[Document 53 — 1883.]

CITY OF BOSTON.

ANNUAL REPORT

OF THE

CITY ENGINEER

FOR THE YEAR 1882.

Office of the City Engineer, City Hall,
Boston, February 23, 1883.

To the Honorable City Council: —

In compliance with the sixth section of the ordinance relating to the Engineer's Department, the following report of the expenses and operations of the department for the year 1882 is respectfully submitted.

The duties of the City Engineer may be classified under the following heads: —

A. — Those pertaining to the City Engineer's Department proper, which consist in the superintendence of the filling of new streets and of districts, in the care and maintenance of bridges, in designing and superintending the construction of new bridges, retaining-walls, city wharves, etc., and in miscellaneous work called for by committees of the City Council. (City Engineer's Department.)

B. — Superintendence of the Sudbury River, Cochituate, and Mystic Water Works, including charge of new constructions for these works. (Water Works.)

C. — Charge of the construction of a system of intercepting and outlet sewers. (Improved Sewerage.)

D. — Charge of the engineering work in connection with the Back Bay and other proposed parks. (Parks.)

The expenses incurred under the head C, are paid wholly from a special appropriation, under the charge of the Joint Special Committee on Improved Sewerage.

(A.) — City Engineer's Department.

The following is a statement of engineering expenses from January 1, 1882, to January 1, 1883 : —

Amount expended from department appropriation for 1881–82	$8,112 76
Amount expended from department appropriation for 1882–83	22,996 84
Total expended from department appropriations	$31,109 60

Condition of department appropriation : —

Amount of appropriation for financial year 1882–83	$32,000 00
Amount expended to January 1, 1883	22,996 84
Unexpended balance, January 1, 1883	$9,003 16

CLASSIFICATION OF EXPENSES.

Salaries of City Engineer, assistants, draughtsmen, transitmen, levellers, rodmen, etc.	$28,505 88
Engineering instruments and repairs of same	228 65
Drawing-paper and materials	323 12
Stationery and printing-stock	335 97
Reference-books, maps, photographs and frames,	142 00
Printing and binding	131 73
Travelling expenses, including horse-keeping, etc.	725 89
Incidental expenses, furniture and small supplies	363 38
"Blue Process" printing	173 03
Committee expenses	179 95
Total	$31,109 60

The number of persons employed and paid from the department appropriation was, on the first of January, 1882 (including the City Engineer), 23. The present number is 20. The operations of the department for the year, together with such general information relating to the various works and structures, finished and in progress, as is thought to be of interest, are given in the following statements: —

BRIDGES.

With the exception of Granite bridge, a comparatively small structure, none of the tide-water bridges have required very extensive repairs during the year.

Several inland bridges in process of construction at the date of the last annual report, have been completed. These comprise the bridge on the Broadway extension over the Boston & Albany railroad, the Commonwealth avenue and Boston & Albany railroad bridges over the Park water-way, and the Beacon-entrance bridge over the Boston & Albany railroad.

Work upon the Boylston-street arch bridge is now being prosecuted; the arch proper is completely turned, and the spandrel walls are rapidly approaching completion.

The system of making the repairs upon the tide-water and inland bridges by day's labor has been continued as for several past years.

The services of Mr. S. S. Lewis as superintendent of repairs of the tide-water bridges were retained by the Committee on Bridges. His compensation was fixed at $150 per month, to include the furnishing of a team and all ordinary tools.

Carpenters have been paid $2.50 per day and laborers $2.00.

The spruce lumber required for repairs has been furnished by Mr. John W. Leatherbee, the lowest bidder and contractor for the past six years. Under his contract for 1881, he has furnished 14,497 feet B. M. at $16.40 per M., and under his contract for 1882, 256,751 feet B. M. at $15.90 per M. Other material used in making repairs has been purchased of various dealers at the lowest market rates.

The painting of the tide-water bridges has been done by day's labor, under the supervision of Mr. A. H. Townsend, as foreman, from June 21st to July 21st, and Mr. E. B. Perry from the latter date until Oct. 14th.

The foreman was paid $3.50, painters $2.25 and $2.50, and laborers employed for cleaning $2.00 per day. The

paint-stock was furnished by Dexter Brothers, the lowest bidders. Total cost of labor, $3,017.13; materials, tools, etc., $940.55.

The total cost of ordinary repairs on tide-water bridges made under the direction of this department was $31,959.33.

All repairs made upon the inland bridges, in charge of the Superintendent of Streets, have been made by day's labor, under the direction of this department. Advantage has been taken of favorable contracts made for the supply of materials for the repair of the tide-water bridges to procure supplies for inland-bridge repairs at same prices. The total cost of repairs on inland bridges was $3,124.87.

The records of the number of vessels passing through the draw-ways, time of passage, name, etc., have been kept by the superintendents of the several bridges in the same manner as last year. These monthly returns have been tabulated, and a summary will be found in Appendix A.

The usual annual examination (required by Section 4 of Chapter 17 of the Revised Ordinances) of all bridges within the city limits, open to team and foot travel, has been made, and the results of this examination respecting the condition of the bridges as to safety and need of renewal or repairs, are given in the succeeding pages.

The following is a list of the bridges inspected. The total number is two more than last year. Three have been added to the list and one removed. The three added are the Commonwealth avenue, Beacon entrance, and Broadway; the one removed was the Beacon street, for which the new bridge over the outlet of the Park pond has been substituted. The old bridge has been torn up and its site filled with gravel.

In the list those marked with an asterisk are over navigable waters, and are each provided with a draw: —

I. — Bridges wholly supported by Boston.

Ashland street, Ward 23, over Boston & Providence Railroad.
Athens street, over N.Y. & N.E. Railroad.
Back-Bay park, over Boston & Albany Railroad.
Beacon street, over outlet to Back-Bay park pond.
Berkeley street, over Boston & Albany Railroad.
Berkeley street, over Boston & Providence Railroad.
Blakemore street, over Boston & Providence Railroad, Ward 23.
*Broadway, over Fort Point Channel.
Broadway, over Boston & Albany Railroad.

