REPORT

OF THE

COCHITUATE WATER BOARD

TO THE

CITY COUNCIL OF BOSTON,

FOR THE YEAR ENDING

APRIL 30, 1874.

BOSTON:
ROCKWELL & CHURCHILL, CITY PRINTERS,
122 WASHINGTON STREET.
1874.

CITY OF BOSTON.

In Board of Aldermen, May 5, 1874.

Ordered, That the Cochituate Water Board be and hereby are authorized to submit their annual report in print; the expense thereof to be charged to the appropriation for Printing.

Passed in Common Council.

Came up for concurrence.

Read and concurred.

Approved by the Mayor May 6, 1874.

A true copy. S. F. McCLEARY, *City Clerk.*

CITY OF BOSTON.

Cochituate Water Board Office, May 20, 1874.

To the City Council of the City of Boston: —

The Cochituate Water Board, in compliance with the provisions of the City Ordinance, respectfully submits its annual report for the year ending April 30, 1874, together with the report of the Clerk of the Board, the City Engineer, the Water Registrar, and the Superintendents of the Eastern and Western Divisions of the Water Works. The detailed statements made by each of these officers give much valuable information in relation to the condition and progress of the works.

With the exception of the conduit, the Board has the pleasure of reporting that the condition of the works, in all departments, is entirely satisfactory. Recent examinations however, show conclusively that no valuable time ought to be wasted in providing means for a permanent and ample water supply, independent of the present conduit. It was supposed that definite means to secure the required supply had been taken by the City Council of 1873, which, in the early months of that year, not only formally approved the Sudbury river plan, presented by the Water Board, but appropriated $500,000 for the prosecution of the work, and ordered the Board to proceed forthwith in its execution, — which it did, with what was thought a commendable degree of alacrity and energy. A final location of the line was made, plans and specifications of the whole work prepared, and a contract was let for

excavating the long tunnel through the Chestnut Hill ridge, which work is now progressing favorably. In October last, when it became necessary to take certain lands in the valley of the Sudbury river for storage basins, it was found by the City Solicitor that the authority to seize these lands had been inadvertently omitted by the City Council when the appropriation was made. The Water Board then applied for the requisite authority, but up to this time no authority has been given. The causes which have led to this delay may be briefly stated.

The moderate rainfall of 1871 and 1872 necessitated the use of pumps at the lake to supply the city, and public attention was at once directed to the best means for preventing any such threatened water famine in the future. The universal demand from the press, the people, and the City Government, was for an ample and generous supply, a supply large enough to meet every possible emergency, for the next fifty years at least. There was nothing said in favor of piecing out the present supply by procuring a few million of gallons from elsewhere, on the score of economy, and this Board has never been asked or ordered to report upon a partial supply to reinforce the present system. Acting under the stimulus, as the Board still thinks, of a wise public opinion, the City Council applied to the Legislature for a new source of supply, and the Sudbury river was granted. As soon as the Act was signed, and accepted by the City Government, the Board proceeded to turn the water from the river into Lake Cochituate, thus relieving the immediate necessities of the city. While the surveys and plans for a permanent supply from the Sudbury were being perfected, the great conflagration of November 1872 occurred, and in May, 1873, the city suffered from another disastrous fire. The great losses from these fires caused no change in the policy of the City Council, and the Sudbury river scheme of permanent works was adopted with great unanimity. Within a few months, however, the ques-

tion of the annexation of Charlestown began to be discussed, and it was favored upon the ground, mainly, that the large water supply of the Mystic river could be utilized for the needs of Boston. The large losses by the two great fires, the dread of heavy taxation, and the financial panic of September, 1873, produced finally the natural reaction in favor of great economy in public expenditure; and, if a large saving could be made by the control of the Mystic Works, it was certainly the duty of the citizens of Boston to avail themselves of it. The annexation of Charlestown was consummated, and the Mystic Water supply passed into the possession of the city.

The application of the Water Board to the City Council for the authority to take land and water rights in the Sudbury, in October, 1873, was laid upon the table, where it still remains; and an investigation was ordered and made of the capabilities of the Mystic basin, to meet the needs of this city. The results of this investigation, not proving as satisfactory as was hoped, other sources of supply have since been examined, including the Shawshine, the Concord, the Merrimac and the Charles rivers, with no definite results as yet.

These examinations and consequent protracted discussions have practically deferred any movement for relief for a twelvemonth, while the needs and the population of the city are rapidly increasing; and the precarious condition of the conduit renders it a matter of some doubt whether even the present supply can be depended upon without interruption for any given time. In connection with this subject the Board desires to call particular attention to the remarks of the City Engineer upon the facts developed by recent examinations of the conduit.

During 1873 the supply of water at the lake was ample, the average height above the bottom of the conduit having been $10\frac{50}{100}$ feet. This year, up to the present date, May 20, the supply is large, now standing at high-water mark. The

amount wasted over the dam in 1873 was 2,917,977,000 gallons, or about thirty-two per cent. of the rainfall received into the lake. Had the conduit been originally constructed with the requisite capacity and strength, a large portion of this overflow could have been utilized, and the necessity for building a new conduit deferred for some years hence perhaps. The conduit was not designed to be operated under pressure, but was calculated to bring to the city only some seven or eight million gallons per day,—that amount being supposed to be sufficient for the needs of the city for the next fifty years. The conduit, however, now at the end of only twenty-seven years, is at times required to bring nearly three times that amount daily, and still the supply does not keep pace with the immediate and pressing needs of the citizens. The same error in judgment was made with regard to the capacity of the Brookline reservoir. It was seriously argued, by some in authority, that ten acres were sufficient for storage purposes; but, finally, twenty-two acres were taken, and since then the Chestnut Hill reservoir of one hundred and twenty-three acres has been added to the storage capacity, making, it will be confessed by our careful citizens, not too large a provision for the safety of the city, in case of large conflagrations, or a serious break in the conduit.

Reference is made to the above facts, with the design of showing the importance of taking the proper steps for *securing an adequate supply for the future*, whenever the City Council determines to proceed to the construction of the new works. New uses are being constantly found for water for business purposes, the demand for which the Board is compelled either to refuse, or to grant with extreme reluctance, since the report upon the condition of the conduit has been made, limiting its safe capacity to 17,000,000 gallons daily. The free use of hand-hose and ornamental fountains should be encouraged for sanitary reasons rather than checked; but during the hot summer months our citizens cannot safely indulge

in either, although a handsome revenue could be gained for both uses if there were plenty of water to supply the demand. The large increase of buildings in the Roxbury and Dorchester districts now demands a considerable extension of main pipe in those sections, which, if granted, will lead to a corresponding consumption of water. Numerous petitioners in West Roxbury and Brighton have indicated their wishes for an early supply for domestic purposes and protection from fire. The Board has no doubt but that the rights and needs of these rapidly growing sections of the city will be properly appreciated and cared for, in the provision which it is hoped will be early made for an adequate supply for the enlarged city limits.

The Water Board has no hesitation in reaffirming its opinion, fully expressed in former reports, in favor of that plan of supply adopted by the City Council of 1873. The Act passed by the Legislature, granting the Sudbury river to the city, is a very favorable and valuable one; the watershed is singularly free from sources of pollution, and, if any are found to exist, can be easily controlled; the water is excellent, and the storage facilities very favorable, while the cost — predicated upon actual and intelligent surveys — is not large, considering that our citizens will, with it, beyond all question, secure what they all desire, — *an adequate supply of pure water for the next fifty years.*

It is computed by the Auditor and Sinking Fund Commissioners, that the Funded Water Debt, amounting to $6,912,-711.11, under the operation of the sinking fund established for its redemption, will be retired and paid in full in 1903. The income from water is increasing constantly from year to year; and during the past year has been sufficient to pay the current expenses, including the cost of relaying the "burnt district," and considerable other exceptional expenses, which ought to be charged to construction, together with the interest on the entire debt, and the premium paid for re-

placing a portion of the funded debt, leaving a deficiency of only some $14,600, as will be seen by the following brief statement, made up in the form heretofore used in the reports of this department: —

The income for the past year, as appears from the report of the Water Registrar, has been	$906,430 48
Being a gain over the previous year, of . .	57,846 21
The estimated income from water-rates, for the year 1874, is	950,000 00
The expenses have been as follows: —	
For current expenses	506,888 20
Interest and premium on water debt . .	497,016 79
	$1,003,904 99
The Treasurer has credited the Water Works, for the same year	989,266 86
Excess of expenditures over income . .	$14,638 13
Add amounts expended in Wards 13, 14, 15 and 16	119,886 01
Add amounts expended on Parker Hill reservoir	32,690 78
Add amounts expended on additional supply .	114,102 77
Add cost of works to May, 1873 . . .	9,860,956 24
Showing a net cost to May 1st, 1874 .	$10,142,273 93

A more strict classification of the expenditures of the past year, as adopted by the City Auditor, discriminating more carefully between "current expenses" and "construction or extension expenses," shows the following result: —

Aggregate expenditures . . .		$1,270,584 55
Current expenses . . .	$364,662 74	
Interest and premium on debt	497,016 79	
Construction expenses . .	408,905 02	
		$1,270,584 55

Income as per City Treasurer's credits . .		$989,266 86
Current expenses . . .	$364,662 74	
Interest and premium on debt	497,016 79	
		861,679 53
Balance of net earnings		$127,587 33

It will be seen, from this statement, that the water-works have, for the first time, fairly earned a profit upon the entire cost of construction. Extensions of main pipe are now only made when the yearly income is estimated to pay six per cent. upon the cost; and if this safe rule is enforced hereafter, our citizens may rest assured that the present system of works will not only be self-sustaining, but a source of yearly increasing and handsome profit to the city treasury.

EASTERN DIVISION.

This division is in charge of Mr. E. R. Jones, and embraces all that portion of the works lying east of the Brookline reservoir. During the past year some twenty-four and one-half miles of pipe have been laid, of which 31 feet were 20-inch, 9,229 feet were 16-inch, 49,384 were 12-inch, 456 feet were 9-inch, 20,323 were 8-inch, 47,210 were 6-inch, and 2,617 feet were 4-inch; and 356 stopcocks have been put in during the same time.

The total length of pipe laid from the commencement of the works up to May 1st, 1874, amounts to 262 miles 1,056 feet; the total number of stopcocks is 2,767, and the total number of hydrants is 2,982, put in up to the same date.

During the past year a new blacksmith shop has been built, and the machine shop has been furnished with some much-needed new tools and machinery, adding very much to the effectiveness and economy of the work. Many articles

hitherto largely consumed or used in this department are now manufactured at a very considerable saving over the prices charged by manufacturers. A large amount of work has been done on this division during the past year, under somewhat adverse circumstances, and the results reflect great credit upon the Superintendent and his faithful assistants. A detailed statement of the pipes laid, and other interesting particulars, accompany the report of the Superintendent.

THE CITY RESERVOIRS.

The three reservoirs, the East Boston, the South Boston and Beacon Hill, remain about in the same condition as they were reported a year since; they have been kept partially filled, but are still disconnected with the pipe system. Upon the completion of the Parker Hill reservoir and the connection of the high-service pipe across Dover street bridge, the 20-inch main from Dorchester to South Boston, which is now used to supply the high-service, will be turned upon the low-service there, thus giving two very effective low-service lines, and one high-service line, reinforced by the Parker Hill reservoir, for that locality. Under these circumstances, it becomes a question whether there is a necessity for the continued maintenance of the South Boston reservoir, especially as it is in a leaky condition, and requiring extensive repairs to make it fully effective.

The Beacon Hill reservoir, which, when filled to its maximum capacity, holds less than a sixth of a day's ordinary supply for the city, will, upon the completion of Parker Hill reservoir, become practically useless. The land is quite valuable for the erection of dwelling-houses or other purposes, and if sold the proceeds might be judiciously applied, either to a reduction of the present water debt, or for laying a new main from Chestnut Hill reservoir to the city.

The East Boston reservoir is in good condition, having

undergone thorough repair within a few years. As East Boston has but a single line of supply, and should any accident happen to that, it would prove a serious disaster, unless, as a matter of precaution, the reservoir should be retained, kept full, and the water, some 5,600,000 gallons, held in reserve to meet the emergency.

PARKER HILL RESERVOIR.

This new work, which was put under contract in July last, is designed to reinforce the high-service system of Beacon Hill, South Boston, and the Roxbury and Dorchester districts. Its capacity, when full, will be some 7,000,000 gallons, or nearly seven times as great as the average amount now pumped daily through the stand-pipe; and, in case of a large conflagration in the high-service districts, or accident to the pumping works, it must be of great value to meet such an emergency. It is hoped that the reservoir will be finished, filled and fully connected with the high-service system during the present season.

During the past year a large number of stand-pipes, from three to six inches in diameter, connected directly with the street mains, have been put into manufactories, warehouses, hotels and other large and high buildings. These pipes are used for fire purposes *only*, being independent of the ordinary supply. As most of these high and costly structures are located in the low-service district, the water will only rise to a height governed by the street pressure; and these pipes, though quite effective against a fire *in* the building, are not of much value against a fire in the upper portion of very high adjoining buildings, except when steam power with a proper pump is connected with them; they then become a very efficient protection. As the use of these stand-pipes is becoming almost universal, it may be thought judicious, upon the

completion of the Parker Hill reservoir, to extend a high-service pipe through such streets as need this extra protection, and have all these stand-pipes connected with it. The expense fairly divided among the insurance companies, real estate owners and others directly interested, would not be large, while the protection from fire would be very great.

THE WESTERN DIVISION.

Mr. Albert Stanwood, the efficient and faithful Superintendent of this division, resigned that office in July last, and Mr. Desmond Fitzgerald was elected in his place. Mr. Stanwood, however, is still retained in the service of the city in an important and responsible position on the proposed new supply. The Western Division embraces the lake and all that portion of the works lying between the lake and the gate-house of the Brookline reservoir. Everything is in good condition at the lake, except that the dwelling-house occupied by the Attendant is very old and very much out of repair; it is likewise very ill-designed and inconvenient for the purposes for which it is needed. When it becomes necessary to employ a number of mechanics at the lake for construction or repairs, a great deal of valuable time is wasted by the men being compelled to go several miles away to their boarding-houses. It would be substantial economy to build an appropriate and convenient house, where these occasional employés can be fed and lodged. The fences around the city property require some considerable repairs, which will be attended to during the present season.

THE DISTRIBUTING RESERVOIRS.

Chestnut Hill and Brookline reservoirs remain in their usual satisfactory condition. The levels of both reservoirs are some two feet below high-water mark, although the con-

duit has been operated at considerable pressure during the moderate spring weather, in the endeavor to fill them to meet the usual large consumption of the hot summer months. The difficulty of keeping a full supply in the reservoirs during the future will be largely increased by the additional pressure given in the street mains, caused by the substitution of larger pipes in many streets, and, therefore, a more free circulation of water throughout the entire low-service districts. The more care exercised by consumers, to prevent this and all other extra waste, the more valuable will the system become as a protection from fire. The most rigorous measures ought to be taken to prevent waste, until a large additional supply is brought to the city.

WATER REGISTRAR'S DEPARTMENT.

The number of water-takers for the year is 42,345, an increase of 1,657 over the previous year. The number of cases in which the water has been turned off for non-payment of rates during the year 1873, is 1,098; of this number, 918 have been again turned on upon payment of dues, and a balance of 180 still remains off.

Meters. — The number of meters in use is 977.

The report of the Registrar contains a classification of the buildings in which water is measured for consumption, with the usual details of business in that department. In the Appendix to the Water Registrar's Report will be found some account of the results of a rigorous system of inspection in a foreign city, upon the consumption of water per capita of population. These details are interesting and important for consideration at a moment like the present, when the population of this city is increasing, and the water supply — caused by fear of accident to the overburdened conduit — is decreasing.

The number of the various kinds of water fixtures on the premises of water-takers, January 1st, 1874, was 170,281, showing an increase of 10,627 during the year.

JOHN A. HAVEN, *President.*

EDWARD A. WHITE.
THOMAS GOGIN.
CHARLES R. McLEAN.
LEONARD R. CUTTER.
WILLIAM G. THACHER.
EDWARD P. WILBUR.

REPORT OF THE CLERK.

OFFICE OF THE COCHITUATE WATER BOARD,
BOSTON, May 1st, 1874.

JOHN A. HAVEN, Esq.,
President of the Cochituate Water Board: —

SIR, — The following is a statement of the Expenditures and Receipts of this department for the year commencing May 1, 1873, and ending April 30, 1874: —

EXPENDITURES.

Carting	$3,273 75
Damage	1,287 93
Advertising	202 63
Stable	7,777 66
Taxes	1,292 98
Tools	9,987 79
Travelling expenses of the Board	166 00
Fountains	3,629 30
Postage and express	56 51
Aqueduct repairs, including cost of "Flume"	5,851 36
Printing for all departments	1,452 87
Eastern avenue wharf (rent and salary of agent)	2,999 99
Telegraph, repairing instruments and wire	166 36
Stationery for all departments	408 00
Salaries	21,866 59
Shutting off and letting on water for repairs	10,545 47
Inspectors	9,457 50
Amount carried forward,	$80,422 69

Amount brought forward,		$80,422 69
Upper yard (Albany street)		11,472 69
Miscellaneous expenses, including for negotiating loan	$5,822.50	11,748 79
Lake Cochituate		2,233 17
Maintaining meters		2,864 68
Meters		2,416 30
Hydrant and stopcock boxes		4,870 09
Blacksmith shop		148 78
Main pipe		147,384 83
Laying main pipe		16,468 71
Service pipe		16,612 67
Proving yard		3,178 65
High-service		6,368 94
Chestnut Hill reservoir		21,393 36
Beacon " "		594 20
East Boston "		1,472 11
South " "		354 75
Brookline "		1,105 27
Repairing stopcocks		1,959 31
Stopcocks		21,383 21
Repairing hydrants		7,281 14
Hydrants		25,070 47
Repairing main pipe		5,603 08
" service pipe		11,394 88
" streets		14,864 76
Wages, laying main pipe		36,981 92
" " service pipe		16,524 30
" blacksmith shop		1,543 50
" proving yard		8,336 70
" high-service		4,570 75
Laying service pipe		2,897 27
Blasting, etc., in wards 13 to 16		9,810 96
Amount carried forward,		$499,332 93

Amount brought forward,		$499,332 93
Detection of leaks		4,775 77
Chestnut Hill driveway		5,000 00
Wards 13, 14, 15 and 16		119,886 01
Parker Hill reservoir		32,690 78
Additional supply water		114,102 77
Total amount drawn for by Water Board		$775,788 26

And which is charged as follows: —

To Water Works	$504,108 70	
" Chestnut Hill driveway	5,000 00	
" Wards 13, 14, 15 and 16	119,886 01	
" additional supply	114,102 77	
" Parker Hill reservoir	32,690 78	
	$775,788 26	
Amount charged to Water Works		$770,788 26

RECEIPTS.

Fire department for use of hydrants	$32,256 00	
Rent of land	133 00	
Off and on water	2,356 75	
Fines	586 00	
Fire and elevator pipes, repairs, etc., etc.	32,178 96	
Rent of part of E. ave. wharf	300 00	
Old material	393 96	
Hay at reservoirs	349 50	
Use of engines loaned to towns of Waltham and Woburn	948 00	
Amounts carried forward,	$69,502 17	$770,788 26

Amounts brought forward,	$69,502 17	$770,788 26
City of Charlestown, repairs on Warren bridge . . .	60 41	
		69,562 58
Net amount to Water Works . .		$701,225 68
Amount drawn for the Water Works, not including Chestnut Hill driveway, additional supply of water, Parker Hill reservoir, or Wards 13, 14, 15, and 16 . . .		$504,108 70

EXTENSION OF THE WORKS.

Main pipe, laying, etc. . .	$200,835 46	
Service " " " . .	36,034 24	
		$236,869 70
Amount of expenses from April 30, 1873, to May 1, 1874 . . .		$267,239 00

Expenditures and Receipts on account of the Water Works, to May 1, 1874.

Amount drawn by Commissioners . .	$4,043,718 21
" " " Water Board in 1850 .	366,163 89
" " " Cochituate Water Board, from January 1, 1851, to May 1, 1873 .	7,103,639 66
Amount drawn from April 30, 1873, to May 1, 1874, for Water Works . . .	770,788 26
	$12,284,310 02

Amount paid the City Treasurer by Commissioners .	$47,648 38	
Amount paid by Water Board, 1850	8,153 52	
Amounts carried forward,	$55,801 90	$12,284,310 02

Amounts brought forward,	$55,801 90	$12,284,310 02
Amount paid by Cochituate Water Board to May 1, 1873	364,768 29	
Amount paid April 30, 1873, to May 1, 1874 . . .	69,562 58	
		490,132 77
Net amount drawn from Treasurer .		$11,794,177 25
Gross payments (including interest, premiums, etc.) for account of the Water Works		$22,743,169 99
Gross receipts		12,600,896 06
Net cost to May 1, 1874 . . .		$10,142,273 93

Respectfully submitted.

J. A. WIGGIN,
Clerk of the Cochituate Water Board.

COST OF THE WORKS TO MAY 1, 1874.

WESTERN DIVISION.

Amount paid Wm. H. Knight, for the Lake		$100,000 00
" " " " factories, $50,000.00, less amount on account of the sale of land and machinery, and insurance at the time of the fire		20,818 22
Expense of raising the lake two feet, including damages		28,002 18
Cost of roads, bridges and swamps		38,332 48
Gate-house at the lake		29,907 12
Dam at the outlet of the lake		8,458 20
Dudley pond, lower dam, and making connections with the lake		18,982 23
New dams, and improvements at the lake		19,610 90
Total cost of lake dep't, *not including land*		$264,111 33
Land and land damages, less credit for land sold	$225,523 15	
Constructing brick conduit	817,717 73	
Brookline reservoir, land	$58,418 92	
Construction	108,301 92	
Gate-house	33,356 37	
	200,077 21	
Compensating reservoirs, less amount received when sold	66,859 80	
Engineering expenses on the Western Division	69,900 31	
Miscellaneous expenses on the Western Division	149,464 74	
Am'ts carried forward,	$1,529,542 94	$264,111 33

Am'ts brought forward,		
Chestnut Hill reservoir, land and construction	$1,529,542 94	$264,111 33
	2,449,982 07	
Payments on account of the "new supply of water"	177,684 41	
		4,157,209 42
Total cost of Western Division		$4,421,320 75

EASTERN DIVISION.

Main and service pipes	$3,349,667 99	
Beacon Hill reservoir, land	$145,107 10	
Construction	368,426 11	
	513,533 21	
South Boston reservoir, land	$55,103 23	
Construction	35,804 87	
	90,908 10	
East Boston reservoir, land	$23,862 50	
Construction	46,328 59	
	70,191 09	
Engineering expenses on the Eastern Division	31,403 02	
Machine shop and pipe yard	110,264 09	
Hydrants and stopcocks	183,862 81	
Proving pipes	35,983 96	
Meters	132,039 92	
Miscellaneous expenses on the Eastern Division	713,455 06	
Payment on account of Wards 13, 14, 15 and 16	1,495,868 18	
Am'ts carried forward,	$6,727,177 43	$4,421,320 75

Am'ts brought forward,	$6,727,177 43	$4,421,320 75
Payment on account of new pipe in East Boston . . .	$45,877 51	
Payment on account of high-service, South Boston . .	26,832 25	
Payment on account of Parker Hill reservoir . . .	32,690 78	
Total cost of Eastern Division . . .		$6,832,577 97

Cost of Eastern Division	$6,832,577 97
" " Western Division	4,421,320 75
	$11,253,898 72

REPORT OF CITY ENGINEER.

OFFICE OF CITY ENGINEER, CITY HALL,
BOSTON, May 1st, 1874.

JOHN A. HAVEN, ESQ.,
President of the Cochituate Water Board: —

SIR, — In compliance with the requirements of the ordinance on Engineer's Department, the following report, upon matters pertaining to water supply, is respectfully submitted: —

SUDBURY RIVER AND LAKE COCHITUATE.

No water has been drawn from the Sudbury river or Farm pond during the past year, the supply from the lake alone having proved sufficient for all purposes.

In fact, as matters now are, no relief can be had from the river, even in case of a deficiency in the Cochituate supply.

The monthly average heights of the water surface of the lake, above the bottom of the conduit, will be found in the table on page 38.

On Jan. 1st, 1873, the water in Lake Cochituate stood at 12 feet 1 inch above the bottom of the conduit. At the beginning of the previous year there was no water in store, the conduit being then supplied by pumping from a level below its flow line.

To maintain the supply, about 1,676,600,000 gallons were turned into the lake from Sudbury river; this, combined with the copious rains of the latter part of the year, brought the water level within about 15 inches of high-water mark at the beginning of 1873. From this date it rose gradually till

Jan. 17th, when waste over the dam commenced, and continued till April 23d, the water then standing at 12 feet 11½ inches.

On May 4th, the stop planks were again removed, and the water allowed to waste, till May 20th. From this time till Aug. 14th it gradually fell, and at the latter date stood at 8 feet 7 inches; on Aug. 27th it stood at 8 feet 9½ inches; Oct. 4th, 6 feet 8½ inches; Oct. 10th, 7 feet 6 inches; Oct. 19th, 7 feet 3 inches; and on Dec. 31st, 9 feet 9 inches.

To secure a flow that will supply the city with the rate of consumption of the past year, there are required from 6 to 7½ feet of water above the bottom of the conduit; and, as in September there were less than 7 feet, fears were entertained that a resort to pumping would again be required, but fortunately heavy rains furnished the needed relief.

The total waste over the dam for the year has been 2,917,977,000 gallons, equal to an average daily supply of 7,994,460 gallons. Had there been no aid from the Sudbury river the previous year, the waste in 1873 would have been equal to an average daily supply of about 3,400,000 gallons. This waste is due to the want of storage room. The lake is now (May 1st) full, and wasting largely.

The town of Natick has obtained an act to take water for a domestic supply from Dug pond, and has recently decided to build works for elevating and distributing it. This will tend to diminish, somewhat, the supply for Boston, though a portion of the water will be received again by the lake in the form of sewage-water; but should a system of sewerage be carried out by the town, it may become necessary to divert even this portion, that the purity of the lake may be maintained.

A table will be found on pages 36 and 37, giving, as has been customary, the rainfall on the lake water-shed, amount of water consumed and wasted, rise or fall of the lake-surface, and quantity of water and percentage of fall received into the lake.

As has been stated in previous reports, the figures of this table are only approximate.

Similar tables have been printed in the annual reports for a number of years past; and as the figures of these tables have lately acquired considerable importance from being quoted and used as a basis of computation in estimating the probable yield of other sources of supply, it is necessary to again call attention to the fact that they are not accurate, and unless used with a knowledge of the nature of their inaccuracy, will lead to fallacious conclusions.

In the report of 1863, Mr. Crafts shows that for a number of years previous, the consumption (and consequently the yield of the lake) had been overestimated by a large percentage; and also states his belief, that even the method now used for computing the consumption gives a result considerably in excess.

As was said in the last annual report: "Although it would cost a considerable sum to provide the means for properly measuring the flow in the conduit, the water at the dam, the average rainfall for the entire water-shed, etc., yet the value of the results to be obtained from reliable measurements would fully warrant the necessary expenditure;" and the experience of the last twelve months is strongly confirmatory of this opinion.

Conduit. — On Nov. 19th and 20th, a thorough examination of the interior of the conduit was made by Mr. Wiggin, Clerk of the Water Board, and others, who passed through its entire length from the lake to Chestnut Hill reservoir.

A detailed report of this examination, made by Mr. D. W. Cunningham, will be found in City Doc. No. 134, 1873.

A number of new and dangerous cracks were discovered; those on the embankment to the west of Charles river were of such alarming character that it was considered imperative they should be repaired at once; accordingly, the water was

kept shut off, and a force of masons put at work night and day, until temporary security was ensured.

At this point there was found a crack in the bottom, varying in width from $\frac{1}{2}$ to $1\frac{1}{2}$ inch, and 200 feet long, through which an iron rod readily passed and penetrated the gravel filling below. The leakage here must have been considerable, but it did not make its appearance at the surface of the bank, owing to the very porous nature of the material forming it.

The repairs made in no way add to the strength of the conduit; the best that could be done was to stop the leakage, and thus remove for a while the danger of undermining the masonry.

A new examination has been made this spring (April 14th), which shows that changes in the form of the conduit continue to take place.

The crack on the embankment to the west of Charles river, mentioned above, has again opened nearly its whole length, to a width of from $\frac{1}{8}$ to $\frac{1}{4}$ inch. The water in the conduit was drawn down to a less depth than for the examinations of the past two or three years; and the upper reach near the lake was more carefully examined. A number of large springs were found coming up through the masonry of the bottom, and in a number of places the cement was entirely washed from the joints, and the bricks were loose.

These springs bring in large quantities of sand; and it is reasonable to suppose that the masonry is slowly undermined and allowed to settle and break up. The bottom, judging from the depth of water at different points, is quite uneven, and the unevenness is probably due to settlements.

