct, one day's pay.
“ William Dixon, Nineteenth Precinct, one day's pay.
“ William Burke (No. 1), Twentieth Precinct, five days' pay.
“ Henry Butts, Twenty-second Precinct, three days' pay.
“ Thomas Dalton, Twenty-second Precinct, three days' pay.
“ George M. Palmer, Twenty-third Precinct, two days' pay.
“ Cornelius Scully, Twenty-seventh Precinct, two days' pay.
“ William Kelly, Twenty-ninth Precinct, five days' pay.
“ Chester L. Ketchum, Twenty-ninth Precinct, five days' pay.

Reprimand.

Patrolman Thomas McBride, Twenty-sixth Precinct.

Street Cleaning.

Communication from the Health Department, relative to nuisances at No. 2 State street and 42 Whitehall street, was referred to Captain Caffrey to report without delay to the Chairman of the Committee on Street Cleaning.

Communication from Ambrose Snow, President Board of Pilot Commissioners, relative to refusal of keeper of scow to receive ashes from steamship Niagara, was referred to the Chief Clerk to answer, giving reasons as reported by the Chairman of the Committee on Street Cleaning.

Resolved, That John W. Michell and John A. Squires be granted permission to appear before this Board, at any regular meeting, and that they be heard in relation to their proposals.

Commissioner MacLean offered the following:

Resolved, That Joseph D. Hoff be appointed Captain of the tug “U. S. Grant,” with compensation at the rate of \$ per annum, in place of William H. Rightmeyer, hereby removed.

Commissioner French moved that the resolution lie over until next Board meeting. Carried—Commissioners French and Morrison voting aye, Commissioner McLean voting no.

Resolved, That the following named persons be employed in, and removed from, the Bureau of Street Cleaning:

James Mahoney, employed as Watchman.
James G. Murphy, employed as Watchman.
Sherman T. Stone, employed as Watchman.
David Cognay, employed as P. D. Driver.
Daniel Daly, employed as P. D. Driver.
John McNally, employed as hired Cartman.
David Prendergast, employed as hired Cartman.
James Curtis, employed as Laborer.
Michael Carman, employed as P. D. Driver.
John Lyons, Cartman, removed.
Joseph Winters, Cartman, removed.

—and that those employed be assigned to duty by Captain Hedden.

Resolved, That the Chairman of the Committee on Street Cleaning be authorized to have a telephone put up between Central Office and Street Cleaning stables.

On recommendation of the Committee on Street Cleaning, it was,

Resolved, That the following bills be and are hereby ordered to be paid by the Treasurer—all voting aye:

Allen Bros., use of scow.....	\$175 50	Tug “Kalbfleisch,” towing scows...	\$440 00
Manly A. Britton, car fares.....	6 00	“ “ “ “ “ “ “ “	680 00
Edward L. Carey, coal.....	9 00	A. T. Stewart & Co., kersey and	
Daniel Dailey, use of scows.....	78 00	“ “ “ “ “ “ “ “	26 70
Wm. H. Gautier & Co., use of scows	225 00	Van Winkle & Co., rope.....	153 07
“ “ “ “ “ “ “ “	240 00	“ “ “ “ “ “ “ “	32 72
Horace Ingersoll, horse feed.....	297 72	“ “ “ “ “ “ “ “	18 26
“ “ “ “ “ “ “ “	379 28	“ “ “ “ “ “ “ “	12 81
James D. Leary, coal.....	20 30	“ “ “ “ “ “ “ “	12 38
Wm. J. Mack, use of scows.....	75 00	Lewis S. Wandell, use of scows.....	220 00
“ “ “ “ “ “ “ “	80 00	“ “ “ “ “ “ “ “	380 00
Manhattan Gas Co., gas.....	25 43	J. N. Waterbury, timber and plank..	28 37
N. Y. Towing and Trans. Co., use of		“ “ “ “ “ “ “ “	15 00
scows.....	225 00	Wetmore & Co., fire iron.....	65 31
N. Y. Towing and Trans. Co., use of		“ “ “ “ “ “ “ “	62 23
scows.....	240 00	“ “ “ “ “ “ “ “	21 48
N. F. Palmer, Jr., & Co., machine		J. N. Waterbury, lumber.....	39 20
fixtures.....	20 00	Harmer, Hays & Co., currycombs, etc.	8 75
Pollock & Van Wagenen, gauge		J. G. Moody, expenses.....	3 10
glasses, etc.....	10 80	D. D. Mangam, horse feed.....	284 79
Total.....			\$4,611 20

Adjourned.

S. C. HAWLEY, Chief Clerk.

FINANCE DEPARTMENT.

Abstract of transactions of the Department of Finance for the week ending August 23, 1879:

Deposits in the Treasury.

On account of the Sinking Fund.....	\$28,683 83
“ “ City Treasury.....	152,938 17
Total.....	\$181,622 00

Warrants Registered and Ready for Payment.

Aqueduct—Repairs and Maintenance.....	\$1,292 14
Commissioners of Excise Fund.....	9 00
Contingencies—Comptroller's Office.....	6 36
“ Department of Public Works.....	11 56
“ Law Department.....	114 25
Croton Water-main Fund.....	3,561 53
Croton Water Rent—Refunding Account.....	6 00
Dock Fund.....	4,315 37
Fire Department Fund.....	2,965 00
Free Floating Baths.....	36 89
Fund for Small-pox Hospital and Care of Contagious Diseases.....	587 97
Health Fund.....	794 83
Interest on the City Debt.....	5,532 50
Intestate Estates.....	1,015 85
Lamps and Gas.....	37,177 40
Maintenance and Government of Parks and Places.....	3,266 95
Nursery and Child's Hospital.....	8,333 33
New York Infirmary for Women and Children.....	175 00
Public Buildings—Construction and Repairs.....	548 21
Public Charities and Correction.....	12,189 74
Public Drinking-hydrants.....	627 18
Public Instruction.....	6,700 70
Repairing and Renewal of Pipes, Stop-cocks, etc.....	3,074 08
Repairs and Renewal of Pavements.....	11,657 28
Roads and Avenues and Sprinkling.....	2,134 31
Sewers—Repairing and Cleaning.....	620 61
Street Improvement Fund.....	5,899 82
Street Improvements above Fifty-ninth street.....	2 50
Supplies for and Cleaning Public Offices.....	680 25
Total.....	\$113,336 61

SUITS, ORDERS OF COURT, JUDGMENTS, Etc.

COURT.	PLAINTIFF OR RELATOR.	AMOUNT.	NATURE OF ACTION, ETC.	ATTORNEY.
Supreme..	Patrick Farley.....	\$46,669 76	For amount due under contract for regulating, etc., Fourth avenue, Fifty-eighth to Seventy-first street.....	E. Sandford.
“	Geo. W. Morton and Jacob M. Patterson, Jr., against Owen Murphy and others; John McGrath and Jno. F. Bohmfalk against George W. Morton and others.	12,788 94	Order to pay over to J. Sanford Potter, Trustee and Receiver, \$12,788.94, amount received by Chamberlain from Owen Murphy, Treasurer of Board of Excise, for licenses issued between May 1, 1876, and December 22, 1877.....	B. N. Harrison.
“	Frederic Booss.....	“	Order to vacate assessment for underground drains in One Hundred and Tenth and One Hundred and Twenty-fourth streets..	A. B. Johnson.
“	Daniel R. Kendall....	“	Order to vacate assessment for underground drains in One Hundred and Tenth and One Hundred and Twenty-fourth streets..	“
“	Susan R. Kendall....	“	Order to vacate assessment for underground drains in One Hundred and Tenth and One Hundred and Twenty-fourth streets..	“
“	The Manhattan Savings Institution.....	“	Order to vacate assessment for Ninety-second and One Hundred and Sixth street underground drains.....	“
“	Barbara Fuchs, ex'x.....	“	Order to vacate assessment for paving Ludlow street, Canal to Stanton street.....	“
“	Susan Rothschild.....	“	Order to vacate assessment for paving Seventy-second street, between Eighth avenue and Harlem river.....	“
Com. Pleas	Edward Morrissey vs. William F. Morgan, The Mayor, etc....	1,000 00	For amount advanced to complete contract for building public bath, and for injunction to restrain payment of balance to Wm. F. Morgan, and that this claim be adjudged a prior lien.....	T. Brennan.
“	Edward Morrissey vs. William F. Morgan, The Mayor, etc....	1,000 00	Notice lis pendens for payment of claim of \$1,000, advanced under contract between The Mayor, etc., and Wm. F. Morgan....	“

CLAIMS FILED.

NAME OF CLAIMANT.	AMOUNT.	NATURE OF CLAIM.	ATTORNEY.
Robert Sillery.....	\$10,000 00	For damages for personal injuries received through dangerous condition of sidewalk in Morton street....	J. T. Patey.
Daniel F. Tiemann.....	4,500 00	For award in matter of closing the Bloomingdale road..	E. Sandford.

CONTRACTS REGISTERED.