Brookline avenue, over Muddy river, Ward 22.
*Charles River, from Boston to Charlestown.
*Chelsea (South), over South Channel, Mystic river.
*Chelsea street, from East Boston to Chelsea.
Columbus avenue, over Boston & Albany Railroad.
*Commercial Point, or Tenean, Ward 24.
Commonwealth avenue, over outlet to Back-Bay park pond.
*Congress street, over Fort Point Channel.
Dartmouth street, over Boston & Albany and Boston & Providence Railroad.
*Dover street, over Fort Point Channel.
*Federal street, over Fort Point Channel.
Ferdinand street, over Boston & Albany Railroad.
Huntington avenue, over Boston & Albany Railroad.
*Malden, from Charlestown to Everett.
*Meridian street, from East Boston to Chelsea.
*Mt. Washington avenue, over Fort Point Channel.
Newton street, over Boston & Providence Railroad.
Public Garden, foot-bridge.
Shawmut avenue, over Boston & Albany Railroad.
Swett street, east of N.Y. & N.E. Railroad.
Swett street, west of N.Y. & N.E. Railroad.
*Warren, from Boston to Charlestown.
West Chester park, over Boston & Albany Railroad.
West Chester park, over Boston & Providence Railroad.
Winthrop, from Breed's Island to Winthrop.

II. — Bridges of which Boston supports the Part within its Limits.

*Cambridge street, from Brighton (Ward 25) to Cambridge.
Central avenue, from Ward 24 to Milton.
*Chelsea (North), from Charlestown to Chelsea.
*Essex street, from Ward 25 (Brookline) to Cambridge.
*Granite, from Dorchester (Ward 24) to Milton.
Longwood avenue, from Ward 22 to Brookline.
Mattapan, from Ward 24 to Milton.
Milton, from Ward 24 to Milton.
*Neponset, from Ward 24 to Quincy.
*North Beacon street, from Ward 25 to Watertown.
*North Harvard street, from Ward 25 to Cambridge.
Spring street, from West Roxbury (Ward 23) to Dedham.
*Western avenue, from Ward 25 to Cambridge.
*Western avenue, from Ward 25 to Watertown.

III. — BRIDGES OF WHICH BOSTON PAYS A PART OF THE COST OF MAINTENANCE.

Albany street, over Boston & Albany Railroad.
*Canal, from Boston to Cambridge.
Dorchester street, over Old Colony Railroad.
*Prison Point, from Charlestown to Cambridge.
*West Boston, from Boston to Cambridge.

IV. — BRIDGES SUPPORTED BY RAILROAD CORPORATIONS.

1st. — Boston & Albany Railroad.

Brighton avenue, Ward 25.
Harrison avenue.
Market street, Ward 25.
Tremont street.
Washington street.

2d. — Boston & Maine Railroad.

Mystic avenue.
Main street.

3d. — Boston & Providence Railroad.

Beech street, Ward 23.
Bellevue street, Ward 23.
Canterbury street, Ward 23.
Centre street, or Hog Bridge, Ward 23.
Centre and Mt. Vernon streets, Ward 23.
Dudley avenue, Ward 23.
Park street, Ward 23.

4th.—Boston, Revere Beach, & Lynn Railroad.

Everett street.

5th.—Eastern Railroad.

Mystic avenue.
Main street.

6th.—New York & New England Railroad.

Broadway.
Dorchester avenue.
Fifth street.
Forest Hill avenue, Ward 24.

Fourth street.
Harvard street, Ward 24.
Norfolk " " "
Norfolk " " "
Second street.
Silver street.
Sixth street.
Third street.
Washington street, Ward 24.

7th.—Old Colony Railroad.

Adams street.
Ashmont street and Dorchester avenue.
Cedar Grove cemetery.
Commercial street.
Savin Hill avenue.

Recapitulation.

I.	Number wholly supported by Boston	35
II.	Number of which Boston supports the part within its limits	14
III.	Number of which Boston pays a part of the cost of maintenance	5
IV.	Number supported by Railroad Corporations:—	
1.	Boston & Albany	5
2.	Boston & Maine	2
3.	Boston & Providence	7
4.	Boston, Revere Beach, & Lynn	1
5.	Eastern	2
6.	New York & New England	13
7.	Old Colony	5
	Total number	89

1.—BRIDGES WHOLLY SUPPORTED BY BOSTON.

Ashland-street Bridge (over Boston & Providence Railroad, Ward 23).

This bridge has been painted and the roadway has been sheathed. The abutments have needed repointing for the past two years; otherwise the bridge and abutments are in excellent condition.

Total cost of repairs, $442.74.

Athens–street Bridge (over New York & New England Railroad)

Has not required any repairs, and is in good order.

Beacon–entrance Bridge (over Boston & Albany Railroad).

This is a new iron bridge of the deck pattern, and was completed September 30th, although not yet opened for public travel. The abutments were built of stones from the Beacon-Hill reservoir. The entire structure is of the most substantial character. A more detailed description of it is given in my report to the Park Commissioners.

Beacon–street bridge (over Outlet of Back Bay Park Pond).

No repairs have been made upon this bridge during the past year. It will require painting, and probably sheathing, the coming season.

Berkeley–street Bridge (over Boston & Albany Railroad).

Although this is a bridge of insufficient strength for the travel of the thoroughfare upon which it is located, no change for the worse has been observed in it, and it is apparently in good order. The only repairs required were upon the roadway sheathing.

Total cost of repairs, $101.75.

Berkeley–street Bridge (over Boston & Providence Railroad.)

The wearing surface of the roadway has been renewed and the hard-pine under-floor recalked.

The under-floor showed signs of decay, confined principally to a small amount of rot on the edges of some of the planks. All rotten wood was removed, and the floor left in good condition.

The iron-work and other portions of the bridge are in good order.

Total cost of repairs, $1,029.16.