In former years, when the consumption in the city was much less than now, it was the custom to draw the water out of the conduit a number of times in each year, and to patch up the cracks with cement, or by driving in pine wedges where springs prevented the use of cement. In

this way it was kept in a tolerably safe condition for use under pressure. For want of such constant attention and repairs during late years, it has deteriorated considerably, and is not now so safe for such use as formerly.

Each time that it is drawn off, several hours are required to empty it and several more to fill it again; also a large volume of water is wasted. If it could be drawn off in sections much time and water would be saved, as many portions of its length do not require frequent examinations. A gate at Grantville waste-weir would be of great service in this respect, and, besides, would afford a ready means of stopping the flow should any accident happen near Charles river, the point where the chief danger exists. I therefore recommend that such a gate be provided.

When the volume of flow is large there is a loss of head or fall, in passing it through the syphon pipes, of one foot and upwards, and as the entire fall from the lake to Chestnut Hill reservoir is only about 4 feet, this loss at Charles river materially diminishes the capacity of the conduit. This loss is not of much consequence when the volume of flow is not greater than 15 or 16 million gallons per day, but I have estimated that when the conduit is under a 4-feet head a gain of about $1\frac{1}{2}$ million gallons per day would be made by the addition of a new siphon pipe 36 inches in diameter. The cost of the pipe (if of cast iron) and labor of laying, etc., would be from $20,000 to $25,000, and in case the city take possession of the Sudbury river and use it for the next few years as a supplement to the Cochituate supply, by turning a portion of its waters into the lake, it will be advisable to have such a pipe laid.

As a purely precautionary measure, material for about 500 feet of wooden flume has been bought and fitted, and is stored at Chestnut Hill, ready for use in case of an accident to the conduit that shall destroy the masonry. It is hoped

and expected, however, that it will never be used for the purpose for which it is kept.

New gauges (float) for giving the height of water in the conduit have been put in along its line during the past season, and observations can now be taken much more readily and accurately than formerly. The record of these gauges is used in computing the daily consumption of water.

LOW SERVICE RESERVOIRS.

The tables on pages 31–33 give the monthly and yearly average heights above tide marsh level, of the water in the several reservoirs.

The average height, for the year, of the Chestnut Hill reservoir, has been 120.40 feet, or 1.06 feet less than in 1872.* This is due to the increase of consumption. The top of the conduit where it enters the reservoir is at elevation 123.50, and high water-mark of the reservoir is 124; hence, as the water in the latter is drawn down, the delivery of the conduit is increased. Within certain limits this fluctuation of the water surface acts as a regulator to equalize the delivery of the conduit with the city consumption.

Two new sluice-gates, made at the works of the Boston Machine Co., have been put in place at the lower or effluent gate-house, to shut off or regulate the flow in the distributing main.

The need of gates at this point, that can be quickly operated, has been felt ever since the reservoir was first put into use; in fact, in building the gate chambers provision for sluice-gates was made. These have been designed with special reference to easy and rapid movement. One man can fully open either of them in less than four minutes,

* The zero of the new gauge is .18 of a foot higher than that of the old gauge.

and they close by their own weight in rather less than twenty seconds, settling to their seats quietly and without shock.

The openings are 48 inches square and the movement is vertical. When in motion they are each carried on three pairs of wheels, twelve inches in diameter; thus changing the sliding friction of gates, made in the usual manner, into rolling friction. The seats are not exactly parallel to the gate frame, being inclined slightly from the vertical, so that when the gate is closed, the gate face and seat are in contact and the wheels are lifted a fraction of an inch from their tracks.

Vertically over each gate is a water-cylinder fitted with a piston 8 inches diameter and 4-feet stroke. The pistons are moved by a force pump fastened to the floor of the house. The gates can be held in any position by means of a friction clutch applied to the gate rods and operated by a hand wheel.

If it should be thought desirable, they may be made to close themselves, by the tripping of a weight, in case of an accident to the distributing main which shall materially increase the rate of flow in the pipe; such an accident, for instance, as happened March 15, 1872.

A float gauge, to denote the height of water in the reservoir, has been set in this gate-house.

The average height of water in the Brookline reservoir has been 119.91 feet during 1873, or 1.64 feet less than in 1872* and 0.49 feet less than in the Chestnut Hill reservoir.

A float gauge has been set at the Brookline gate-house, thus making a complete set of float gauges, referred to a common base (tide marsh level), from the lake to the reservoirs.

The Beacon Hill, South Boston and East Boston reservoirs, though kept partially filled with water to be used in case of necessity, have been almost constantly shut off from the street pipes for the past year.

* The zero of the new gauge is .08 of a foot *higher* than that of the old gauge.

DISTRIBUTING SYSTEM.

Considerable work has been done during the past year in extending the street pipes, more particularly in the Highland and Dorchester Districts, and important changes have been made in the old system of distribution, especially in the city proper. Many of these changes were recommended in the last annual report; others have been marked out in special reports made in response to orders of the City Council or of the Water Board, and others still have been suggested by the experience of an inadequate supply at certain points, either for fire or other purposes.

In all 129,520 feet, or about 24½ miles, of pipes, of various sizes, were laid in 1873.

Early in the season plans and estimates were made for re-piping the "burnt district," and an appropriation of $85,000 for this purpose was made by the City Council. This work is now finished. Nearly all the streets in this district were re-piped with 12 and 8-inch pipes in place of 6-inch, and the plan required all the old tuberculated pipes of small diameter to be taken up, to make room for new pipes coated with coal-tar.

The new system has a capacity of delivery several times greater than the old, even if, for the latter, no deduction for tuberculation be made, and is provided with Lowry hydrants placed at distances apart never exceeding 260 feet, and generally falling much below this. In place of 80 of the old 3-inch hydrants, 113 Lowry hydrants with 9-inch barrels have been substituted. The former accommodated but one steamer; the latter will accommodate four; hence it will be seen the facilities for extinguishing fires have been very largely increased. The changes made have given an improved head or pressure throughout the district.

Aug. 16, 1873, a report (City Doc. No. 112) was made in response to an order requiring the Water Board "to con-

sider and report to the City Council, as soon as practicable, what alterations in, and additions to, the present system of water pipes and hydrants would be required to render them of such capacity as would afford an adequate supply of water for all necessary purposes," etc.

In the report it was recommended that certain changes be made in the old system, by laying new and enlarged submains and feeders to the smaller pipes, by uniting the smaller pipes at many of the points where they cross, and by setting Lowry hydrants at the intersections.

The estimated cost of this work was $389,000.

The City Council authorized the Board, last fall to contract for 200,000 dollars' worth of pipes, to be delivered in the spring and used for the purposes recommended, and accordingly contracts for about 3,500 tons were made. The pipes are now being rapidly delivered and laid, and the old hydrants, of small calibre, removed in laying them, are replaced with those of the Lowry pattern.

During last year and to May 1st of this year, the following lengths of 16, 12 and 8-inch pipes have been laid in place of smaller sizes removed.

4,848 lineal feet of 16-inch in place of 6-inch.
7,054 " " " 12 " " " " 6-inch.
15,861 " " " 8 " " " " 6 and 4-inch.

In all, 5¼ miles.

186 Lowry hydrants have been set in the city proper.

A report was made, by order of the City Government, upon the cost and expediency of building street reservoirs, and the Water Board was subsequently authorized to build these reservoirs at such points as should be selected by it and the Fire Department.

In July plans were prepared for a syphon at the Dover-street draw, for the South Boston high-service main. The pipes for this work were not received till late in the fall. The syphon was successfully lowered into its place Dec. 24.

It consists of a strong box, made of 12 by 14-inch hard-pine timber, well bolted together and held by iron straps and knee timbers at the angles (where the horizontal portion joins the vertical arms), in which is laid a 16-inch water-pipe, the space between the box and pipe being filled solid with concrete. The syphon box is 48 feet in length, with vertical arms of $28\frac{1}{2}$ and $25\frac{2}{3}$ feet in height, and the grade of the bottom of the box is 17 feet below mean low water.

HIGH-SERVICE RESERVOIR AND PUMPING WORKS.

Parker Hill Reservoir. — On March 4, a report upon various methods of increasing the effective capacity of the high-service system of supply was made to the Water Board, and the building of a reservoir with a capacity of about 7,000,000 gallons, upon Parker Hill, in the Highland District, was recommended.

An act of the Legislature granting the right to take lands for the purpose of building this reservoir was obtained May 14, 1873, and an appropriation of $161,000 was passed by the City Council, June 6, 1873.

Contract and specifications were drawn up, and proposals or doing the work, to be received till July 29, were adverftised for. Three bids were received, of which that of Stephen H. Tarbell and Martin Hayes, both of Boston, was the successful one, being the lowest. The contract was awarded July 30, and the work on the ground commenced August 11, and continued till frost interfered. On Jan. 1st, 1874, about 20,000 cubic yards of earth had been excavated and 600 cubic yards of stone collected.

Pumping Engines.—The following table shows the total and monthly work done by the high-service engines during the past year, and the quantity of coal consumed in doing it: —

Statement of Operations at the High-Service Pumping Works, for the year 1873.

1873	Total pumping time.			Daily average pumping time.		Daily average amount pumped.	Hourly average am't pumped.	Average maximum hourly draft.	Average minimum hourly draft.	Greatest hourly draft.	Least hourly draft.	Average No. of revolutions per minute.	Average load on pump.	Average amount coal used per day.	Percentage ashes and clinkers.	Quantity pumped per pound of coal.
	Days.	Hours	Min.	Hours	Min.	Gallons	Gallons	Gallons	Gallons	Gallons	Gallons		Lbs.	Lbs.		Gal.
January	31	...	...	24	...	1,027,102	42,796	59,809	27,715	70,970	23,500	15.176	70.49	2,945	19.33	348.7
February	28	...	...	24	...	1,078,692	44,945	62,408	29,316	78,960	23,970	15.934	70.13	3,277	18.92	329.
March	31	...	...	24	...	1,004,701	41,863	60,710	25,153	70,735	22,325	14.84	70.33	2,788	19.41	360.
April	30	...	...	24	...	979,099	40,796	60,967	22,372	71,910	18,565	14.466	70.456	2,819	20.15	347.
May	31	...	...	24	...	939,431	39,143	58,627	20,392	75,200	18,800	13.88	71.38	2,434	17.097	386.
June	29	23	15	23	58.5	1,059,176	44,178	65,753	21,299	77,080	10,575	15.66	71.58	2,768	19.087	382.6
July	30	23	30	23	58.	1,049,775	43,770	63,586	22,257	74,730	19,270	15.52	71.33	2,925	19.31	359.
August	31	...	...	24	...	949,938	39,581	57,680	20,551	70,030	11,985	14.03	71.32	2,796	21.55	339.7
September	30	...	...	24	...	1,061,706	44,238	65,424	23,680	80,605	20,680	15.69	71.21	2,634	12.99	403.
October	30	22	...	23	56.11	1,059,964	44,284	66,217	23,659	77,785	20,210	15.70	71.29	2,569	11.02	413.
November	29	11	45	23	35.5	1,013,751	42,971	65,794	23,359	78,960	20,210	15.24	71.36	2,727	11.03	372.
December	31	...	...	24	...	1,062,920	44,288	66,268	25,372	77,785	19,270	15.70	71.31	2,868	11.95	376.
Totals and averages	364	8	30	23	57.45	1,023,353	42,715	62,770	23,760			15.147	71.015	2,792.6	16.92	366.

The cost of pumping for 1873 has been as follows: —

Salaries	$4,614 50
Fuel	3,178 88
Repairs	397 41
Gas	352 80
Small supplies	192 32
Painting	270 23
Total	$9,006 14

Approximate cost per million gallons raised one foot high, $28\frac{3}{10}$ cents.

Approximate duty per pound of coal, 260,175 lbs.-ft.

The pumps now operate much more quietly at a high speed than formerly, owing, chiefly, to the use of stronger and stiffer springs on the valves.

CONSUMPTION OF WATER.

The table on pages 34 and 35 gives the average daily consumption of water for each month since 1849. The daily average for 1873 was 17,842,700 gallons, which is in excess of the average for 1872 by 2,779,300 gallons, or $18\frac{1}{2}$ per cent. The greatest consumption was for July, when the daily average was very nearly 21,000,000.

On July 20 observations were made at the Beacon Hill reservoir, to determine the rate of night consumption, or, more properly speaking, the rate of *waste*, in a certain district of the city.

This district comprises what is called the west end, north end and burnt district, and contains not far from 60,000 inhabitants. In it are located many of the manufacturing houses, principal hotels, newspaper offices, printing-houses, etc., of the city; but at the time selected for the experiment, between twelve and three o'clock, Sunday morning, the legitimate use of water must have been very small.

This section was shut off from all communication with the Brookline and Chestnut Hill reservoirs, by gates on Bedford, Washington, Tremont, Charles and other streets, and fed exclusively from the Beacon Hill reservoir. The leakage through the gates, if any, must have been inappreciable, as the pressures on opposite sides could have differed but slightly.

Observations were commenced at midnight, and readings of the gauge taken every fifteen minutes. At the first of the experiment the consumption was found to be somewhat irregular, but between one and three o'clock it was remarkably uniform, showing that the draft was not due to irregular opening and shutting of cocks, but to a continuous flow at almost unvarying outlets.

There were drawn from the reservoir during these two hours, 386,857 gallons, equal to a rate of 4,642,284 gallons in 24 hours. This enormous rate of night consumption indicated either a heavy leakage or great waste. A party of inspectors was at once organized, under the direction of Mr. Joseph Whitney, of Cambridge, who, from experience gained on the Cambridge works, was particularly qualified for this work, and a careful inspection of all the fittings in the district was made, and the street mains were tested for leaks in various ways. No leaks were discovered in the mains, but many hundreds of defective fittings were found and repaired, and some leaks in the house service-pipes detected and stopped. Before the examination was concluded, however, it became manifest that much the greater portion of the night consumption was caused by waste, that is, by flow through open fittings. All the leaks that could be discovered having been stopped, a second observation was made on Sunday morning, October 5, between the hours of twelve and three, as before. The water in the reservoir at the commencement of the trial stood at the same height as on the morning of July 20.

There was a slight wind blowing at the time of the latter trial, which caused an oscillation in the gauge-tube, and the readings were not so satisfactory as those of July. During the three hours of observation the water fell 2 feet 4⅝ inches, showing a consumption of 506,182 gallons, which is at the rate of 4,049,456 gallons in 24 hours. The consumption between one and three o'clock was 336,294 gallons, or at the rate of 4,035,528 gallons in 24 hours, showing a small saving, about 13 per cent., caused by the repairs made.

That everything to stop waste within the power of the Board to do might be done, the inspection from house to house was continued throughout nearly the whole city. Mr. Whitney, in his final report of Dec. 1st, says: "The work has proceeded without interruption until the present time (the number of inspectors employed averaging about 6), and the entire city has been canvassed with the exception of East Boston, part of the Highland District, and a part of Dorchester.

"The result of the investigation, to the first day of December, has been the discovery of four thousand one hundred and eleven leaks, as follows: —

"347 bursted service-pipes.
"491 ball cocks.
"1,173 hopper cocks.
"1,754 taps.
"169 water-closets.
"50 stop and waste cocks.
"127 hydrants.

"At the time when these leaks were discovered, a notice was left on the premises requiring that the same should be repaired within three days, and with very few exceptions the repairs have been promptly made."

Although a considerable saving must have resulted from the stoppage of so many leaks, yet the quantity thus saved

was so small in comparison to the immense waste through fittings left open wilfully or carelessly, that it proved of no appreciable value in diminishing the daily consumption.

ADDITIONAL SUPPLY.

A report of the City Engineer, bearing date Jan. 27, 1873, together with plans and estimates relating to the various sources, within fifty miles of the city, available for the supply of Boston, and giving in detail the proposed scheme of works for a supply from the Sudbury river, was presented to the Water Board in that month.

This report, together with one from Mr. Chesbrough, City Engineer of Chicago, and another from the Water Board upon the same subject, was presented to the City Council early in the year.

The plan proposed received the approval of the City Government, and an appropriation of $500,000 was made to cover the estimated expenses of the past year.

A number of engineering assistants were engaged early in May, and placed under the direction of Mr. A. Fteley, who was appointed Resident Engineer in charge of the whole work, and the final location of the conduit line, dams, etc., and plans of structure, and forms of contracts and specifications were commenced.

The line is now located, and cross sections of the ground have been taken, and a large number of plans, profiles, etc., have been prepared.

A contract, amounting to about $340,000, for excavating a tunnel and building a portion of the conduit, was let early in August, and considerable work has been done under it.

Other portions of the work were made ready for contract, and advertisements for proposals would have been made last fall, had not subsequent events rendered such course unwarrantable.

In October surveys and plans of certain lands in the valley of the Sudbury were made, for the purpose of preparing papers for the taking of such lands. It was, however, decided by the City Solicitor that the City Council had not authorized the Water Board to take lands or water-rights; and accordingly the Board made application, October 20, for the needful authority.

Charlestown, with its water supply, had recently been annexed by vote of the people, and the strong argument urged in favor of annexation had been the use of the Mystic water for the partial supply of Boston, and the consequent postponement for a number of years of the large expenditure required for the building of the Sudbury river works, as projected. Under the circumstances, it was thought best by the City Council, before granting the power asked for, to have made a more thorough investigation of the capacity and purity of the water of the Mystic valley, and accordingly an order was passed requiring the Water Board to enter into further examination on these points. For this purpose the Board engaged the services of Mr. J. P. Kirkwood, of Brooklyn, Mr. J. B. Francis, of Lowell, and Professor E. N. Horsford, of Cambridge.

The reports of these gentlemen, together with one from the Water Board and another by Mr. W. F. Davis, Water Registrar, on the question of waste of water, were presented in January of this year.

In January and February, orders were passed requiring the Joint Standing Committee on Water to report upon various sources of supply and schemes of works, and in the latter part of April the committee presented majority and minority reports, together with one from the City Engineer. No action has since been taken.

Work upon the Beacon-street tunnel in Newton is progressing favorably, and at a much faster rate than was anticipated. At the date of this report 622 lin. feet of tunnel have been excavated.

It is now worked from four faces, and the rate of progress since the four headings were all commenced, has been about $7\frac{1}{2}$ feet per day, and for the month of April it has been $8\frac{8}{10}$ feet per day.

The west heading and the two headings of the shaft are worked with hand drills; the east heading is worked with compressed-air drills, and arrangements are making for working all the headings in the latter manner. When these are completed the rate of progress, judging from that at the east heading, will be fully 15 feet per day.

PIPE PLANS, ETC.

A large amount of work has been done during the past year in the preparation of plans showing the sizes, location, etc., of pipes, hydrants, and other appurtenances to the street system of distribution, as is shown by the following extracts from the report of Assistant Dexter Brackett: "A large portion of my time has been spent in preparing plans to show more fully the pipe distribution of the city, and under this head the following has been accomplished: The sectional plans of Boston and the Highland District, spoken of in my last report, have been finished, together with a duplicate set of those of the Highland District, for the use of the Cochituate Water Board."

"Early in the year, sectional plans of Dorchester, thirty-four in number, similar to those of the Highland District, showing, on a scale of 100 feet to an inch, the location of the water-pipes, gates and hydrants, were commenced, and these with duplicates of the same for the Water Board are practically completed.

"A plan is now in progress which will show, on one sheet sixty by seventy-two inches, the entire pipe system of the City proper, South Boston, and Roxbury Highlands, with a portion of Dorchester.

"When the system is extended through the recently annexed territory, a similar plan will be required for West Roxbury and the remaining portion of Dorchester.

"During the year, plans of the City proper, South and East Boston have been made, showing the changes proposed, with estimates of the lengths of pipe required to make the system more effective; others, showing the pipes as re-laid in the burnt district, and the plans belonging to the Water Board and the Superintendent of the Eastern Division, which, together with our own, number 160, have been corrected, as the system has been extended.

"Sectional plans in duplicate, showing the property owned by the city on the line of the Cochituate aqueduct, and the lots which have from time to time been sold therefrom, are in preparation, and will be completed early in the year."

A set of finished drawings, showing the gate-houses and other structures at the Chestnut Hill reservoir, as they were actually built, has been completed.

RAINFALL.

The usual tables, giving the rainfall at various points for the year 1873, will be found appended.

JOS. P. DAVIS,
City Engineer.

Average Monthly and Yearly Heights, in feet and decimals, of the several Reservoirs above "tide marsh level," 1862–73.

BROOKLINE.
Maximum high-water line, 124.60.

MONTH.	1863.	1864.	1865.	1866.	1867.	1868.	1869.	1870.	1871.	1872.	1873.
January	123.64	122.37	123.31	122.28	122.00	123.29	122.58	122.83	121.89	118.64	120.46
February	123.23	122.61	122.82	122.47	123.12	122.79	122.64	122.60	122.54	120.48	119.86
March	123.23	123.62	123.26	123.19	123.05	122.33	122.48	122.77	122.08	122.04	119.71
April	123.85	123.82	123.38	123.45	123.00	123.04	122.60	122.56	122.00	122.10	121.36
May	123.52	123.62	122.65	123.04	123.07	123.04	122.77	122.75	121.79	122.29	121.84
June	123.17	122.66	123.23	123.29	122.34	122.77	121.85	122.64	121.98	122.25	120.90
July	122.76	122.87	123.33	122.97	122.98	122.77	122.10	122.50	122.19	121.25	118.79
August	123.11	122.64	123.39	122.80	122.23	122.75	122.19	122.23	122.06	122.14	118.48
September	123.36	122.03	123.29	122.81	122.52	122.12	122.50	122.35	121.50	123.44	119.04
October	122.26	123.19	123.29	123.03	122.65	122.31	122.58	122.64	119.54	122.96	119.09
November	123.63	122.78	123.38	122.75	122.89	122,56	122.46	122.60	116.94	120.98	119.69
December	122.53	122.29	123.24	122.64	122.37	122.00	122.92	122.50	117.71	121.06	119.71
Yearly Average . .	123.19	122.87	123.21	122.89	122.69	122.65	122.48	122.58	121.02	121.63	119.91

BEACON HILL.
Maximum high-water line, 121.53.

MONTH.	1863.	1864.	1865.	1866.	1867.	1868.	1869.	1870.	1871.	1872.	1873.
January	118.36	117.72	119.18	119.20	119.11	120.20	118.51	118.63	119.26	116.20	119.01
February	118.18	117.54	118.91	119.65	118.59	120.11	118.72	117.78	118.95	116.38	119.32
March	118.03	116.38	120.58	120.72	119.45	120.57	118.30	118.07	119.38	116.49	119.63
April	117.27	117.21	121.28	120.70	119.86	120.57	118.82	118.34	119.59	116.72	119.01
May	116.33	116.53	120.31	119.53	118.50	118.65	119.68	118.63	119.09	116.70	120.28
June	115.40	115.31	120.56	118.53	118.34	118.45	117.13	118.03	. .	116.99	119.99
July	116.34	115.32	121.23	119.51	119.00	120.24	117.20	119.30	109.63	116.95	118.05
August	116.05	115.19	119.83	119.17	117.70	117.11	117.63	119.59	109.68	117.11	115.93
September	116.12	115.91	119.03	119.39	120.46	118.20	117.45	117.72	. .	117.65	116.20
October	115.87	118.17	118.43	119.50	120.46	118.61	118.36	117.80	. .	118.20	118.11
November	116.85	118.55	120.14	119.78	120.84	119.03	118.45	118.61	. .	118.36	120.59
December	118.30	117.35	120.50	119.37	120.02	117.78	118.36	119.38	. .	118.51	120.68
Yearly Average . .	116.92	116.77	120.00	119.59	119.36	119.11	118.13	118.49	116.51	117.19	118.90

Average Monthly and Yearly Heights, etc. — Continued.

SOUTH BOSTON.

Maximum high-water line, 122.86.

MONTH.	1863.	1864.	1865.	1866.	1867.	1868.	1869.	1870.	1871.	1872.	1873.
January	115.73	110.63	114.21	114.38	112.46	111.15	111.15	114.46	112.51	109.34	111.30
February	115.54	110.94	113.42	114.44	111.36	111.15	111.34	114.80	112.61	109.42	111.69
March	115.36	111.13	113.64	113.51	111.74	111.11	111.63	114.51	112.74	109.38	112.01
April	114.73	112.07	114.82	114.99	111.88	111.55	111.96	113.57	112.63	109.67	112.74
May	112.71	111.64	115.44	114.90	111.63	111.61	111.78	113.53	112.71	109.32	113.40
June	111.39	109.06	114.91	114.32	111.19	112.15	111.51	113.36	112.44	109.24	110.69
July	109.75	108.57	114.36	113.96	111.53	111.53	111.19	112.21	115.32	109.05	109.40
August	109.80	109.53	113.80	114.07	111.90	111.53	110.65	110.78	114.03	108.82	110.21
September	109.64	110.21	113.69	113.41	111.70	111.44	108.76	110.15	113.13	106.49	110.84
October	109.90	112.49	112.89	112.74	111.29	111.44	113.15	110.01	112.80	109.34	111.21
November	111.25	112.49	112.74	112.03	111.26	111.44	113.76	111.86	112.76	110.61	111.30
December	109.90	113.89	113.78	112.62	111.08	111.11	113.88	112.61	109.26	110.71	114.40
Yearly Average . .	112.14	111.05	113.97	113.78	111.59	111.44	111.74	112.65	112.74	109.28	111.60

EAST BOSTON.

Maximum high-water line, 107.60.

MONTH.	1863.	1864.	1865.	1866.	1867.	1868.	1869.	1870.	1871.	1872.	1873.
January	95.64	90.22	96.12	93.61	91.89	92.81	99.72	104.45	101.18	103.47	. .
February	93.86	92.88	97.00	96.61	92.06	92.10	100.56	104.20	104.33	102.56	. .
March	94.29	93.50	94.83	94.22	91.69	91.14	100.60	100.89	106.12	100.41	. .
April	95.65	96.16	96.52	96.47	90.91		Shut off for repairs.	104.93	107.14	100.10	. .
May	93.07	97.68	96.04	95.85	89.63			105.91	106.50	101.54	. .
June	91.10	94.22	93.91	93.71	91.82	Shut off for repairs.		106.00	106.43	106.83	. .
July	90.43	92.34	96.82	95.35	94.60		100.60	103.87	106.47	. .	. .
August	91.23	92.84	95.78	93.85	94.16		95.08	104.25	105.22	. .	. .
September	91.96	95.00	94.52	Shut off for repairs.	99.40		94.87	102.77	104.91	. .	. .
October	95.02	97.55	93.38		96.85		96.97	105.20	104.81	. .	. .
November	93.36	98.14	92.23		93.47		101.12	104.75	104.56	. .	. .
December	89.79	97.27	94.34	92.29	92.57		102.06	105.18	104.58	. .	. .
Yearly average . .	92.95	94.83	95.12	94.63	93.25	92.02	99.06	104.37	105.18	. .	. .

Average Monthly and Yearly Heights, etc. — Continued.

CHESTNUT HILL.
Maximum high-water line, 125.00.

MONTH.	1870.	1871.	1872.	1873.
January	...	102.00	116.90	120.76
February	...	102.81	120.46	120.26
March	...	105.19	122.29	120.11
April	...	110.48	122.52	121.55
May	...	116.21	122.54	122.03
June	...	121.46	122.35	121.24
July	...	122.40	121.77	119.65
August	...	122.02	122.15	119.32
September	...	121.44	122.77	119.74
October	...	119.67	122.08	119.70
November	100.80	117.08	122.42	120.21
December	101.29	115.35	121.40	120.21
Yearly Average	101.04	114.67	121.64	120.40

Consumption of Water. Daily Average Number of Wine Gallons drawn from the Brookline Reservoir.

Month.	1849.	1850.	1851.	1852.	1853.	1854.	1855.	1856.	1857.	1858.	1859.	1860.
January	1,700,000	5,181,700	7,233,700	8,280,900	8,050,500	10,695,200	9,702,700	12,669,000	15,089,000	12,160,000	14,512,000	17,862,000
February	. . . .	5,214,000	7,221,100	8,790,300	8,643,600	10,654,200	10,349,800	11,791,000	14,175,000	14,399,000	14,769,000	18,901,000
March	1,550,000	4,841,200	6,137,900	8,521,100	8,202,200	9,582,100	10,125,600	12,504,000	13,941,000	14,154,000	14,480,000	15,409,000
April	. . . .	4,961,000	5,365,200	8,048,700	7,903,600	8,738,500	8,540,000	10,800,000	12,454,000	13,465,000	13,760,000	14,621,000
May	3,600,000	5,346,100	6,238,400	8,350,000	8,123,400	9,685,300	9,103,800	10,378,000	12,414,000	11,423,000	11,302,000	14,790,000
June	4,300,000	6,906,500	7,925,000	8,033,100	8,945,900	11,745,200	9,984,400	11,223,000	12,504,000	10,867,000	11,639,000	17,838,000
July	4,800,000	8,514,200	7,180,200	9,608,000	8,809,200	10,613,800	11,056,600	13,167,000	13,551,000	13,621,000	13,219,000	17,239,000
August	4,100,000	8,004,600	7,235,000	9,709,300	8,461,900	10,028,100	11,120,800	12,664,000	13,077,000	13,141,000	12,704,000	19,297,000
September . . .	4,800,000	6,585,500	7,230,600	7,920,000	8,640,700	9,712,400	11,710,800	11,522,000	12,030,000	12,745,000	12,389,000	17,957,000
October	4,550,000	4,504,300	1,716,600	6,930,000	8,876,100	8,769,800	10,771,200	11,891,000	10,864,000	12,969,000	12,026,000	16,938,000
November . . .	3,800,000	4,960,500	6,473,500	6,637,900	8,624,700	8,030,200	10,383,200	11,691,000	11,372,000	12,143,000	12,715,000	16,862,000
December	3,600,000	5,037,000	7,663,400	7,195,800	9,228,400	10,597,600	11,307,200	13,284,000	11,241,000	13,075,000	14,586,000	19,151,000
Average for year	3,680,000	5,837,900	6,883,800	8,125,800	8,542,300	9,902,000	10,346,300	12,048,600	12,726,000	12,847,000	13,175,000	17,238,000

Consumption of Water. — Continued.