NO.	DATE OF CONTRACT.	DEPARTMENT.	NAMES OF CONTRACTORS.	DESCRIPTION OF WORK.
4636	June 14, 1879	Charities & Correction	Samuel W. Sears.....	Furnishing 307,000 brick, 100 bbls. lime, 100 bbls. cement, 6 boxes tin, and 150 kegs nails. Total, \$2,340.27.
4637	July 22, “	Public Works.....	Gilbert Palmer (Special)....	Flagging sidewalk on east side Fourth avenue, between Sixty-fifth and Sixty-sixth streets. Estimate, \$216.20.
4638	“ 30, “	“	Michael Mahoney (Special).	Fencing vacant lots southeast and southwest corners Madison avenue and One Hundred and Twenty-seventh street. Estimate, \$136.68.
4639	Aug. 13, “	“	Richard A. Cunningham.... (Special.)	Fencing vacant lots on block bounded by Eightieth and Eighty-first streets, Madison and Fifth avenues. Estimate, \$396.44.
4640	“ 7, “	“	Owen Fitzpatrick (Repaving under chap. 476, Laws 1875)	Regulating and paving Twenty-first street, from Seventh to Eighth avenue; Twenty-sixth street, from Seventh to Eighth avenue; Thirty-seventh street, from Sixth to Seventh avenue; Forty-fifth street, from Lexington to Fourth avenue, and Forty-fifth street, from Madison to Fifth avenue. Estimate, \$16,366.
4641	“ 2, “	“	Leonard W. Johnson (Repaving under chap. 476, Laws 1875).....	Regulating and paving Seventh avenue, from Forty-seventh to Fifty-ninth street. Estimate, \$32,297.
4642	“ 11, “	“	John Witherell.....	Furnishing materials and building a Keeper's house, barn, etc., at Boyd's Corners Reservoir, in Kent, Putnam Co., N. Y. Total, \$3,896.
4643	July 30, “	“	Wm. E. Dean and Wm. M. Dean.....	Sewer in One Hundred and Thirteenth street, between Tenth avenue and Summit east of Tenth avenue. Estimate, \$2,867.70.
4644	Aug. 2, “	“	Michael Gavin.....	Sewer in Fifty-second street, between Third and Lexington avenues. Estimate, \$1,000.
4645	July 28, “	“	Patrick Farley.....	Regulating, grading, curbing and guttering Seventy-third street, from Third avenue to East river. Estimate, \$41,137.
4646	“ 25, “	Charities & Correction	Edwin F. Gibson.....	Furnishing 60,000 yards brown muslin, 20,000 yards bandage muslin, and 10,000 yards ticking. Total, \$6,743.

Opening of Proposals.

The Comptroller, by representative, attended the opening of proposals at the following Departments, viz.:

August 21. Department of Public Charities and Correction—For furnishing dry goods, groceries, oils, lumber, etc., for the use of said Department.

August 21. Department of Public Works—For laying Croton water-mains in Eighty-seventh, One Hundred and Thirty-second One Hundred and Fifty-first, Cliff and other streets; for furnishing stop-cocks and boxes; hydrants and boxes; for building a floating swimming bath, and for building sewers and laying pavements in the streets and avenues named in advertisement of Department of Public Works, published in CITY RECORD dated August 7, 1879.

Approval of Sureties.

The Comptroller approved of the adequacy and sufficiency of the sureties on the following proposals, viz.:

August 18. For paving Water street, from Fulton to Market street, and Madison street, from Market to Clinton street.

John M. Shannon, 102 Palisade avenue, Jersey City, Principal.

Matthew Baird, 306 East Fifty-seventh street, { Sureties.

John McAndrew, Jr., 149 West Thirteenth street, }

August 19. For paving with granite block pavement Mercer street, from Bleecker to Eighth street; Clarkson street, from Varick street to North river; Fifteenth street, from Sixth to Seventh avenue; and University place, from Eighth to Fourteenth street.

Thomas Gearty, 415 East Eighty-third street, Principal.

Christopher C. Ellis, 443 Ninth avenue, { Sureties.

John Lynch, 304 Eighth avenue, }

August 19. For furnishing 1,225 tons straight pipe, and 100 tons branches and special castings, for the use of the Department of Public Works.

The Warren Foundry and Machine Co., Phillipsburgh, N. J., Principals.

George A. Crocker, 6 East Twelfth street, { Sureties.

Robert Campbell, 5 Madison avenue, }

August 22. For building sewers in Sixty-ninth and Seventieth streets, between Second and Third avenues.

John H. McCabe, 307 E. Sixty-second street, Principal.

Charles H. Field, 957 Madison avenue, { Sureties.

Francis McCabe, 725 Lexington avenue, }

Return of Proposal.

Proposal of the Warren Foundry and Machine Co., for furnishing water pipe and castings, returned to the Department of Public Works for action on the proposed substitution of George A. Crocker, No. 6 East Twelfth street, as a surety thereon in the place of Joseph Richardson, the surety originally offered.

Application for substitution of Charles H. Field, 957 Madison avenue, as a surety on the proposal of John H. McCabe for building sewers in Sixty-ninth and Seventieth streets, between Second and Third avenues, in the place of Maurice B. Flynn, 624 East Fourteenth street, transmitted to the Department of Public Works for action thereon.

JOHN KELLY, Comptroller.

DEPARTMENT OF PUBLIC PARKS.

Abstract of Proceedings for the week ending August 23, 1879.

Meeting held Wednesday, August 20, 1879.

Present—Commissioners Wenman, President, Wetmore, Conover, and Lane.

The following communications were received:

From the Comptroller of the City, calling for a Departmental estimate of moneys that will be required for the year 1880.

Referred to the President to prepare such estimate.

From John McMahon, desiring the use of building at East River Park for dwelling and business purposes.

Laid over.

From the Superintendent of Twenty-third and Twenty-fourth Wards, relative to injuries to Patrick Connell, while employed in cleaning a sewer, and asking that a leave of absence be granted him, with pay, during his sickness. Granted.

From Mrs. Margaret Gilmore, in relation to alteration of grade affecting her property between One Hundred and Fortieth and One Hundred and Forty-first streets.

Referred to the Engineer of Construction to examine into and report upon.

Petitions were received from property owners, asking for the construction of sewers in Third avenue, One Hundred and Thirty-seventh and One Hundred and Forty-first streets, and referred to the Engineer of Construction to examine into and report upon.

The following resolutions were adopted.

Resolved, That under and by virtue of the powers conferred on the Commissioners of the Department of Public Parks of the City of New York, by chapter 604 of the Laws of 1874, and chapter 436 of the Laws of 1876, they do hereby alter, lay out, and classify the following streets, roads, or avenues, viz.:

Walton avenue, from Sedgwick avenue to Cheever place;

Gerard avenue, from the Spuyten Duyvil and Port Morris Railroad to One Hundred and Thirty-eighth street:

River avenue, from the Spuyten Duyvil and Port Morris Railroad to the new line of Gerard avenue;

Cromwell avenue, from the Spuyten Duyvil and Port Morris Railroad to One Hundred and Fiftieth street, Cheever place;

One Hundred and Forty-fourth street, from the new line of Gerard avenue to the new line of River avenue;

—as the same are shown on a map or plan dated "New York, August 13, 1879," and signed "Julius Munckwitz, Superintending Architect, Department Public Parks," and "E. B. Van Winkle, Topographical Engineer, Department Public Parks," and that the President of the Department cause to be prepared and submitted to this Board, three similar maps or plans of the same, to be filed in pursuance of said laws above mentioned.

Resolved, That the Secretary be, and he is hereby directed to prepare and publish the necessary advertisements for proposals for furnishing uniform overcoats and pants for Park and Gate Keepers, after having submitted the same, together with the form of contract and specification, to the Corporation Counsel and received his approval thereof.

Resolved, That three similar maps or plans, entitled "Plans and Profiles showing Sedgwick avenue from Boston avenue to junction of Bailey avenue, in the Twenty-fourth Ward of the City of New York," as laid out, entitled, and classified by the Commissioners of the Department of Public Parks, in pursuance of the provisions of chapter 604 of the Laws of 1874, and 436 of the Laws of 1876, and signed "Julius Munckwitz, Superintending Architect, Dept. of Pub. Parks," and "E. B. Van Winkle, Topographical Engineer, Dept. of Pub. Parks," dated "New York, August 1, 1879," be and the same are hereby approved and ordered filed, and that James F. Wenman, the President, and one of the Board of Commissioners of the Department of Public Parks, be and he is hereby designated and directed to certify and file said maps as provided by law.

Resolved, That the map or plan for the sewerage and drainage district in the Twenty-third Ward, lying west of Mott and Railroad avenues, south of the Spuyten Duyvil & Port Morris Railroad, and east of River avenue, entitled "Proposed Plan of drainage for Sewerage District No. 31 B," dated "New York, 19th August, 1879," and signed "Julius Munckwitz, Superintending Architect, D. P. P.," and "E. B. Van Winkle, Topographical Engineer, D. P. P.," be and hereby is approved; and that the President of the Department cause to be prepared and submitted to this Board five similar copies for filing.

Resolved, That a cement pavement, laid in blocks, similar to that on Chambers street, be selected as the pavement to be laid on the walks in the City Hall Park.

Resolved, That the proposal of Jacob Asiel for laying the walks in the City Hall Park with cement pavement, laid in blocks, be accepted, he being the lowest bidder for that class of pavement, and that said proposal be transmitted to the Comptroller for an approval of sureties, and that, when so approved, the President be authorized to enter into a contract for the same on behalf of this Department.

Resolved, That a Neufchatel pavement be selected as the pavement to be laid on the walks of the City Hall Park subject to wheel wear.

Resolved, That the proposal of Edward H. Wootton for laying the walks in the City Hall Park subject to wheel wear with Neufchatel pavement be accepted, he being the lowest bidder for that class of pavement, and that said proposal be transmitted to the Comptroller for an approval of sureties, and that when so approved, the President be authorized to enter into a contract for the same on behalf of this Department.