Blakemore–street Bridge (over Boston & Providence Railroad, Ward 23).

This is a new iron bridge with granite masonry abutments and wing-walls. The bridge was completed at the date of the last annual report, but had not been opened for travel, as the filling of the approaches had not been done. The filling was completed early in the year, and the bridge has been open to travel since.

It will probably require painting this year; otherwise it is in excellent condition.

* Broadway Bridge (over Fort Point Channel).

The principal repairs made during the year consisted in renewing the roadway sheathing, recalking the under-floor of the draw, and painting.

The timber floor built last year to replace the iron plate and wood-pavement flooring of the column section on the Boston side of the channel has given good satisfaction, and has not required any expenditure for repairs.

The iron plate and wood-pavement floor on the column section on the South Boston side of the channel has, as heretofore, given considerable trouble, on account of the expansion of the wood blocks, caused by frost.

To remedy this difficulty rows of the blocks have been taken out at intervals of about one hundred feet, and their places filled by planks fitted in such a way as to permit the expansion of the pavement without its being raised in waves, as has usually been the case.

The remedy has proved successful so far as to prevent the former stoppages of travel from this expansion of the pavement in frosty weather; but the wooden blocks are nevertheless a source of annoyance, expense, and possible danger, and have proved extremely undesirable as a road surface for a bridge structure, either of iron or wood.

The timber curbing in the gutters of the wood pavement section is rotten, and must be renewed soon. The under-floor of the concrete sidewalks is in bad condition, and will require more or less repairs the present year. The floor of the draw-pier will also require renewal to a considerable extent.

The sheet-piling of the draw-pier, to which attention has been called in previous reports, on account of its worm-eaten condition, has not shown any change for the worse.

The substructure of the bridge has been painted for about

three-fourths of its length with red lead. The remainder of it and the superstructure should be painted in the spring.

Total cost of repairs, $4,841.94.

Broadway Bridge (over the Boston & Albany Railroad).

The abutments and retaining-walls were ready to receive this iron bridge early in the year. There still remained some grading of the approaches to be done by the contractors, Messrs. John Cavanagh & Co., and this work was finally completed by the city in connection with its own filling outside the lines embraced by the contract. A final settlement was made with the contractors Sept. 16, 1882; the total amount paid was $64,228.50.

The iron bridge was completed by Mr. D. H. Andrews, the contractor, in April, about three and one-half months behind the contract time.

The cost of the iron bridge was $29,366.80, exclusive of the fences. The fences were furnished and erected by the Manly & Cooper Company, of Philadelphia, at a cost of $1,860.

Brookline-avenue Bridge (over Muddy River).

This small timber bridge will be destroyed on the completion of the Muddy-river covered channel, a work now in progress and probably to be completed the present year.

It is in safe condition and has cost nothing for repairs.

* Charles-river Bridge (from Boston to Charlestown).

The condition of the draw of this bridge is not such as could be wished in view of the much larger amount of travel which will probably go over it on account of the reconstruction and widening of Warren bridge. The draw foundation is in very poor condition, and although all the work which could be done to any advantage while the draw was in use has been done, much more is required to make the foundation what it ought to be for a structure of this kind.

As soon as the reconstructed Warren bridge is opened for travel, so that this bridge can be out of use for a time without great inconvenience, an entirely new draw foundation above the piles should be built.

The draw has received two severe blows in nearly the same place from passing vessels, and one girder is bent considerably. If it should be struck again with so much force as in either of the other cases it would probably be disabled.

If the draw is to be retained, — a measure of somewhat doubtful expediency if the foundation is renewed, — steam-power should be applied for moving it off and on, and also as an aid to vessels passing through the draw-way.

The bridge, as a whole, may be said to be in fair condition.

Total cost of repairs, $2,438.05.

* Chelsea Bridge (South) (over South Channel, Mystic River).

Only the usual small repairs have been made upon this bridge, and it is now in good condition.

Total cost of repairs, $314.76.

* Chelsea-street Bridge (from East Boston to Chelsea).

The draw to this bridge was replanked early in the year, but no other repairs have been made upon it. The fixed portion of the bridge is in good condition and the draw is in good enough condition for street travel. If the draw had to be opened frequently for the passage of vessels it would soon require extensive repairs or entire renewal; but as it is seldom or never opened, although always kept in condition for use, it is probable that it will answer its purpose for some time to come.

Total cost of repairs, $149.90.

Columbus-avenue Bridge (over Boston & Albany Railroad).

The roadways have been replanked. The bridge needs painting, but is otherwise in excellent condition.

Total cost of repairs, $81.40.

*Commercial Point, or Tenean Bridge (Ward 24).

The plank flooring of this bridge has been entirely renewed the past season, and the structure is now in good order.

Commonwealth-avenue Bridge (over water-way, Back Bay Park.)

This new iron bridge was completed by the contractors, Messrs. Cook, Rymes, & Co., in May.

It is an iron-plate girder bridge of the deck pattern, and cost, exclusive of the fence, $9,803.59.

It has not been opened for public travel, as the Common-

wealth-avenue extension is not completed. The bridge has, however, been in use for the passage of gravel trains during the filling of the avenue and adjacent lands.

No fences have yet been placed upon the bridge, as it was thought desirable to await the adoption of some style of fence by the Park Commissioners for the portions of the Beacon entrance, which require fencing, and then make the bridge fences of a similar pattern.

The bridge is a thoroughly substantial structure, and has shown no signs of weakness under the unusual strains caused by the passage over it of the gravel trains and heavy engines which draw them.

* Congress-street Bridge (over Fort Point Channel).

A new centre-pivot bearing, by which the weight of the draw is carried upon flat steel-plates $12\frac{3}{8}$ inches in diameter, has replaced the steel friction-roll centre-bearing, which was not only considerably worn, but was unsatisfactory in its action. The new centre-bearing works well; the old one will be retained for use in case of accident.

The planking on the sides of the water-ways, which was badly worn by the passage of such large numbers of vessels, has been partially renewed with planks of greater thickness; this work should be continued and completed the coming season.