MONTH.	1861.	1862.	1863.	1864.	1865.	1866.	1867.	1868.	1869.	1870.	1871.	1872.	1873.
January . . .	21,106,769	17,000,000	16,112,000	18,954,000	13,412,000	14,850,000	13,511,000	15,992,000	15,426,000	12,525,000	14,110,000	12,203,900	17,639,100
February . . .	20,804,131	17,000,000	17,328,000	18,846,000	13,318,000	13,385,000	13,831,000	16,927,000	14,731,000	14,052,000	15,070,000	15,172,000	18,461,000
March	19,453,344	17,300,000	16,681,000	16,841,000	12,027,000	12,284,000	13,100,000	13,722,000	14,789,000	14,646,000	10,162,000	15,788,500	15,983,700
April	17,151,593	15,300,000	15,125,000	16,506,000	11,975,000	11,251,000	12,770,000	12,636,000	14,650,000	14,703,000	11,814,000	12,281,000	14,781,800
May	16,687,832	14,300,000	15,407,000	16,094,000	13,660,000	11,076,000	12,301,000	13,846,000	13,902,000	13,759,000	12,222,000	13,830,600	17,637,400
June	17,231,984	16,600,000	16,138,000	17,730,000	14,391,000	11,878,000	13,625,000	14,351,000	14,252,000	14,824,000	15,695,000	14,617,600	20,100,600
July	18,897,809	16,400,000	15,954,000	18,112,000	13,207,000	12,668,000	14,250,000	14,676,000	18,378,000	16,392,000	15,748,000	16,377,100	20,917,100
August	18,272,365	17,000,000	16,980,000	16,188,000	13,426,000	12,441,000	14,546,000	14,479,000	17,632,000	17,107,000	16,019,000	15,017,900	19,544,600
September . .	18,098,259	17,000,000	17,035,000	16,798,000	12,624,000	11,842,000	13,186,000	16,072,000	15,741,000	16,785,000	16,512,000	15,072,600	19,572,700
October. . . .	17,987,128	17,300,000	15,779,000	15,479,000	11,273,000	12,396,000	13,518,000	14,954,000	14,096,000	16,528,000	13,856,000	15,544,800	17,113,800
November . .	16,604,076	17,100,000	16,028,000	14,079,000	11,750,000	11,262,000	12,707,000	13,975,000	13,608,000	14,677,000	13,574,000	17,591,400	16,633,400
December . .	15,976,362	17,000,000	16,295,000	14,547,000	10,877,000	11,412,000	15,434,000	15,600,000	13,640,000	14,094,000	12,564.000	17,263,700	15,727,100
Av'age for year	18,189,304	16,600,000	16,238,500	16,681,000	12,662,000	12,229,000	13,565,000	14,769,167	15,070,400	15,007,700	13,945,500	15,063,400	17,842,700

Statement showing amount of Rainfall on Water-shed of Lake Cochituate, amount of Water consumed and wasted, available amount received into Lake, available percentage of Rainfall, etc., from 1852 *to* 1873, *inclusive. Water-shed of Lake* = 12,077 *acres.*

YEAR.	Rainfall.	Amount of rainfall on Water-shed of Lake Cochituate.	Amount of Water drawn from Lake.	Amount of Water wasted from Lake.	Total amount consumed and wasted.	Rise of Lake during the year.	Fall of Lake during the year.	Total amount of R'nfall received into Lake.	Daily ave'ge am't of rainfall received into Lake.	Percentage of Rainfall rec'd into Lake.
	Inches.	*Gallons.*	*Gallons.*	*Gallons.*	*Gallons.*	*Gallons.*	*Gallons.*	*Gallons.*	*Gallons.*	
1852*	47.93	15,759,207,000	2,974,042,800	4,020,566,885	6,994,609,685	. . . . .	261,360,000	6,733,249,685	18,396,857	43 per cent.
1853	55.73	18,366,561,000	3,117,939,500	3,166,417,500	6,284,357,000	239,580,000	. . . .	6,523,937,000	17,873,800	35 per cent.
1854	43.15	14,187,562,000	3,614,230,000	4,187,733,020	7,801,963,020	. . . . .	217,800,000	7,584,163,020	20,778,529	53 per cent.
1855	34.96	11,494,719,000	3,776,399,500	No acc't kept.	. . . . .	. . . . .	326,700,000	. . . . .	. . . .	. . . . .
1856	40.80	13,414,892,000	4,409,787,600	No acc't kept.	. . . . .	598,950,000	. . . .	. . . . .	. . . .	. . . . .
1857	63.10	20,747,052,000	4,644,990,000	10,625,900,000	15,270,890,000	32,670,000	. . . .	15,303,560,000	41,927,562	74 per cent.
1858	48.66	15,999,232,000	4,689,155,000	1,934,500,000	6,623,655,000	. . . . .	141,570,000	6,482,085,000	17,759,013	40 per cent.
1859†	49.02	16,117,602,000	4,808,875,000	7,569,000,000	12,377,875,000	283,140,000	. . . .	12,661,015,000	34,687,712	78 per cent.
1860	55.44	18,228,471,000	6,309,108,000	None.	6,309,108,000	174,240,000	. . . .	6,483,348,000	17,714,065	35 per cent.
1861	45.44	15,269,303,000	6,639,095,900	3,377,558,966	10,016,654,866	. . . . .	1,459,260,000	8,557,394,866	23,444,917	56 per cent.
1862	49.69	16,337,890,000	6,059,000,000	33,200,000	6,092,200,000	1,306,800,000	. . . .	7,399,000,000	20,271,233	45 per cent.
1863	69.30	22,785,586,000	5,927,052,500	2,165,696,470	8,092,748,970	762,300,000	. . . .	8,855,048,970	24,260,408	39 per cent.
1864	42.60	14,006,726,000	6,105,306,700	1,368,746,000	7,474,052,700	. . . . .	1,848,577,000	5,625,475,700	15,370,152	40 per cent.
1865	49.46	16,262,266,000	4,621,630,000	1,688,120,674	6,309,750,674	743,242,500	. . . .	7,052,993,174	19,323,270	43 per cent.
1866	62.32	20,490,455,000	4,463,585,000	None.	4,463,585,000	743,242,500	. . . .	5,206,827,500	14,265,280	25 per cent.
1867	56.25	18,494,795,000	4,951,225,000	2,482,041,000	7,433,266,000	. . . . .	698,811,000	6,734,455,000	18,450,600	36 per cent.

1868	49.71	16,459,544,000	5,405,515,000	2,507,684,000	7,913,199,000	346,371,000	. . . .	8,259,570,000	22,567,160	50 per cent.
1869	64.34	21,099,808,000	5,500,696,000	1,635,570,000	7,139,321,000	480,882,000	. . . .	7,620,203,000	20,877,300	36 per cent.
1870	55.89	18,328,694,000	5,477,810,000	4,818,971,000	10,296,781,000	. . . . .	1,736,085,000	8,560,696,000	23,453,900	47 per cent.
1871	45.39	14,885,300,000	5,223,500,000	None.	5,223,500,000	. . . . .	250,933,000	4,972,567,000	13,623,470	33 per cent.
1872	48.47	15,895,364,000	‡5,775,151,200	None.	5,775,151,200	‡1,543,995,500	. . . .	5,642,480,300	15,416,610	35 per cent.
1873	45.43	14,898,419,000	6,511,826,900	2,917,977,000	9,429,803,900	. . . . .	515,132,000	8,914,671,900	24,423,760	60 per cent.
Average .	51.05	Average daily waste for 20 years		7,460,600	Average daily yield of Lake water-shed for 20 years,			21,244,280.		45 per cent.
		" " " " 6 years, '52-59 .		14,378,900						
		" " " last 14 years, '60-73 .		4,496,600						

* Observations of Rainfall at Lake Cochituate commenced 1852, and these observations are assumed as correct for the whole district. † Lake raised two feet.

‡ Amount received from Sudbury River in 1872, 1,676,666,400 gallons.

Table of the average monthly and yearly heights of water in the Lake above the bottom of the Aqueduct.

Month.	1853.	1854.	1855.	1856.	1857.	1858.	1859*	1860.	1861.	1862.	1863.	1864.	1865.	1866.	1867.	1868.	1869.	1870.	1871.	1872.	1873.
January .	9.51	10.54	10.16	8.06	9.53	10.75	10.80	10.83	11.93	6.09	11.33	13.88	7.41	8.37	12.14	10.29	12.27	13.25	5.29	4.23	12.53
February .	10.78	10.95	10.65	7.59	10.28	10.05	12.17	11.36	12.77	6.57	12.85	13.71	8.24	8.73	13.14	9.75	12.96	13.19	5.40	2.52	12.31
March . .	10.44	10.93	10.68	6.96	10.67	9.35	12.45	12.67	13.21	8.65	13.95	14.33	12.28	10.58	13.57	10.96	13.21	12.81	7.96	1.19	12.06
Aprll . . .	10.68	10.66	11.57	10.24	12.30	9.36	12.06	12.72	14.14	12.40	14.59	14.32	14.00	11.96	13.50	13.29	13.40	13.33	9.31	4.19	13.17
May . . .	10.98	10.87	11.35	12.05	12.05	10.67	12.06	11.52	13.88	14.45	14.01	14.26	14.00	12.01	13.44	13.67	13.65	13.12	10.37	5.10	13.17
June . . .	10.62	10.33	10.69	11.78	12.14	11.72	11.96	10.83	12.99	14.43	13.29	13.51	13.41	12.72	13.20	13.37	13.23	13.02	9.27	5.79	12.04
July . . .	9.45	9.00	9.86	10.67	11.41	11.74	10.22	10.42	11.50	14.05	12.82	11.33	12.28	11.84	12.12	12.46	12.62	12.12	7.83	6.33	10.25
August . .	8.64	6.67	9.01	11.59	11.70	11.30	10.24	9.42	10.27	12.97	13.73	9.65	11.18	11.79	12.17	11.70	11.04	10.37	6.27	7.04	8.87
September	7.78	6.64	7.52	10.82	11.72	10.40	9.84	9.42	8.71	11.33	13.43	7.91	10.09	11.59	12.00	11.61	9.73	8.67	5.00	10.02	7.60
October . .	7.34	5.90	6.42	10.10	11.10	8.72	10.15	10.35	7.79	10.30	12.94	6.46	9.02	11.72	11.10	11.83	10.58	8.10	3.81	11.46	7.29
November .	9.58	6.09	6.28	10.80	11.16	9.01	9.98	10.44	7.22	10.24	13.26	5.48	8.74	11.41	11.03	11.75	11.21	7.10	3.60	12.67	7.60
December .	10.57	8.38	7.29	10.97	11.02	9.85	10.54	11.17	6.88	11.70	14.06	5.41	8.48	11.68	10.51	12.33	11.77	6.40	3.83	12.40	9.08
Yearly av. .	9.70	9.00	9.29	10.14	11.26	10.24	11.04	11.93	10.94	11.10	13.52	10.84	10.76	11.20	12.33	11.92	12.15	10.96	6.50	6.91	10.50

* High-water mark raised two feet.

Table showing the height of water in the conduit at the gate-house, Lake Cochituate, the number of days it was running at those depths, and the average depth for each month.

1873.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	T'l Ds.
0-10	...	...	...	...	...	...	...	...	...	...	2	...	2
0-11¾	...	...	...	...	...	...	...	...	...	...	1	...	1
1-10¾	...	...	...	...	...	...	...	...	...	...	1	...	1
5-10	...	...	...	8	9	...	...	...	...	...	...	...	17
5-11	...	...	...	...	1	13	...	...	13	31	2	...	60
5-11¾	...	...	...	...	...	1	...	...	...	...	...	...	1
6-0	29	28	31	22	1	3	...	...	...	...	8	31	153
6-0¾	...	...	...	...	1	...	...	...	...	...	...	...	1
6-1	1	...	...	...	...	...	...	...	...	...	...	...	1
6-2	1	...	...	...	...	13	22	...	...	...	...	...	36
6-3¾	...	...	...	...	...	...	1	...	...	...	...	...	1
6-4	...	...	...	...	19	...	...	...	...	...	...	...	19
6-5	...	...	...	...	...	...	...	...	...	...	1	...	1
6-7	...	...	...	...	...	...	2	...	...	...	...	...	2
6-8¾	...	...	...	...	...	...	...	...	1	...	...	...	1
6-9	...	...	...	...	...	...	1	...	...	...	...	...	1
6-11	...	...	...	...	...	...	1	...	...	...	...	...	1
7-0	...	...	...	...	...	...	4	31	2	...	15	...	52
7-2	...	...	...	...	...	...	...	...	2	...	...	...	2
7-4¼	...	...	...	...	...	...	...	...	1	...	...	...	1
7-6	...	...	...	...	...	...	...	...	11	...	...	...	11

Average Monthly Depths.

Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Aver. for year.
6-0	6-0	6-0	5-11½	6-1½	6-0½	6-4¼	7-0	6-8¾	5-11	6-7	6-0	6-2¾

Annual Amount of Rainfall, in Inches, at Lake Cochituate, Boston and vicinity, 1849 to 1873, inclusive.

YEAR.	PLACES AND OBSERVERS.						
	Lake Cochituate, by Supt. of Western Division, B.W.W.	Boston, by J. P. Hall, to 1865, by W. H. Bradley since.	Cambridge, by the Director of the Observatory.	Waltham, by Agent Boston Manufacturing Company.	Lowell, by Merrimac Manufacturing Company.	Lowell, by Locks and Canals Co., J. B. Francis.	Providence, by A. Caswell.
1849	. .	40.30	40.97	40.74	51.09	. .	34.69
1850	. .	53.98	54.07	62.13	45.68	. .	51.48
1851	. .	44.31	41.97	41.00	41.00	. .	43.30
1852	*47.93	47.94	40.51	42.24	42.78	. .	38.58
1853	*55.73	48.86	53.83	45.04	43.92	. .	53.27
1854	43.15	45.71	45.17	41.29	42.08	. .	46.25
1855	34.96	44.19	47.59	40.63	44.89	48.41	39.05
1856	40.80	52.16	53.79	42.33	42.49	45.97	40.97
1857	63.10	56.87	57.92	44.04	49.38	52.02	44.74
1858	48.66	52.67	45.46	37.40	37.73	35.80	44.51
1859	49.02	56.70	. .	48.49	47.51	48.41	45.29
1860	55.44	51.46	46.95	45.97	46.91	46.67	38.24
1861	45.44	50.07	50.14	36.51	43.32	42.95	44.25
1862	49.69	61.06	57.21	46.42	44.26	44.61	50.09
1863	69.30	67.72	56.42	53.66	52.37	57.81	54.17
1864	42.60	49.30	39.46	36.56	38.11	40.64	36.83
1865	49.46	47.83	43.59	35.84	37.38	38.82	44.69
1866	62.32	50.70	. .	43.46	38.18	41.36	46.04
1867	56.25	55.64	41.71	41.40	45.54	45.87	47.04
1868	49.71	64.11	39.89	44.65	47.96	49.58	53.52
1869	64.34	66.28	47.98	47.30	47.30	48.96	47.70
1870	55.89	59.73	41.53	39.40	46.30	48.71	49.02
1871	45.39	48.33	40.56	36.82	44.45	44.17	47.91
1872	48.47	58.04	52.73	45.80	44.32	48.67	48.71
1873	45.43	54.94	46.81	42.58	39.86	45.05	52.56

* By J. Vannevar.

Table showing the Rainfall in Boston for the year 1873, and the days on which it occurred, from observations by Wm. H. Bradley, Esq., Superintendent of Sewers.

Day of Month.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	. . .	. . .	. . .	. . .	. . .	. . .	.20	. . .	.17	. . .	.02	. . .
2	. . .	. . .	. . .	.24	.32	. . .	. . .	.54	. . .	. . .	. . .	. . .
3	.69	. . .	. . .	. . .	1.07	. . .	.04	. . .	. . .	. . .	. . .	.16
4	. . .	.04	.48	. . .	1.09	. . .	. . .	.04	.50	. . .	. . .	. . .
5	1.90	. . .	. . .	.05	. . .	.02	. . .	. . .	. . .	.15	. . .	. . .
6	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .
7	. . .	. . .	. . .	.09	. . .	.03	. . .	. . .	. . .	1.84	. . .	. . .
8	. . .	.71	. . .	. . .	. . .	.08	. . .	. . .	.03	.34	1.91	. . .
9	.44	. . .	. . .	. . .	.47	. . .	. . .	. . .	. . .	. . .	. . .	.12
10	. . .	. . .	.34	.06	.73	. . .	. . .	. . .	. . .	. . .	. . .	. . .
11	. . .	. . .	.46	. . .	.61	.03	. . .	. . .	. . .	. . .	. . .	. . .
12	. . .	. . .	. . .	. . .	. . .	. . .	.11	. . .	. . .	. . .	.54	.64
13	. . .	. . .	. . .	1.77	.18	. . .	. . .	. . .	. . .	. . .	. . .	1.43
14	.08	. . .	. . .	.70	. . .	. . .	. . .	2.51	.08	. . .	. . .	. . .
15	. . .	. . .	. . .	. . .	. . .	.05	. . .	1.20	. . .	. . .	. . .	. . .
16	. . .	1.62	.12	. . .	. . .	. . .	. . .	. . .	.01	. . .	. . .	. . .
17	.90	. . .	. . .	. . .	. . .	. . .	.04	.01	. . .	. . .	.52	. . .
18	.79	. . .	. . .	.72	.03	. . .	1.18	.92	. . .	. . .	2.80	. . .
19	. . .	.03	.04	. . .	. . .	. . .	1.34	.18	1.05	.29	. . .	. . .
20	. . .	. . .	. . .	.12	. . .	. . .	. . .	. . .	.14	2.00	. . .	.66
21	.02	. . .	1.59	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .
22	.27	1.20	. . .	. . .	.42	. . .	. . .	.74	. . .	. . .	. . .	. . .
23	. . .	. . .	. . .	. . .	. . .	. . .	. . .	.24	. . .	. . .	. . .	. . .
24	.96	. . .	. . .	. . .	. . .	. . .	. . .	. . .	.63	. . .	1.50	. . .
25	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	.02	. . .
26	. . .	. . .	.47	.02	. . .	. . .	. . .	. . .	. . .	. . .	. . .	1.02
27	. . .	. . .	. . .	. . .	. . .	. . .	.34	. . .	. . .	.77	. . .	. . .
28	.64	.14	. . .	. . .	. . .	.37	. . .	. . .	. . .	. . .	.03	1.30
29	. . .	. . .	1.02	.04	. . .	.07	. . .	. . .	. . .	. . .	. . .	. . .
30	. . .	. . .	. . .	. . .	. . .	. . .	. . .	.08	.17	. . .	. . .	. . .
31	. . .	. . .	.02	. . .	. . .	. . .	. . .	. . .	. . .	.04	. . .	. . .
Totals .	6.69	3.74	4.54	3.81	4.92	0.65	3.25	6.46	2.78	5.43	7.34	5.33

Total for the year . . . . . 54.94 inches.

SCHEDULE OF PROPERTY AT CHESTNUT HILL RESERVOIR.

1 two-horse express-wagon, 1 single ditto, 1 water cart, 2 two-horse water carts, 2 iron road rollers, 1 single horse pung, 1 two-horse ditto, 1 horse truck, 1 horse power, 1 horse cart, 1 hay wagon, 2 hand carts, 1 pair large wheels, 3 clay mills and shafting, 1 tank, 6 gravel screens, 25 ox-tie chains, 2 7-inch rotary pumps, 2 4-inch ditto, 1 18-inch ditto, 1 house force-pump, 1 stone-crushing machine and castings, 1 blacksmith's forge and tools, 1 derrick and rigging, 4 clay knives, 1 man head, 4 grub axes, 30 picks, 26 shovels, 14 spades, 4 hoes, 26 iron bars, 7 stone hammers, 3 striking hammers, 8 iron rakes, 23 wooden rakes, 4 border knives, 1 root-puller, 5 snaiths, 14 scythes, 3 doz. scythe stones and rifles, 3 lawn-mowers, 1 garden engine, 1 Johnson's pump, 4 hay forks, 8 lanterns, 6 oil cans, 3 reflectors, 8 peat knives, 8 tin dippers, 22 tin candlesticks, 2 bushels grass seed, 18 barrels cement, 64 drills, 14 pails, 18 fire buckets, 13 rattan brooms, 5 wooden rammers, 5 wheelbarrows, 10 ladders, 2 grindstones, 2 jack screws, 1 window brush, 3 paint brushes, 1 whitewash brush, 3 telegraph batteries, 7 rubber coats and caps, 25 pairs rubber boots, 2 horses, 1 Concord wagon, 1 covered ditto, 1 carryall, 3 harnesses, 1 rain gauge, 1 set scales, 1 safe, 12 feet 18-inch Scotch pipe, 42 feet 15-inch ditto, 12 feet 30-inch cement pipe, 1 25 h. p. engine, 1 20 h. p. ditto, 1 12 h. p. ditto, 1 6 h. p. ditto, and pung.

PROPERTY AT LAKE COCHITUATE.

1 extension dining-room table, 1 parlor table, 18 dining-room chairs, 1 oil-cloth carpet, 1 marble wash-bowl, 1 cooking range, 1 air-tight stove, 1 mirror, 1 map, 1 horse, 1 beach wagon, 1 express-wagon, 1 pung, 1 tip-cart, 2 single har-

nesses, 1 cart, 1 buffalo robe, 3 ps. 18-inch copper pipes, 1 18-inch pump, 2 12-inch pumps, 1 7-inch pump, 2 ps. 12-inch copper pipes, 10 picks, 2 grub hoes, 2 iron rakes, 6 hoes, 4 hay rakes, 2 coal shovels, 2 spades, 2 square pointed shovels, 5 long-handle shovels, 4 stop plank hooks, 2 ice hooks, 16 buckets, 12 lanterns, 9 brooms, 8 wheelbarrows, 2 grass hooks, 2 gravel screens, 2 sand sieves, 9 pairs rubber boots, 2 pairs rubber hose, 1 boat, 2 pump frames, 6 hand drills, 1 stone hammer, 2 hand hammers, 1 double pulley, 3 ox chains, 1 engine, 25 h. p., 1 steelyards, 1 rain gauge, 6 iron bars, 1 1 telegraph battery, 1 hand saw, 1 manure fork, 2 hay forks.

PROPERTY AT BROOKLINE RESERVOIR.

1 desk, 2 settees, 1 large stove, 4 stop plank hooks, 1 stove brush, 1 screen brush, 1 coal hod, 1 dust pan and brush, 2 scrubbing brushes, 2 shovels, 1 pick, 1 spade, 1 hay rake, 1 iron rake, 1 border knife, 1 scuffle hoe, 2 corn brooms, 2 floor mats, 2 ladders, 1 water pail, 1 iron bar, 1 oil can, 1 bushel basket, 1 wheelbarrow, 1 sponge, 1 scythe.

Note. — The foregoing Schedule of Property (pp. 42 and 43) should have been appended to the Report of the Superintendent of Western Division, following.

REPORT OF SUPERINTENDENT OF WESTERN DIVISION.

WESTERN DIVISION BOSTON WATER WORKS,
May 1st, 1874.

HON. JOHN A. HAVEN,
President Cochituate Water Board: —

SIR, — I submit the following report for the past year, in compliance with the rules of the Board: —

LAKE COCHITUATE.

My appointment as Superintendent of the Western Division did not take effect until the 1st of July, 1873. At this date the water in the lake stood at 11 feet 1½ inches above the bottom of the conduit. From this time, the water gradually fell to 6 feet 8½ inches on the 5th of October, leaving only 4½ inches above the top of the conduit. Dug and Dudley ponds were both called upon, for a few days, for a portion of their supply, but a heavy rain between the 6th and 8th rendered their further assistance unnecessary and the stop-planks were put in.

From October 5th the lake gained steadily until February 1, 1874, at which time it stood at 12 feet 6½ inches. The water was now allowed to waste until the 14th of February; and on the 22d the lake had risen to 13 feet 1 inch. Water was again allowed to waste until March 3d, the lake at that time standing at 12 feet 8 inches. The stop-planks were put in, and the water rose to 13 feet 1½ inches. On the 13th of April, when the second examination of the conduit took place, the first being in November, and referred

to under the head of conduit. During the twenty-four hours that the water was shut off in April, the lake rose to about high-water mark, or 13 feet 4 inches, at which point it has been kept ever since, a very large amount of water running to waste over the dam during the recent storms.

The grounds and buildings at the lake have been kept in the usual condition.

Some of the fences require to be rebuilt during the present year; and it would be advisable to build a new house for the attendant. While the water was shut off the past month, I had the gates at the gate-house taken out and examined, at the City Engineer's suggestion. Repairs were made upon them as far as we were able, in the short time allowed. A piece of the brass facing was broken from one of the gates, which could not be remedied without sending the valve to the shop. The other gate was made tight. A new water-gauge, consisting of a 12-inch iron pipe and a hundred feet of lead pipe running into the conduit, was secured in position while the water was shut off. The rods are graduated to read from tide marsh level. By this arrangement, we are enabled to gauge the gates to a nicety, and the correct level of the water in the conduit is obtained.

THE CONDUIT.

Owing to the low state of the reservoirs, arising from increased consumption in the city, the conduit has been severely taxed during the past year. From the 28th of July, 1873, until the 17th of September, it has been run under a head of from 7 to 14 inches. The same occurred in November, and again in April, 1874.

Twice during the year the water has been drawn off for examination and repairs. Once in November, for about four days, and again in April, for one day and a half. The dangerous condition of the conduit in certain places has been

thoroughly explained by others, and I will not repeat here what is now so well known. By order of the Committee on the Western Division, a flume has been prepared, to use in case of emergency. It has been stored at Chestnut Hill reservoir.

The waste weirs and culverts are all in good condition. A new set of locks has been placed upon them the whole length of the line. Gauges, to read by floats, and recording the absolute heights of the water above tide, have been placed at the east and west pipe chambers at Charles River. I would recommend that all the timber growing upon the line of the conduit be cut.

CHESTNUT HILL RESERVOIR.

This reservoir is in good condition. The banks late last fall were covered with a heavy coating of manure, and will, I hope, show the effects of it this year. The paved slopes have been kept in good order. The most important improvement that has been made in connection with this reservoir is the increased facility provided for shutting off the water from the 48-inch main in case of accident. Two new gates, mounted on wheels, and worked by an hydrostatic press, were ordered by your Board last year, and are now in place in the effluent gate-house. These gates can be closed by one man in less than half a minute, and one man can raise one gate in three minutes. It has formerly taken three men nearly an hour to perform the same service. The size of the opening is four feet square. We had some difficulty in getting the frames in position, having a head of some twenty-one feet to contend with; but it was accomplished without shutting off the water. A dam of stop-planks, filled with clay, was placed on the reservoir side, and the chambers pumped out and kept dry by a large pump. The gates were built by the Boston Machine Co.

The driveway during the last season was covered with a layer of gravel for over a thousand feet of its length, but there was so much clay in the gravel that it proved unsatisfactory during the winter, and we are now crushing stone to place upon the driveway, intending to use as little gravel as possible. A liberal appropriation has been made by the City Council to put this favorite driveway in good condition this year.

I would recommend that a chimney be built for the effluent gate-house. A fire is required there for more than half the year, and there is at present no place for a smoke-pipe.

BROOKLINE RESERVOIR.

No arrangements can be made for cleaning out this reservoir in the present scarcity of water. New fences are required on Boylston street, and on two sides of the reservoir. New stop-planks have been prepared for this reservoir, and the iron work painted. The town of Brookline last fall raised the grade of Boylston street, rendering the extension of the iron fence upon the wall necessary. This they have partly completed, and have left in an unfinished state ever since. The sidewalk, too, has been unnecessarily obstructed for a long time, and so continues.

Our reservoirs are all at the present time about three feet below high water, and we are trying to fill them by running the conduit under a head.

Annexed is a schedule of property.

Very respectfully yours,

DESMOND FITZGERALD,
Superintendent Western Div. B. W. W.

WATER REGISTRAR'S REPORT FOR 1873.

WATER REGISTRAR'S OFFICE, BOSTON, May 1, 1874.

JOHN A. HAVEN, ESQ.,

President of the Cochituate Water Board: —

SIR, — The following report is made in conformity with the requirements of the ordinance providing for the care and management of the Cochituate Water Works.