Resolved, That the Secretary be and he is hereby directed to prepare and publish the necessary advertisements for proposals for paving the walks in Washington Square with Neufchatel, cement, or other pavements, after having submitted them, together with the form of specification and contract, to the Counsel to the Corporation, and received his approval of the same.

Resolved, That the Superintendent of Parks be directed to proceed at once with the work of necessary repairs to the Battery walks and sea wall.

Resolved, That the action of the President in authorizing the laying of pavements around the Park at Thirty-second and Thirty-third streets, and around the Arsenal in Central Park be and the same is hereby approved.

Resolved, That the penalties for the non-completion of the work of constructing Riverside avenue by the 31st of October, 1877, the time stipulated in the contract, be remitted up to date.

Resolved, That acting Captain, Thomas Beatty, be and he hereby is appointed Captain of the Police force, and that his pay be fixed at \$1,600 per annum.

Resolved, That Christopher McLennan be and he is hereby appointed an assistant engineer to aid in the preparation of tax maps of the Twenty-third and Twenty-fourth Wards.

Resolved, That it be referred to Mr. Eugene E. McLean, Engineer of Construction, and Mr. Edgar B. Van Winkle, Topographical Engineer, to examine and report upon the work of the Brook avenue sewer.

Resolved, That the action of the Board, at a meeting held July 30, appointing Commissioner Lane Inspector of Licenses, be and the same is hereby resinded, and that the President be authorized to appoint an Inspector until otherwise ordered by the Board.

Bills amounting to \$53,953.87 were audited and sent to the Finance Department for payment.
E. P. BARKER, Secretary.

HEALTH DEPARTMENT.

HEALTH DEPARTMENT OF THE CITY OF NEW YORK,
NEW YORK, August 19, 1879.

The Board of Health met this day.

Reports Received.

From the Sanitary Superintendent: On the operations of the Sanitary Bureau; on contagious diseases; on slaughter-houses; on application for permits; weekly report from Riverside Hospital; on operations of the Disinfecting Corps; weekly report of Sanitary Company of police; on work performed by Vaccinating Corps; on street pavements.

From the Attorney and Counsel: Weekly report, and opinion in reference to letter of Executive Committee of National Board of Health, suggesting inspection of vessels in port.

From the Register of Records: Weekly mortuary statement; weekly letter on mortality; weekly abstract of marriages, births, and still-births; weekly report of deaths from contagious diseases; on attendance of clerks; on violations of Sanitary Code.

Hearing.

Mr. Langbein and David Frank, in respect to driving cattle through streets to slaughter-house at the foot of One Hundred and Sixth street, East river, and after a hearing the subject was referred to the President and Chairman of the Sanitary Committee.

Reports Referred to other Departments.

To the Department of Public Works: On street pavement in West Ninety-fourth street, corner Ninth avenue; in front of No. 47 Canal street, and on westerly side of West street, between Vesey and Barclay streets; on street crossing at north side of One Hundred and Twenty-ninth street and Lexington avenue.

To the Police Department: On nuisance at No. 2 State street.

Bills Audited.

Clark & Wilkins..... \$162 00
Pay-roll of laborers for two weeks ending August 16..... 614 33

Permits Granted.

To drive two cows from the southwest corner of One Hundred and Forty-second street and Broadway to One Hundred and Fortieth street and Broadway.

To drive four cows from High Bridge street, near Anderson avenue, to three hundred feet south.

To drive four cows from Lind avenue, near Devoe street, to Sedgwick avenue, near Devoe street.

To drive four cows from Fourth avenue, near Bremer avenue, to lot opposite stable.

Permits Denied.

To keep chickens at 185 Rivington street.

To keep 25 chickens at 158 Thompson street.

To keep 10 chickens at 537 Second avenue.

Communications from other Departments.

From Finance Department: Weekly Statement of Comptroller; notification in respect to the Departmental Estimate for 1880.

From Department of Public Works: In respect to the construction of a sewer in Eleventh avenue, between Fifty-ninth and Sixtieth streets.

The report of Sanitary Inspector Viele, upon the sunken lots at One Hundred and Seventh and One Hundred and Eighth streets, Second and Third avenues, was taken from the table and referred to the Attorney and Counsel.

METEOROLOGICAL OBSERVATORY

OF THE

DEPARTMENT OF PUBLIC PARKS.

CENTRAL PARK, NEW YORK.

Latitude 40° 45' 58" N. Longitude 73° 57' 58" W. Height of Instruments above the Ground, 53 feet; above the Sea, 97 feet.

ABSTRACT OF REGISTERS FROM SELF-RECORDING INSTRUMENTS

For the Week Ending August 23, 1879.

Barometer.

DATE. AUGUST.	7 A. M.		2 P. M.		9 P. M.		Mean for the Day.	MAXIMUM.		MINIMUM.	
	Observed Height.	Reduced to Freezing.	Observed Height.	Reduced to Freezing.	Observed Height.	Reduced to Freezing.		Observed Height.	Reduced to Freezing.	Observed Height.	Reduced to Freezing.
Sunday, 17	29.846	29.748	29.898	29.787	29.922	29.811	29.782	29.933	29.822	12 P. M.	29.800
Monday, 18	29.948	29.837	29.858	29.757	29.588	29.500	29.698	29.958	29.849	9 A. M.	29.588
Tuesday, 19	29.880	29.787	29.976	29.851	30.048	29.937	29.858	30.084	29.983	12 P. M.	29.688
Wednesday, 20	30.146	30.048	30.152	30.027	30.112	29.001	29.692	30.170	30.067	9 A. M.	30.084
Thursday, 21	30.102	30.004	30.112	29.982	30.020	29.898	29.961	30.132	30.031	0 A. M.	30.012
Friday, 22	29.928	29.817	29.886	29.745	29.822	29.684	29.749	30.012	29.898	0 A. M.	29.780
Saturday, 23	29.724	29.605	29.748	29.602	29.770	29.645	29.617	29.780	29.650	0 A. M.	29.718

Mean for the week..... 29.765 inches.

Maximum " at 9 A. M., August 20..... 30.067 "

Minimum " at 9 P. M., August 18..... 29.500 "

Range "567 "

Thermometers.

DATE. AUGUST.	7 A. M.		2 P. M.		9 P. M.		MEAN.	MAXIMUM.		MINIMUM.		MAX- IMUM.
	Dry Bulb.	Wet Bulb.	Dry Bulb.	Wet Bulb.	Dry Bulb.	Wet Bulb.		Dry Bulb.	Wet Bulb.	Dry Bulb.	Wet Bulb.	
Sunday, 17	65	64	70	66	70	66	68.3	71	67	64	60	118
Monday, 18	70	66	66	65	62	62	66.0	70	66	61	58	78
Tuesday, 19	63	61	75	64	70	65	69.3	78	66	61	58	136
Wednesday, 20	65	61	75	65	70	64	70.0	78	66	62	58	137
Thursday, 21	65	64	77	67	74	66	72.0	81	69	64	58	132
Friday, 22	70	65	81	71	80	77	77.0	85	71	69	64	137
Saturday, 23	73	68	84	70	75	68	77.3	85	70	72	68	139

Mean for the week..... 71.2 degrees.

Maximum for the week, at 4 P. M., 22d..... 85. " at 5 P. M., 22d..... 71. "

Minimum " at 6 A. M., 19th..... 61. " at 6 A. M., 19th..... 61. "

Range " 24. " 10. "

Wind.

DATE. AUGUST.	DIRECTION.			VELOCITY IN MILES.				FORCE IN POUNDS PER SQUARE FOOT.				
	7 A. M.	2 P. M.	9 P. M.	7 A. M.	2 P. M.	9 P. M.	Distance for the Day.	7 A. M.	2 P. M.	9 P. M.	Max.	Time.
Sunday, 17	ENE	E	ESE	15	19	26	60	0	1/4	0	1 1/4	0 A. M.
Monday, 18	SSE	E	NNW	22	40	100	162	0	1/2	5/8	6 1/4	8.10 P. M.
Tuesday, 19	WNW	NNW	NNW	82	72	22	176	1/2	1 1/2	0	3 1/4	9 A. M.
Wednesday, 20	E	SSE	S	17	24	33	74	1/2	1/4	0	1/2	7 A. M.
Thursday, 21	WSW	SE	SSW	39	25	40	104	0	1/2	1/2	1 1/2	8.10 P. M.
Friday, 22	WSW	SW	SSW	81	76	61	218	1/2	3/4	1/2	1 1/2	11.00 P. M.
Saturday, 23	WSW	W	W	100	72	59	231	1 1/4	1 1/4	1/4	3 1/4	7.50 P. M.

Distance traveled during the week..... 1025 miles.

Maximum force " 6 1/4 pounds.

DATE. AUGUST.	Hygrometer.						Clouds.			Rain and Snow.				
	FORCE OF VAPOR.			RELATIVE HUMIDITY.			CLEAR, o. OVERCAST, 10.			DEPTH OF RAIN AND SNOW IN INCHES.				
	7 A. M.	2 P. M.	9 P. M.	7 A. M.	2 P. M.	9 P. M.	7 A. M.	2 P. M.	9 P. M.	Time of Beginning.	Time of Ending.	Duration. H. M.	Amount of Water.	Depth of Snow.
Sunday, 17	.583	.586	.586	94	80	80	10	5 Cu.	10	0 A.M.	12 P. M.	24 00	.64	..
Monday, 18	.586	.604	.556	80	95	100	10	10	10	0 A.M.	10.30 P.M.	22 30	3.95	..
Tuesday, 19	.510	.449	.550	87	52	75	0	1 Cu.	0	.....	.....	.....	..	..
Wednesday, 20	.483	.483	.516	78	56	70	0	0	0	.....	.....	.....	..	..
Thursday, 21	.583	.527	.532	94	57	63	Hazy. 0	8 Cu.	0	.....	.....	.....	..	..
Friday, 22	.550	.624	.598	75	59	58	Hazy. 10	2 Cu.	0	.....	.....	.....	..	..
Saturday, 23	.618	.545	.591	76	47	68	2 Cu.	7 Cir. Cu.	7 Cu.	.....	.....	.....	..	..