Under the direction of the Harbor and Land Commissioners the channel has been dredged to a depth of sixteen feet below low-water as far as the bridge. As there are but twelve feet in depth at low water in the draw-ways and above the bridge, vessels drawing more than this amount may accidentally get caught in the draw-way. The sixteen-foot depth should be continued to such distance above the bridge as to render such an occurrence impossible, as the stoppage of travel over this bridge causes the greatest inconvenience to the large traffic over it to and from the railroad freight-yards and steamship-docks on the South Boston side of the channel.

The machinery for turning the draw has been kept in good repair, and the bridge, as a whole, is in good condition.

Total cost of repairs, $3,554.45.

Dartmouth-street Bridge (over Boston & Albany and Boston & Providence Railroads).

The iron-work above the floor has been painted, and the roadways sheathed. The bridge is in good order.

Total cost of repairs, $761.10.

* Dover-street Bridge (over Fort Point Channel).

The draw-way of this bridge was narrower than the law required by more than a foot. It has been made the full legal width of thirty-six feet at the level of high water.

Two of the main trucks under the draws have been removed on account of wear, and two spare trucks substituted for them. The old trucks have been put in order, and are ready for use when required.

The roadways of both draws have been sheathed, and the entire bridge painted. It is now in good condition.

Total cost of repairs, $3,248.08.

* Federal-street Bridge (over Fort Point Channel).

The sides of the draw-ways of this bridge have been trimmed off so as to make the opening the full legal width of thirty-six feet.

The bulkheads at the ends of the draws have been rebuilt with new timber, a considerable amount of repaving has been done in the bridge roadway, and the machinery for working the draws has been thoroughly repaired.

For a wooden bridge that is growing old its condition is fair, — the floor is known to be badly decayed in places, and the draws will not last many more years.

Total cost of repairs, $3,040.07.

Ferdinand-street Bridge (over Boston & Albany Railroad).

The roadway has been sheathed, and the bridge proper is in good condition. The bulkhead referred to in last year's report is still in an unsafe condition, nothing having been done to improve it.

Total cost of repairs, $51.26.

Huntington-avenue Bridge (over Boston & Albany Railroad)

Is in good order, no repairs have been made upon it the past year.

* Malden Bridge (from Charlestown to Everett).

A small section of this bridge rests upon an old timber crib, which it was found impracticable to drive piles through when the bridge was rebuilt in 1875. This section has settled somewhat, but not enough to require any work to be done

upon it yet. The cross-timbers, which transfer the weight of the draw to the centre pivot, are badly bent. With the exception of these defects the bridge is in good order, although only slight repairs have been made.

Total cost of repairs, $80.32.

* Meridian-street Bridge (from East Boston to Chelsea).

The turning-gear, tracks, and wheels of the draw have been put in good order, and a small amount of paving has been done on the bridge.

The plank floor, bulkheads, and railing of the fixed portion of the bridge are in poor condition.

Total cost of repairs, $451.32.

* Mt. Washington-avenue Bridge (over Fort Point Channel).

The draw-pier has been strengthened at one end, and will require similar work at the other end in the spring. The draw has been sheathed twice, and the entire bridge has been painted. It is now in good condition.

Total cost of repairs $2,164.52.

Newton-street Bridge (over Boston & Providence Railroad).

The abutments have been repointed. No other repairs have been made. The bridge is in good order.

Public Garden Foot-Bridge.

The stone masonry of this bridge has needed repointing for several years; otherwise the bridge is in good condition.

Shawmut-avenue Bridge (over Boston & Albany Railroad).

The roadway has been newly sheathed, and the concrete sidewalk has been repaired to a slight extent. The bridge is in excellent order.

Total cost of repairs, $283.97.

Swett-street Bridges (over South-Bay sluices).

The northerly bridge has been sheathed and the sidewalks on both put in order. The abutment wings, which are of a temporary character, show some signs of weakness; otherwise the bridges are in fair condition.

Total cost of repairs, $185.85.

* Warren Bridge (from Boston to Charlestown).

Only the most necessary repairs have been made on this bridge, owing to the uncertainty of its future as an avenue of travel. The action of the City Government in granting the appropriation for widening and reconstructing the bridge will render any further large expenditure in the way of repairs unnecessary.

There are two particulaly weak piles in the bridge, which may do service until the new structure is completed, but they will require careful watching in the meantime.

During the year the pavement has been extensively patched, the concrete sidewalk resurfaced, and the usual minor repairs made.

The general condition of the bridge is very poor.

Total cost of repairs, $1,870.25.

West Chester Park Bridge (over Boston & Albany Railroad)

Is in good order; no repairs have been made upon it during the year.

West Chester Park Bridge (over Boston & Providence Railroad).

The roadway sheathing has been patched and the trusses cleaned. The bridge is in good order.

Total cost of repairs, $51.68.

Winthrop Bridge (from Breed's Island to Winthrop).

The under floor has been recalked, the roadway sheathed, and railing painted. One of the main piles, near the centre of the bridge, has mysteriously disappeared. The bridge has been strengthened at this weak point and is now in good condition.

Total cost of repairs, $987.45.

II. — BRIDGES OF WHICH BOSTON SUPPORTS THE PART WITHIN ITS LIMITS.

* Cambridge-street Bridge (from Ward 25 to Cambridge).

The buoy has been reset, the draw newly sheathed, and the Superintendent's house repaired. The bridge is now in fair condition.

Total cost of repairs, $253.46.

Central-avenue Bridge (over Neponset River, Dorchester Lower Mills).

With the exception of new roadway sheathing, no repairs have been made on this bridge. It will require painting the coming season; but is in other respects in excellent condition.

Total cost of repairs, $128.69.

* Chelsea Bridge (North) (from the Mystic River Corporation's Wharf to Chelsea)

Is in excellent condition, and only ordinary repairs have been made upon it during the year.

Total cost of repairs, $420.16.