The total number of water-takers now entered for the year 1874 is 42,345, being an increase since January 1, 1873, of 1,657.

The total number of cases where the water has been turned off for non-payment of rates during the year is 1,098. Of this number, 918 have been turned on, leaving a balance of 180 still remaining off.

The total amount of water-rates received from April 30, 1873, to May 1, 1874, is . .		$961,658 88
Less amount paid to the city of Charlestown, as per contract		57,194 40
		$904,464 48
Of this amount there was received for water used in previous years the sum of . .	$61,207 00	
Leaving the receipts for water furnished during the financial year 1873 and 1874, the sum of	$843,257 48	
Amount carried forward,		$904,464 48

Amount brought forward,	$904,464 48
In addition to the above there has been received for turning on water in cases where it had been turned off for non-payment of rates, the sum of	1,966 00
	$906,430 48
The increased amount of income for the financial year ending April 30, 1874, over the previous year is	$57,846 21
The total amount of assessments now made for the present year is	$682,000 00
The estimated amount of income from the sales of water during the year 1874 is .	$950,000 00
The expenditures of my office during the year 1873 have been	$22,009 62

The total number of meters now applied to the premises of water-takers is 977. Of this number 637 are $\frac{5}{8}$-inch, 290 1-inch, 39 2-inch, 9 3-inch, 2 4-inch.

The total amount of revenue derived from meters is $240,638.77.

The following table exhibits the class of premises to which meters are attached, together with the amount of revenue received during the year 1873 : —

TABLE SHOWING CLASS OF PREMISES TO WHICH METERS ARE ATTACHED, ETC.

NAME.	CLASS.	5-8 inch.	1 inch.	2 inch.	3 inch.	4 inch.	Indicator.	Total.	REVENUE.
Revere House	Hotel.		3				1	4	$3,000 30
American House	"		1	1				2	2,621 67
Parker House	"	1	4					3	3,297 91
U. S. Hotel	"		3					3	1,962 71
Tremont House	"	1	3					4	2,190 63
Young's Hotel	"	1	2					3	1,089 44
Adams House	"	2	1					3	952 41
Hotel Berkeley	"	1	1	1				3	1,415 48
Marlboro House	"		1					1	826 59
Albion Building	"		1					1	266 87
W. D. Park	"	1						1	81 99
Hotel Pelham	"	1	3					4	647 01
Hotel Boylston	"		1					1	286 42
La Grange House	"	1	1					2	124 84
St. Cloud	"	2						2	131 14
Hotel Clarendon	"		1					1	340 94
Seaver House	"	1						1	97 24
Evans House	"		2					2	320 72
Wm. Pfaff	"	1						1	103 51
Hotel Kempton	"	1	1				1	3	385 97
Hotel Hamilton	"	1	1				1	3	203 86
Hotel Vendome	"		2					2	377 56
Coolidge House	"		5					5	355 56
City Hotel	"	2						2	284 10

TABLE SHOWING CLASS OF PREMISES, ETC. — Continued.

NAME.	CLASS.	5-8 inch.	1 inch.	2 inch.	3 inch.	4 inch.	Indicator.	Total.	REVENUE.
Hancock House	Hotel	1	.	.	.	.	.	1	43 75
Merrimac House	"	1	.	.	.	.	.	1	113 48
Sheridan House	"	1	.	.	.	.	.	1	71 07
Derby House	"	3	.	.	.	.	.	3	238 59
White, Frame & Co	"	1	.	.	.	.	.	1	98 50
Merchants Hotel	"	1	.	.	.	.	.	1	62 13
M. J. Flatley	"	1	.	.	.	.	.	1	65 93
New England House	"	.	1	.	.	.	.	1	165 22
Winthrop House	"	1	.	.	.	.	.	1	178 64
Dooley's House	"	1	.	.	.	.	.	1	41 21
Commercial House	"	2	.	.	.	.	.	2	166 36
Job A. Turner	"	.	1	.	.	.	.	1	164 90
Milliken House	"	3	.	.	.	.	.	3	134 93
Sherman House	"	.	3	.	.	.	.	3	390 21
Everett House	"	.	1	.	.	.	.	1	135 95
Metropolitan House	"	.	2	.	.	.	.	2	357 35
Commonwealth Hotel	"	.	2	.	.	.	.	2	997 16
Thomas L. Robinson	"	1	.	.	.	.	.	1	13 40
St. James Hotel	"	.	4	.	.	.	.	4	1,611 67
Massachusetts House	"	1	.	.	.	.	.	1	32 44
Webster House	"	1	1	.	.	.	.	2	162 07
Mariner's House	"	1	.	.	.	.	.	1	74 96
Robertson House	"	2	.	.	.	.	.	2	95 31
Boston Hotel	"	3	.	.	.	.	.	3	268 94
Creighton House	"	2	.	.	.	.	.	2	210 83
Van Rensselaer	"	.	2	.	.	.	.	2	233 39
Wilde's Hotel	"	1	.	.	.	.	.	1	157 15
Quincy House	"	2	2	.	.	.	.	4	788 28
Marston House	"	1	.	.	.	.	.	1	238 39
Stumcke & Goodwin	"	3	.	.	.	.	.	3	539 91
Pavilion House	"	.	1	.	.	.	.	1	136 92
Norfolk House	"	1	.	.	.	.	.	1	237 70
National House	"	1	.	.	.	.	.	1	92 70

TABLE SHOWING CLASS OF PREMISES, ETC. — Continued.

NAME.	CLASS.	5-8 inch.	1 inch.	2 inch.	3 inch.	4 inch.	Indicator.	Total.	REVENUE.
Phillips House	Hotel	1	.	.	.	.	.	1	28 32
Hotel Marion	"	2	.	.	.	.	.	2	3 91
Dio Lewis	"	2	.	.	.	.	.	2	339 86
Old Colony & Newport R. R. Co.		6	2	2	.	.	.	10	6,048 77
Boston & Albany R. R. Co.		13	7	2	.	.	.	22	10,040 01
Eastern Railroad Co.		1	3	1	.	.	.	5	3,474 19
New York & New Eng. R. R. Co.		.	1	1	.	.	.	2	3,004 82
Boston & Providence R. R. Co.		3	.	3	.	.	.	6	3,219 18
Boston & Maine R. R. Co.		1	3	.	.	.	.	4	1,225 33
Boston & Lowell R. R. Co.		.	3	1	.	.	1	5	1,384 97
Fitchburg R. R. Co.		.	1	1	.	.	.	2	1,021 71
Boston Gas Light Co.		1	4	1	.	1	.	7	14,127 88
South Boston Gas Light Co.		1	1	.	.	.	.	2	326 72
East Boston Gas Light Co.		.	1	.	.	.	.	1	447 72
Roxbury Gas Light Co.		2	1	.	.	.	.	3	274 21
Dorchester Gas Light Co.		.	1	.	.	.	.	1	79 39
Stand. Sugar Refinery, Granite st.		.	.	3	1	.	.	4	11,695 53
Stand. Sugar Refinery, Eastern av.		.	1	1	.	.	.	2	3,301 07
Continental Sugar Refinery		.	.	2	.	.	.	2	1,085 22
Bay State Sugar Refinery		.	.	1	.	.	.	1	2,307 76
Oxnard Sugar Refinery		.	3	.	.	.	.	3	1,451 57
Boston Sugar Refinery		.	.	.	1	.	.	1	7,393 58
Bay State Rolling Mill		.	4	1	1	.	.	6	4,982 02
Norway Iron Works		1	7	.	.	.	.	8	6,561 03
Highland Spring Brewery	Brewery	.	1	1	.	.	.	2	2,763 90
Augustus Richardson	"	.	1	.	.	.	.	1	1,312 34
Wheat & Carberry	"	.	.	1	.	.	.	1	1,009 16
H. & J. Pfaff	"	.	1	.	.	.	.	1	774 97
A. J. Houghton & Co.	"	.	1	.	.	.	.	1	732 51
Gottlieb Burkhardt	"	.	1	.	.	.	.	1	635 31
John Roessle	"	.	1	.	.	.	.	1	327 76
Christian Jutz	"	1	.	.	.	.	.	1	165 44
Henry Souther & Co.	"	1	1	.	.	.	.	2	255 91

TABLE SHOWING CLASS OF PREMISES, ETC. — Continued.

NAME.	CLASS.	5-8 inch.	1 inch.	2 inch.	3 inch.	4 inch.	Indicator.	Total.	REVENUE.
Conrad Decker	Brewery	1						1	149 82
Mt. Washington Brewery Co.	"			1				1	1,353 51
Burton Brewery	"		1					1	363 07
Standard Brewery	"		1					1	180 97
Vincent & Hathaway	Beer Factory		1					1	245 87
Moses Fairbanks & Co.	"		1					1	235 87
Coburn, Lang & Co.	"	1						1	141 59
Comstock, Gove & Co.	"	1						1	95 08
Leonard & Co.	Building		1					1	324 29
Wesleyan Association	"	3						3	240 40
Tremont Temple	"	1	1					2	265 00
S. S. Houghton & Co.	"	1						1	104 61
P. McAleer	"	2						2	185 24
Smith & Porter	"	2						2	358 42
T. H. Carter	"	2						2	225 52
Boston Journal	"		1					1	603 74
John L. Gardner	"	1						1	125 66
Joseph Byers	"	2						2	223 88
Western Union Telegraph Co.	"	1						1	102 19
N. E. Mut. Life Ins. Co., 39 State st.	"		1					1	285 36
" " 70 State st.	"	2						2	74 92
Horticultural Hall	"		1					1	78 44
Suffolk National Bank	"	2	1					3	89 49
Benj. Leeds	"	2						2	124 28
Stone, Bier & Weiss	"	2						2	108 87
John Rayner, heirs	"	2						2	156 57
Otis T. Ruggles	"	2						2	83 87
B. B. Appleton, heirs	"	1						1	177 73
J. W. Merriam	"	2						2	138 32
R. H. Spaulding	"	2						2	137 27
Mrs. Ellen Brooks	"	1						1	83 96
Oriental Tea Co.	"	1						1	93 66
S. D. Hicks	"	2						2	329 25

TABLE SHOWING CLASS OF PREMISES, ETC. — Continued.

NAME.	CLASS.	5-8 inch.	1 inch.	2 inch.	3 inch.	4 inch.	Indicator.	Total.	REVENUE.
A. Wentworth	Building	2	1	.	.	.	.	3	277 82
William Ropes, heirs	"	4	1	.	.	.	.	5	894 87
A. D. Puffer	"	1	. .	.	.	.	.	1	110 21
Eastern Express Co.	"	. .	1	.	.	.	.	1	142 62
Grand Lodge of Masons	"	1	1	.	.	.	.	2	77 26
James W. Rollins	"	1	. .	.	.	.	.	1	131 06
Haley, Morse & Co., 411 Wash. st.	"	2	. .	.	.	.	.	2	19 15
Mass. Institute of Technology	"	. .	1	.	.	.	.	1	294 74
S. N. Brown, Jr.	"	1	. .	.	.	.	.	1	106 71
A. H. Vinton	"	1	. .	.	.	.	.	1	61 98
J. W. Pierce	"	1	. .	.	.	.	.	1	133 51
H. A. Choate	"	1	. .	.	.	.	.	1	106 44
Shepard, Norwell & Co.	"	4	. .	.	.	.	.	4	190 29
D. J. Hastings	"	. .	1	.	.	.	.	1	88 75
C. U. Cotting, 456 Washington st.	"	5	. .	.	.	.	.	5	144 22
Parsons & Stoddard	"	2	. .	.	.	.	.	2	88 66
W. H. Mann	"	2	. .	.	.	.	.	2	79 18
Hallett & Davis	"	1	. .	.	.	.	.	1	37 59
Galvin & Currie	"	. .	1	.	.	.	.	1	206 63
P. Donahoe	"	. .	1	.	.	.	.	1	85 74
Jonas Fitch	"	. .	1	.	.	.	.	1	138 27
Samuel A. Way, heirs	"	2	. .	.	.	.	.	2	70 04
H. C. Stephens	"	1	. .	.	.	.	.	1	152 48
Jordan, Marsh & Co.	"	4	. .	.	.	.	.	4	240 11
G. T. Burnham	"	. .	1	.	.	.	.	1	148 95
G. D. Dows & Co.	"	1	. .	.	.	.	.	1	48 31
Stephen H. Bennett, heirs	"	2	. .	.	.	.	.	2	360 81
J. P. Dimond	"	1	. .	.	.	.	.	1	103 43
Taylor Page	"	1	. .	.	.	.	.	1	85 36
Franklin Evans	"	2	. .	.	.	.	.	2	62 63
Thomas Y. Crowell	"	2	. .	.	.	.	.	2	151 26
J. Zane & Co.	"	2	. .	.	.	.	.	2	182 00
Metropolitan Railroad Co.	"	1	. .	.	.	.	.	1	46 05

TABLE SHOWING CLASS OF PREMISES, ETC. — Continued.

NAME.	CLASS.	5-8 inch.	1 inch.	2 inch.	3 inch.	4 inch.	Indicator.	Total.	REVENUE.
Allen & Woodworth	Building	1						1	44 62
Merchants Exchange	"	1	1					2	489 90
C. U. Cotting, 7 Court sq.	"	1	1					2	106 95
J. J. Stevens	"	2						2	58 28
J. T. Brown & Co.	"	1						1	102 85
J. C. Gray	"	3	1					4	262 80
C. F. Hovey	"	3	1					4	322 92
John Foster	"	1						1	134 86
R. B. Brigham	"	1						1	13 12
M. M. Ballou	"	1						1	161 81
J. M. Smith & Co.	"	1						1	18 62
Charles Rollins	"	1						1	189 66
Adams Express Co.	"	2	1					3	393 78
Jordan, Marsh & Co.	"	1						1	152 25
H. S. Lawrence	"	1						1	108 58
J. M. Beebe	"		1					1	129 99
F. Tudor	"	3						3	133 46
Studio Building		1	2					3	278 04
Boston Post Building		1	1					2	297 96
Traveller Building		2	1					3	187 09
Union Building		5						5	285 91
Wentworth Building		1						1	64 64
Rice Building			1					1	280 01
Carter Building		2						2	115 11
Edmands Building		1						1	96 00
Washington Building		3						3	208 51
Niles Building			2					2	321 84
Palmer's Building		1						1	119 93
Joy's Building		3						3	99 11
Sears' Building		2	1					3	303 42
Advertiser Building		1						1	168 26
Charity Building		2						2	69 54
Massachusetts General Hospital		2	4	1				7	1,136 05

TABLE SHOWING CLASS OF PREMISES, ETC. — Continued.

NAME.	CLASS.	5-8 inch.	1 inch.	2 inch.	3 inch.	4 inch.	Indicator.	Total.	REVENUE.
City Hospital		3	4	.	.	.	.	7	2,482 69
Lunatic Hospital		3	4	.	.	.	.	7	964 63
New England Hospital		. .	1	.	.	.	.	1	226 95
Notre Dame Academy		1	. .	.	.	.	.	1	67 06
St. Mary's Institute		2	. .	.	.	.	.	2	15 37
House of the Angel Guardian		1	. .	.	.	.	.	1	110 30
Home for Catholic Children		. .	1	.	.	.	.	1	277 86
Church Home		1	. .	.	.	.	.	1	202 08
Temporary Home		1	. .	.	.	.	.	1	144 84
Somerset Club House		2	. .	.	.	.	.	2	395 10
Union Club House		1	. .	.	.	.	.	1	193 66
Temple Club		. .	1	.	.	.	.	1	83 38
Boston Music Hall		2	. .	.	.	.	.	2	264 22
City Hall		1	2	.	.	.	.	3	397 67
State of Massachusetts	State House	2	1	.	.	.	.	3	220 06
Howard Athenæum		1	. .	.	.	.	.	1	45 56
Boston Theatre		1	4	.	.	.	.	5	217 55
Globe Theatre		2	1	.	.	.	.	3	71 76
Boylston Market		5	. .	.	.	.	.	5	310 35
Washington Market		1	1	.	.	.	.	2	302 21
Suffolk Market		4	. .	.	.	.	.	4	237 99
Franklin Market		. .	1	.	.	.	.	1	147 59
Williams Market		3	. .	.	.	.	.	3	103 79
Tremont Market		. .	1	.	.	.	.	1	88 47
Union Market		1	. .	.	.	.	.	1	31 70
Medical College		1	. .	.	.	.	.	1	106 39
Boston College		1	. .	.	.	.	.	1	132 36
Mary Stearns	Boarding	2	. .	.	.	.	.	2	108 46
Mrs. J. R. Hill	"	2	. .	.	.	.	.	2	198 30
Mrs. R. W. Prescott	"	1	. .	.	.	.	.	1	86 81
J. H. Baker	"	1	. .	.	.	.	.	1	85 92
Mrs. W. A. Colson	"	2	. .	.	.	.	.	2	65 58
F. E. Ruggles	"	2	. .	.	.	.	.	2	96 80

TABLE SHOWING CLASS OF PREMISES, ETC. — Continued.

NAME.	CLASS.	5-8 inch.	1 inch.	2 inch.	3 inch.	4 inch.	Indicator.	Total.	REVENUE.
A. Carr	Boarding	1						1	$43 70
W. A. Prescott	"	2						2	124 00
Geo. Odin, heirs	"	1						1	48 21
James F. Goodwin	"	2						2	98 88
Mrs. A. P. Cleverly	"	2						2	76 70
D. C. Knowlton	"	1						1	99 30
Mrs. C. Farley	"	1						1	69 23
Mrs. C. Cummings	"	1						1	93 59
James Knowlton	"	1	1					2	279 36
Ruel Philbrick	"	2						2	83 21
E. B. Osgood	"		1					1	163 21
S. V. Loring	"	1						1	58 32
D. L. Morse	"	1						1	81 27
William Evans	Model	3						3	235 07
E. Cutler, 147 Kneeland st.	"	2						2	68 33
" 146 "	"	2						2	118 45
Michael Doherty	"	5						5	197 16
Job A. Turner, 17 Webster av.	"	1						1	67 24
" 6 Melrose pl.	"	1						1	46 70
Peter McFarland	"	1						1	79 85
J. Collins	"	2						2	179 97
D. L. Webster	"	1					1	2	167 68
Thomas Cantlon	"	1						1	167 30
W. B. Mendum	"	2						2	86 06
Brown & Wilcox	Factory	3						3	304 03
Jacob J. Storer	"	1						1	14 79
Joseph Nickerson & Co.	"		1					1	386 25
J. Morrill, Jr. & Co.	"	1						1	49 35
Pearson Bros. & Co.	"		1					1	385 48
J. Morse	"	1						1	45 86
L. Whittaker	"	1						1	62 04
C. Wright & Co.	"	1						1	95 41
Howard Watch and Clock Co.	"		2					2	501 98

TABLE SHOWING CLASS OF PREMISES, ETC.— Continued.

NAME.	CLASS.	5-8 inch.	1 inch.	2 inch.	3 inch.	4 inch.	Indicator.	Total.	REVENUE.
Haley, Morse & Co.	Factory	1						1	$203 45
Roxbury Carpet Co.	"		1					1	986 89
W. G. Train	"	1						1	151 08
Back Bay Co.	"		2					2	185 31
S. S. Putnam	"	1	1					2	317 23
John Preston	"	1						1	57 82
Union Elastic Goods Co.	"	2						2	129 30
Thomas H. Dunham	"		1					1	38 01
Mason & Hamlin	"	3						3	395 10
William Carleton	"	3						3	199 93
Boston Star Collar Co.	"	1						1	100 57
Murphy, Leavens & Co.	"	1						1	146 38
H. M. Richards	"	1						1	173 93
Charles E. Kershaw	"	1						1	301 71
E. Strain & Co.	"	1						1	33 13
Hasse & Pratt	"	1						1	337 53
D. R. Whitney	"	1						1	179 09
H. F. Miller	"	1						1	46 11
Stephen Smith & Co.	"	1						1	173 10
Chickering & Sons	"		3					3	432 91
Mace & Keyes	"	1						1	55 35
Bagnall & Loud	"	1						1	85 68
Boston Car Spring Co.	"		1					1	230 33
Wassineus & Whittle	"	1						1	122 49
A. Folsom & Sons	"		1					1	146 87
Dwinell & Co.	"	1						1	77 33
Standard Vinegar Works	"	1						1	. . .
J. M. Cook, estate	"		1					1	28 92
Hallett & Davis	"		1					1	168 87
S. G. Taylor & Co.	"	1						1	300 43
S. D. & H. W. Smith	"		1					1	209 55
James W. Vose & Co.	"	1						1	54 90
Daniels, Harrison & Co.	"	1						1	493 38

TABLE SHOWING CLASS OF PREMISES, ETC.— Continued.

NAME.	CLASS.	5-8 inch.	1 inch.	2 inch.	3 inch.	4 inch.	Indicator.	Total.	REVENUE.
S. & A. R. Whittier	Factory	1	. .	.	.	.	.	1	$141 80
W. P. Emerson Piano Forte Co.	"	. 1	. .	.	.	.	.	1	141 73
Hallett & Cumston	"	1	. .	.	.	.	.	1	123 11
P. Lally	"	. .	1	.	.	.	.	1	367 69
J. Hertkorn	"	1	. .	.	.	.	.	1	5 67
S. D. & H. W. Smith	"	. .	1	.	.	.	.	1	180 37
S. G. Underhill	"	1	. .	.	.	.	.	1	155 20
Am. Moulded Collar Co.	"	1	. .	.	.	.	.	1	189 46
Kittredge & Co.	"	. .	1	.	.	.	.	1	26 14
John Clark	"	1	. .	.	.	.	.	1	122 40
Christopher Blake	"	1	. .	.	.	.	.	1	168 20
G. H. Dickerman	"	1	. .	.	.	.	.	1	121 92
J. L. Ross	"	1	1	.	.	.	.	2	104 70
Vance & Co.	"	1	. .	.	.	.	.	1	99 54
J. W. Lowe	"	1	. .	.	.	.	.	1	52 13
F. King & Co.	"	1	. .	.	.	.	.	1	141 65
Nesmith & Chapin	"	1	. .	.	.	.	.	1	25 32
Peet Valve Co.	Machinist	1	. .	.	.	.	.	1	388 23
G. F. Waldron	"	1	. .	.	.	.	.	1	30 71
A. K. Young	"	2	. .	.	.	.	.	2	159 82
Harrison Loring	"	2	1	.	.	.	.	3	112 95
S. A. Woods & Co.	"	1	. .	.	.	.	.	1	230 86
Holmes & Blanchard	"	. .	1	.	.	.	.	1	153 34
Geo. F. Blake & Co.	"	. .	1	.	.	.	.	1	528 28
E. H. Ashcroft	"	. .	1	.	.	.	.	1	181 14
L. M. Ham	"	2	. .	.	.	.	.	2	261 89
Eyelet Tool Co.	"	1	. .	.	.	.	.	1	58 61
Shorey & Co.	"	2	. .	.	.	.	.	2	250 97
L. A. Bigelow	"	. .	1	.	.	.	.	1	257 28
William Evans	"	3	1	.	.	.	.	4	255 09
Smith & Lovett	"	1	. .	.	.	.	.	1	95 50
Am. Tool and Machine Co.	"	. .	1	.	.	.	.	1	224 38
J. Souther & Co.	"	1	. .	.	.	.	.	1	86 86

TABLE SHOWING CLASS OF PREMISES, ETC.— Continued.

NAME.	CLASS.	5-8 inch.	1 inch.	2 inch.	3 inch.	4 inch.	Indicator.	Total.	REVENUE.
Boston Machine Co.	Machinist	1	1	.	.	.	.	2	$481 77
Hersey Brothers	"	1	.	.	.	.	.	1	112 58
Hinckley, Williams & Co.	"	1	3	.	.	.	.	4	923 14
Boston Screw Co.	"	.	1	.	.	.	.	1	3 69
U. S. Manuf. Co.	"	.	1	.	.	.	.	1	283 02
J. A. Maynard	"	1	.	.	.	.	.	1	57 89
Atlantic Works	"	.	.	1	.	.	.	1	446 81
Geo. T. McLaughlin	"	2	.	.	.	.	.	2	261 43
So. Boston Iron Co.	Foundry	3	2	2	.	.	.	7	1,064 55
Boston Iron Co.	"	.	.	.	.	.	.	1	343 28
Holmes & Blanchard	"	.	1	.	.	.	.	1	72 21
Dyer & Gurney	"	1	.	.	.	.	.	1	77 00
William Blake & Co.	"	.	1	.	.	.	.	1	296 94
Whiting Foundry Co.	"	1	.	.	.	.	.	1	6 45
Tremont Foundry Co.	"	1	.	.	.	.	.	1	19 53
Fulton Iron Foundry Co.	"	.	1	.	.	.	.	1	116 33
John Lally	Boilermaker	1	.	.	.	.	.	1	127 25
Downer's Kerosene Oil Co.	Oil Works	2	.	1	.	.	.	3	1,963 94
F. H. Jenney	"	.	2	.	.	.	.	2	257 11
Wilkinson, Carter & Co.	"	.	1	.	.	.	.	1	172 88
Farrar, Pierce & Canterbury	"	.	1	.	.	.	.	1	381 80
Kidder, Vaughan & Co.	"	.	1	.	.	.	.	1	45 49
Bowker, Torrey & Co., Bowker st.	Marble Works	1	1	.	.	.	.	2	1,023 18
Bowker, Torrey & Co., Foundry st.	"	1	1	.	.	.	.	2	470 15
Torreys & Co.	"	2	1	.	.	.	.	3	1,504 90
C. E. Hall & Co.	"	2	1	.	.	.	.	3	1,152 87
W. C. Taylor & Co.	"	1	.	.	.	.	.	1	215 84
A. Wentworth & Co.	"	4	.	.	.	.	.	4	1,104 06
Richard Power & Son	"	2	.	.	.	.	.	2	507 10
Carew & Walsh	"	2	.	.	.	.	.	2	134 75
E. F. Meaney	Stone Yard	2	1	.	.	.	.	3	665 22
Geo. F. Chapin & Co.	Vinegar Works	1	.	.	.	.	.	1	57 82
C. D. Brooks	Pickle Factory	.	1	.	.	.	.	1	135 34

TABLE SHOWING CLASS OF PREMISES, ETC.— Continued.

NAME.	CLASS.	5-8 inch.	1 inch.	2 inch.	3 inch.	4 inch.	Indicator.	Total.	REVENUE.
W. K. Lewis & Bros., 211 Broad st.	Pickle Factory	1						1	$99 08
W. K. Lewis & Bros.	"	1						1	76 13
B. M. Clark	"	1						1	70 75
E. T. Cowdey & Co.	"	2						2	205 24
Francis Baker	Salt Works	1						1	84 81
Fobes, Hayward & Co.	Confectionary	1						1	166 28
Chase & Co	"	2						2	248 96
Charles Copeland	Restaurant	4						4	483 94
Messenger Bros.	"	1						1	126 90
Mrs. G. F. Harrington	"	1						1	170 16
Marston & Cumo	"	1						1	151 29
Edward B. Pierce	"	3						3	363 26
Alex. Crawford	"	2						2	51 34
J. Brown & Co.	"	1						1	115 10
Egerton & Kendall	"	1						1	89 98
S. E. Kendall & Co.	"		1					1	6 31
Geo. Fera	"	2						2	243 46
D. T. Copeland	"		1					1	354 48
F. E. Weber	"	1						1	113 23
R. B. Brigham	"		1					1	480 95
W. S. Mathews	"	1						1	122 36
Pearson, Tibbetts & Co.	"	1						1	148 64
R. R. & J. S. Higgins	Saloon	2						2	326 25
Atwood & Bacon	"	1						1	75 61
B. S. Wright & Co.	"	2						2	178 68
Felton & Stone	Distillery		1					1	850 91
Jonas H. French	"		1					1	388 92
C. H. Graves	"	1						1	113 95
Rand, Avery & Frye	Printing	2						2	273 78
J. A. Whipple	Photographer		1					1	113 50
James Edmand & Co.	Fire Brick	1						1	88 03
E. L. Perkins			1					1	76 27
A. Hale & Co.	Rubber Works	1						1	47 65

TABLE SHOWING CLASS OF PREMISES, ETC. — Continued.