Total amount of water for the week..... 4.59 inches.

DANIEL DRAPER, Director.

OFFICIAL DIRECTORY.

STATEMENT OF THE HOURS DURING WHICH
all the Public Offices in the City are open for business, and at which each Court regularly opens and adjourns, as well as of the places where such offices are kept and such Courts are held; together with the heads of Departments and Courts.

EXECUTIVE DEPARTMENT.

Mayor's Office.

No. 6 City Hall, 10 A. M. to 3 P. M.
EDWARD COOPER, Mayor; JOHN TRACY, Chief Clerk.

Mayor's Marshal's Office.

No. 7 City Hall, 10 A. M. to 3 P. M.
JOHN TYLER KELLY, First Marshal.

Permit and License Bureau Office.

No. 1 City Hall, 10 A. M. to 3 P. M.
DANIEL S. HART, Registrar.

LEGISLATIVE DEPARTMENT.

Office of Clerk of Common Council.

No. 8 City Hall, 10 A. M. to 4 P. M.
JORDAN L. MOTT, President Board of Aldermen.
JACOB M. PATTERSON, Jr., Clerk Common Council.

DEPARTMENT OF PUBLIC WORKS.

Commissioner's Office.

No. 19 City Hall, 9 A. M. to 4 P. M.
ALLAN CAMPBELL, Commissioner; FREDERICK H. HAMLIN, Deputy Commissioner.

Bureau of Sewers.

No. 21 City Hall, 9 A. M. to 4 P. M.
STEVENSON TOWLE, Engineer-in-Charge.

Bureau of Chief Engineer.

No. 11½ City Hall, 9 A. M. to 4 P. M.

Bureau of Street Improvements.

No. 11 City Hall, 9 A. M. to 4 P. M.
GEORGE A. JEREMIAH, Superintendent.

Bureau of Repairs and Supplies.

No. 18 City Hall, 9 A. M. to 4 P. M.
THOMAS KEECH, Superintendent.

Bureau of Water Purveyor.

No. 4 City Hall, 9 A. M. to 4 P. M.
DANIEL O'REILLY, Water Purveyor.

Keeper of Buildings in City Hall Park.

JOHN F. SLOPER, City Hall.

FINANCE DEPARTMENT.

Comptroller's Office.

Nos. 19 and 20 New County Court-house, 9 A. M. to 4 P. M.
JOHN KELLY, Comptroller; RICHARD A. STORRS, Deputy Comptroller.

Auditing Bureau.

No. 19 New County Court-house, 9 A. M. to 4 P. M.
DANIEL JACKSON, Auditor of Accounts.

Bureau of Arrears.

No. 5 New County Court-house, 9 A. M. to 4 P. M.
ARTEMAS CADY, Clerk of Arrears.

Bureau for the Collection of Assessments.

No. 16 New County Court-house, 9 A. M. to 4 P. M.
EDWARD GILON, Collector.

Bureau of City Revenue.

No. 6 New County Court-house, 9 A. M. to 4 P. M.
EDWARD F. FITZPATRICK, Collector of City Revenue.

Bureau of Markets.

No. 6 New County Court-house, 9 A. M. to 4 P. M.
JOSHUA M. VARIAN, Superintendent of Markets.

Bureau for the Collection of Taxes.

First floor, Brown-stone Building, City Hall Park.
MARTIN T. MCMAHON, Receiver of Taxes; ALFRED VREDENBURG, Deputy Receiver of Taxes.

Bureau of the City Chamberlain.

No. 18 New County Court-house, 9 A. M. to 4 P. M.
J. NELSON TAPPAN, City Chamberlain.

LAW DEPARTMENT.

Office of the Counsel to the Corporation.

Staats Zeitung Building, third floor, 9 A. M. to 4 P. M.
WILLIAM C. WHITNEY, Counsel to the Corporation;
ANDREW T. CAMPBELL, Chief Clerk.

Office of the Public Administrator.

No. 49 Beekman street, 9 A. M. to 4 P. M.
ALGERNON S. SULLIVAN, Public Administrator.

Office of the Corporation Attorney.

No. 49 Beekman street, 9 A. M. to 4 P. M.
WILLIAM A. BOYD, Corporation Attorney.

Attorney to Department of Buildings' Office.

Corner Cortland and Church streets.
JOHN A. FOLEY, Attorney.

POLICE DEPARTMENT.

Central Office.

No. 300 Mulberry street, 9 A. M. to 4 P. M.
President: SETH C. HAWLEY, Chief Clerk.

DEPARTMENT OF CHARITIES AND CORRECTION.

Central Office.

Third avenue, corner Eleventh street, 9 A. M. to 4 P. M.
TOWNSEND COX, President; JOSHUA PHILLIPS, Secretary.

FIRE DEPARTMENT.

Headquarters.

Nos. 153, 155, and 157 Mercer street, 9 A. M. to 4 P. M.
VINCENT C. KING, President; CARL JUSSEN, Secretary.

HEALTH DEPARTMENT.

No. 301 Mott street, 9 A. M. to 4 P. M.
CHARLES F. CHANDLER, President; EMMONS CLARK, Secretary.

DEPARTMENT OF PUBLIC PARKS.

No. 36 Union square, 9 A. M. to 4 P. M.
JAMES F. WENMAN, President; EDWARD P. BARKER, Secretary.

Civil and Topographical Office.

Arsenal, 64th street a d 5th avenue, 9 A. M. to 5 P. M.

Office of Superintendent of 23d and 24th Wards.

Fordham, 9 A. M. to 5 P. M.

DEPARTMENT OF DOCKS.

Nos. 117 and 119 Duane street, 9 A. M. to 4 P. M.
EUGENE T. LYNCH, Secretary.

DEPARTMENT OF TAXES AND ASSESSMENTS.

Brown-stone Building, City Hall Park, 9 A. M. to 4 P. M.
JOHN WHEELER, President; ALBERT STORER, Secretary.

BOARD OF ASSESSORS.

Office, No. 114 White street, 9 A. M. to 4 P. M.
THOMAS B. ASTEN, President; WM. H. JASPER, Secretary.

DEPARTMENT OF BUILDINGS.

No. 2 Fourth avenue, 8:30 A. M. to 4 P. M.
HENRY J. DUDLEY, Superintendent.

BOARD OF EXCISE.

Corner Mulberry and Houston streets, 9 A. M. to 4 P. M.
RICHARD J. MORRISON, President; J. B. ADAMSON, Chief Clerk.

SEALERS OF WEIGHTS AND MEASURES.

No. 236 West Forty-third street.
ELIJAH W. ROE.

SHERIFF'S OFFICE.

Nos. 3 and 4 New County Court-house, 9 A. M. to 4 P. M.
BERNARD REILLY, Sheriff; JOHN T. CUMMING, Under Sheriff.

COMMISSION FOR THE COMPLETION OF THE NEW COUNTY COURT-HOUSE.

No. 28 New County Court-house, 9 A. M. to 5 P. M.
WYLLIS BLACKSTONE, President; ISAAC EVANS, Secretary.

REGISTER'S OFFICE.

East side City Hall Park, 9 A. M. to 4 P. M.
FREDERICK W. LOEW, Register; AUGUSTUS T. DOCHARTY, Deputy Register.

COMMISSIONERS OF ACCOUNTS.

No. 27 Chambers street, 9 A. M. to 4 P. M.
WM. PITT SHEARMAN, ROBERT F. HATFIELD.

COMMISSIONER OF JURORS.

No. 17 New County Court-house, 9 A. M. to 4 P. M.
THOMAS DUNLAP, Commissioner; ALFRED J. KEEGAN, Deputy Commissioner.

COUNTY CLERK'S OFFICE.

Nos. 7 and 8 New County Court-house, 9 A. M. to 4 P. M.
HUBERT O. THOMPSON, County Clerk; J. HENRY FORD, Deputy County Clerk.

DISTRICT ATTORNEY'S OFFICE.

Second floor, Brown-stone Building, City Hall Park, 9 A. M. to 4 P. M.
BENJAMIN K. PHELPS, District Attorney; MOSES P. CLARK, Chief Clerk.

THE CITY RECORD OFFICE.

And Bureau of Printing, Stationery, and Blank Books.
No. 2 City Hall, 8 A. M. to 6 P. M.; Saturdays, 8 A. M. to 5 P. M.
THOMAS COSTIGAN, Supervisor; R. P. H. ABELL, Book-keeper.

CORONERS' OFFICE.

No. 40 East Houston street.
HENRY WOLTMAN, MORITZ ELLINGER, RICHARD CROKER, and RICHARD FLANAGAN, Coroners.

RAPID TRANSIT COMMISSIONERS.