* Essex-street Bridge (from Ward 25 to Cambridge).

The portion of this bridge maintained by Cambridge has been rebuilt during the past year. The draw is of the leaf or lifting pattern, and the half on the Boston side was old and in poor condition. Advantage was taken of the stoppage of travel over the bridge by Cambridge to substitute a new leaf for the old one on the Boston side of the channel. The roadway of the bridge was also newly sheathed. The underfloor of the roadway was found in much poorer condition than was anticipated, considering that it has been down but four years and consists of hard-pine plank, calked and paid. It was rotten in many places, and although repaired to some extent was in such condition that entire renewal would be cheaper in the end than thorough repair. The floor will probably be safe for a few years, but will require careful watching. No reason is known for the early decay of this floor; an examination of other bridge-floors, similarly constructed and much older, shows them to be in good condition. That the timber of which it is composed might not have been sufficiently seasoned; that it was made from trees from which the sap had been drawn, or that it was overheated in transportation, furnish the only reasons which have been suggested for its failure.

Total cost of repairs, $2,860.62.

* Granite Bridge (from Ward 24 to Milton).

This bridge has been rebuilt above the pile-work with new materials. The draw has been repaired, and the entire bridge is now in good condition.

The repairs consisted of splicing three defective piles,

putting on new girder-caps at a lower grade than the old ones in all the bents of piles; a new hard-pine floor, 4 inches thick, calked and paid, and covered with 2-inch spruce; and a new sidewalk, 5 feet wide, on one side of the bridge. The draw was also replanked, and the approach to the bridge newly fenced. All of the work was done by the repair-gang, under the immediate supervision of Mr. Lewis, the foreman.

The portion of the bridge in Milton was rebuilt, on substantially the same plan, under the direction of the Road Commissioners.

Total cost of repairing Boston's portion, $2,350.93.

Longwood-avenue Bridge (from Ward 22 to Brookline)

Is in fair condition; no repairs have been made upon it the past year.

Mattapan Bridge (from Ward 24 to Milton).

A weak structure, in fair condition; no repairs have been made during the past season.

Milton Bridge (from Ward 24 to Milton).

Slight repairs have been made on the sidewalks. It is probable that the floor is somewhat rotten, as it is old, but no signs of weakness have been noticed. A careful examination of it will be made early in the season to determine its condition. The iron-work needs painting; otherwise the bridge is apparently in good condition.

Total cost of repairs, $7.27.

*Neponset Bridge (from Ward 24 to Quincy).

Only small repairs have been required. The bridge is in good order.

Total cost of repairs, $93.86.

*North Beacon-street Bridge (from Ward 25 to Watertown).

A new railing is needed on this bridge; otherwise it is in fair condition. No repairs have been made upon it the past year.

* NORTH HARVARD-STREET BRIDGE (FROM WARD 25 TO CAMBRIDGE.)

The dolphin on the down-stream side of the bridge was damaged by vessels, and has been repaired, so that it is now in fair condition. The contemplated dredging operations in the vicinity of this bridge by the United States Government will render the dolphin useless as soon as they are done, and it should then be replaced by a buoy. It will probably be a constant source of expense until that time, owing to its exposed position and careless use by vessels.

The sheathing on the bridge roadway has been patched, and the counterbalance of the draw increased in weight.

The bridge is now in good order.

Total cost of repairs, $284.25.

SPRING-STREET BRIDGE (FROM WARD 23 TO DEDHAM)

Is a stone arch bridge in good order; no repairs have been required.

* WESTERN-AVENUE BRIDGE (FROM WARD 25 TO CAMBRIDGE).

The roadway of this bridge has been newly sheathed, a new buoy put in place, and the superintendent's building repaired. The bridge is now in good condition.

Total cost of repairs, $274.07.

* WESTERN-AVENUE BRIDGE (FROM WARD 25 TO WATERTOWN).

Attention has been called in last year's and several former reports to the obstruction to navigation caused by the bad position of this draw in reference to the channel. It remains in the same condition as last year, and will probably continue to do so until the Watertown authorities are impressed with the necessity for a change in its location.

The draw is often twisted and racked by passing vessels, and the shafting has been removed and straightened twice during the year from this cause.

The sheathing and part of th eunder-floor have been renewed, but the abutment remains in the unstable condition reported last year. The bridge proper and the draw are in fair condition.

The total cost of repairs, $304.70.

III. — BRIDGES FOR MAINTENANCE OF WHICH BOSTON PAYS A PART OF THE COST.

Albany-street Bridge (over Boston & Albany Railroad).

The bad condition of this bridge and its abutments was fully described in last year's report. No special change for the worse in the condition of this structure has been noted.

The retaining-wall between the westerly abutment and the Broadway extension will have to be rebuilt in connection with the raising of the grade of Albany street at its junction with the extension. The abutments of the bridge ought to be rebuilt at the same time to avoid closing the street to travel more than once. If this work is done a new bridge will probably become necessary, as the old one is not worth putting back again if removed.

* Canal Bridge (from Boston to Cambridge).

* Prison-Point Bridge (from Charlestown to Cambridge).

* West-Boston Bridge (from Boston to Cambridge).

The Canal and Prison-Point bridges are in fair condition. The West Boston bridge will require somewhat extensive repairs the coming season. (For further details, see report of the Commissioner for Boston, City Doc. No. 15, 1883.)

Dorchester-street Bridge (over Old Colony Railroad)

Has required no repairs, and is in good condition.

IV. — BRIDGES SUPPORTED BY RAILROAD CORPORATIONS.

The main truss of the Ashland-street bridge, over the Shawmut branch of the Old Colony Railroad, is out of line and grade, and looks overloaded. Beech-street bridge, on the Dedham branch of the Boston & Providence Railroad, is old and poor, and is supported by temporary props from the road-bed. A new iron bridge has replaced the old wooden bridge on Canterbury-street, Ward 23, over the Boston & Providence Railroad.

The remaining bridges, supported by railroad corporations given in the list, are in good order or fair condition, and require no special mention.