NAME.	CLASS.	5-8 inch.	1 inch.	2 inch.	3 inch.	4 inch.	Indicator.	Total.	REVENUE.
Suffolk Wood Preserving Co.		1						1	$41 53
W. H. Swift & Co.	Fertilizers	1	1					2	126 93
W. T. Bradley	"		1					1	92 99
B. Randall	"	1						1	85 85
Committee on Bathing	Baths			1				1	779 16
C. W. Blodgett	"		1					1	267 05
W. A. Holland	"		3					3	253 89
Boston Dye Wood & Chemical Co.	Chemicals		2					2	2,358 38
Hodges, Coolidge & Co.	"		1					1	497 62
M. Crocker & Co.	"	2	1					3	411 93
G. W. & F. Appleton	"	1						1	16 93
Preston & Merrill	Extracts			1				1	443 96
Geo. S. Gill & Co.	Tannery	1						1	177 05
F. S. Merritt	"	1						1	155 07
Guild, White & Co.	"	1						1	158 52
R. W. Ames & Son	"	1						1	63 69
Schayer Bros.	"	1						1	19 35
Boston Forge Co.			1					1	583 40
Boston Lead Co.		1	1					2	497 49
National Bridge Co.		1	1					2	118 25
Am. Steam Safe Co.			1					1	131 23
Suffolk Glass Co.		1						1	303 00
Washington Pipe Works			1					1	257 04
East Boston Pottery			1					1	141 43
Curtis, Knowles & Co.	Bacon Works	1						1	22 68
Simpson's Dry Dock Co.		1						1	224 91
Cunard Steamship Co.					1			1	4,472 47
Munson & Co.	Sup. Locomotives		1					1	327 72
Union Freight Railway					1			1	56 49
J. B. Crosby	Carving	1						1	118 69
Farrar, Follett & Co.	Wire Works		1					1	578 87
Metropolitan Railroad Co.	Stables	6	4					10	1,745 27
So. Boston Railroad Co.	"		2					2	858 16

TABLE SHOWING CLASS OF PREMISES, ETC.— Continued.

NAME.	CLASS.	5-8 inch.	1 inch.	2 inch.	3 inch.	4 inch.	Indicator.	Total.	REVENUE.
Draper & Hall	Stables	3						3	$579 83
Martin Hayes	"	2						2	132 32
Draper Bros.	"	1						1	31 17
Wilbur & Locke	"	2						2	7 01
J. Austin Rogers	"	1						1	90 81
Norfolk House Stable	"	1						1	85 37
Nathend & Foster	"	1						1	148 13
Jennings & Noyes	"	1						1	194 20
Robert H. Douglas	"	1						1	98 59
A. L. Wright	"	1						1	55 96
C. & J. F. Baker	"	2						2	51 33
W. P. Pierce	"	1						1	29 33
J. Pratt	"	1						1	71 29
L. E. Hartshorn	"	1						1	29 02
A. Garcelon, 108 Chestnut street	"	1						1	139 93
A. Garcelon, 87 Chestnut street	"	1						1	40 68
J. P. Barnard, Chestnut street	"		1					1	216 14
J. P. Barnard, Joy street	"	3						3	287 60
C. S. Godfrey	"	1						1	50 81
G. W. Sherburn	"	1						1	52 08
Highland Railway Co.	"	2						2	429 39
I. H. Ayers	"	1						1	64 82
A. Goss	"	1						1	66 85
Adams Express Co.	"	1						1	149 42
John Eaton, Jr.	"	1						1	76 73
F. H. Merritt	"	1						1	11 66
L. W. Porter & Co.	"	1						1	106 38
Warner & Richardson	"	2						2	239 77
George M. King	"	1						1	144 76
Milo Whitney	"	1						1	73 34
Daniel Wood	"	1						1	118 13
T. D. Sullivan	"	1						1	38 51
Ham & Co.	"	2						2	78 12

TABLE SHOWING CLASS OF PREMISES, ETC. — Continued.

NAME.	CLASS.	5-8 inch.	1 inch.	2 inch.	3 inch.	4 inch.	Indicator.	Total.	REVENUE.
F. E. Russell	Stables	1						1	$68 31
Blanchard & Snow	"	1						1	43 56
G. D. Pattee, Fleet street	"	1						1	28 04
G. D. Pattee, Hanover street	"	1						1	96 30
James Jellison	"	1						1	52 41
John Miller	"	1						1	24 44
J. N. Harwood	"	1						1	121 12
H. C. Nims, Mason court	"	3						3	125 92
Geo. F. Bonney & Co.	"	2						2	57 64
J. A. Riedell & Co.	"	2						2	116 18
H. W. Eames & Co., Berkeley st.	"	1						1	32 31
H. W. Eames & Co., Stanhope st.	"	1						1	81 51
A. B. Atherton & Co.	"	1						1	243 12
Geo. S. Johnson & Co., 680 Wash.	"		1					1	120 84
Geo. S. Johnson & Co., 774 Wash.	"	1						1	40 93
T. Thaxter	"	1						1	53 02
James Monroe	"	1						1	57 18
Miller & Robinson	"	2						2	221 09
L. L. Howland	"	2						2	53 51
P. E. Murray	"	1						1	72 07
J. E. Maynard	"	1						1	149 80
John Rice	"	3						3	251 96
Geo. S. Fogg & Co.	"	2						2	277 80
Dean & Brown	"	1						1	71 58
John F. Bowers	"	1						1	90 11
Moses Coleman & Son	"	1						1	63 56
Boston Hotel Coach Co.	"	2						2	451 99
U. S. & Canada Express	"	1						1	28 05
Eastern Express Co.	"		1					1	82 46
J. O. Barnard	"	1						1	22 98
Riverside Club Stable	"	1						1	39 53
Club Stable, Chardon street	"	1						1	33 76
Beacon Club Stable	"	1						1	62 74

TABLE SHOWING CLASS OF PREMISES, ETC.— Continued.

NAME.	CLASS.	5-8 inch.	1 inch.	2 inch.	3 inch.	4 inch.	Indicator.	Total.	REVENUE.
Club Stable, 75 Chestnut street	Stable	1						1	$50 99
B. F. Wrightington	"	1						1	74 41
Clark & Brown	"	2						2	100 41
H. C. Nims, 8 Lime street	"	1						1	13 37
John Sawyer	"	1						1	64 94
Cilley & Stimson	"	1						1	66 85
Club Stable, 44 Joy street	"	1						1	46 37
Gray, Bell & Bailey	"	1						1	72 70
Joel Gray	"	1						1	96 16
Asa Critchett	"	1						1	42 61
Patrick Morrison	"	1						1	30 34
L. A. Noyes	"	1						1	89 54
Met. R. R. Co., Meridian street	"	1						1	33 62
A. S. Eaton	"		1					1	57 22
A. Thompson	"	1						1	28 47
J. H. Hathorne	"	1						1	227 66
Henry K. Wing	"	1						1	175 08
National Tube Works			2					2	2,750 89
Globe Nail Works			1					1	528 36
Grover & Baker S. M. Co., Alb'y st.			1					1	268 53
Grover & Baker S. M. Co., Wash st.			3					3	664 59
Farrington & Hunnewell	Silver Smith	1						1	79 93
Boston Wheat & Bread Co.		1						1	172 14
B. M. Cunningham	Laundry	1						1	300 69
S. H. Sanborn	Bindery	1						1	90 50
Byam, Carleton & Co.	Watch Factory	1						1	25 50
Knowles, Freeman & Co.	Fish House	2						2	287 71
Manley Howe	Chemist	1						1	76 76
L. Prang & Co.	Chromos	1						1	130 49
Cook, Jordan & Morse	Engine	1						1	95 88
Briggs & Robinson	Mill	1						1	202 66
Carpenter, Woodward & Morton	"		1					1	438 28
S. B. Stebbins	"		1					1	227 74

TABLE SHOWING CLASS OF PREMISES, ETC. — Continued.

NAME.	CLASS.	5-8 inch.	1 inch.	2 inch.	3 inch.	4 inch.	Indicator.	Total.	REVENUE.
Boston City Flour Mills	Mill	. .	1	.	.	.	.	1	$932 31
D. Dyer	"	. .	1	.	.	.	.	1	28 26
J. J. McNult	"	. .	2	.	.	.	.	2	911 15
Jewett & Pitcher	"	. .	1	.	.	.	.	1	425 06
Manson & Peterson	"	2	. .	.	.	.	.	2	324 45
W. W. Bennett	"	1	. .	.	.	.	.	1	291 01
W. L. Sturtevant	"	1	. .	.	.	.	.	1	194 38
McQuesten & Fogg	"	1	. .	.	.	.	.	1	83 02
J. F. Paul & Co.	"	1	2	.	.	.	.	3	428 02
Bugbee & Spooner	"	1	. .	.	.	.	.	1	295 10
J. A. Robertson	"	1	. .	.	.	.	.	1	258 51
J. M. Lincoln	"	. .	1	.	.	.	.	1	109 89
Chauncey, Page & Co.	"	. .	1	.	.	.	.	1	339 52
S. H. L. Pierce	"	1	. .	.	.	.	.	1	303 13
A. J. Stearns & Son	"	. .	1	.	.	.	.	1	21 29
H. Parker & Son	"	1	. .	.	.	.	.	1	231 85
J. F. Keating	"	1	. .	.	.	.	.	1	31 39
S. C. Calef	"	1	. .	.	.	.	.	1	147 93
Watson & Bisbee	"	1	. .	.	.	.	.	1	111 34
D. A. Reed	"	1	. .	.	.	.	.	1	261 08
Boston Drug Mill	"	. .	1	.	.	.	.	1	75 44
Laming & Drisco	"	1	. .	.	.	.	.	1	339 61
Cressey & Noyes	"	1	1	.	.	.	.	2	548 88
Smith & Jacobs	"	1	. .	.	.	.	.	1	272 06
B. D. Whitcomb	"	1	. .	.	.	.	.	1	450 30
F. B. Jenkins	"	2	. .	.	.	.	.	2	134 40
A. C. Hopkins	"	1	. .	.	.	.	.	1	22 54
R. S. Gilmore	"	1	. .	.	.	.	.	1	37 68
Clapp & Co.	"	1	. .	.	.	.	.	1	1 39
Glover and Jones	"	1	. .	.	.	.	.	1	103 18
Boston Dye Wood Mill	"	1	. .	.	.	.	.	1	114 02
H. T. Litchfield, Agt	Steamboats	. .	. .	.	1	.	.	1	196 24
David Snow, Jr., & Co.	Fish House	2	. .	.	.	.	.	2	38 61

TABLE SHOWING CLASS OF PREMISES, ETC. — Continued.

NAME.	CLASS.	5-8 inch.	1 inch.	2 inch.	3 inch.	4 inch.	Indicator.	Total.	REVENUE.
J. H. Chadwick	House & Fountain	1	.	.	.	.	.	1	$78 84
Horatio Harris	"	1	.	.	.	.	.	1	145 18
W. V. Hutchings	Fountain	1	.	.	.	.	.	1	75 33
J. C. Nichols	Wharf purposes	1	.	.	.	.	.	1	30 34
John Dyer		1	.	.	.	.	.	1	4 70
J. E. Taylor	Ship Building	1	.	.	.	.	.	1	12 97
House of Correction		.	.	.	.	1	.	1	3,753 89
Suffolk County Court House		.	1	1	.	.	.	2	1,306 75
Suffolk County Jail		2	3	.	.	.	.	5	470 47
Directors of Public Institutions.		2	2	1	.	.	.	5	943 32
South Ferry		.	.	1	1	.	.	2	2,776 98
North Ferry		.	.	.	1	.	.	1	2,020 25
Police Station No. 1		1	.	.	.	.	.	1	183 51
" No. 2		1	.	.	.	.	.	1	92 53
" No. 3		.	1	.	.	.	.	1	140 30
" No. 4		1	.	.	.	.	.	1	160 17
" No. 5		1	.	.	.	.	.	1	128 06
" No. 6		1	.	.	.	.	.	1	99 82
" No. 7		1	.	.	.	.	.	1	150 52
" No. 8		1	.	.	.	.	.	1	50 73
" No. 9		1	.	.	.	.	.	1	57 25
" No. 10		1	.	.	.	.	.	1	69 74
Cedar Grove Cemetery		.	.	.	1	.	.	1	142 12
First Church	Organ	.	.	.	.	.	1	1	62 10
King's Chapel	"	.	.	.	.	.	1	1	79 00
St. Mary's Church	"	.	1	.	.	.	.	1	51 68
Tremont-street M. E. Church	"	.	1	.	.	.	.	1	49 75
South Cong'l Church	"	.	.	.	.	.	2	2	23 15
Church of the Advent	"	.	1	.	.	.	.	1	156 88
First Universalist Church	"	.	.	.	.	.	1	1	30 85
Columbus-av. Universalist Church	"	.	1	.	.	.	.	1	23 65
Shawmut Cong'l Society	"	.	.	.	.	.	1	1	38 46
Church of the Holy Redeemer	"	.	1	.	.	.	.	1	30 86

TABLE SHOWING CLASS OF PREMISES, ETC. — Continued.

NAME.	CLASS.	5-8 inch.	1 inch.	2 inch.	3 inch.	4 inch.	Indicator.	Total.	REVENUE.
St. James Church	Organ	.	.	.	.	.	1	1	$102 29
Brattle-street Church Society	"	.	.	.	.	.	1	1	13 84
Bancroft & Boyden	Elevator	.	1	.	.	.	.	1	215 53
John L. Gardner	"	.	.	1	.	.	.	1	22 60
Job F. Bailey	"	.	1	.	.	.	.	1	171 68
George O. Hovey	"	.	.	1	.	.	.	1	9 44
Sidney Squires	"	.	1	.	.	.	.	1	134 50
Davis & Co.	"	.	.	.	.	.	1	1	48 18
J. C. Tucker & Co.	"	.	.	.	.	.	1	1	42 36
E. Williams	"	.	.	.	.	.	1	1	3 60
A. W. Clapp	"	.	.	.	.	.	1	1	5 01
Rufus Gibbs	"	.	.	.	.	.	1	1	2 73
James Tucker & Co.	"	.	.	.	.	.	1	1	10 32
Boston Rubber Shoe Co.	"	.	.	.	.	.	1	1	5 88
Henry G. Denney	"	.	.	.	.	.	1	1	2 09
William Claflin	"	.	.	1	.	.	.	1	25 74
Goldthwait, Snow & Knight	"	1	.	.	.	.	.	1	9 82
Mrs. S. S. Dunn	"	.	1	.	.	.	.	1	10 55
Thomas Richardson, heirs	"	.	.	1	.	.	.	1	. . .
Barker Bros. & Gardner	Shop	1	.	.	.	.	.	1	. . .

The following table exhibits the yearly revenue from the sale of Cochituate water since its introduction into the city October 25th, 1848 :—

Received by Water Commissioners, as per Auditor's Report, in 1848,						$972 81
From January 1, 1849, to	January 1,	1850,				71,657 79
" "	1850,	"	1851,			99,025 45
" "	1851,	"	1852,			161,052 85
" "	1852,	"	1853,			179,567 39
" "	1853,	"	1854,			196,352 32
" "	1854,	"	1855,			217,007 51
" "	1855,	"	1856,			266,302 77
" "	1856,	"	1857,			282,651 84
" "	1857,	"	1858,			289,328 83
" "	1858,	"	1859,			302,409 73
" "	1859,	"	1860,			314,808 97
" "	1860,	"	1861,			334,544 86
" "	1861,	"	1862,			365,323 96
" "	1862,	"	1863,			373,922 33
" "	1863,	"	1864,			394,506 25
" "	1864,	"	1865,			430,710 76
" "	1865,	"	1866,			450,341 48
" "	1866,	"	1867,			486,538 25
" "	1867,	"	1868,			522,130 93
" "	1868,	"	1869,			553,744 88
" "	1869,	"	1870,			597,328 55
" "	1870,	"	1871,			708,783 68
" "	1871,	"	1872,			774,445 70
" "	1872,	"	1873,			806,102 51
" "	1873,	"	1874,			859,436 55
" "	1874, to	May 1,	1874,			666,217 67
						$10,705,216 62

Statement showing the number of houses, stores, steam engines, etc., in the City of Boston, supplied with Cochituate water to the 1st of January, 1874, with the amount of water-rates paid for 1873: —

27,738	Dwelling-houses	$436,854 98
29	Boarding-houses	1,462 50
836	Model-houses	23,862 97
14	Lodging-houses	525 67
15	Hotels	1,055 00
5,221	Stores and Shops	51,118 38
411	Buildings	18,745 26
514	Offices	4,442 08
43	Printing-offices	759 42
24	Banks	361 50
32	Halls	581 17
1	Museum	41 00
29	Private Schools	546 00
16	Asylums	980 00
4	Hospitals	220 00
40	Greenhouses	566 25
95	Churches	1,340 51
5	Markets	1,030 00
117	Cellars	764 67
681	Restaurants and Saloons	14,330 54
8	Club-houses	235 13
1	Bath-house	26 00
35	Photographers	1,059 22
13	Packing-houses	560 59
1,607	Stables	12,836 74
42	Factories	1,274 50
6	Bleacheries	134 50
1	Brewery	109 00
	Amount carried forward,	$575,823 58

Amount brought forward,		$575,823 58
4	Beer Factories	243 14
109	Bakeries	922 91
1	Boat-house	49 00
12	Freight-houses	209 17
5	Gasometers	48 00
5	Ship-yards	68 33
2	Dry docks and engines	50 00
47	Shops and engines	2,671 63
28	Stores and "	1,210 75
15	Factories "	945 50
5	Printing "	317 65
4	Bakeries "	193 50
5	Ship-yards "	75 00
5	Buildings "	709 00
1	Mill "	110 00
11	Stationary "	772 22
96	Hoisting and pile-driving engines	1,095 50
17	Armories	275 00
1,302	Hand-hose	7,725 00
14	Fountains	190 00
58	Tumbler-washers	870 00
57	Water-pressures	285 00
3	Laundries	70 00
1	Commercial College	26 00
1	Laboratory	50 00
1	Milk Company	50 00
	Boston & Albany R. R. Co. Gravel Train	115 08
	Custom-house	150 00
	Post Office	80 00
	Branch Post Offices	39 00
	Filling Cisterns	28 00
Amount carried forward,		$595,467 96

	Amount brought forward,	$595,467 96
2	Steam-dredging Machines	72 88
1	Steam Scow	22 67
1	Ice Company (washing ice)	30 00
	Pumping Machine	10 00
78	Steamboats	13,995 15
1	Lock-up	6 00
	Office (City scales)	11 00
	Police Court (Adams street)	6 00
	Probate building	75 00
	House of Reception	10 00
33	Fire-engines, hose and hook-and-ladder houses	730 00
2,606	Fire hydrants	46,908 00
96	Reservoirs	1,728 00
	Insurance Brigade	26 00
	Fire boat "Wm. Flanders"	200 00
369	Public Schools	3,238 00
	City Stables	203 75
	Washing-carts	125 00
	Offal station	225 00
	Faneuil Hall	40 00
	Public Library	50 00
2	Branch Libraries	28 00
	Paving Department	150 00
	" " shop and stable	52 00
	Common Sewer Department	250 00
	" " " Office	6 00
	Deer Park	10 00
	Public Urinals	120 00
	Street Sprinkling	500 00
	Public Garden	25 00
	Drinking-fountains	920 00
	Amount brought forward,	$665,241 41

Amount carried forward,		$665,241 41
	Steamer "Henry Morrison" . . .	200 00
	Steamer "Samuel Little" . . .	100 00
2	Small-pox Hospitals	100 00
1	Cemetery	5 42
1	Depot	34 00
4	Railroad Stations	44 50
	Building purposes	10,151 38
	Metered Water (9 months) . .	183,559 84
		$859,436 55

Statement showing the number and kind of Water Fixtures contained within the premises of Water-takers in the City of Boston to January 1, 1874, as compared with previous years.

1871.	1872.	1873.	
6,041	6,452	6,768	Taps. These have no connection with any drain or sewer.
58,946	64,454	67,089	Sinks.
27,856	30,632	32,690	Wash-hand basins.
9,130	10,289	11,580	Bathing-tubs.
13,077	14,863	16,222	Pan water-closets.
14,104	14,891	17,081	Hopper water-closets.
241	278	248	" " " pull.
258	213	223	" " " self-acting.
434	503	589	" " " waste.
619	602	590	" " " door.
2,470	2,755	2,445	Urinals.
10,743	11,826	12,779	Wash-tubs. These are permanently attached to the building.
741	714	734	Shower-baths.
468	445	419	Private hydrants.
578	641	712	Slop-hoppers.
79	96	112	Foot-baths.
145,786	159,654	170,281	

WATER SUPPLY AND PREVENTION OF WASTE OF WATER.

The city ordinance for the care and management of Cochituate water imposes upon the Registrar, in addition to other duties, a constant supervision over its use.

The sources for a supply of water are in the province and power of the City Council, but when provision for this is made, its distribution, its remuneration for it under the rules, with its economy of use, including the saving of waste, paid or unpaid for, is regarded as necessarily within the province of this department. The most serious and embarrassing of these duties arise from the enormous amount of waste water. It is serious from the fact that it threatens at no distant day to interfere with the absolute prime necessities of this community; it is enormous from the fact that waste shows in figures an amount equal to one third of the total supply, and it is embarrassing because efficient and adequate means for preventing this waste are withheld from the proper department which should deal directly with its causes. Other cities have been imperatively compelled to deal with this subject, and have effectually reduced this loss from waste to a minimum by simple and reasonable measures, producing no complaint from consumers, because unobjectionable in character, and incurring trifling cost.

From the nature of the case, the city itself is the party who can enforce economy in the use of water, without in the least effecting its free and generous use by the citizens for domestic purposes, and as a matter of course for sanitary, ornamental and all proper requirements.

The domestic consumer, drawing from twenty-five to fifty gallons a person daily, and the larger consumer in any of the varied calls for water, heeds not, nor can they be expected to heed the fact, that, in the aggregate, one third of the supply drawn is positively wasted, not at all necessary, but simply a waste, which can be prevented without being

felt by consumers; indeed, without the knowledge of anybody, and this aggregate is from five to six millions of gallons daily.

This question is not only a matter of profit and loss in money, but the question of a short supply of water, a real famine in this prime article, enforcing the terrible necessity of cutting off its employment in the manifold industries it promotes, in order to supply the household.

The constant reiteration upon this subject for twenty years in water reports, it is feared, may have dulled apprehensions; also it is to be feared that unworthy motives among real-estate owners, such as an unwillingness to make small renewals and changes in objectionable fixtures, have prevented attention to this subject; be this as it may, this department, with its full knowledge and absolute convictions of its importance, cannot acquit itself of due responsibility without presenting, again and again, the contingency which threatens our water supply.

Causes of waste water and preventive measures.

In City Document No. 134, under date of January 7th, 1874, the Registrar had the honor to report for the department on the "causes of waste, and the changes needed to remedy it." In that report, with its titles and statistics, to which a reference is now respectfully asked, the permanent, serious, and continual causes of the waste of Cochituate water were placed under the following heads: —

The use of hopper closets; the so-called "self-acting closets;" the use of hand hose for the purpose of irrigation; bad plumbing material and bad plumbing work; and the steady run of water, which is suffered in winter, to prevent freezing; much of the waste under this last-named head is chargeable to cheap and indifferent plumbing.

The remedy for these main causes was then urged, and is

again urged to be solely from additional ordinances, stringent in their action, and carefully considered, whereby the Water Board shall be enabled by law to so supervise all the means of use of Cochituate water that waste shall be the rare exception, and not as now the general rule.

Next to this a revision of the water tariff is urged, together with an adjustment of the present inequalities in rates.

The advantage of meter measurements, so fully illustrated in my late report, will enter largely into any proper consideration of a change in rates. The manifest justice as well as essential importance of at once acting upon this subject cannot be more forcibly put, than by simply stating that this enormous waste of Cochituate water resolves itself, after all, into two items, namely, waste owing to design, and waste owing to carelessness.

INSPECTION AND RENEWALS IN LIVERPOOL, WITH RESULTS.

Since making my report in January, I have been kindly furnished by Mr. James P. Kirkwood with a manuscript copy of a report (see Appendix) of the Water Engineers of Liverpool, England, on the prevention of waste in water in that city.

It is highly interesting and valuable, because it treats of a state of circumstances on this important matter precisely analogous to those existing in Boston. That city, unlike this, is divided into districts, each of which can be isolated in its water service from every other.

This plan is not feasible with us, but in Liverpool it has enabled their Water Board, under suitable legal authorization, to test in single districts, containing a population of 5,000 and upwards, through remedial agency of close inspection, repairs and renewals of all fittings, and also of introducing approved ones.

A system of late-at-night inspection is also organized for

the purpose of discovering leaks in hou se-pipes and fixtures and supply pipes.

It is stated that the leakage from street pipes, although old and needing extensive renewals, bears a very small proportion to the total waste, which is attributed to exactly the same class of causes which occur in Boston.

It is refreshing to note, in this Liverpool report, the opportunity provided by ordinance for thorough examinations for waste, and its causes, and its perfect results. Among numbers of cases which are reported, I take one as an example of thousands, probably, in Boston, which we are powerless to reach.

The case is this: A house in Great Crosshead street was found to be using 46 gallons a day for each person; the fixtures were inspected, and it was found that a valve in the water-closet was out of order, allowing a small and unobserved stream to flow; on this being repaired, the consumption was reduced to nine gallons a day for each person.

Under the head of "Test Districts," the Liverpool engineer gives a table showing the quantity used per head, under the old intermittent system of 8 to 10 hours' daily supply. Second, the quantity used when the districts were first placed on constant service. Third, the present consumption with constant source, after means to prevent waste had been instituted.

No. of District.	Population.	Former intermittent supply.	Former constant supply.	Present constant supply. Average per week.
1. Henry Edwards st.	2,134	18	35	6.6
2. Charters st. . . .	2,285	14½	24	13.66
3. Hatton Garden st.	2,574	23	40	19.19
4. Bispham st. . . .	1,540	11½	19	13.37
5. Cockspur st. . . .	967	22¼	38¼	14.39
6. Gascoyne st. . . .	1,534	18½	33	11.46
7. Plumbe st.	2.570	31	55	17.28
8. Leeds st.	827	17¼	45	13.51
9. Barrastre st. . . .	1,824	14½	26	10.27
10. Midghall st. . . .	1,826	20¼	29	10.77
11. Burlington st. . .	5,798	18½	28	12.85
12. St. Paul st.	899	24¼	37	17.54
13. Harrison st. . . .	3,399	18½	33	12.77
14. Paul st.	838	24	41	10.74
Average		19.59	33.55	13.32

The results of these tests in 14 districts of Liverpool was a saving, wholly due to inspection, repairs, and renewals, of 627,251 gallons daily, or 229,000,400 gallons yearly, which, estimated at the rate of the cost of water, say nine pence a thousand gallons, amounted to £8,587 sterling per annum.

It must be borne in mind that the above table shows the saving in only 14 districts of that city, and including a population of less than 30,000 out of 500,000, the latest population of Liverpool. Now, the analogy is good for Boston, and is as conclusive an argument as could be presented in favor of a similar course of measures to prevent waste in this city.

It is striking to observe in this valuable report, how the various causes of waste, from precisely the same defects, etc., etc., are detailed in the same way and manner as have been set forth from time to time in our own documents, and, of course, the remedies are similar.

One remark upon the above table is made by the engineer, which should be especially noted; he says that the first district, Henry Edwards street, was more thoroughly dealt with than any other; 219 taps were changed, and the result was a low and steady rate of consumption. As will be seen in the table, 35 gallons a day per head was reduced to a trifle over six gallons.

In conclusion, the engineer says "that the average domestic consumption of water in Liverpool, under the intermittent system, is 24 gallons per head, per day; and now that in 14 districts a constant supply is given, since inspection and renewals, etc., etc., the average is reduced to 13 gallons. This average does not include water sold by meter measurement for trade purposes.

The close of the report is in these words: "The results have been eminently satisfactory; and there is every indication that, as different classes of property are reached, they will become more so; although, until the proposed Parliamentary powers are obtained, there must always be a large amount of waste."

We are certainly at liberty to draw from the foregoing, that our British brethren are alive to the subject of waste water; that they cannot afford it, and, moreover, that it can be prevented.

Furthermore, so essential has economy in the use of water become, that powers even beyond those which have produced the astonishing saving which has been shown, are now sought in Parliament. In view of all this, can we in Boston afford further delay, and is it not of pressing consequence that we should move at once, and to the point, in the face of a wicked waste of water, which imperils so many interests?

INCREASING USE FOR WATER AS A MOTIVE POWER, AND FOR FIRE PROTECTION.

Stand-pipes as a means of instantly combating fire by the help at hand are getting to be regarded as indispensable fixtures in large warehouses and other structures; and although they are not to be considered as an additional drain upon the supply, yet their efficiency is to the last degree dependent upon a good pressure in the street mains, and this cannot be depended upon in the face of thousands of petty wasting flows of water from the mains.

The introduction of these stand-pipes should be encouraged; they save insurance, a private gain, but nevertheless a public one. Again, in preventing great conflagrations, the benefit cannot be estimated.

Now, one of the strongest encouragements to their general use is, that they can be depended upon for instant pressure.

Next as a motive power in the arts and trade purposes.

If water can be supplied abundantly, and with certainty, it is almost incalculable the advantages which this use will promote in the future, and it should be borne in mind that the gain in the water revenues must keep pace and be commensurate with such increased use.

The use of water power for elevators is now largely introduced; it is more economical, less objectionable and offensive in working than steam power, and diminishes greatly the risk from fire.

Inventions now in progress propose still further to enlarge the capacities of water as a motive power in cities; besides this, the calls for its supply in various sorts of handicraft is constantly increasing.

This sale of water is and promises to become a large source of revenue to the city; but in fear of any doubt of a

constant supply for these objects, and in the knowledge that these interests must suffer on behalf of domestic call, must prevent a full development in this direction.

Boston as a centre of manufactures, representing also a large and varied production within her own corporate boundaries, cannot afford to imperil any opportunity from an unpardonable and needless waste of so simple a resource of wealth as water.