HENRY F. SPAULDING, 15 Nassau street.
BENJAMIN G. ARNOLD, 125 Front street.
HENRY G. STEBBINS, 48 Exchange place.
LEWIS G. MORRIS, 25 Pine street.
SAMUEL R. FILLEY, Prospect avenue and 165th street.

THE CITY RECORD.

COPIES OF THE CITY RECORD CAN BE obtained at No. 2 City Hall (northwest corner basement). Price three cents each.

POLICE DEPARTMENT.

CENTRAL DEPARTMENT OF THE MUNICIPAL POLICE, PROPERTY CLERK'S OFFICE,
No. 300 MULBERRY STREET, Room 39,
NEW YORK, August 6, 1879.

OWNERS WANTED BY THE PROPERTY
Clerk of the Police Department, City of New York, 300 Mulberry street, Room 39, for the following property now in his custody without claimants: Boats, revolvers, male and female clothing, coffee, tea, gold and silver watches, harness, saws, billiard balls, leaf tobacco, bags and contents, also small amount of money found and taken from prisoners.

C. A. ST. JOHN,
Property Clerk.

CORPORATION NOTICE.

PUBLIC NOTICE IS HEREBY GIVEN TO THE
owner or owners, occupant or occupants of all houses and lots, improved or unimproved lands affected thereby, that the following assessments have been completed and are lodged in the office of the Board of Assessors for examination by all persons interested, viz:

No. 1. Regulating, grading, curb, gutter, and flagging in Ninety-ninth (99th) street, between Eighth and Eleventh avenues.

No. 2. Regulating and grading in One Hundred and Ninth street, from Third (3d) to Fifth (5th) avenue.

No. 3. Paving Eighty-first street, between Fourth and Fifth avenues, with Belgian pavement.

No. 4. Fencing vacant lots on block bounded by Sixty-ninth and Seventieth streets and Lexington and Fourth avenues.

No. 5. Flagging full width west side of First avenue, between Fifty-ninth and Sixtieth streets.

No. 6. Flagging full width east side of Madison avenue, between Eightieth and Eighty-first streets.

No. 7. Flagging full width on north side of Fifty-first street, between Broadway and Eighth avenue.

No. 8. Fencing vacant lots on east side of Madison avenue, between Eightieth and Eighty-first streets, and in Eightieth street, between Madison and Fourth avenues.

No. 9. Fencing vacant lots on east side of Sixth avenue, between One Hundred and Twenty-fourth and One Hundred and Twenty-fifth streets.

No. 10. Fencing vacant lots on southwest corner of Seventy-fourth street and Fourth avenue.

No. 11. Fencing vacant lots in Forty-fourth street, between the Tenth and Eleventh avenues.

No. 12. Flagging full width in Sixtieth street, between Ninth avenue and the Boulevard.

No. 13. Flagging full width in Seventy-second street, from Lexington to Third avenue.

No. 14. Flagging full width on south side of Eighty-fifth street, 100 feet west of Lexington avenue.

No. 15. Sewer in One Hundred and Fifteenth street, between the Fourth and Madison avenues.

The limits embraced by such assessment include all the several houses and lots of ground, vacant lots, pieces and parcels of land situated on—

No. 1. Both sides of Ninety-ninth street, from the Eighth to Eleventh avenue, and to the extent of half the block at the intersection of Tenth avenue.

No. 2. Both sides of One Hundred and Ninth street, from Third to Fifth avenue.

No. 3. Both sides of Eighty-first street, from Fourth to

Fifth avenue, and to the extent of half the block at the intersecting avenues.

No. 4. North side of Sixty-ninth street, south side of Seventieth street, and on the east side of Fourth avenue, from Sixty-ninth to Seventieth street.

No. 5. West side of First avenue, between Fifty-ninth and Sixtieth streets.

No. 6. East side of Madison avenue, between Eightieth and Eighty-first streets.

No. 7. North side of Fifty-first street, between Broadway and Eighth avenue.

No. 8. East side of Madison avenue, between Eightieth and Eighty-first streets, and north side of Eightieth street, from Fourth to Madison avenue.

No. 9. East side of Sixth avenue, between One Hundred and Twenty-fourth and One Hundred and Twenty-fifth streets.

No. 10. Southwest corner of Seventy-fourth street and Fourth avenue.

No. 11. North side of Forty-fourth street, between the Tenth and Eleventh avenues.

No. 12. Both sides of Sixtieth street, between Ninth avenue and the Boulevard.

No. 13. North side of Seventy-second street, between Third and Lexington avenues.

No. 14. South side of Eighty-fifth street, between Fourth and Lexington avenues.

No. 15. Both sides of One Hundred and Fifteenth street, between Fourth and Madison avenues.

All persons whose interests are affected by the above-named assessments, and who are opposed to the same, or either of them, are requested to present their objections in writing to the Board of Assessors, at their office, No. 114 White street, within thirty days from the date of this notice.

The above described lists will be transmitted as provided by law to the Board of Revision and Correction of Assessments for confirmation, on the 29th day of August ensuing.

THOMAS B. ASTEN,
JOHN MULLALLY,
EDWARD NORTH,
DANIEL STANBURY,
Board of Assessors.

OFFICE BOARD OF ASSESSORS,
No. 114 WHITE STREET (CORNER CENTRE),
NEW YORK, July 28, 1879.

SUPREME COURT.

In the matter of the application of the Department of Public Works, for and in behalf of the Mayor, Aldermen, and Commonalty of the City of New York, relative to the opening of Eighty-first street, from the Boulevard to the new avenue, and from Twelfth avenue to the Hudson river, in the City of New York.

WE, THE UNDERSIGNED, COMMISSIONERS
of Estimate and Assessment in the above-entitled matter, hereby give notice to the owner or owners, occupant or occupants, of all houses and lands, and improved and unimproved lands affected thereby, and to all others whom it may concern, to wit:

That we have completed our estimate and assessment, and that all persons interested in these proceedings, or in any of the lands affected thereby, and who may be opposed to the same, to present their objections, in writing, duly verified, to Charles Price, Esq., our Chairman, at the office of the Commissioners, No. 82 Nassau street, Room No. 24, in the said city, on or before the 16th day of September, 1879, and that we, the said Commissioners, will hear parties so objecting within the ten week days next after said 16th day of September; and, for that purpose, will be in attendance at our said office on each of said ten days, at one o'clock P. M. That the abstract of the said estimate and assessment, together with our maps, and also all the affidavits, estimates, and other documents which were used by us in making our report, have been deposited in the office of the Department of Public Works, in the City of New York, there to remain until the 27th day of September, 1879.

That the limits embraced by the assessment aforesaid are as follows: All those lots, pieces, or parcels of land lying and being on Eighty-first street, between the Boulevard and the new avenue, and between the Twelfth avenue and the Hudson river, and extending on either side of Eighty-first street, as aforesaid, one-half the distance to the next street thereto, in the City of New York.

That our report herein will be presented to the Supreme Court of the State of New York, at a Special Term thereof, to be held in the Court-house, in the City of New York, on the 13th day of October, 1879, at ten o'clock A. M., on that day, and that then and there, or as soon thereafter as counsel can be heard, a motion will be made that the said report be confirmed.

Dated New York, August 15, 1879.
CHARLES PRICE,
JOSEPH MEEKS,
LOUIS MESIER,
Commissioners.

In the matter of the application of the Mayor, Aldermen and Commonalty of the City of New York, relative to the opening of One Hundred and Forty-fourth street, from Eighth avenue to the Harlem river, in the City of New York.

WE, THE UNDERSIGNED COMMISSIONERS
of Estimate and Assessment in the above-entitled matter, hereby give notice to the owner or owners, occupant or occupants, of all houses and lots and improved or unimproved lands affected thereby, and to all others whom it may concern, to wit:

First—That we have completed our estimate and assessment, and that all persons interested in these proceedings, or in any of the lands affected thereby, and who may be opposed to the same, do present their objections in writing, duly verified, to John Breslin, our Chairman, at the office of the Commissioners, No. 82 Nassau street (Room No. 22), in the said city, on or before the 2d day of September, 1879, and that we, the said Commissioners, will hear parties so objecting within the ten week-days next after the said 2d day of September, and for that purpose will be in attendance at our said office on each of said ten days, at 2 o'clock, P. M.

Second—That the abstract of the said estimate, together with our maps, and also all the affidavits, estimates, and other documents which were used by us in making our report, have been deposited in the office of the Department of Public Works, in the City of New York, there to remain until the 15th day of September, 1879.

Third—That the limits embraced by the assessment are as follows, to wit: All those lots, pieces, or parcels of land situate, lying, and being in the City of New York, contained within the following mentioned lines, that is to say: Beginning at a point on the easterly line or side of Avenue St. Nicholas, distant one hundred and one feet and three and three-eighths inches northerly from the northerly line of One Hundred and Forty-fourth street, as formerly laid out, and running thence easterly and parallel with said One Hundred and Forty-fourth street to the established bulkhead line on the Harlem river; thence southerly along said bulkhead line to a point where the centre line of the block between One Hundred and Forty-third and One Hundred and Forty-fourth streets, if projected easterly, would intersect said bulkhead line; thence westerly and parallel with said One Hundred and Forty-fourth street to the easterly line of said Avenue St. Nicholas, and thence northerly along said easterly line of Avenue St. Nicholas to the point or place of beginning.

Fourth—That our report herein will be presented to the Supreme Court of the State of New York, at a Special Term thereof, to be held in the County Court-house in the City of New York, on the 30th day of September, 1879, at 10 o'clock A. M., on that day, and that then and there, or as soon thereafter as counsel can be heard thereon, a motion will be made that the said report be confirmed.