MISCELLANEOUS WORK AND CONSTRUCTIONS IN 1882.

Atlantic-avenue Sidewalk.

When this avenue was built, wherever it crossed the head of a dock a retaining or sea-wall was constructed on a line 24 feet from the line of the avenue; the sidewalk was built on pile-work which extended to within 4 feet of the line. On the line of the avenue across all of the docks an oak-pile and hard-pine timber fender-guard was built.

The sidewalk and fender-guard thus constructed aggregates 1,450 feet in length, and have been thoroughly reconstructed and repaired during the past season.

The work consisted principally in building new fences, outside bulkheads, and renewal of plank flooring where it was rotten. The floor was found in good condition except in a few places, a result undoubtedly to be attributed to the fact that it was creosoted or treated with "dead oil" vapor at the time it was laid. Although the treatment was very imperfect, as the creosoting process had at that date (1869–70) been but a short time in use in this city, yet, without it, 6 inch spruce-plank, covered with 18 inches of gravel as this was, could not have lasted probably for more than one-half of the number of years which have since elapsed.

The total cost of the stock and carpenters' work for the repairs was $2,143.62.

D-street Extension.

Under this head is included all the work done by the Old Colony Railroad Company, to fulfil its contract with the city, dated Dec. 28, 1881, and also the building of a culvert or passage-way under and across the railroad from E street to Ames street.

The railroad company's contract required the building of granite-masonry abutments on the lines of D street where it crossed the railroad, the building of an iron bridge upon them to carry the railroad over the street, the building of retaining-walls wherever it was necessary to prevent the filling of the road-bed from encroaching upon land not owned by the company, and in general all the work necessary to give the city a clear headway of 13 feet above grade 10, city base, under the railroad on the lines of D street extended. The work was to be completed Nov. 15, 1882, and the city was to pay for its proportion of the cost, $45,000.

The work has been very actively prosecuted by the railroad company during the past year, and it was practically completed on Nov. 22d. A final estimate and payment was made Feb. 12th of this year.

The masonry of the abutments and retaining-walls is of the most substantial character, fully up in most respects to the standard of such work as done by the city, and the entire improvement has been carried on by the company's officials apparently with the desire to do the best possible work of the class required without reference to the fact that the terms of the contract might permit them to make it less expensive.

The grading of D street and its extension, to conform to the bridge built by the railroad company, is the only work now remaining to be done to render this much-needed avenue available for public travel.

While the work under the railroad company's contract was in progress, a petition was presented to the City Council for the construction of a passage-way under and across the railroad between E street and Ames street. The petition was favorably considered, and an appropriation of $600 was made to construct a timber passage-way. It was afterwards deemed desirable by the Committee on Streets to have a more permanent structure built, and a further appropriation of $600 was obtained.

The structure, as built, consists of an arched passage-way or culvert 4 feet 6 inches wide, and 7 feet high, constructed entirely of hydraulic cement concrete. The foundations extend through several feet of mud to hard clay, and for them American cement concrete was used. Above the foundations the structure consists principally of English Portland cement concrete. Two or three hundred dollars could be advantageously spent in improving the approaches to this passageway, and in making provision for lighting it with gas at night.

East Boston Ferries.

By request of the Board of Directors of these ferries, surveys, plans, estimates, and specifications were made for building new slips on the Boston side of the North ferry. Plans were also made for a new foundation and spring for the shore end of the southerly drop.

The city's lot at this ferry is very narrow, rendering a radical change in the form of the slips and piers a necessity if provision was made for the dockage of two boats at the same time. The form of pier desired for the sides of the slips was decided upon by the Board of Directors; and in the plans and specifications for the work furnished by

this department every provision that could be made for increasing their strength and durability was adopted. The outside pier of each slip consists of two rows of oak-piles, the inner one sheathed with maple-planks four inches in thickness, placed vertically and securely treenailed to oak girders bolted to the piles. The piles of the outer row were strongly connected together by lines of oak-girders bolted to them.

The centre pier consists of two rows of piles, the piles of each row being connected together by oak-girders. Both faces of the centre pier were sheathed with maple planks in the same manner as the faces of the piers opposite to them. The piles of every row were chained together at their tops with heavy iron chains.

Base-lines and grades for the work were given by this department; but the construction was in charge of a competent inspector, appointed by and under the direction of the Board of Directors.

St. Charles-street Retaining-Wall.

In June, plans and specifications were prepared for building a retaining-wall on the line of the Boston & Albany Railroad across the end of St. Charles street.

Proposals for doing the work were received July 13th, but, being greatly in excess of the estimated cost, they were rejected, and the work readvertised, proposals being received the second time July 27th; again the price was considered too high, and it was decided to do the work by day's labor. Work was begun at once, and completed on November 24th.

The wall has a foundation of spruce piles, driven 3 feet apart lengthwise of the wall, by 2 feet 6 inches and 3 feet apart in the other direction. They were driven at an inclination to the vertical of 1 inch in 12; the tops were cut off at grade 3 feet 6 inches above city base. A foundation course of concrete masonry 3 feet 6 inches in depth, 11 feet wide on the bottom, and 8 feet on top was built on the piles surrounding them to a depth of 6 inches below their tops. The concrete was mixed in the proportion of one part cement to two parts of sand and five of gravel, Portland cement being used for a shell of one foot in thickness on the outside of the mass, and Rosendale cement for the interior. The top of the concrete is six inches below the surface of the earth in front. On this is a wall of granite masonry, laid in cement, 6 feet 6 inches wide on the bottom, 3 feet 6 inches wide on top, and 11 feet 1 inch high, surmounted by a cut-granite coping 1 foot 8 inches high. The wall is ballasted with broken con-

crete. The granite and broken concrete were brought from Beacon-hill reservoir. On top of the wall is a close board-fence 5 feet high.

The lowest bid received for doing the work was $4,790. Its cost by day's labor was $3,074.01.