It is beyond the province of this report to amplify on this topic, but I cannot be unmindful of the great possibilities which the sale of water for other than domestic uses more and more opens to view, and the manifest prosperity to the city suggested thereby.

HAND-HOSE.

Extra use of water by hand-hose cannot be depended upon the coming season, as must appear from the conditions of our supply.

Since the large territorial augmentation of the city, numerous and extensive gardens have been brought within reach of the Cochituate; also considerable sections of farming land, and, as detailed in my report of January 7th, City Document 134, hand-hose were used to water acres of garden and tillage land, at the same rates of charge that the down-town citizen paid for washing his sidewalk. This is but another inequality of the present water tariff, but hardly more glaring than will be found to exist under common circumstances in the use of water.

CONDITIONS OF THE DEMAND AND OF THE SUPPLY OF WATER.

The average daily consumption of Cochituate water for the past year has been 18,000,000 of gallons daily, a quantity equal to the full capacity of the present conduit. If subjected

to pressure, this amount might be increased to 20,000,000 or 22,000,000 daily; but it would not be prudent so to do.

The annual increase of consumption is at the rate of 8 per cent. Should mains be laid in the West Roxbury and Brighton districts, additional supply must be furnished unless authority is given to stop the present waste, in which case, five to six millions of gallons can be spared from existing sources.

The time estimated to realize increased resources of water from Sudbury river is four to five years. To the cost of this must be added (if this waste is continued) the sum of $500,000 to $1,000,000 for new mains from the Chestnut Hill reservoir for distribution in the city.

In view, then, of the natural increase of the demand for water, together with the new uses to which it is being put as a motive power, for stand-pipes and manifold requirements in the arts and trades, as before stated, it will not be prudent for the city to rest content with its present resources for water.

Any extension of water source outside the old districts of the city, of course, will demand new resources; but, considering the water question as it stands, without regard to any extension of service to new districts, that is to say, dealing with the city, as it was of old territorially, the natural increasing demand must be supplied, and it can be so from only one of two sources: —

First: a reinforcement from Sudbury river or elsewhere.

Secondly: by saving the present waste.

The necessity of economy, which has above been shown to have overtaken the city of Liverpool, must, sooner or later, be forced upon Boston; and as the former city has wisely met it effectually, and at trifling cost, without inconvenience to any, so may we, and the department would be derelict of duty not to state it.

The fear is that Boston will not *begin* the practice of an economy of waste, which must be inevitable, until vast sums of money shall have been spent, loss of trade endured, and in other ways more or less suffering.

Respectfully submitted,

WM. F. DAVIS,
Water Registrar.

Borough of Liverpoool.

REPORT OF THE BOROUGH AND WATER ENGINEER,

AS TO

PREVENTION OF WASTE OF WATER, RESTORATION OF CONSTANT SERVICE, AND WASTE WATER-METERS.

The Engineer has the honor to submit the following statement of the measures which have been adopted for the prevention of waste, and the restoration of constant service in fourteen districts, selected for experimental purposes.

The districts in question extend from Byrom St. and Scotland Road to Hatton Garden, Key St. and Old Hall St., and from Dale St. to Burlington St. They comprise 5,403 houses and a population of 31,000 persons.

The first step taken in each district was to attach a meter to the main pipe, in order to measure the quantity of water used; readings of the indexes were and are still taken at 6 A. M. and 6 P. M. daily, occasionally during the night, and in some cases hourly. These readings form a useful and interesting record of the varying demands upon the water, the extent of waste, and the influence of operations for its prevention. After connecting a meter to a district the conditions of supply were left unchanged until a fair average had been obtained of the consumption under the intermittent system; constant service was then introduced and continued without interruption for some time; these preliminary facts having been placed on record, measures for the prevention of waste were commenced, and the effect of each operation upon the consumption noted. Waste Water Inspectors were sent

to examine carefully and describe in detail all the pipes and fittings in every house, and to ascertain the number of inhabitants; Night Inspectors were employed to examine for external indications of waste, and by sounding stopcocks to discover defects in pipes; the defects reported were vigorously followed up, and notices served where repairs devolving upon the owners or occupiers were required. In several of the streets special examinations of the sewers were made, and contributed materially to the detection of leakages.

The first efforts to diminish waste by external plumbing work were made in connection with the fixing of stand-pipes in courts, where the taps were inside of the houses; a measure participated in by the Health Committee on sanitary grounds. The separate taps were disconnected, the old and generally light and defective pipes supplying the taps were taken up, and new piping was laid from the mains. In districts such as Henry Edwards st. and Charters st., where courts are numerous, the action produced material results; but it was found that branch pipes to trough closets, and to front houses adjoining the courts, which had not been interfered with, were constantly bursting, and it became necessary, in order to make the work in the courts effectual, to renew all those branches so as to clear away as much as possible of the old piping. This course has since been pursued systematically wherever stand-pipes have been laid. In districts where courts are comparatively few, the alterations in connection with the erection of stand-pipes had very little influence in reducing the consumption.

During the progress of these works frequent leakages were discovered in the street pipes, both of lead and iron, which, throughout the districts were known to be for the most part old and shallow; it was obviously important to place the corporation pipes in a sound condition, while calling upon owners and occupiers to repair defects upon private property; an examination was therefore made of all the lead communica-

tion pipes, and where necessary they have been taken up, and strong, new pipes laid at a proper depth from the surface, while in several streets the iron pipes have been entirely renewed; at the same time stopcocks have been attached to each lead pipe, so that the supply can be controlled from the street, and the water at once shut off in the event of a breakage with very little inconvenience.

The renewal of street pipes has merely been the concentration at a particular time, and the systematic performance of works which must, in any event, have been carried out in a short time.

The following statement shows the length of piping taken up and laid in connection with the work already described: —

	Old Pipe taken up. Feet.	New Pipe laid. Feet.
In connection with stand-pipes in courts within the 14 districts . . .	39,267	49,384
In connection with stand-pipes in courts outside the 14 districts . . .	10,851	15,041
In streets, relaying service-pipes .	14,934	16,156
Total lead pipe	65,052	80,581

The first item includes piping to trough closets and branches to front houses, referred to above. The defects in the pipes taken up were numerous; their character, and the general condition of the piping, may be judged from the specimens which have been preserved, and may be seen at the Engineer's office.*

NIGHT INSPECTIONS.

Shortly after the fixing of the first district meter, a system of night inspections was commenced, and proved to be so productive in the discovery of leakages that it has been continued until the present time. There are two inspectors en-

* Full particulars of the cost of these operations were given in the Engineer's report of 21st Oct., 1873, on the expenditure in connection with the erection of stand-pipes, and the prevention of waste water.

gaged upon the night duty, and they report an average of 15 cases per night. By means of the stopcocks they are enabled to hear even a slight trickling of water from a pipe or tap at a considerable distance. One inspector and two laborers are fully employed in following up and tracing during the day the cases thus brought under notice. So far, the Night Inspectors have been confined entirely to the test districts. The following is an analysis of the reports received from them up to the 31st ultimo. The nature of the defects is given as ascertained by the subsequent day examinations: —

Cocks	345
Ball cocks	103
Water-closets	223
Pipes	465
Trough water-closets	56
Taps left open	85
Stopcocks	65
Stand-pipes	100
Hydrants, ferrules, plugs, etc.	61
Meters	4
Total	1507

SEWER EXAMINATIONS.

In four of the districts where considerable waste from the street pipes was believed to take place, useful results have been obtained by night examinations of the sewers. When the ventilation and cleansing of the sewers has been completed, systematic and periodical examinations may be made, and there is no doubt such a course will lead to the discovery of a great deal of waste which now takes place unperceived.

HOUSE–TO–HOUSE INSPECTION.

Until recently two inspectors have been employed, with the occasional assistance of others, in house-to-house visits for the examination of fittings in these districts. Returns have been prepared which show the number and character of the various kinds of taps and fittings in every house. Where slight defects have been met with, the inspectors have themselves effected the necessary repairs, but where the defects have been of a more serious description the usual notices have been served on the persons responsible.

A source of waste deserving of special mention is an arrangement which is, unfortunately, very common in these districts, of flushing water-closets by means of a simple tap, and a pipe laid direct from the main or from a supply cistern; scarcely less objectional are cisterns containing only single valves. The taps or valves are frequently left open, and large volumes of water flow to waste. Although the tenants are usually careful to close the taps or valves when the inspectors are near, no fewer than 88 such taps have been found open. The course adopted has been to cut off the supply, and serve a notice upon the landlord or tenant to provide a double-valve cistern of aproved pattern.

The following Table is a summary of the defects discovered by the Waste-Water Inspectors, in each of the Districts, from the time of fixing the metres until the end of October: —

TITLE OF DISTRICT.	NOTICES ISSUED FOR DEFECTS.					REPAIRS EFFECTED BY INSPECTORS.					
	Cocks	Ball Cocks	Wat'r Closet	Pipes.	Total.	Cocks.	Ball Cocks	Wat'r Closet	Pipes.	Total.	Total. Noticed and re-paired.
Henry Edward st.	31	5	9	118	163	2	. .	5	. .	7	170
Charters st. . . .	55	12	25	95	187	8	3	. .	. .	11	198
Hatton Garden .	72	30	91	131	324	30	20	7	3	60	384
Bispham st. . . .	26		6	66	98	6	2	1	2	11	109
Cockspur st. . .	47	30	64	126	267	45	10	11	5	71	338
Gascoyne st. . .	82	8	30	63	183	9	4	5	1	19	202
Plumbe st. . . .	75	19	81	106	281	32	5	7	. .	44	325
Leeds st.	25	3	16	41	85	6	. .	1	. .	7	92
Banastre st. . .	33	7	24	58	122	10	2	5	1	18	140
Midghall st. . . .	33	4	30	46	103	21	1	1	. .	23	136
Burlington st. .	96	11	101	189	397	37	4	3	. .	44	441
St. Paul's sq. . .	43	20	12	30	105	4	. .	2	. .	6	111
Harrison st. . .	89	21	61	117	288	33	10	11	12	66	354
Paul st.	16	. .	4	49	69	6	. .	. .	2	8	77
Total	713	5	555	1232	2665	253	58	55	28	394	3,076

HOUSE METERS.

In order to ascertain the consumption under various circumstances, special meters have been attached to houses of different classes, and the results have been tabulated. The following instances will illustrate the value of the proceeding: —

A meter was fixed at a house in Great Crosshall street, assessed at £25. The consumption was found to be at the rate of 46 gallons per head per day. An inspection of the fittings was made, and all appeared to be satisfactory, but a closer examination resulted in the discovery that the valve

of the water-closet cistern (one of the old form) was out of order, and that water was flowing almost noiselessly down the overflow pipe into the drain. The leak was stopped; a new cistern obtained, and the consumption reduced to $7\frac{1}{2}$ gallons per head per day.

In Johnson street, at a lodging-house assessed at £10, the consumption was found to be very variable, ranging from 70 to 7 gallons per head per day. This variation and excess were attributed to the fact that the water-closet was supplied from a common tap, although it was never found to be actually open. The landlord was requested to erect a proper cistern, did so, and the consumption at once became steady at a rate of about 12 gallons per head per day.

OFFICE SUPPLIES.

In connection with this subject reference may be made to metres recently attached to three blocks of offices, outside of the test district, viz., the Queen's Insurance Buildings, Walmer Buildings and Brown's Buildings.

The first readings of the meters showed that water was being used at the following rate: —

Queen's Insurance Buildings, about 80 gallons per head per day. Walmer Buildings, about 23 gallons per head per day. Brown's Buildings about 32 gallons per head per day.

The undue consumption appears to arise chiefly from the urinals and water-closets. On examination the fittings were found to be generally in good order, but of a very wasteful character.

The presence of the inspectors exercised a wholesome influence, and the consumption has been considerably reduced, but continues to be far more than it ought to be. The average extending over 41 days has been, —

In Queen's Insurance Building,	$21\frac{1}{2}$	per head per day.
In Walmer Buildings,	13	" " " "
In Brown's Buildings,	$20\frac{1}{2}$	" " " "

It must be remembered that most of the persons included in this calculation are only day tenants, and consume water at their residences in addition to what is used in their offices.

RESULTS OBTAINED IN TEST DISTRICTS.

Having given an outline of the measures adopted for the prevention of waste, it now remains to show their effect on the consumption of water. The following statement gives, —

1st. The quantity used per head, per day, under the old intermitted system of eight to ten hours' daily supply.

2d. The quantity used when the districts were first placed on constant service.

3d. The present consumption with constant service.

The figures are averages of several days.

No. District.	Population.	Former intermittent supply.	Former constant supply.	Present constant supply. Average for week ending 17th Nov.
1. Henry Edward st.	2,134	18	35	6.6
2. Charters st. . . .	2,285	14½	24	13.66
3. Hatton Garden . .	2,574	23	40	19.19
4. Bispham st. . . .	1,540	11½	19	13.37
5. Cockspur st. . . .	967	22¼	38¼	14.39
6. Gascoyne st. . . .	1,534	18½	33	11.46
7. Plumbe st.	2,570	31	55	17.23
8. Leeds st.	827	17¼	45	13.51
9. Banastre st. . . .	1,824	14½	26	10.27
10. Midghall st. . . .	1,826	20¼	29	10.77
11. Burlington st. . .	5,798	13½	28	12.85
12. St. Paul sq. . . .	899	24½	37	17.54
13. Harrison st. . . .	3,399	18½	33	12.77
14. Paul st.	833	24	41	10.74
Average . . .		19.59	33.55	13.32

The average saving in the districts, as they at present stand, is, therefore

Gallons per head per day.

From former intermittent service . . . 6.27
= 194,407 gals. per day, and to 71,000,000 gals. per annum.

From former constant service 20.23*
= 627,251 gals. per day, and to 229,000,000 gals. per annum.

CONDITION OF THE STREET PIPES.

By closing the stopcocks on the lead service-pipes, and preventing all use of water in the district, it is evident that any water passing through the meter must be flowing to waste under the streets. This test has been applied in twelve of the districts, with the results stated below: —

* The value at 9d. a thousand gals. of water, saved between former intermittent and present constant service, is £2,662 per annum, and between former constant service and present constant service, £8,587 per annum.

DISTRICT.		Stopcocks shut and Taps tied. Lowest reading Rate per hour. Gallons.	Rate per head per day.
Henry Edward st.	3d February.	180	2.0
" " "	25th April.	80	.9
Charters st.	13th February.	288	2.7
" "	28th October.	486	5.0
Hatton Garden	2d April.	1,140	12.5
" "	29th May.	750	7.0
" "	7th November.	411	3.83
Bispham st.		22	0.34
Cockspur st., reduced district		Meter stopped.	All tight.
Gascoyne st.	17th June.	240	3.75
" "	28th October.	Experiments repeated, but interrupted, and results not satisfactory.	
Plumbe st.	14th October.	405	3.8
Leeds st.	16th April.	146	4.35
" "	14th October.	55	1.6
Banastre st.	2d July.	96	1.26
St. Paul's sq.	11th June.	340	9.0
" " " half district	28th October.	48	2.3
Harrison st.	27th August.	360	2.5
Paul st.	17th June.	42	1.2

NIGHT READINGS.

Readings of the meters are taken by the night inspectors in the districts where they are engaged, and give excellent indications of the extent of waste by showing what quantity of water is being used at a time when cisterns ought to be full and the inhabitants at rest. Subjoined is a statement of readings at various dates : —

Water passing through the District Meters between the hours of 1 and 4 o'clock, A. M.

District.	Former Night Readings.		Lowest Night Readings.		Latest Night Readings. (Special.)	
	Date.	Rate per head per day. Gallons.	Date.	Rate per head per day. Gallons.	Date.	Rate per head per day. Gallons.
1. Henry Edward st.	February	23.0	July	0.75	Oct. 27	2.7
2. Charters st. . .	"	18.0	. . . .	. . .	" 25	8.6
3. Hatton Garden .	April 3	28.0	July 5	11.0	" 29	10.0
4. Bispham st. . . .	May 16	17.2	" 26	4.5	" 27	6.7
5. Cockspur st. . .	June 2	23.7	Aug. 25	4.0	" 23	7.1
6. Gascoyne st. . .	" 14	21.7	July 8	3.0	Nov. 25	7.5
7. Plumbe st. . . .	May 13	20.0	Oct. 22	10.3	" 20	7.0
8. Leeds st.	June 27	11.6	Aug. 1	3.4	Oct. 28	5.2
9. Banastre st. . .	" 17	10.5	July 4	3.1	" 27	5.2
10. Midghall st. . . .	July 7	4.0	Oct. 16	4.7	Nov. 26	2.8
11. Burlington st. . .	" 16	18.2	" 10	5.96	Oct. 10	5.9
12. St. Paul's sq. . .	June 20	18.7	Aug. 15	11.0	Nov. 19	10.7
13. Harrison st. . . .	" 18	14.5	Sept. 11	3.3	" 25	5.8
14. Paul st.	May 21	17.1	" 10	2.9	Oct. 28	3.7

The "rate per head per day" shows what the consumption would be in 24 hours, assuming it to continue at the same rate as when the observations were made.

PRINCIPAL SOURCES OF WASTE.

The several operations described have afforded valuable evidence of the causes of waste, and the most effectual means of preventing it. From the daily records which have been kept of the consumption, the results obtained under various conditions and circumstances can be compared, and any increase or decrease in the quantity used during the day or

night may be immediately seen. It has been found that the leakages from street pipes bear only a small proportion to the total waste. Although many of the distributing mains are very old, worn and corroded, and break at the least disturbance, the number of actual defects discovered in them has been few.

The chief sources of waste have proved to be private pipes and fittings. Nearly all the private piping hitherto examined has been found too light for the ordinary pressure, and often in a very bad condition. Unskilful attempts have been made to repair defects, while joints of imperfect and unsound character, cisterns and taps of faulty construction, and water-closets without proper regulating apparatus, have been very general. After the alterations that have been made in compliance with waste-water notices, there are still in these 14 districts 852 water-closets, and about 2,000 taps which are contrary to the present regulations. There are 275 water-closets supplied by common taps, 239 water-closets supplied by single valves, and 338 by old regulating cisterns. The corporation have at present no power to order the removal of such objectionable fittings except when they are seen to be actually wasting water. In such cases, care is taken that the regulations are strictly complied with.

By vigilant inspection a great deal has been done in this direction, and it is mainly to these efforts that the reduction in consumption is due. In the districts where the greatest number of alterations in private pipes and fittings have been made, the minimum consumption has been reached. Henry Edward street district has been more thoroughly dealt with than any others. 219 taps have been taken out of the cellars of courts and adjoining front houses in favor of self-closing stand-pipes. The result is that the consumption is very low and very steady. For the past three months the average daily quality used has been at the rate of 8.47 gallons per head, and for the last month the average consumption has

been $6\frac{3}{4}$ gallons per head per day. As a contrast to Henry Edward street, the district known as Plumbe street shows the increased difficulty of overcoming waste where the same sweeping changes cannot be made. The courts being much fewer, the proportion of renewals effected by the Corporation men on private property has been correspondingly smaller. The number of objectionable water-closets here, is 139.

It is also to be observed that, in districts containing houses of a better class, and where there are many business premises, as in Plumbe street, and Hatton Garden, the consumption is invariably higher than in a low-class district. A considerable quantity of water is used for trade purposes and for horses, which is included in the consumption per head given in the table, and must be allowed for when a comparison is made.

The stand-pipes do not of themselves appear to have had much influence in diminishing waste. In a district (Paul street) where the courts were supplied by means of common taps, the average consumption was about the same as in districts where stand-pipes had been erected. The Paul-street district has, within the last month, been similarly treated, and no marked change in the consumption produced, excepting that the variations from day to day are less, which is doubtless owing to the stand-pipe being self-closing, and the waste consequent on a tap being occasionally left open stopped.

WASTE-WATER METERS.

About eighteen months ago a plan was prepared, showing the division of the Borough of Liverpool into 300 districts, the whole of the water fittings in each of which were commanded by a single service-main.

It was at that time suggested, that if the water in each such main were caused to pass through a meter, the various steps for the systematic reduction of waste might be proceeded

with in the most economical and efficient manner. It was believed that when once the districts had been reduced to a proper rate of consumption, that rate could without difficulty be maintained by systematic reading of the meters, and by sending into the districts in which the consumption had unduly risen, the Waste-Water Inspectors, who formerly spent their time equally on good and bad grounds. The cost of the meters would, however, have been very great; and the actual saving capable of being effected by them was not at that time understood.

It was, therefore, decided to try the experiment at first with 14 districts.

The value of the results has far surpassed the most sanguine expectations, as the figures already quoted show; and it may be safely stated that such results could not have been obtained without the meters.

The great cost of the ordinary piston meters, and the fact that, although they register the total quantities between any two observations, they do not register the quantities passing through the mains at any required time when an observation is not being made, induced the engineer to give his attention to the design of a meter which could be constructed at a small cost, and which would fulfil the special objects of a waste-water meter.

The four-inch meter designed for this purpose has the following properties: —

1. It can be constructed for less than one-fifth the price of the piston meters at present in use.

2. It can be fixed, including the cover, for less than one seventh the cost of chambers and fixing for the ordinary meter.

3. It is absolutely self-registering; that is, it registers on a diagram the quantity of water flowing through the main at every moment, instead of the total quantity between any two observations. The minimum night reading is such, a dia-

gram is especially useful, as it indicates almost exactly the quantity of waste. Such information can only be obtained from an ordinary meter — and then but indifferently — by watching and counting the strokes during the night.

4. It distinguishes the variable waste due to taps and other water-fittings left running from the comparatively constant waste due to leaks in pipes.

5. A single diagram may be taken for any required length of time up to seven days, and when applied to a district of 1,000 to 2,000 persons, it indicates distinctly the closing and opening of every separate tap. It is, moreover, equally sensitive at high and low velocities.

6. It may be safely stated that its accuracy is much less liable to change than that of a meter constructed on the principle of direct quantitative measurements, because it depends chiefly upon the accuracy of the dimensions of certain fixed parts, and not upon the maintenance of the accuracy of the oints of moving parts, or upon the condition of cup-leathers, or other packing, as is usually the case.

7. The meter does not present the usual and objectionable obstruction to the motion of the water, the reduction of pressure probably never exceeding four or five ounces per square inch.

ADDITIONAL DISTRICTS UNDER TEST.

Two districts have been commanded by waste-water meters for a sufficient time to show the value of their indications in practice. One of these includes the greater part of the Exchange Buildings, Hackings Hey, Williams street, Tempest Hey, and Tithebarn street, between Moorfields and Exchange street. The district consists principally of offices, and contains a population of 263 residents, and 1,110 non-residents, who consume water elsewhere. Total, 1,373.

The diagram being left on for three days before any inti-

mation had been given to the consumers gave the following results: —

	Gallons per head per day (Constant service.)	Average rate during the night.
Oct. 4th and 5th,	58.4	50.4
" 5th and 6th,	59.5	52.44
" 7th and 8th,	59.7	50
Average,	59	50.95

After the census of the district had been taken, and some superficial repairs made, the day reading came down to 26, and the night reading to 15 gals. per head. It is not for a moment to be supposed that this great change was brought about by the few repairs made; on the contrary, there is every reason to believe that it was due chiefly to the greater care exercised by keepers and others in closing taps at night, after the visits of the Waste-Water Inspectors. Indeed, the details of the diagrams confirm this view. The saving in this case would probably not continue long, unless regulating cisterns were substituted for the present apparatus.

OPERATIONS OUTSIDE THE TEST DISTRICTS.

When the re-piping work had been completed in the 14 districts mentioned, it was necessary, in order to avoid breaking up the staff, to employ the men in a similar manner in districts unprovided with meters. This course is by no means satisfactory, as the result of the operation cannot be tested. The Engineer, therefore, strongly recommends that meters be applied at once to a sufficient number more of the service mains to avoid going over the grounds twice.

CONCLUSIONS.

The average domestic consumption of water in Liverpool under the intermittent system is about 24 gals. per head per day.* In the first 14 districts of low-class property that

* This includes all water used from the service mains, except that sold by meter measurement for trade purposes.

average was 19.59, and yet constant supply has been given, and the consumption reduced to 13.32, or more than ten below the general average.

On the other hand the tests on office property have shown that the consumption is much above the average, notwithstanding the fact that more than three-fourths of the people use water elsewhere. In the Exchange district already mentioned, the average intermittent consumption was about 6 gallons above the general average, and was easily converted to constant service, and reduced to only one above that average.

Isolated meter tests, conducted in districts containing a better class of dwelling-houses, have indicated that the consumption is equal to about the general average, and this might reasonably be expected from the averages in the two first classes.

Hitherto, then, the results have been eminently satisfactory, and there is every indication that as different classes of property are reached, they will become even more so, although, until the proposed Parliamentary powers are obtained, there must always be a very large amount of waste, and a great expenditure in only partially successful efforts to keep it down.

(Signed) GEORGE F. DEACON,

Borough and Water Engineer.

WATER ENGINEER'S DEPARTMENT.
November 11, 1873.

WATER SUPPLY.

WASTE AND CONSTANT SERVICE.

The following paper was read by Mr. Deacon, Liverpool Borough Engineer, to the Lancashire and Cheshire Committee of the Association of Municipal and Sanitary Engineers, in the Council Chamber, on the 3d instant: —

In the following paper I propose to state, first, what appear to me to be the inducements to undertake systematically the prevention of waste, next, my experience as to the working of the district waste-water meter system, and I will begin by submitting to you the three following propositions, which have failed in gaining universal acceptance, owing principally, as I believe, to the superficial manner in which the subject has been considered: —

Proposition 1. The prevention of waste of water, or, in other words, the conservation of all water not actually required for domestic or manufacturing purposes is, or may be, accompanied by vast sanitary benefits arising from the more efficient action of existing drains, as well as from the dryness of the sub-soil of dwellings.

Proposition 2. The prevention of waste by the system hereafter described is practicable, and, apart from all sanitary considerations, it is by far the most economical mode that can be resorted to for increasing the available water supply, while it will always diminish the working expenses in cases of supply by pumping from wells.

Corollary. — Towns and districts at present supplied on the intermittent system, when the total supply is more than sufficient to meet the necessities of the people, which is the case when more than ten to fifteen gallons per head per day are taken for domestic purposes, may obtain constant supply,

accompanied by a surplus of water or by corresponding reduction in the working expenses of the supply.

With respect to the first proposition, that the prevention of waste is or may be accompanied by vast sanitary benefits, arising from the more efficient action of existing drains, as well as from the dryness of the subsoil of dwellings, I would call attention to the very prevalent notion that a town cannot have too much water, and that all the water which can be passed into the mains should, if possible, be given to it, as it is conducive to cleanliness, and as the sewers require it. The prevention of waste is assumed to be equivalent to stinting the supply, when in reality it may have the contrary effect. Take the common case of a town demanding twenty-five gallons per head per day for domestic purposes. Now, ten gallons per head per day is probably the maximum quantity actually used for such purposes. Of the remaining fifteen gallons a large proportion is lost by defective fittings and misuse, and flows down a few isolated drains to the sewers. But the maximum waste due to this cause considerably exceeds the average, and it exists where the pressure on the mains is greatest, viz., in the lower parts of the town, so that the greater part of such waste water enters the sewers near their outfalls, where it is useless; while at their upper ends, where water is most required, the supply to the sewers from this cause is trifling. Among the sewers of a town many are, or ought to be, permanently self-cleansing, and without entering upon the consideration of the various circumstances which conduce to so desirable a condition, I may say that all sewers which are not self-cleansing, with the reasons why they are not self-cleansing, should be systematically tabulated, and if want of water be the cause, — which is certainly not always, and, I think, not usually so, — the cure is very simple when you have a surplus of water, formerly wasted, to use for this most beneficial purpose.

Imagine the influence on a single system of sewers, if only a quarter of a gallon per head per day of the population whose drains fall into it were used for flushing that system.

I will give, as an example, a single existing case, and in most towns there are many cases more striking. The sewer system to which I refer carries away the refuse of 52,000 persons. There are in it about 250 dead ends of branch sewers, of which probably 100 require artificial flushing to keep them absolutely free from deposit. A quarter of a gallon per head per day will give 4,000 gallons for each of those sewer ends every month, a quantity which — whether flushing direct from the mains, or the tank system, which is by far the best, be adopted — is more than ought ever to be used. It would in short fill a 3-foot by 1 foot 10 inch sewer to the crown for 145 feet of its length.

But the private drains also require flushing. It is certain that the dribble of waste water will never flush them; the small pipes of ordinary water-closets kept running all night will never do it; but the regulating cistern, delivering its two gallons through a $1\frac{1}{4}$-inch pipe, will do it most effectually, and that cistern will help you greatly in your work.

Of course there are other private drains, but the dribble of waste water, if it exists, is no advantage to them.