Dated New York, August 2, 1879.
JOHN BRESLIN,
FRANCIS MCCABE,
HENDERSON MOORE,
Commissioners.

JURORS.

NOTICE

IN RELATION TO JURORS FOR STATE COURTS

OFFICE OF THE COMMISSIONER OF JURORS,
NEW COUNTY COURT-HOUSE,
NEW YORK, June 1, 1879.

APPLICATIONS FOR EXEMPTIONS WILL BE
heard here, from 9 to 4 daily, from all persons hitherto liable or recently serving who have become exempt, and all needed information will be given.

Those who have not answered as to their liability, or proved permanent exemption, will receive a "jury enrollment notice," requiring them to appear before me this year. Whether liable or not, such notices must be answered (in person, if possible, and at this office only) under severe penalties. If exempt, the party must bring proof of exemption; if liable, he must also answer in person, giving full and correct name, residence, etc., etc. No attention paid to letters.

Persons "enrolled" as liable must serve when called or pay their fines. No mere excuse will be allowed or interference permitted. The fines, received from those who, for business or other reasons, are unable to serve at the time selected, pay the expenses of this office, and if unpaid will be entered as judgments upon the property of the delinquents.

All good citizens will aid the course of justice, and secure reliable and respectable jurors, and equalize their duty by serving promptly when summoned, allowing their clerks or subordinates to serve, reporting to me any attempt at bribery or evasion, and suggesting names for enrollment. Persons between sixty and seventy years of age, summer absentees, persons temporarily ill, and United States and District Court jurors are not exempt.

Every man must attend to his own notice. It is a misdemeanor to give any jury paper to another to answer. It is also punishable by fine or imprisonment to give or receive any present or bribe, directly or indirectly, in relation to a jury service, or to withhold any paper or make any false statement, and every case will be fully prosecuted.

THOMAS DUNLAP, Commissioner,
County Court-house (Chambers street entrance).

DEPARTMENT OF PUBLIC CHARITIES AND CORRECTION.

DEPARTMENT OF PUBLIC CHARITIES AND CORRECTION,
No. 66 THIRD AVENUE,
NEW YORK, August 23, 1879.

IN ACCORDANCE WITH AN ORDINANCE OF
the Common Council, "In relation to the burial of strangers or unknown persons who may die in any of the public institutions of the City of New York," the Commissioners of Public Charities and Correction report as follows:

At Hart's Island Hospital—Mary Graham; aged 40 years; 5 feet 4 inches high; brown hair; blue eyes. Had on when admitted, brown skirt, black sack, black striped shawl, shoes and stockings. Nothing is known of her friends or relatives.

By Order,
JOSHUA PHILLIPS,
Secretary.

DEPARTMENT OF PUBLIC CHARITIES AND CORRECTION,
No. 66 THIRD AVENUE.

PROPOSALS FOR GROCERIES, LEATHER, PAINTS AND LUMBER.

TO CONTRACTORS.

SEALED BIDS OR ESTIMATES FOR FURNISHING

GROCERIES.

25,000 pounds Hard Soap.
10,000 " good sweet Dairy Butter.
500 " best quality State Creamery Butter.
5,000 " Dried Apples.
5,000 " Pearl Barley.
5,000 " Coffee Sugar.
1,000 " Prime Kettle Rendered Lard.
500 bushels Beans.
200 quintals best quality Grand Bank Codfish.
25 barrels New Family Mess Pork.
25 barrels Syrup.
20,000 Fresh Eggs (all to be candled).

LEATHER.

10,000 feet Waxed Upper Leather.

PAINTS.

6,000 pounds Pure White Lead equal to "Atlantic" in packages of 25 to 100 pounds each, as may be required.
5 barrels Metallic Roof Paint.
250 pounds Chrome Green in oil, in cans, 20 at 1, 10 at 3, 20 at 5, and 10 at 10 pounds.

LUMBER.

500 feet best quality 2 inch. White Oak.
500 feet best quality 1½ inch. White Oak.
20 pieces 3 x 10 x 13 feet Spruce.

—or any part thereof, will be received at the office of the Department of Public Charities and Correction, in the City of New York, until 9 o'clock A. M., of Thursday, the 4th day of September, 1879. The person or persons making any bid or estimate shall furnish the same in a sealed envelope, indorsed "Bid or Estimate"

Corporation, is directly or indirectly interested therein, or in the supplies or work to which it relates, or in any portion of the profits thereof. The bid or estimate must be verified by the oath in writing, of the party or parties making the estimate, that the several matters stated therein are in all respects true. Where more than one person is interested, it is requisite that the verification be made and subscribed by all the parties interested.

Each bid or estimate shall be accompanied by the consent, in writing, of two householders or freeholders in the City of New York, with their respective places of business or residence, to the effect, that if the contract be awarded to the person making the estimate, they will, on its being so awarded, become bound as his sureties for its faithful performance; and that if he shall omit or refuse to execute the same, they shall pay to the Corporation any difference between the sum to which he would be entitled on its completion, and that which the Corporation may be obliged to pay to the person or persons to whom the contract may be awarded at any subsequent letting; the amount in each case to be calculated upon the estimated amount of the work by which the bids are tested. The consent above mentioned shall be accompanied by the oath or affirmation, in writing, of each of the persons signing the same that he is a householder or freeholder in the City of New York, and is worth the amount of the security required for the completion of this contract, over and above all his debts of every nature, and over and above his liabilities, as bail, surety, and otherwise; and that he has offered himself as a surety in good faith and with the intention to execute the bond required by section 27 of chapter 8 of the Revised Ordinances of the City of New York, if the contract shall be awarded to the person or persons for whom he consents to become surety. The adequacy and sufficiency of the security offered to be approved by the Comptroller of the City of New York.

Should the person or persons to whom the contract may be awarded neglect or refuse to accept to contract within forty-eight (48) hours after written notice that the same has been awarded to his or their bid or proposal, or if he or they accept but do not execute the contract and give the proper security, he or they shall be considered as having abandoned it and as in default to the Corporation, and the contract will be re-advertised and relet as provided by law.

The quality of the articles, supplies, goods, wares, and merchandise must conform in every respect to the samples of the same respectively at the office of the said Department. Bidders are cautioned to examine the specifications for particulars of the articles, etc., required, before making their estimates.

Bidders will state the price for each article, by which the bids will be tested.

Bidders will write out the amount of their estimate in addition to inserting the same in figures.

Payment will be made by a requisition on the Comptroller, issued on the completion of the contract, or from time to time as the Commissioners may determine.

Bidders are informed that no deviation from the specifications will be allowed, unless under the written instruction of the Commissioners of Public Charities and Correction.

The Department of Public Charities and Correction reserves the right to decline any and all bids or estimates it deemed to be for the public interest, and to accept any bid or estimate as a whole, or for any one or more articles included therein. No bid or estimate will be accepted from, or a contract awarded to, any person who is in arrears to the Corporation upon debt or contract, or who is a defaulter, as surety or otherwise, upon any obligation to the Corporation.

The form of the agreement, including specifications, and showing the manner of payment, can be obtained at the office of the Department.

Dated New York, August 21, 1879.

TOWNSEND COX,
THOMAS S. BRENNAN,
JACOB HESS,

Commissioners of the Department of
Public Charities and Correction.

DEPARTMENT OF PUBLIC CHARITIES AND CORRECTION,
No. 66 THIRD AVENUE,
NEW YORK, August 18, 1879.

IN ACCORDANCE WITH AN ORDINANCE OF the Common Council, "In relation to the burial of strangers or unknown persons who may die in any of the public institutions of the City of New York," the Commissioners of Public Charities and Correction report as follows:

At Hart's Island Hospital—Sarah Wilson: aged 36 years; 5 feet 4 inches high; brown hair; blue eyes. Had on when admitted, purple calico dress, gray striped over-skirt, black and gray striped shawl, black straw hat, shoes and stockings. Nothing known of her friends or relatives.

At Hart's Island Hospital—Adolph Vogel: aged 53 years; 5 feet 5 inches high; gray hair; brown eyes. Had on when admitted, brown sack coat, gray pants, white cotton shirt, black felt hat, shoes and stockings. Nothing known of his friends or relatives.

By Order,
JOSHUA PHILLIPS,
Secretary.

DEPARTMENT OF
PUBLIC CHARITIES AND CORRECTION,
No. 66 THIRD AVENUE.

TO CONTRACTORS.

SEALED BIDS OR ESTIMATES FOR REPAIRS to the engine and boiler of the steamboat "Fidelity" will be received at the office of the Department of Public Charities and Correction, in the City of New York, until 9 o'clock A. M., of Thursday, the 4th day of September, 1879. The person or persons making any bid or estimate shall furnish the same in a sealed envelope, indorsed "Bid or Estimate" for repairing the engine and boiler of the steamboat "Fidelity," and with his or their name or names, and the date of presentation, to the head of said Department, at the said office, on or before the day and hour above named, at which time and place the bids or estimates received will be publicly opened by the head of said Department and read.

The Department of Public Charities and Correction reserves the right to decline any and all bids or estimates if deemed to be for the public interest. No bid or estimate will be accepted from, or contract awarded to, any person who is in arrears to the Corporation upon debt or contract, or who is a defaulter, as surety or otherwise, upon any obligation to the Corporation.

The award of the contract will be made as soon as practicable after the opening of the bids.

The entire work will be required to be completed on or before thirty (30) days after the date of the contract.