West Rutland square and Durham-street Retaining-Walls, and Foot-Bridge over Boston & Providence Railroad.

These walls are located, one on each side of the Boston & Providence Railroad, at the ends of West Rutland square and Durham street, these streets being in line with each other.

The work was advertised at the same time as the St. Charles-street wall, with the same results; no satisfactory bids being received, it was therefore decided to do it by day's labor. It was begun immediately, and is now completed. The foundation of each wall consists of spruce piles, spaced 3 feet by 2 feet 6 inches apart, driven at an inclination to the vertical of 1 in 12, and cut off at grade 4 feet above city base. On the piles is a mass of concrete 7 feet wide and 4 feet 6 inches high, mixed and deposited in the same manner as at St. Charles street. On the concrete is a wall of granite masonry laid in cement, 5 feet 6 inches wide on the bottom, 3 feet 6 inches wide on top, and 9 feet 5 inches high, with a coping on top 1 foot 5 inches high; the whole is surmounted by a close board-fence 5 feet high. Buttresses were built on the backs of the walls so as to give sufficient foundation for the iron foot-bridge which has been erected. The wall was ballasted with broken concrete. The granite and broken concrete were brought from Beacon-hill reservoir.

The iron foot-bridge over the Boston & Providence Railroad at this point is a through bridge, and rests upon iron piers built upon the retaining-walls. The piers are made of wrought-iron posts, thoroughly braced together, and are 10 feet 10½ inches high. The tops of the piers, which are on a level with the floor of the bridge, are reached by stairways from each side of each street. These stairways are of wrought-iron, excepting the stair treads, which are of hard-pine.

The trusses of the bridge, two in number, are of the riveted bowstring type, have eight panels each, and are 69 feet 7 inches long over all, and 10 feet deep at centre.

Cross floor-beams of 8-inch channel-iron are riveted to the trusses at their panel-points, and on these rest hard-

pine stringers 3 inches by 8 inches, which support a flooring of 1¼-inch hard-pine plank, planed and rabbetted.

The lower lateral system is of angle iron, and the top chords are braced together for four panels at centre of bridge. The strain from the top bracing is transferred to the lower lateral system by special vertical bracings placed one panel each side of centre of bridge.

The stairways, piers, and bridge are provided with gas-pipe railings, connected to cast-iron posts and to the bridge trusses.

The bridge was furnished and erected by the Boston Bridge Works, D. H. Andrews, Engineer, and cost $2,370.

The cost of the retaining-walls was $7,227.21. The lowest bid received when advertised was $9,497.73.

Falmouth–street Filling.

Work was begun on September 1st, by the Boston & Albany Railroad Co., on the filling of Falmouth street, between Newton street and West Chester park. The material was brought from Newton where the Railroad Co. were making some changes in the location of their tracks. Work was stopped on November 16th, on account of the exhaustion of the source of supply of earth, but was resumed on January 25th, with gravel from Riverside. The work is not yet completed. There were deposited to January 1, 1,539 squares of filling, at a cost of $3.20 per square.

Paving–Yard Wharf at Charlestown.

The bulkhead forming one side of this wharf has been for some time in a dilapidated condition. It became necessary the past season either to rebuild the old bulkhead or build a new one outside of it. The latter alternative was adopted, and a new bulkhead was constructed, partly with old oak piles from the Mt. Washington-avenue bridge and partly with new spruce piles. The space between the old and new bulkheads was then filled with ashes.

Tyler–street Retaining–Walls.

The raising of the grade of Tyler street, in connection with the extension of Broadway, involved the building of retaining walls on both sides of the street, on the rising grade. These walls were built by day's labor, and the stone used was furnished from the Beacon-hill reservoir. The wall on the northerly side of the street is about 100 feet in length, and that on the southerly side about 40 feet.

The cost of the work was $2,987.36.

In General.

A considerable amount of work of a miscellaneous character has been done during the year. Under this head may be classed surveys and estimates of quantities of materials required for filling the Prison-Point flats for the Board of Health; plans for extending and relocating one pier on the easterly side of the South ferry, East Boston side; plans and specifications for a new tank for East Boston ferries; estimates of cost of raising grades of Beacon street and Brookline avenues, to avoid grade crossings of the Boston & Albany Railroad; plans, estimates of cost, and models of various methods of providing increased bridge facilities between Boston and Charlestown; repairs of pile-work and capping of South Paving-yard wharf, etc.

In the draughting-room the usual large amount of work of a general character, such as copying, tracing, blue-printing, and revising plans, has been done. Plans and specifications for the following work have also been made: —

Beacon Entrance bridge over Boston & Albany Railroad, Back Bay park.

Foot-bridge over Boston & Providence Railroad at West Rutland square.

New centre for Congress-street bridge draw.

New centre for West Boston bridge draw.

Iron-work, etc., connected with the engines and boilers, and their foundations, at Improved Sewerage pumping-station.

All inspection of the above work, both in the shops and during erection, has been done by Mr. John E. Cheney, designer and principal draughtsman, and his assistants. The erection of the Blakemore-street, Commonwealth-avenue, and Broadway-extension iron bridges was under the same supervision.

B. — WATER-WORKS.

Sudbury-River Reservoirs, Farm Pond, and Lake Cochituate. — On January 1, 1882, Reservoirs Nos. 2 and 3 were full; Reservoir No. 1 was empty, the water having been drawn off for the purpose of repairing the 48-inch pipe leading from Dam 2 to the gate-chamber at Dam 1. On January 3, Reservoir No. 1 commenced to fill, and on January 11 water was flowing over the crest of the dam. All of the reservoirs remained full until July 1. During July and August Reservoir No. 2 was lowered very rapidly, and on September 3 it was practically empty. Reservoir No. 3, which

had also been falling during the month of August, continued to fall until September 22, when its surface was 7.48 feet below the crest of the dam. Reservoir No. 1 was drawn upon for the city's supply from July 26 to August 5, about 160,000,000 gallons being taken for that purpose, lowering its surface about four feet. Since the latter date no water has been drawn from this reservoir, except the 1,500,000 gallons per day which are allowed to run into the river.