I have spoken of the proportion of the lost 15 gallons due to defective fittings and misuse, and I now come to the remainder of that quantity which leaks from innumerable defects in public and private service pipes. This water sinks into the subsoil; it renders healthy soils unhealthy; it makes the houses damp, and certainly militates against the cleanliness of the lower orders; but its influence for harm does not end here; part of it reaches the sewers, and even though it may get into them it can only do so by damaging the brick-work and mortar. The second proposition and its corollary is to the effect that the prevention of waste by the system hereafter described is practicable, and that it is, apart

from all sanitary considerations, by far the most economical mode that can be resorted to for increasing available water supply, while it will always diminish the working expenses in case of supply by pumping from wells; while towns and districts at present supplied on the intermittent system, when the total supply is more than sufficient to meet the necessities of the people, which is the case when more than ten to fifteen gallons per head per day is taken for domestic purposes, may obtain constant supply, accompanied by a surplus of water, or by a corresponding reduction in the working expenses of the supply. I think I may satisfy you as to the truth of this statement by giving an example of the cost of the work in a district of Liverpool where the consumption was 20 per cent. below the average before the prevention of waste under the new system was commenced, and the pipes in which, being very old, required in a great number of instances to be entirely renewed. Add to this the fact that the corporation relaid at their own cost all defective private service pipes not within the dwellings, and you can understand that I have good grounds for saying that while the saving was a minimum, the cost was a maximum. The district in question contains 31,000 persons; the saving of water between former constant and present constant supply was 21.38 gallons per head per day, and between former intermittent and present constant 7.42 gallons per head per day; and the saving of water between former and present constant service was obtained at a cost to the corporation of less than a farthing per 1,000 gallons. In districts containing a better class of property the saving is often greater while the work to be performed in obtaining that saving is far less. When we consider this in connection with the fact that water obtained from new works usually costs 5d. or 6d. per 1,000 gallons, we must admit the last proposition as an established fact.

The inducements to undertake systematically the preven-

tion of waste have been laid before you in what appear to me their most striking aspects; but to those who have taken up the subject in practice many other important features, which I am unable to consider in a short paper, suggest themselves. I will, therefore, at once describe to you the method by which the prevention of waste and restoration of constant service is being rapidly carried on in Liverpool.

I believe a suggestion to place meters upon water mains has been made in former times; but it remained for Mr. J. H. Wilson, the chairman of the Liverpool Water Committee, to propose the systematic adoption of the plan, and to see it carried out with the most complete success, and with results far surpassing anything that could be anticipated.

The system I now practise, and the reasons for it, may be better explained if I premise that the piston meters at first used, and which were placed upon the 3 and 4 inch service mains, indicated the necessity for obtaining not merely the total consumption for the twenty-four hours, but the minimum consumption during the night, and, if possible, the consumption at short intervals during the whole twenty-four hours. It is evident that such results could only be obtained from the ordinary meters by constantly watching and even counting the strokes. A short experience of the system, notwithstanding its great success, showed the enormous advantages which would accrue from the use of a meter so arranged as to draw a diagram representing graphically the exact quantity of water flowing through any main at every instant during the twenty-four hours. The great cost and wear and tear of all meters which I have tried was an additional incentive in my endeavors to produce such an instrument.

The best form of the waste-water meter may be described as follows: —

It consists essentially of a vertical tube lined with brass,

and equal in diameter at the upper end, where it is connected with the inlet from the main to the diameter of that main, but larger at its lower end. In the tube is a horizontal disc of the same diameter as the main, with a vertical spindle on the centre of its upper face, from the end of which the disc is hung by a fine wire passing out at the top of the tube through a brass gland; this wire is connected above with a counter balance weight which, when the water is at rest, retains the disc at the top of the tube, which it completely fills.

It is obvious, then, that if water is caused to flow through the instrument, the disc will find somewhere in the tube a position which it will retain until the velocity of the water changes. The lower end of the conical tube being about double the area of the main, no obstruction to the flow can take place, such as must necessarily be the case in all piston meters, while the motion for any given increment of velocity near the top, or place of minimum flow, can be made equal to or even greater than that due to an equal increment at the bottom or point of maximum flow, so that its senitiveness it not diminished at low velocities, — a feature which is unattainable in any meters constructed on the turbine or analogous principles.

In order to insure the absence of any friction sufficiently great to prevent the disc and wire from reaching the exact point at which they would stand if perfectly free during the continuance of each particular velocity, I found it desirable to abandon the use of a stuffing-box, properly so called, and to substitute a single brass gland, the hole in which fits the wire accurately, but not tightly. This wire, being an alloy of iridium and platinum, maintains its condition for any length of time, and the small quantity of water which oozes past it is allowed to drain away.

The absolute accuracy and freedom with which the meter acts has been proved by the strictest tests. The vertical

motions of the wire are registered by a pencil connected with it, on a drum revolving once in 24 hours, the paper on which can easily be removed at any time and replaced by a sheet with horizontal lines, each of which corresponds with the height at which the pencil stands when the number of gallons per hour marked upon the line is equal to the quantity passing through the meter. The essential peculiarity, then, of the waste-water meter is that it registers on paper the exact quantity of water passing at every instant, and the exact time and rate at which that quantity changes. The meter is fixed close to the curb, just beneath the foot-path. A single length of the main is removed, and a loop formed to it by two double elbow pipes. Access to the drum and clock is easily obtained by simply lifting the parapet cover and opening the inner lid.

I will now, as shortly as possible, describe the process of detecting the various kinds of waste, and the system to be ultimately adopted in order to prevent its recurrence : —

A district (of about 1,300 persons) supplied by a 3 or 4-inch main having been chosen, a waste-water meter is placed upon that main, and diagrams are taken for a few days before the condition of the supply is disturbed. If stopcocks outside all premises do not exist, they are at once fixed under the footway on every service-pipe ; and at the same time a day inspector calls at each tenement and fills up a suitable form ; besides giving much information with respect to the fittings the forms afford, in connection with the diagrams already taken, the means of tabulating the normal condition of the supply, as in the three first lines of the following form : —

Example of form used to record information contained on waste-meter diagram.

..... STREET. DISTRICT NO. .....

Population. — Day Occupants	263
Day and Night Occupants	1,110
Total	1,373

DATE.	TOTAL CONSUMPTION FOR THE 24 HRS. IN GALS.	RATE OF CONSUMPTION IN GALS. PER HEAD PER DAY.			
		Average for the 24 hrs.	Lowest point reached.	Time of reaching lowest point.	Average from 1 to 5 A. M.
* Octo. 4–5, 1873,	80,183.2	58.4	27	8 A. M.	50.4
† 5–6, "	81,693.5	59.5	39	7 "	52.44
† 7–8, "	81,418.9	59.7	44.5	7 "	50.0
‡ 10–11, "	69,479.3	54.1	33.2	9 "	49.0
§ 29–30, "	35,698.0	26.0	15.0	6–30 "	21.0
|| Dec. 10–11, "	28,252.0	20.5	12.7 12.2	9–45 P.M. 5 A. M.	15.0

* Saturday afternoon and Sunday morning.
† Normal condition of district.
‡ Taking census, inspecting and making sundry small repairs.
§ Fixing stopcocks.
|| Stopcocks fixed.

NOTE. — The figures are those of an office district in Liverpool, in connection with which the operations for the prevention of waste are incomplete, the next step being to serve general notice and proceed with the detail examination.

In this form the 3d, 4th, 5th and 6th columns contain information peculiar to the waste-water metre of the greatest value. The result of deducting any one of the figures in the fourth column from the corresponding one in the 3d is generally found to be about equal to the actual quantity of water used. Thus, from the 4th to the 5th of October, nine gallons per head per day was about the actual quantity used, while fifty gallons per head per day was about the waste from all sources. The figures in the fourth column, being the lowest rates of consumption, are reached at times when the intermittent waste due to carelessness is accidentally at its minimum, and the constant waste due to leakages in the pipes is nearly equal to these figures; when it appears that they are quite or nearly reached more than once on the same

diagram, as happened on the 11th of December, where the constant waste is shown to be about twelve gallons per head per day. The use of column four in the detection of waste is further shown by the following table, the figures in which are those which actually occurred in the district: —

Night readings of Meters between 1 *and* 4 *A.M., at various dates, in No.* 1 *District.*

January	22,	1873,	30.0	gallons per head per day.	
April	19,	"	9.4	"	"
June	27,	"	.74	"	"

The moral influence of the Waste-Water Inspectors' presence in bringing down the figures in column four to those in column five is sometimes very curious. By referring to the actual diagrams, it will be seen that figures in column four are only maintained for very short periods, often only a few seconds.

After stopcocks have been fixed, it is desirable to issue official notices to all tenants and owners of property in the district under test, embodying the full powers of the corporation or company with respect to fittings, and explaining the steps which will be taken upon the discovery of the waste of water within any premises.

At this stage the work of discovery is commenced in earnest. At twelve, on the first fine night, a Waste-Water Inspector sounds each stopcock, partly closing it, if necessary, in order to contract the passage and increase the noise. If the inmates have retired, and a flow of water is heard, the stopcock is closed, its number and the time being accurately noted. At the same instant the metre registers the reduction in the flow of water, and the time at which it takes place. It is sometimes found desirable to arouse the inmates and enter the house, in order to obtain the necessary evidence of waste, especially when the running of water from taps is heard. In other cases the house is visited by the inspector early on the

following morning, and, if while he is within, another inspector outside turns on the stopcock, there is generally no difficulty in detecting the source of waste at once. If, however, the waste is not superficial, sounding with the teeth at the taps and other fittings will generally discover a leak in the buried pipes.

Each source of internal waste having been discovered by these means, the greatest care must be exercised by the inspectors to ensure its remedy in the best possible manner.

In most districts the whole of the stopcocks may be sounded by one inspector in a single night; but a large number of such night inspections, followed by day inspections and repairs, are always necessary before the internal waste is nearly removed. A test for the condition of pipes is conducted as follows, and generally with most valuable results :—

Any convenient section, say one-fourth of the district, is isolated from the remainder by a valve, and commanded by the metre. In this sub-district all the fittings are closed and tied with string, a number of men being employed for the purpose, and each having several houses to watch. The stopcocks are then closed one by one, the time being noted, waste in the pipes of any premises is thus discovered and measured. The following statement shows the various classes of defects in fourteen waste-water districts in Liverpool, containing an aggregate of 3,000 persons :—

	Notices Issued for Defects.					Simple Repairs by Inspectors.					
	Cocks.	Ball Cocks.	Water Closets.	Pipes.	Total.	Cocks.	Ball Cocks.	Water Closets.	Pipes.	Total.	Total noticed and repaired.
Total for 14 Districts. ..	713	5	555	1,232	2,665	253	58	55	28	394	3,076

Tests for leaks in public pipes are conducted as follows: The condition of the main and branches to the stopcocks may be ascertained by closing those stopcocks entirely when any flow must be due to leakage. By sounding closed stopcocks, and all other exposed meter work connected with the pipes, that leakage may often be localized. An internal examination of the neighboring sewer on a dry night may lead to many important discoveries, especially if large isolated leakages exist.

If, however, the pipes are old, and the metre indicates a considerable flow, it is well worth while to strip them entirely, having at hand new pipes with which to replace the old ones, if thought desirable.

It only remains for me to point out the means by which I propose to maintain the condition of comparative freedom from waste in those districts in which a fair normal consumption has been attained. Taking, for example, a town of the size of the borough of Liverpool, containing 500,000 persons, there will be about 300 waste-water districts and 300 waste-water meters. Unless the consumption of a district has suddenly become abnormal, it is not objectionable to leave each diagram on for a week, and to allow the seven diagrams to be superimposed upon each other. Each day fifty diagrams will be removed and replaced by blank sheets and brought to the office.

The work can easily be performed by two meter inspectors and two boys, with the reserve of one inspector and one boy, who, in addition, will wind up the clock and do any other necessary work in connection with the meters.

Any district, the consumption in which the diagrams brought in shows to have increased unduly, will be excluded from the general, and omitted by the ordinary meter inspector. Two or three special inspectors will at once be sent into it, and there is no doubt that a few days' work, or even

less, will generally bring it back to its normal condition. The advantage of such a system is manifest.

Without it, waste-water inspectors discover only superficial defects, and spend their time equally on good and bad ground; but the best evidence of its value is the unprecedented success which is attending its adoption in Liverpool.

I do not now propose to speak of what I really think we shall be able to do here, but the result up to the present time is, that out of a population within the borough of about 500,000 persons with eight to ten hours' supply, and without the borough of about 125,000 persons with constant supply, taking each case about 24 gallons a head (excluding only water used for trade purposes), we commenced work in a district within the borough of 31,000 persons, who were taking only $19\frac{1}{2}$ gallons a head in the eight or ten hours, and $33\frac{1}{2}$ gallons per head per day when on constant service, and that we have given and continued the constant service, and reduced the consumption to 12.17 gallons per head per day, which is maintained without the slightest difficulty.

REPORT OF SUPERINTENDENT OF EASTERN DIVISION.

BOSTON, May 1st, 1874.

JOHN A. HAVEN, ESQ.,

President of the Cochituate Water Board:—

SIR, — Following is my report for the year ending with April 30th, which I respectfully submit.

The whole length of main pipe laid during the year is twenty-four and one-half miles; the tables beyond show the sizes and localities. The number of service pipes put in is 1,678, length, 47,171 feet.

The relaying of mains of enlarged sizes, with Lowry hydrants connected throughout the burnt district, is just completed.

The following table shows the changes in the sizes: —

	Size Now.	Size Formerly
Summer street	12 inch.	6 inch.
Federal "	12 "	6 "
Congress "	8 and 6 "	6 "
Washington "	8 "	6 "
Hawley "	8 "	6 "
Arch "	8 "	6 "
Devonshire "	8 "	6 "
High "	8 "	6 "
Purchase "	8 "	6 "
Franklin "	12 "	6 "
Kilby "	8 "	6 "
Gridley "	6 "	4 "
Federal court	6 "	4 "
Milton place	6 "	4 "

	Size Now.	Size Formerly.
Sullivan place . . .	6 inch.	4 inch.
Matthews street . . .	12 "	6 "
Leather square . .	6 and 8 "	4 "
Water street . . .	12 "	6 "
Hawes " . . .	6 "	4 "
Otis " . . .	8 "	6 "

NEW BURNT DISTRICT.

	Size Now.	Size Formerly.
Washington street, from Bedford to Essex,	12 in.	6 in.
Essex street, from Washington to Oxford,	8 "	6 "

Work was commenced early in the month of March of this year, laying main pipes of larger sizes, and locating hydrants of the Lowry pattern at suitable distances (not over 250 feet apart), for the better supply for fire purposes, and thus far has been prosecuted as vigorously as the weather would admit, and will be through the entire season.

The new line of pipe which the Board ordered to be laid from the 24-inch main on Heath street to Beacon Hill and Telegraph Hill, South Boston, was commenced last year by laying a 16-inch main on the Common from opposite Mason street to Mount Vernon street, and I have just completed the remainder to the connection at Berkeley street of the 12-inch line to Telegraph Hill. This 12-inch line is also completed, beginning at Columbus avenue, and running through Berkeley, Dover, Fourth, Fifth, Old Harbor, and Thomas streets to the connection opposite the reservoir, with the high-service pipes already laid, making this line ready for use, with the exception of a short piece on Dover-street bridge, which I am waiting for suitable weather to complete. The syphon for this line under the draw of the bridge was successfully built and lowered last December, by Boynton Bros. and Freeman.

By the sectioning off the high-service portion of South Boston from the low, the inhabitants on Broadway, in the neighborhood of Independence square, were deprived of a portion of their accustomed supply, so much so as to create a general complaint.

A 6-inch main was laid from the high service on Atlantic street, through Broadway, to N street, a distance of 4,321 feet, which has remedied effectually this trouble.

A line of 12-inch pipe was laid in the Dorchester district through portions of Minot and Adams streets to Milton Lower Mills, and smaller pipes through the principal streets in that vicinity. I call your attention to the importance of continuing the 12-inch line on Dorchester avenue to, and connecting with, the mains at the Lower Mills, thus making a second supply. In case of a break, or an alteration, or the connection of another pipe with the main as now laid, the whole supply from Park street, on Adams street, comprising the territories known as Neponset and Milton Lower Mills, may be deprived of water. The line of pipes that was laid over Winthrop bridge (double boxed), in place of the first line that gave so much trouble, has passed through two winters with no trouble whatever. There has been, up to date, 21 drinking-fountains, with stone troughs attached, established; and, as far as I know, give general satisfaction. There are now on hand 6 troughs, which I can set as soon as suitable localities are selected. At the Albany-street yard a new blacksmith shop has been built, and now nearly all of our wrought-iron work and horse-shoeing is done by our own workmen. A new engine of 20-horse power has been set up in place of the old one, and additional machinery put in at our works on Federal street, so that I am able now to make all of our 3, 4, 6, 8, and 12-inch stop-valves.

TAKEN UP OR ABANDONED.

	Number of Feet.
12-inch pipe	18
9 " "	19
8 " "	586
6 " "	17,274
4 " "	9,870
2 " lead pipe	19
1 " "	262
$\frac{5}{8}$ " "	242
$\frac{3}{4}$ " "	30
$1\frac{1}{2}$ " iron	1,074
$1\frac{1}{4}$ " "	20

RESERVOIRS CONNECTED.

1 corner Boston and Cottage street.
1 Ruggles street, between Halleck and Avon place.

Statement of Location, Size and Number of Feet of Pipe laid in 1873.

IN WHAT STREET.	BETWEEN WHAT STREETS.	Diam. of Iron Pipe in In.	Feet of Pipe.
	BOSTON PROPER.		
N. Charles	Pinckney and Cambridge	16	858
N. Charles	Leverett and Poplar	16	576
N. Charles	Livingston and Cambridge	16	1,564
Boston Common and Joy st.	Tremont and Mt. Vernon	16	1,688
Columbus av.	Berkeley and Boston Common	16	2,693
Tremont	Mason and School	16	1,850
	Total 16-inch	...	9,229
Summer	Church Green and Washington	12	1,114
Columbus av.	Berkeley and Albany R. R.	12	420
Columbus av.	Berkeley and Clarendon	12	344
Brighton av	Beacon and St. Mary's	12	2,500
Atlantic av.	Fleet and Lewis Wharf	12	165
Berkeley	Columbus av. and St. James av.	12	363
Berkeley	Columbus av. and Tremont	12	1,416
Milk	Pearl and Batterymarch	12	424
Albany	Newton and E. Chester Park	12	1,236
High	Hartford and Pearl	12	192
Dover	Tremont and Albany	12	2,450
Federal	Franklin and Purchase	12	850
Franklin	Washington and Pearl	12	1,500
Washington	Bedford and Essex	12	800
Water	Congress and Washington	12	440
Matthews	Congress and Federal	12	376
Federal	Purchase and Summer	12	122
	Total 12-inch	...	14,712

Statement of Location, Size, etc. — Continued.

IN WHAT STREET.	BETWEEN WHAT STREETS.	Diam. of Iron Pipe in In.	Feet of Pipe.
Charles	Cambridge and Leverett	9	36
Central wharf	From India	9	8
Lewis wharf	From Commercial	9	8
Washington	Opposite 312	9	8
Newbury	Clarendon and Dartmouth	9	8
Montgomery	Clarendon and Dartmouth	9	8
West Springfield	Shawmut avenue and Tremont	9	15
East Springfield	Harrison avenue and Washington	9	28
Worcester	Shawmut avenue and Tremont	9	20
Purchase	Congress and Federal	9	16
Chauncey	Bedford and Essex	9	12
Tremont	School and Boylston	9	30
East Chester park	Harrison av. and Albany	9	9
Hawkins	Corner Chardon	9	6
Central court	From Washington	9	6
	Total 9-inch		218
Devonshire	Milk and State	8	806
Devonshire	Washington and State	8	317
Devonshire	Milk and Summer	8	1,176
Central court	From Washington	8	178
Niles av.	From School	8	328
Lewis wharf	From Atlantic av.	8	540
Berkeley	Beacon and Commonwealth av.	8	607
High	Pearl and Federal	8	826
Congress	Milk and Franklin	8	500
Congress	Milk and State	8	750
Washington	Milk and Summer	8	716
Otis	Winthrop sq. and Summer	8	376
Arch	Franklin and Summer	8	427
	Carried forward		7,547

Statement of Location, Size, etc. — Continued.

IN WHAT STREET.	BETWEEN WHAT STREETS.	Diam. of Iron Pipe in In.	Feet of Pipe.
	Brought forward	. . .	7,547
Federal	Franklin and Milk	8	489
Hawley	Summer and Milk	8	800
Norfolk place	From Washington	8	280
Arch	Milk and Franklin	8	495
Essex	Washington and Oxford	8	515
Central wharf	From India	8	2,700
Water	Kilby and Congress	8	315
Purchase	Pearl and Federal	8	844
Kilby	Milk and State	8	677
Chapman place	From School	8	244
Batterymarch	Kilby and Milk	8	77
Central	Kilby and India	8	490
Chauncy	Essex and Summer	8	844
Hawkins	Chardon and Sudbury	8	468
	Total 8-inch	. . .	16,785
Mt. Washington av.	Federal and the Bridge	6	179
Pearl place	Pearl and Oliver	6	336
Wendall	Broad and Oliver	6	460
Wharf	Broad and India	6	240
Union Freight R. R.	Mercantile and Atlantic av.	6	384
School	Tremont and Province	6	268
Hinkley Locomotive Works	Albany and Harrison av.	6	480
South Market st.	Commercial and Atlantic av.	6	750
Commonwealth av.	Exeter and Dartmouth	6	60
Williams ct.	Court sq. Washington	6	100
Lewis wharf	From Atlantic av.	6	523
High	Summer and Federal	6	241
	Carried forward	. . .	4,021

Statement of Location, Size, etc. — Continued.

IN WHAT STREET.	BETWEEN WHAT STREETS.	Diam. of Iron Pipe in In.	Feet of Pipe.
	Brought forward	. . .	4,021
T wharf	From Atlantic av.	6	779
Sullivan place	From Federal	7	150
Randolph	Albany and Harrison av.	6	84
Newbury	Clarendon and Dartmouth	6	320
Congress	Broad and Franklin	6	806
Franklin	Hawley and Devonshire	6	136
Exchange place, ...	Congress and Kilby	6	295
Leather square	Channing and Matthews	6	275
East Brookline	Harrison av. and Washington	6	428
Gridley	High and Purchase	6	270
Oliver	Milk and Franklin	6	100
Hawes	Congress and Kilby	6	100
Union wharf	From Commercial	6	612
Federal and Milton place .	Federal and Federal	6	550
	Total 6-inch	. . .	8,926
St. Charles	Chandler and B. & A. R. R.	4	70
State	Devonshire and Cornhill court	4	106
For City Hall	School st. and City Hall	4	105
N. Ferry av. Boston side .	From Commercial	4	68
Hinckley Locomotive W'ks	From Albany	4	188
	Total 4-inch	. . .	537

Statment of Location, Size, etc. — Continued.

IN WHAT STREET.	BETWEEN WHAT STREETS.	Diam. of Iron Pipe in In.	Feet of Pipe.
	SOUTH BOSTON.		
Fourth	A and B	20	31
	Total 20-inch	...	31
M	Fourth and Broadway	12	328
M	Third and Broadway	12	296
H	Second and Third	12	150
Fourth	Foundry and Bridge	12	400
Foundry	Fourth and Swan	12	300
Swan	Foundry and Dorchester av.	12	637
Fifth	Dorchester av. through Old Harbor to Thomas	12	3,454
Thomas	Telegraph and Atlantic	12	685
Thomas	Junction of Atlantic	12	50
	Total 12-inch	...	6,300
Third	N and O	9	8
Thomas	Old Harbor and Atlantic	9	20
	Total 9-inch	...	28
First	B and C	6	164
Third	O and P	6	100
Fourth	A and B	6	118
Fifth	A and B	6	204
Sixth	O and P	6	420
Eighth	M and N	6	216
C	First and Second	6	112
G	Third and Broadway	6	116
P	Fifth and Sixth	6	106
	Carried forward	...	1,556

Statement of Location, Size, etc. — Continued.

IN WHAT STREET.	BETWEEN WHAT STREETS.	Diam. of Iron Pipe in In.	Feet of Pipe.
	Brought forward	. . .	1,556
K	First and the water	6	450
Dorchester and Broadway .	Fourth and N	6	4,321
Jay	Fourth and Fifth	6	160
Knowlton	Eighth and Telegraph	6	350
Baxter	C and D	6	233
Bay State Iron Co. Block .	Second and Third	6	302
	Total 6-inch	. . .	7,372

Statement of Location, Size, etc. — Continued.

IN WHAT STREET.	BETWEEN WHAT STREETS.	Diam. of Iron Pipe in In.	Feet of Pipe.
	EAST BOSTON.		
Princeton	Prescott and Chelsea	9	8
Eagle	Knox and Putnam	9	18
Paris	Brooks and Marion	9	10
Paris	Porter	9	20
	Total 9-inch		56
Putnam	Trenton and Saratoga	6	212
Putnam	Bennington and Saratoga	6	280
Putnam	Eagle and Trenton	6	315
Princeton	Eagle and Prescott	6	280
Eagle	Knox and Putnam	6	150
Paris	Brooks and Marion	6	580
Paris	Porter and Marion	6	780
	Total 6-inch		2,797
North Ferry av.	Sumner and the Ferry	4	287
	Total 4-inch		287

Statement of Location, Size, etc. — Continued.

IN WHAT STREET.	BETWEEN WHAT STREETS.	Diam. of Iron Pipe in In.	Feet of Pipe.
	BOSTON HIGHLANDS.		
New Heath	Tremont and Day	12	678
Pynchon	New Heath and Centre	12	774
Centre	Old Heath and Lamartine	12	486
Tremont	Francis and Brookline av.	12	2,354
Ruggles	Tremont and Halleck	12	528
Norfolk av.	Magazine and N. Y. and N. E. R. R. Bridge	12	1,019
Magazine	Norfolk av. and George	12	274
Brookline av.	Burlington and Beacon	12	33
Blue Hill av.	Stafford and Woodbine	12	815
Ruggles	Tremont and Roger av.	12	529
	Total 12-inch	...	7,490
Rockland	Warren and Rockland av.	9	9
Hammond Park	Shawmut av. and Warwick	9	25
	Total 9-inch	...	34
Centre	Highland and New Heath	8	110
	Total 8-inch	...	110
Woodville square	Dennis and Blue Hill av.	6	475
Alleghany	From Parker	6	693
Vale	Marcella and Marcella	6	29
Marcella	Highland and Centre	6	701
Tremont	Providence R. R. crossing and Parker	6	600
Wyman place	From Centre	6	157
Highland	Marcella and Centre	6	813
Halleck	Prentiss and Station	6	499
	Carried forward	...	3,967

Statement of Location, Size, etc. — Continued.

IN WHAT STREET.	BETWEEN WHAT STREETS.	Diam. of Iron Pipe in In.	Feet of Pipe.
	Brought forward	...	3,967
Regent	Circuit and Akron	6	629
Rockland	Warren and Walnut av.	6	559
Rockland court	From Rockland	6	145
Woodward av.	Dudley and George	6	192
Clarence	Dudley and George	6	710
Rand	Blue Hill av. and Blue Hill av.	6	169
Wigglesworth	Tremont and Longwood av.	6	740
Columbus	Tremont and Longwood av.	6	663
New	From Norfolk av.	6	308
Dennis	Dudley and Stafford	6	696
Bickford	Bromley park and Centre	6	90
Faxon place	From Tremont	6	258
Shawmut av.	Washington and Dudley	6	203
Taber	From Winslow	6	168
Sumner place	From Cabot	6	221
Greenwich	Westminster and Warwick	6	136
King street court	From King	6	125
Gerard	Norfolk av. and Howard	6	184
Gerard	Swett and Island	6	26
Howard	Gerard and Magazine	6	97
Tupelo	Savin and Quincy	6	175
Alpine	Regent and Akron	6	686
Bromley	Old Heath and Bromley park	6	246
Albert	Old Heath and Bromley park	6	294
Fountain	Regent and Circuit	6	478
Woodbine	Blue Hill av. and Warren	6	239
Court	From Copeland	6	201
Phœnix place	From Hampden	6	170
	Total 6-inch	...	12,757

Statement of Location, Size, etc. — Continued.

IN WHAT STREET.	BETWEEN WHAT STREETS.	Diam. of Iron Pipe in In.	Feet of Pipe.
Codman park	From Townsend	4	381
Hunneman court	From Harrison av.	4	23
Tremont	Brookline line and Downer	4	67
Norfolk av.	Magazine and Franklin	4	25
Grosvenor place	From Cliff	4	68
Burlington av.	From Brookline av.	4	345
Tremont place	From Tremont	4	331
Ruggles	Avon pl. and Halleck	4	15
Prescott	Eustis and Hampden	4	25
	Total 4-inch	...	1,280

Statement of Location, Size, etc. — Continued.