Any bidder for this contract must be known to be engaged in and well prepared for the business, and must have satisfactory testimonials to that effect; and the person or persons to whom the contract may be awarded will be required to give security for the performance of the contract by his or their bond, with two sufficient sureties, in the penal sum of one thousand dollars.

Each bid or estimate shall contain and state the name and place of residence of each of the persons making the same; the names of all persons interested with him or them therein; and if no other person be so interested, it shall distinctly state that fact; also that it is made without any connection with any other person making an estimate for the same purpose, and is in all respects fair and without collusion or fraud; and that no member of the Common Council, head of a Department, Chief of a Bureau, Deputy thereof or Clerk therein, or other officer of the Corporation, is directly or indirectly interested therein, or in the supplies or work to which it relates, or in any portion of the profits thereof. The bid or estimate must be verified by the oath, in writing, of the party or parties making the estimate, that the several matters stated therein are in all respects true. Where more than one person is interested, it is requisite that the verification be made and subscribed by all the parties interested.

Each bid or estimate shall be accompanied by the consent, in writing, of two householders or freeholders in the City of New York, with their respective places of business or residence, to the effect that if the contract be

awarded to the person making the estimate, they will, on its being so awarded, become bound as his sureties for its faithful performance; and that if he shall omit or refuse to execute the same, they will pay to the Corporation any difference between the sum to which he would be entitled on its completion, and that which the Corporation may be obliged to pay to the person or persons to whom the contract may be awarded at any subsequent letting; the amount in each case to be calculated upon the estimated amount of the work by which the bids are tested. The consent above mentioned shall be accompanied by the oath or affirmation, in writing, of each of the persons signing the same that he is a householder or freeholder in the City of New York, and is worth the amount of the security required for the completion of the contract, over and above all his debts of every nature, and over and above his liabilities, as bail, surety, and otherwise; and that he has offered himself as a surety in good faith and with the intention to execute the bond required by section 27 of chapter 8 of the Revised Ordinances of the City of New York, if the contract shall be awarded to the person or persons for whom he consents to become surety. The adequacy and sufficiency of the security offered to be approved by the Comptroller of the City of New York.

Should the person or persons to whom the contract may be awarded neglect or refuse to accept to contract within forty-eight (48) hours after written notice that the same has been awarded to his or their bid or proposal, or if he or they accept but do not execute the contract and give the proper security, he or they shall be considered as having abandoned it and as in default to the Corporation, and the contract will be re-advertised and relet as provided by law.

Bidders are cautioned to examine the specifications for particulars of the work, etc., required, before making their estimates.

Bidders will state a price for repairs to the engine and boiler, by which the bids will be tested.

Bidders will write out the amount of their estimate, in addition to inserting the same in figures.

Payment will be made by a requisition on the Comptroller, issued on the completion of the contract, or from time to time as the Commissioners may determine.

Bidders are informed that no deviation from the specifications will be allowed, unless under the written instruction of the Commissioners of Public Charities and Correction.

The form of the agreement, including specifications, and showing the manner of payment for the work, will be furnished at the office of the Department.

Dated New York, August 20, 1879.

TOWNSEND COX,
THOMAS S. BRENNAN,
JACOB HESS,
Commissioners of the Department of
Public Charities and Correction.

DEPARTMENT OF PUBLIC CHARITIES AND CORRECTION,
No. 66 THIRD AVENUE,
NEW YORK, August 18, 1879.

IN ACCORDANCE WITH AN ORDINANCE OF the Common Council, "In relation to the burial of strangers or unknown persons who may die in any of the public institutions of the City of New York," the Commissioners of Public Charities and Correction report as follows:

At Charity Hospital, Blackwell's Island—John Brennan: aged 26 years; 5 feet 9 inches high; black hair and eyes. Had on when admitted, black coat and pants, gray vest, colored shirt, black felt hat, gaiters. Nothing known of his friends or relatives.

By Order,
JOSHUA PHILLIPS,
Secretary.

DEPARTMENT OF PUBLIC CHARITIES AND CORRECTION,
No. 66 THIRD AVENUE.

TO CONTRACTORS.

SEALED BIDS OR ESTIMATES FOR EACH OF the following named ten works, viz:

1. The mason work including the blue stone and granite work required in building a west wing to the Insane Asylum on Ward's Island.
2. Furnishing and setting the cut stone for such wing.
3. The carpenter work required in building such wing.
4. The iron work required for such wing.
5. Doing the slating and tinning required for such wing.
6. Building a water closet tower for Bellevue Hospital.
7. Furnishing and putting in the steam heating and ventilating apparatus for such tower.
8. The plumbing and gasfitting for such tower.
9. Building a building for gas works on Blackwell's Island.
10. Building the iron work for such gas works.

will be received at the office of the Department of Public Charities and Correction, in the City of New York, until 9 o'clock A. M. of Thursday, the 4th day of September, 1879, at which place and time the bids or estimates received will be publicly opened by the head of said Department and read, and the awards of the contracts will be made as soon thereafter as practicable.

The person or persons making any estimate shall furnish the same in a sealed envelope, to the head of said Department, on or before the day and hour above named.

The envelope containing the estimate shall be indorsed with the name or names of the person or persons presenting the same, the date of its presentation, and a statement of the work to which it relates.

The Department of Public Charities and Correction reserves the right to decline any and all bids or estimates if deemed to be for the public interest. No bid or estimate will be accepted from, or contract awarded to, any person who is in arrears to the Corporation upon debt or contract, or who is a defaulter, as surety or otherwise, upon any obligation to the Corporation.

The above several works will be required to be completed as follows, viz:

- | |
|--|
| No. 1, in (6) six months after the date of the contract. |
| " 2, " (6) six " " " " " " |
| " 3, " (8) eight " " " " " " |
| " 4, " (10) ten " " " " " " |
| " 5, " (6) six " " " " " " |
| " 6, " (6) six " " " " " " |
| " 7, " (6) six " " " " " " |
| " 8, " (6) six " " " " " " |

No. 9, in (60) sixty working days after the date of the contract.

No. 10, in (100) one hundred working days after the date of the contract.

For the amount of work to be performed in each case reference must be made to the plans and specifications for the same, on file in the office of the Department.

Any bidder for a contract must be known to be engaged in and well prepared for the business, and must have satisfactory testimonials to that effect.

The person or persons to whom the several security for the faithful performance of the several contracts will be required, which security will be by the bond of the person or persons to whom the contract may be awarded, with two sufficient sureties in penal sums, as follows, viz:

- | |
|--|
| For No. 1, in the penal sum of ten thousand dollars. |
| " 2, " " " " " " " " |
| " 3, " " " " " " " " |
| " 4, " " " " " " " " |
| " 5, " " " " " " " " |
| " 6, " " " " " " " " |
| " 7, " " " " " " " " |
| " 8, " " " " " " " " |
| " 9, " " " " " " " " |
| " 10, " " " " " " " " |

Each bid or estimate shall contain and state the name and place of residence of each of the persons making the same; the names of all persons interested with him or them therein; and if no other person be so interested, it shall distinctly state that fact; that it is made without any connection with any other person making an estimate for the same purpose, and is in all respects fair and without collusion or fraud; and that no member of the Common Council, head of a Department, Chief of a Bureau, Deputy thereof or Clerk therein, or other officer of the Corporation, is directly or indirectly interested therein, or in the supplies or work to which it relates, or in any portion of

the profits thereof. The bid or estimate must be verified by the oath, in writing, of the party or parties making the estimate, that the several matters stated therein are in all respects true. Where more than one person is interested, it is requisite that the verification be made and subscribed by all the parties interested.

Each bid or estimate shall be accompanied by the consent, in writing, of two householders or freeholders in the City of New York, with their respective places of business or residence, to the effect that if the contract be awarded to the person making the estimate, they will, on its being so awarded, become bound as his sureties for its faithful performance; and that if he shall omit or refuse to execute the same, they will pay to the Corporation any difference between the sum to which he would be entitled on its completion, and that which the Corporation may be obliged to pay to the person or persons to whom the contract may be awarded at any subsequent letting; the amount in each case to be calculated upon the estimated amount of the work by which the bids are tested. The consent above mentioned shall be accompanied by the oath or affirmation, in writing, of each of the persons signing the same that he is a householder or freeholder in the City of New York, and is worth the amount of the security required for the completion of this contract, over and above all his debts of every nature, and over and above his liabilities, as bail, surety, and otherwise; and that he has offered himself as a surety in good faith and with the intention to execute the bond required by section 27 of chapter 8 of the Revised Ordinances of the City of New York, if the contract shall be awarded to the person or persons for whom he consents to become surety. The adequacy and sufficiency of the security offered to be approved by the Comptroller of the City of New York.

Should the person or persons to whom the contract may be awarded neglect or refuse to accept to contract within forty-eight (48) hours after written notice that the same has been awarded to his or their bid or proposal, or if he or they accept but do not execute the contract and give the proper security, he or they shall be considered as having abandoned it and as in default to the Corporation, and the contract will be re-advertised and relet as provided by law.

Bidders are cautioned to examine the specifications for particulars of the work, etc., required, before making their estimates.

Bidders will state the price for doing the whole work by which the bids will be tested.

Bidders will write out the amount of their estimate in addition to inserting the same in figures.

Payment will be made by requisition on the Comptroller issued as set forth in the respective forms of contract.

Bidders are informed that no deviation from the specifications will be allowed, unless under the written instruction of the Commissioners of Public Charities and Correction.

The form of the agreement, including specifications, and showing the manner of payment for the work, will be furnished at the office of the Department.

Dated New York, August 18, 1879.

TOWNSEND COX,
THOMAS S. BRENNAN,
JACOB HESS,
Commissioners of the Department of
Public Charities and Correction.

PUBLIC POUND.

A DARK ROAN HORSE, TO BE SOLD AT THE Public Pound, Ninety-third street and Second avenue, if not called for by the owner, on Friday, 29th inst., at two o'clock, P. M., for expenses.

D. McMAHON,
Pound Keeper.

LEGISLATIVE DEPARTMENT.

THE COMMITTEE ON LAW DEPARTMENT of the Board of Aldermen will meet every Monday in the City Library, Room No. 12 City Hall, at 1 o'clock P. M.

By Order of the Committee,

I. GRAHAM HYATT,
Chairman.

DEPARTMENT PUBLIC WORKS.

DEPARTMENT OF PUBLIC WORKS,
COMMISSIONER'S OFFICE, ROOM 19, CITY HALL,
NEW YORK, August 22, 1879.

TO CONTRACTORS.

PROPOSALS, INCLOSED IN A SEALED ENVELOPE, which must be indorsed with the name of the bidder, the title and number of the work, as in the advertisement, will be received at this office until Wednesday, September 3, 1879, at 12 o'clock M., at which hour they will be publicly opened by the Head of the Department, and read, for the following works:

- No. 1. REGULATING, grading, setting curb and gutter stones, and flagging sixty-second street, from Tenth to Eleventh avenue.
- No. 2. REGULATING, grading, setting curb and gutter stones, and flagging, in Seventy-first street, between Fifth avenue and the East river.
- No. 3.—REGULATING, grading, and setting curb and gutter stones in Eighty-first street, from the Eighth to the Ninth avenue.
- No. 4.—REGULATING, grading, and resetting curb and gutter stones in One Hundred and Twenty-ninth street, from Seventh to Eighth avenue.

Blank forms of proposals, the specifications and agreement, the proper envelope in which to inclose the bids, and any further information desired, can be obtained on application at Room 17, City Hall.

The Commissioner of Public Works reserves the right to reject any or all proposals, if, in his judgment, the same may be for the best interests of the city.

ALLAN CAMPBELL,
Commissioner of Public Works.

DEPARTMENT OF PUBLIC WORKS,
COMMISSIONER'S OFFICE,
ROOM NO. 19, CITY HALL,
NEW YORK, Aug. 22, 1879.

TO CONTRACTORS.

PROPOSALS, IN ACCORDANCE WITH SECTION 476, Laws of 1875, inclosed in a sealed envelope with the title of the work and the name of the bidder indorsed thereon, will be received at this office until Wednesday, September 3, 1879, at 12 o'clock M., at which hour they will be publicly opened by the head of the Department and read, for the following:

PAVING FIFTH AVENUE, FROM SEVENTY-SECOND TO NINETEETH STREET, WITH MACADAM PAVEMENT.

Blank forms of proposals, the specifications and agreements, the proper envelope in which to inclose the bids, and any further information desired, can be obtained on application at Room 4, City Hall.

The Commissioner of Public Works reserves the right to reject any or all proposals, if in his judgment the same may be for the best interests of the city.

ALLAN CAMPBELL,
Commissioner of Public Works.

FIRE DEPARTMENT.

HEADQUARTERS
FIRE DEPARTMENT, CITY OF NEW YORK,
(155 & 157 MERCER STREET),
NEW YORK, August 21, 1879.

SEALED PROPOSALS FOR DOING THE WORK and furnishing the materials required in the proposed rebuilding and erection of the building No. 437 East Houston street (known as the quarters of Engine Co. No. 11), will be received as above until 9 o'clock A. M., on Wednesday, the 3d proximo, when they will be publicly opened and read.

No proposals will be received or considered after the hour named.

Plans and specifications and the form of contract to be entered into by the successful bidder may be seen, and blank proposals will be furnished on application at these headquarters.

Two responsible sureties will be required with each proposal, who must each justify thereon prior to its presentation in not less than one-half the amount thereof.

Proposals must be addressed on the envelope "To the Board of Commissioners," with the indorsement, "Proposal for alterations and repairs, No. 437 East Houston street," and the name of the bidder.

The Commissioners reserve the right to reject any or all of the proposals submitted, if deemed to be for the interests of the city.

VINCENT C. KING,
JOHN J. GORMAN,
CORNELIUS VAN COTT,
Commissioners.

HEADQUARTERS
FIRE DEPARTMENT, CITY OF NEW YORK,
155 and 157 MERCER STREET,
NEW YORK, November 7, 1878.

NOTICE IS HEREBY GIVEN THAT THE Board of Commissioners of this Department will meet daily at 10 o'clock A. M., for the transaction of business.

By order of the Board,
VINCENT C. KING, President,
JOHN J. GORMAN, Treasurer,
CORNELIUS VAN COTT, Commissioners.

CARL JUSSSEN,
Secretary.

FINANCE DEPARTMENT.

DEPARTMENT OF FINANCE,
BUREAU FOR COLLECTION OF ASSESSMENTS,
FIRST FLOOR (NEW WING), NEW COURT-HOUSE,
CITY HALL PARK,
NEW YORK, July 23, 1879.

NOTICE TO PROPERTY-HOLDERS.

PROPERTY-HOLDERS ARE HEREBY NOTIFIED that the following assessment lists was received this day in this Bureau for collection:

CONFIRMED AND ENTERED JULY 18, 1879.
9th avenue, regulating, grading, setting curb, gutter stones, and flagging, from 72d to 81st street.
Concord avenue, regulating and grading, from Home street to Westchester avenue.

155th street, regulating, grading, curbing, flagging, and superstructure, from 9th avenue to Hudson river.
124th street, E.B., regulating, grading, setting and resetting curb, flagging and reflagging, and paving, from Avenue A to 6th avenue.

11th avenue, sewer, between 66th and 76th streets, with branches in 67th, 68th, 69th, 71st, 72d, and 73d streets, with connection of present sewer in 70th street.

119th street, sewer, between 5th avenue and summit west of 5th avenue.

Greenwich avenue, sewer, between 13th street and 8th avenue and sewer in Bank street, between Waverly place and Greenwich avenue, from end of present sewer to near Greenwich avenue.

53d street, paving, from 7th avenue to Broadway.

Lexington avenue, paving, from 8th to 86th street.

1st street, basin on the northwest corner of Extra place.

Bloomfield street, basins on the northwest corners of Bloomfield street and 10th avenue and Little West 12th street and 10th avenue.

54th street, basins on the southwest corner of 54th street and Avenue A, and on the northwest corner of 55th street and Avenue A.

59th street, flagging sidewalk (north side), between Madison and 5th avenues.

7th avenue, tree planting, from 110th to 154th street.

6th avenue, tree planting, from 110th to 145th street.

All payments made on the above assessments on or before September 22, 1879, will be exempt (according to law) from interest. After that date interest will be charged at the rate of seven (7) per cent. from the date of entry.

The Collector's office is open daily from 9 A.M. to 2 P.M., for the collection of money, and until 4 P.M., for general information.

EDWARD GILON,
Collector of Assessments.

WILLIAM KENNELLY & HUGH N. CAMP,
Auctioneers.

CORPORATION SALE OF REAL ESTATE.

PUBLIC NOTICE IS HEREBY GIVEN THAT BY virtue of the powers vested in the Commissioners of the Sinking Fund of the City of New York, they will offer for sale, at public auction, on Thursday, April 24, 1879, at noon, at the Exchange Salesroom, No. 111 Broadway, in the City of New York, the following real estate belonging to the Corporation of the City of New York, viz:

Lots Nos. 13, 14, 15, Harlem market property, south side 121st street, near Third avenue.

West side 3d avenue, between 67th and 68th streets, lots Nos. 1 to 7.

South side 68th street, between 3d and Lexington avenues, lots Nos. 10 to 16.

East side Lexington avenue, between 67th and 68th streets, lots Nos. 22 to 25.

North side 67th street, between Lexington and 3d avenues, lots Nos. 26 to 33.

Lithographic maps of the above real estate may be obtained at the Comptroller's office at the New County Court-house, on and after April 15, 1879.

Full warranty deeds will be given to all purchasers.

COMPTROLLER'S OFFICE,
NEW COUNTY COURT-HOUSE,
March 24, 1879.

JOHN KELLY,
Comptroller.

The sale of the above premises is adjourned to Thursday, September 25, 1879, at the same hour and place.
NEW YORK—COMPTROLLER'S OFFICE,
NEW COUNTY COURT-HOUSE,
July 10, 1879.

JOHN KELLY,
Comptroller.

REAL ESTATE RECORDS

THE ATTENTION OF LAWYERS, REAL Estate Owners, Monetary Institutions engaged in making loans upon real estate, and all who are interested in providing themselves with facilities for reducing the cost of examinations and searches, is invited to these Official Indices of Records, containing all recorded transfers of real estate in the City of New York from 1653 to 1875, prepared under the direction of the Commissioners of Records.

Grantors, grantees, suits in equity, insolvents' and Sheriffs' sales, in 61 volumes, full bound, price, \$100 00

The same, in 25 volumes, half bound, price, 50 00

Complete sets, folded, ready for binding, price, 15 00

Records of Judgments, 25 volumes, bound, price, 10 00

Orders should be addressed to "Mr. Stephen Angell, Comptroller's Office New County Court-house."

JOHN KELLY,
Comptroller.