IN WHAT STREET.	BETWEEN WHAT STREETS.	Diam. of Iron Pipe in In.	Feet of Pipe.
	DORCHESTER.		
Harvard	Washington and School	12	242
Ashmont	Dorchester av. and Carruth	12	632
Dorchester av.	Centre and Codman	12	5,080
Codman	Washington and Adams	12	96
Columbia	Washington and Stanwood av.	12	1,109
Washington	Norfolk and Welles ave.	11	308
Minot	Glide and Adams	12	945
Adams	Minot and Dorchester av.	12	5,901
Cottage	Boston and Humphrey	12	1,124
Cottage	Franklin and Humphrey	12	131
River	Washington and Cedar	12	1,026
Dorchester av.	Washington and Richmond	12	70
Washington	Dorchester av. and Codman	12	1,998
Adams	King and Oak av.	12	2,220
	Total 12-inch	...	20,882
Thornley	Dorchester av. and Pleasant	9	12
Forest Hill av.	From River	9	22
Temple	River and Sanford	9	8
Richmond pl.	From Washington	9	7
Ceylon	Bird and Quincy	9	10
Glenway av.	From Savin Hill av.	9	9
Washington	Dorchester av. and Milton Bridge	9	11
Cottage	Franklin and Stoughton	9	41
	Total 9-inch	...	120
Richmond	Dorchester av. and Adams	8	1,662
Sanford	Washington and Cedar	8	1,425
Washington	Dorchester av. Milton Bridge	8	341
	Total 8-inch	...	3,428

Statement of Location, Size, etc. — Continued.

IN WHAT STREET.	BETWEEN WHAT STREETS.	Diam. of Iron Pipe in In.	Feet of Pipe.
Exchange	From Elm	6	170
Buttonwood	Shelburn and Garden	6	297
School	Washington and Harvard	6	1,135
Park	Adams and Clayton	6	743
King	Adams and Dorchester av.	6	1,526
Wood ct.	Walnut and Wood	6	210
Alexander av.	From Stoughton	6	171
Bailey	Dorchester av. and Washington	6	25
Fuller	Dorchester av. and Washington	6	293
Argyle	Dorchester av. and Ashmont	6	18
Beal	Dorchester av. and Carruth	6	503
Van Winkle	Dorchester av. and Carruth	6	708
Milton	Adams and Granite	6	46
Carruth	Ashmont and Van Winkle	6	332
Humphrey	Cottage and Humphrey pl.	6	700
Baker pl.	From Bird	6	385
Green	Bowdoin and Geneva	6	925
Thornley	Dorchester av. and Pleasant	6	389
Butter	Richmond and Adams	6	529
Glenway av.	From Savin Hill av.	6	330
Richmond	Dorchester av. and Washington	6	676
Grant pl.	From Washington	6	23
Forest Hill av.	From River	6	1,078
Temple	From River	6	1,000
Merrill	Erie av. and New Seaver	6	201
Richmond pl.	From Washington	6	192
Everett av.	From Stoughton	6	72
Taylor	Franklin and Oakman pl.	6	230
Tileston pl.	From Neponset av.	6	84
	Carried forward	...	12,991

Statement of Locatin, Size, etc. — Continued.

IN WHAT STREET.	BETWEEN WHAT STREETS.	Diam. of Iron Pipe in In.	Feet of Pipe.
	Brought forward	. . .	12,991
New	From Tileston pl.	6	348
Ceylon	Bird and Quincy	6	265
Cottage	Franklin and Stoughton	6	1,736
	Total 6-inch	. . .	15,340
Dorchester av.	King and Welles av.	4	15
Adams	Minot and Granite	4	50
Cottage	Boston and Humphrey	4	32
Cedar Grove Cemetery . .	From Milton	4	416
	Total 4-inch	. . .	513

RECAPITULATION.

SECTION.	1873-74.	DIAMETER IN INCHES.								
		24	20	16	12	9	8	6	4	Total.
Boston	Total number of feet laid	..	..	9,229	14,712	218	16,785	8,926	537	..
"	Stopcocks in same	..	..	11	44	..	59	63	21	..
South Boston	Total number of feet laid	..	31	..	6,300	28	..	7,372	..	..
" "	Stopcocks in same	..	..	..	8	..	..	10	3	..
East Boston	Total number of feet laid	..	..	..	..	56	..	2,797	287	..
" "	Stopcocks in same	..	..	..	..	..	..	3	2	..
Boston Highlands	Total number of feet laid	..	..	..	7,490	34	110	12,775	1,280	..
" "	Stopcocks in same	1	..	..	14	..	..	36	5	..
Dorchester	Total number of feet laid	..	..	..	20,882	120	3,428	15,340	513	..
"	Stopcocks in same	..	..	..	30	..	6	35	5	..
	Sums of Pipe	..	31	9,229	49,384	456	20,323	47,210	2,617	129,250
	Sums of Stopcocks	1	..	11	96	..	65	147	36	356

Statement of the Length of different sizes of Pipes laid, and the Number of Stopcocks put in, to May 1, 1874.

	Diameter of Pipes in Inches.														Aggregate
	48.	40.	36.	30.	24.	20.	16.	12.	10.	9.	8.	6.	4.	3.	
Feet of Pipe laid in Brookline, Boston Highlands, and Boston Proper	7,283	23.166	20,070	26,770	5,773	93	16,705	88,534	. .	218	18,805	306,044	93,079	. .	
Number of Stopcocks in same	5	5	8	11	11	3	36	191	. .	. .	64	723	368	. .	
Feet of Pipe laid in Boston Highlands	. .	. . .	. . .	. . .	7,618	. . .	7,141	68.763	. .	721	110	131,306	25,961	238	
Number of Stopcocks in same	. .	. . .	. . .	1	8	. . .	16	98	. .	. .	1	273	109	2	
Feet of Pipe laid in South Boston	. .	. . .	. . .	. . .	. . .	13,206	. . .	29,943	. .	28	2,871	117,619	36,607	. .	
Number of Stopcocks in same	. .	. . .	. . .	. . .	. . .	5	. . .	43	. .	. .	2	189	98	. .	
Feet of Pipe laid in East Boston	. .	. . .	. . .	. . .	1,463	15,972	2,152	29,013	9,923	56	18,584	80,272	5,912	. .	
Number of Stopcocks in same	. .	. . .	. . .	. . .	. . .	8	5	38	3	. .	8	125	42	. .	
Feet of Pipe laid in Dorchester	. .	. . .	. . .	. . .	3,299	3.698	456	81,458	. .	861	3,428	70,901	3,363	. .	
Number of Stopcocks in same	. .	. . .	. . .	. . .	3	1	1	98	. .	. .	6	133	22	. .	
Feet of Pipe laid in Newton and Needham	. .	. . .	1,074	2,140	. . .	. . .	. . .	1,359	. .	. .	. . .	360	. . .	. .	
Number of Stopcocks in same	. .	. . .	. . .	. . .	. . .	. . .	. . .	2	. .	. .	. . .	2	. . .	. .	
Totals, Length of Pipe laid	7,283	23.166	21,144	28,910	18,153	32,969	26,454	299,070	9,923	1,884	43,798	706,502	164,922	238	1,384.416 feet equal to 262 miles, 1.056 feet.
Number of Stopcocks put in	5	5	8	12	22	17	58	470	3	. .	639	1,445	639	2	2.767.

Statement of Service Pipes laid in 1873.

Diameter in Inches.	Boston.		South Boston.		East Boston.		Boston Highlands.		Dorchester.		Totals.	
	Number of Pipes.	Length in Feet.	Number of Pipes.	Length in Feet.	Number of Pipes.	Length in Feet.	Number of Pipes.	Length in Feet.	Number of Pipes.	Length in Feet.	Number of Pipes.	Length in Feet.
2	1	11	. .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	1	11
1¼	1	21	. .	. . .	. . .	. . .	. . .	24	. . .	. . .	2	45
1	15	489	3	102	. . .	. . .	6	137	1	23	25	751
¾	4	112	. .	. . .	1	50	9	217	2	90	16	469
⅝	244	6,528	233	6,631	165	5,376	556	15,424	305	8,273	1,503	42,232
½	13	507	15	496	14	394	36	1,017	53	1,249	131	3,663
Aggregate											1,678	47,171
Making the total number up to May 1, 1874												38,843

Repairs of Pipes during the Year 1873.

WHERE.	DIAMETER OF PIPES IN INCHES.																	
	40	36	30	24	20	16	12	10	6	4	3	2	1½	1¼	1	¾	⅝	¼	Totals.
Boston	2	5	4	1	.	1	15	.	27	35	2	5	82	5	27	5	639	24	879
South Boston	.	.	.	.	1	.	2	.	6	1	.	.	.	.	3	.	151	1	165
East Boston	.	.	.	.	11	.	5	2	4	2	.	.	.	.	1	1	39	1	66
Boston Highlands	.	.	.	2	.	12	1	.	3	8	3	.	.	.	1	.	77	6	113
Dorchester	.	.	.	.	.	.	1	.	2	.	.	.	.	.	.	.	3	.	6
Totals	2	5	4	3	12	13	24	2	42	46	5	5	82	5	32	6	909	32	1,229

Of the leaks that have occurred in pipes of 4 inches and upwards, joints, 119; settling of earth, 13; defective pipe, 13; defective gate, 3; blasting, 1; concussion of falling walls, 2. Total, . . . 151

Stoppages by frost, 1; fish, 1. " . . . 2

Of 3 inch and on service pipes, joints, 9; settling of earth, 184; settling of wall, 5; settling of drain, 1; defective pipe, 57; defective packing, 15; defective coupling, 10; defective faucet, 11; stiff connections, 82; faucet loose at main, 2; struck by pick, 40; faucet pulled out, 8; gnawed by rats, 7; frost, 4; blasting, 26; burnt by parties trying to thaw, 1; pipes not in use, 5; cut by parties unknown, 1, ... 468

Stoppages by fish, 394; rust, 150; gasket, 15; solder, 1; dirt, 6; frost from inside house, 42, . . 608

Total, . . . 1,229

Statement of Number of Leaks, 1850–1873.

YEAR.	DIAMETER OF.		TOTALS.
	Four Inches and upwards.	Less than Four Inches.	
1850	32	72	104
1851	64	173	237
1852	82	241	323
1853	85	260	345
1854	74	280	354
1855	75	219	294
1856	75	232	307
1857	85	278	363
1858	77	324	401
1859	82	449	531
1860	134	458	592
1861	109	399	508
1862	117	373	490
1863	97	397	494
1864	95	394	489
1865	111	496	607
1866	139	536	675
1867	122	487	609
1868	82	449	531
1869	82	407	489
1870	157	769	926
1871	185	1,380	1,565
1872	188	1,459	1,647
1873	153	1,076	1,229

HYDRANTS.

During the year 426 hydrants have been established and 93 abandoned, as follows: —

	Lowry.	Boston.		Abandoned. Lowry.	Boston.		
In Boston proper	178	+ 3	= 181	1	+ 82	= 83	98
South Boston . .	16	+ 1	= 17	—		5	12
East Boston . .	11	+ 1	= 12	—		2	10
Boston Highlands .	73	+ 9	= 82	1	+ 1	= 2	80
Dorchester . .	133	+ 1	= 134	—		1	133
			426	—		93	= 333

Total Number of Hydrants up to May 1, 1874.

Boston Proper, ...	1,191
South Boston, ...	405
East Boston, ...	243
Boston Highlands, ...	648
Dorchester, ...	453
Brookline, ...	9
Charlestown, ...	11
Chelsea, ...	8
Deer Island, ...	14
	2,982

62 hydrants have been taken out and replaced by new, or repaired ones, and 174 boxes have been taken out and replaced by new ones. The hydrants have had the usual attention paid them.

STOPCOCKS.

356 new stockcocks have been established this year. 31 boxes have been taken out and replaced by new ones. All the stopcocks have had the attention of former years paid them.

Statement of Pipes and other stock on hand, exclusive of Tools, May 1st, 1874.

	DIAMETER IN INCHES.															
	48	40	36	30	24	20	18	16	12	10	9	8	6	4	3	2
Pipes	.	14	13	76	277	19	3	277	376	51	111	416	3,566	358	41	.
Blow-off Branches	.	.	3	.	4	.	.	. .	19	.	. .	. .	. . .	. .	.	.
Y Branches	.	.	.	1	1	.	.	1	. .	.	. .	. .	1	. .	.	.
4 Way Branches	.	2	2	2	12	4	.	17	26	4	. .	23	14	1	.	.
3 Way Branches	.	6	4	8	9	11	.	10	79	3	127	28	44	4	8	.
Flange Pipe	.	1	1	2	3	.	.	2	2	.	. .	. .	. . .	32	.	.
Sleeves	5	4	15	12	11	5	.	12	15	16	. .	31	26	23	6	10
Clamp Sleeves	.	2	4	14	. .	.	.	5	1	.	. .	. .	19	11	9	.
Caps	.	2	5	2	2	.	1	2	38	.	. .	18	17	37	.	.
Reducers	.	3	3	.	2	4	.	3	20	.	15	39	27	8	.	.
Bevel Hubs	.	.	.	.	. .	.	.	. .	. .	.	. .	. .	4	2	.	.
Curve Pipes	.	1	3	17	4	1	.	5	9	.	. .	18	17	56	4	.
Quarter Turns	.	.	2	10	3	8	.	5	8	2	. .	5	7	2	.	4
Double Hubs	.	.	.	.	. .	3	.	8	. .	.	. .	. .	11	. .	.	.
Offset Pipes	.	.	.	.	. .	.	.	. .	1	.	. .	. .	12	10	.	.
Yoke Pipe	.	.	.	.	. .	.	.	. .	5	.	. .	. .	3	4	.	.
Manhole Pipes	.	2	4	.	. .	.	.	. .	. .	.	. .	. .	. . .	. .	.	.
One-eighth Turns	.	.	.	1	4	4	.	1	39	6	. .	26	26	6	.	.
Pieces of Pipes	.	2	2	10	3	11	.	1	4	.	. .	4	. . .	12	.	.
Blow-offs and Manholes	.	1	.	2	. .	.	.	. .	. .	.	. .	. .	. . .	. .	.	.
Plugs	.	.	.	.	. .	.	.	. .	. .	.	. .	. .	1	9	.	.
Thawing Clamps	.	.	.	.	. .	.	.	. .	6	.	. .	2	16	28	.	.
Stopcocks	.	1	1	3	3	5	.	3	10	.	. .	40	35	17	16	.

Hydrants. — 249 Lowry, 24 Lowry extensions, 8 Lowry chucks, 141 Lowry frame and covers, 23 Lowry caps, 12 round covers, 15 Wilmarth, 6 wharf hydrants.

For Hydrants. — 15 bends, 48 lengtheners, 37 wastes, 44 nipples, 13 socket nuts, 71 rods, 15 wharf hydrant cocks, 24 nuts, 39 stuffing boxes, 30 rubber valves, 19 screws, 174 frames, 190 covers, 8,558 lbs. iron castings, 20 pairs straps, 10 lbs. Babbitt metal.

For Stopcocks. — 1 16-inch check valve, 55 valves for 12-inch gates, 3 6-inch do., 5 3-inch do., 39 12-inch screws, 9 8-inch do., 3 6-inch do., 5 4-inch do., 9 3-inch do., 55 rings for 12-inch gates, 14 do. for 8-inch, 23 do. for 6-inch, 7 do. for 4-inch, 12,524 lbs. iron castings for 12-inch, 8-inch, 6-inch and 4-inch gates, 80 frames, 75 covers, 100 lbs. mallable iron nuts, 1,200 lbs. bolts, 1 36-inch screw, 1 30-inch do., 1 24-inch do.

Meters in Shop. — 5 3-inch, 4 2-inch, 2 1-inch, 130⅝ inch.

Stock for Meters. — 14 2-inch nipples, 56⅝ inch do., 4 2-inch connection pieees, 7 1-inch do., 17 ⅝-inch do., 31 1-inch cocks, 18 ⅝-inch do., 1 4-inch clock, 3 3-inch do., 2 2-inch do., 4 1-inch do., 20 ⅝-inch do., 90 brass spindles, 30 rubber nipples, 9 fish-boxes, 30 covers, 20 glasses, 50 composition nipples unfinished.

For Service Pipe. — 51 1-inch union cocks, 71 ¾-inch do., 259 ⅝-inch ditto, 101 ½-inch do., 18 1-inch air cocks, 27 ⅝-inch do., 48 1¼-inch T cocks, 20 ⅝-inch do., 15 ⅝-inch Y do., 60 ⅝-inch thawing cocks, 18 1¼-inch tubes, 105 1-inch do., 452 ⅝-inch do., 98 ¾-inch do., 21 ½-inch do., 79 1¼-inch nuts, 112 1-inch do., 12 2-inch couplings, 117 1-inch do., 90 ¾-inch do., 1,285 ⅝-inch do., 158 ½-inch do., 40 ⅝-inch thawing tubes, 500 boxes, 25 T do., 24 Y do., 90 extension tubes, 800 tubes, 800 caps, 674 lbs. unfinished composition castings, 2 4×2 composition reducers, 5 3×2 do., 4 4×3 do., 3 3×2½ do., 2 4×2 2 way do., 42 2×⅝-inch do., 6

2-inch hose nozzles, 3 4-inch tunnel pipe, 150 1-inch plugs, 70 $\frac{3}{4}$-inch do., 112 $\frac{5}{8}$-inch do.

Lead Pipe. — 280 lbs. 3-inch pipe, 2,434 lbs. 2-inch do., 2,640 lbs. $1\frac{1}{2}$-inch do., 3,290 lbs. $1\frac{1}{4}$-inch do., 1,512 lbs. 1-inch do., 1,749 lbs. $\frac{3}{4}$-inch do., 7,184 lbs. $\frac{5}{8}$-inch do., 7,918 lbs. $\frac{1}{2}$-inch, 1,466 lbs. 1-inch tin lined do., 995 lbs. $\frac{5}{8}$-inch do., 198 lbs. $\frac{3}{4}$inch block tin pipe, 25 lbs. solder, 25 lbs. sheet lead, 1 pig banca tin.

Blacksmith Shop. — 917 pounds round iron, 479 lbs. flat iron, 322 lbs. square iron, 400 lbs. working pieces, 1,423 lbs. cast-steel, 115 pick blanks, 5,000 lbs. Cumberland coal.

Carpenter's Shop. — 108 Lowry hydrant boxes, 30 do. unfinished, 253 stopcock boxes, 23 unfinished do., 48 hydrant boxes, 6 unfinished do., 1,050 lbs. spikes and nails, 34,500 feet 2-inch spruce plank, 1,250 feet $1\frac{1}{2}$-inch spruce batting, 40 1-inch pieces for raising boxes, 40 1 foot pieces, 20 1 foot do. for stopcock boxes, 32 do, for Lowry hydrant boxes, 40 feet hard wood plank, 160 feet hard pine floor boards, 400 feet pine boards.

Tools. — 1 steam engine, 1 large hoisting crane, 3 boom derricks, 7 hand-geared derricks, 5 set shears and rigging for same, 7 tool houses, 3 tool boxes, 2 platform scales, 1 portable blacksmith shop, 1 portable covering for Brewer fountain, 1 hand roller, 1 horse do., tools for laying main and service pipes, 2 engine lathes, 1 foot do., 1 hand do., 1 Pratt and Whitney taper do., 1 planer, 1 boring mill, 1 chain-hoisting gear, 1 upright drilling machine, 3 grindstones, 1 trip hammer, the necessary tools for carrying on the machine, blacksmith, carpenter and plumbing shop, 1 circular saw, 1 fan-blower, 1 40-inch proving press, 1 36-inch inch do., 1 small do., 5 wheelbarrows, 1,200 feet hose, also a lot of patterns where we obtain castings.

Stable. — 14 horses, 10 wagons, 3 buggies, 6 pungs, 1 sled, 1 cart, 16 sets harness, 23 blankets, 2 buffalo robes, 2 sleighs, 3 tons English hay, 125 bushels grain, 3 tons straw.

Beacon Hill Reservoir. — 1 large composition cylinder 16-inch jet, 1 6-inch composition jet, 3 composition plates, 9 cast-iron plates, 2 4-inch composition jets, 5 swivel pipe patterns, 1 2-inch copper straight jet, 6 composition jets for small fountains.

Miscellaneous. — 9 tons pig lead, 25 gallons linseed oil, 1½ barrels kerosene oil, 28 tons furnace coal, 3 freights gravel, 2,000 paving brick, 325 lbs. lead washers, lot of paving stones, 44 reservoir covers, 62 cords wood, 11 manholes, 6 plates, lot of old lumber, 1 iron fountain basin, 7 stone troughs for drinking fountains, 1 drinking fountain, 7 lbs. sheet copper, 46 bales gasket.

E. R. JONES,

Sup't Eastern Division.

CIVIL ORGANIZATION OF THE WATER WORKS FROM THEIR COMMENCEMENT, TO MAY 1, 1874.

Water Commissioners.

NATHAN HALE, JAMES F. BALDWIN, THOMAS B. CURTIS. From May 4, 1846, to January 4, 1850.

Engineers for Construction.

JOHN B. JERVIS, of New York, Consulting Engineer. From May, 1846, to November, 1848.

E. S. CHESBROUGH, Chief Engineer of the Western Division. From May, 1846, to January 4, 1850.

WILLIAM S. WHITWELL, Chief Engineer of the Eastern Division. From May, 1846, to January 4, 1850.

City Engineers having charge of the Works.

E. S. CHESBROUGH, Engineer. From November 18, 1850, to October 1, 1855.

GEORGE H. BAILEY, Assistant Engineer. From January 27, 1851, to July 19, 1852.

H. S. MCKEAN, Assistant Engineer. From July 19, 1852, to October 1, 1855.

JAMES SLADE, Engineer. From October 1, 1855, to April 1, 1863.

N. HENRY CRAFTS, Assistant Engineer. From October 1, 1855, to April 1, 1863.

N. HENRY CRAFTS, City Engineer. From April 1, 1863, to November 25, 1872.

THOMAS W. DAVIS, Assistant Engineer. From April 1, 1863, to December 8, 1866.

HENRY M. WIGHTMAN, Resident Engineer at C. H. Reservoir. From February 14, 1866, to November, 1870.

JOSEPH P. DAVIS, City Engineer. From November 25, 1872, to present time.

After January 4, 1850, Messrs. E. S. CHESBROUGH, W. S. WHITWELL, and J. AVERY RICHARDS, were elected a Water Board, subject to the direction of a Joint Standing Committee of the City Council, by an ordinance passed December 31, 1849, which was limited to keep in force one year; and in 1851 the Cochituate Water Board was established.

COCHITUATE WATER BOARD.

Presidents of the Board.

THOMAS WETMORE, elected in 1851, and resigned April 7, 1856 * * . . . . . Five years.

JOHN H. WILKINS, elected in 1856, and resigned June 5, 1860 * * . . . . . Four years.

EBENEZER JOHNSON, elected in 1860, term expired April 3, 1865 . . . . . Five years.

OTIS NORCROSS, elected in 1865, and resigned January 15, 1867 . . . . . One year and nine months.

JOHN H. THORNDIKE elected in 1867, term expired April 6, 1868. . . . . One year and three months.

NATHANIEL J. BRADLEE, elected April 6, 1868, and resigned January 4, 1871 . . Two years and nine months.

CHARLES H. ALLEN, elected from January 4, 1871, to May 4, 1873 . . . . Two years and four months.

JOHN A. HAVEN, elected from May 4, 1873, to present time.

Members of the Board.

THOMAS WETMORE, 1851, 52, 53, 54 and 55 * * . Five years.
JOHN H. WILKINS, 1851, 52, 53, * 56, 57, 58 and 59 * * . Eight years.
HENRY B. ROGERS, 1851, 52, 53, * 54 and 55 . . Five years.
JONATHAN PRESTON, 1851, 52, 53 and 56 . . . Four years.
JAMES W. SEVER, 1851 * * . . . . . One year.
SAMUEL A. ELIOT, 1851 * * . . . . . .
JOHN T. HEARD, 1851 . . . , . . . One year.
ADAM W. THAXTER, Jr., 1852, 53, 54 and 55 * * . . Four years.
SAMPSON REED, 1852 and 1853 . . . . . Two years.
EZRA LINCOLN, 1852 * * . . . . . One year.
THOMAS SPRAGUE, 1853, 54 and 55 * * . . . . Three years.
SAMUEL HATCH, 1854, 55, 56, 57, 58 and 61 . . . Six years.
CHARLES STODDARD, 1854, 55, 56 and 57 * * . . Four years.
WILLIAM WASHBURN, 1854 and 55 . . . . Two years.
TISDALE DRAKE, 1856, 57, 58 and 59 * * . . . Four years.
THOMAS P. RICH, 1856, 57 and 58 . . . . Three years.
JOHN T. DINGLEY, 1856 and 59 . . . . . Two years.
JOSEPH SMITH, 1856 . . . . . Two months.
EBENEZER JOHNSON, 1857, 58, 59, 60, 61, 62, 63 and 64 . Eight years.
SAMUEL HALL, 1857, 58, 59, 60 and 61 * * . . . Five years.
GEORGE P. FRENCH, 1859, 60, 61, 62 and 63 . . Five years.
EBENEZER ATKINS, 1859 * * . . . . . One year.
GEORGE DENNIE, 1860, 61, 62, 63, 64 and 65 . . . Six years.
CLEMENT WILLIS, 1860 * * . . . . . One year.
G. E. PIERCE, 1860 * * . . . . . One year.
JABEZ FREDERICK, 1861, 62 and 63 * * . . . . Three years.
GEORGE HINMAN, 1862 and 63 . . . . . Two years.
JOHN F. PRAY, 1862 . . . . . One year.
J. C. J. BROWN, 1862 . . . . . One year.
JONAS FITCH, 1864, 65 and 66 . . . . . Three years.
OTIS NORCROSS, * 1865 and 66 . . . . . Two years.
L. MILES STANDISH, 1860, 61, 63, 64, 65, 66 and 67 . Seven years.
JOHN H. THORNDIKE, 1864, 65, 66 and 67 . . . Four years.
BENJAMIN F. STEVENS, 1866, 67 and 68 . . . Three years.
WILLIAM S. HILLS, 1867 . . . . . One year.
CHARLES R. TRAIN, 1868 . . . . . One year.
JOSEPH M. WIGHTMAN, 1868 and 69 . . . . Two years.
BENJAMIN JAMES,* 1858, 68 and 69 , . . . Three years.
FRANCIS A. OSBORN, 1869 . . . . . One year.
WALTER E. HAWES, 1870 . . . . . One year.

JOHN O. POOR, 1870	One year.
HOLLIS R. GRAY, 1870	One year.
NATHANIEL J. BRADLEE, 1863, 64, 65, 66, 67, 68, 69, 70 and 71	Nine years.
GEORGE LEWIS, 1868, 69, 70 and 71	Four years.
SIDNEY SQUIRES, 1871	One year.
AMOS L. NOYES, 1871, 72	Two years.
CHARLES H. HERSEY, 1872	One year.
CHARLES H. ALLEN, 1869, 70, 71 and 72	Four years.
ALEXANDER WADSWORTH* 1864, 65, 66, 67, 68, 69 and 72,	Seven years.
JNO. A. HAVEN, 1870, 71, 72, 73 and 74	*Present Board.*
EDWARD A. WHITE, 1872, 73 and 74	
CHARLES R. MCLEAN, 1867, 73 and 74	
THOMAS GOGIN, 1873 and 74	
LEONARD R. CUTTER, 1871, 72, 73 and 74	
EDWARD P. WILBUR, 1873 and 74	
WM. G. THACHER, 1873 and 74	

* Mr. John H. Wilkins resigned Nov. 15, 1854, and Charles Stoddard was elected to fill the vacancy. Mr. Henry B. Rogers resigned Oct. 22, 1865. Mr. Wilkins was re-elected Feb., 1856, and chosen President of the Board, which office he held until his resignation on June 5, 1860, when Mr. Ebenezer Johnson was elected President, and on July 2, Mr. L. Miles Standish was elected to fill the vacancy occasioned by the resignation of Mr. Wilkins. Otis Norcross resigned Jan. 15, 1867, having been elected Mayor of the city. Benjamin James served one year, in 1858, and was re-elected in 1868. Alexander Wadsworth served six years, 1864–69, and was re-elected in 1872.

* * Deceased.

COCHITUATE WATER BOARD, 1874.

JOHN A. HAVEN, President.

LEONARD R. CUTTER, of the Board of Aldermen.

EDWARD P. WILBUR,
WM. G. THACHER, } Of the Common Council.

AT LARGE.

For One Year.

* JOHN A. HAVEN,	CHARLES R. McLEAN,
* EDWARD A. WHITE,	THOMAS GOGIN.

Clerk.

EZRA PERKINS.

Superintendent of the Eastern Division.

EZEKIEL R. JONES.

Superintendent of the Western Division.

DESMOND FITZGERALD.

Water Registrar.

WILLIAM F. DAVIS.

City Engineer.

JOSEPH P. DAVIS.

* Holding over according to city ordinance, no election having taken place.

STANDING COMMITTEES OF THE BOARD.

Eastern Division.

EDWARD A. WHITE, Chairman,

EDWARD P. WILBUR, THOS. GOGIN.

Western Division.

CHAS. R. McLEAN, Chairman.

LEONARD R. CUTTER, WM. G. THACHER.

Water Registrar's Department.

THOMAS GOGIN, Chairman.

WM. G. THACHER, EDWARD P. WILBUR.

On New Supply.

JOHN A. HAVEN, Chairman.

EDWARD A. WHITE, CHAS. R. McLEAN,

SHELF No.....

t., 1882, 20,000.]

OSTON PUBLIC LIBRARY.