During the month of September rain-fall amounting to 8.74 inches raised the surface of Reservoir No. 2 about 11.5 feet.

During the month of October, and until November 24, water for the city's supply was drawn from Reservoir No. 2, and Reservoir No. 3 was allowed to fill. At the latter date Reservoir No. 2 was 11.41 feet, and Reservoir No. 3 was 2.20 feet below the crests of their dams. From November 24 to December 27 water was drawn from Reservoir No. 3, and its surface lowered 5.97 feet. Reservoir No. 2 during the same time had risen 12.12 feet. At the present time, January 1, 1883, Reservoir No. 1 is 154.66 feet; Reservoir No. 2, 165.65 feet; and Reservoir No. 3, 167.96 feet above tide-marsh level.

From January until the middle of April the water in Farm pond was kept at about grade, 146.00, in order that the water from the reservoirs might be run through the temporary channel. Since April 20 the pond has been kept at or near 149.25.

Lake Cochituate, on January 1, 1882, was 128.27 feet above tide-marsh level, or 6.09 feet below high water; on February 21 the lake was so full that waste was begun at the outlet-dam.

The lake remained at or near high-water mark until June 8, after which time it gradually fell, and on December 22 it reached the lowest point during the year (126.25), 5.22 feet above the conduit invert.

Mystic Lake. — At the beginning of the year 1882 the lake was full, and it remained at or near high-water mark until the first of July. During July and August the surface fell, and on September 11 it was 2.4 feet above tide-marsh level, or 11 inches above the top of the conduit; October 1 it had risen to grade, 4.15; November 1, 5.42; December 1, 5.43; and January 1, 1883, 6.02 feet above tide-marsh level.

Consumption. — The average daily consumption from the combined works, for each month, has been as follows: —

	Sudbury and Cochituate Works.	Mystic Works.	Total.
January . .	32,151,100	7,816,200	39,967,300
February . .	34,662,300	7,937,300	42,599,600
March . . .	32,256,300	6,573,700	38,830,000
April . . .	30,827,000	5,946,100	36,773,100
May . . .	28,738,000	5,793,600	34,531,600
June . . .	33,178,400	6,664,400	39,842,800
July . . .	30,992,600	6,881,400	37,874,000
August. . .	34,149,300	6,912,200	41,061,500
September . .	31,691,600	5,964,100	37,655,700
October . .	31,563,800	6,011,300	37,575,100
November . .	31,318,700	5,577,400	36,896,100
December . .	32,352,800	6,877,600	39,230,400
Average . .	31,970,800	6,574,400	38,545,200

The consumption from the Sudbury and Cochituate works shows an increase of about 3 per cent. over that of the year 1881, while that of the Mystic works shows a decrease of about 8.5 per cent. About one-half of this decrease was due to a reduction in the amount furnished from those works for the supply of East Boston. The total consumption shows an increase of 330,300 gallons per day, or about one per cent. over that of 1881.

The daily average consumption per head of population has been 91 gallons from the Sudbury and Cochituate works, 77 gallons from the Mystic works, and 88 gallons from the combined supplies.

Of the 11,669,300,000 gallons consumed on the Sudbury and Cochituate works, the Sudbury-river works have furnished 7,735,200,000 gallons, as follows: —

January,	595,000,000	July,	646,900,000
February,	975,700,000	August,	655,800,000
March,	1,002,300,000	September,	308,900,000
April,	781,200,000	October,	570,300,000
May,	502,800,000	November,	572,300,000
June,	491,800,000	December,	632,200,000

Average daily amount furnished, 21,192,300 gallons, or 66.3 per cent. of the total consumption.

All of the above quantity has been sent from Farm pond to Chestnut-Hill reservoir, none having been sent to Lake Cochituate during the year.

High-Service Works.

The average daily quantities pumped at the Highland station during each month are as follows: —

January,	2,711,800	July,	3,023,000
February,	2,733,000	August,	3,014,000
March,	2,552,000	September,	2,779,670
April,	2,575,100	October,	2,673,500
May,	2,792,000	November,	2,698,030
June,	3,040,580	December,	2,839,000

The daily average for the year has been 2,786,545 gallons, an increase of 15.7 per cent. over that of 1881.

At the East Boston pumping-station the daily average amount pumped has been 422,540 gallons.

Waste of Water.

Mention is made in my last annual report of the trial in the Charlestown District of the Deacon system of preventing waste of water. A full statement of the results of this trial is given in my last report to the Water Board. These results show that a very large percentage of the water supplied to the city is wasted, and that the prevention of this waste is possible at a reasonable cost. The subject is so fully considered in the report above referred to, that I only allude to it here for the purpose of calling especial attention to facts and figures in relation to a matter which I consider one of the most important for the consideration of the City Council.

Mystic-valley Sewer.

The treatment of the sewage from the Mystic valley, in the manner described in my last report, has been continued during the year with as much success as could be expected.

On July 15, at my request, the work, which no longer required the direct supervision of this department, was placed in charge of the superintendent of the Mystic Works.

The change of legislation asked for last winter, in order to reduce the cost of maintenance of the present expensive system of pumping, and to accomplish other improvements for the purification of the lower Mystic pond, was not obtained. An attempt should be made to procure it at the earliest opportunity.

Sudbury-river Basin, No. 4.

The work on the dam for this basin was continued, although to a small extent, during the winter months, but was resumed more actively in the spring. 31,000 cubic yards of loam and

perishable materials have been removed from the site of the embankment. 19,300 cubic yards of trench excavation, extending to the underlying bed-rock which forms the foundation of the masonry, were removed during the year. This excavation was made to a greater depth than was indicated by the borings, and was somewhat delayed by the blasting of a large number of heavy boulders, which could not be removed by other methods; the shaping of the upper surface of the ledge required also considerable time and labor. 1,727 linear feet of trench were thus excavated, leaving 326 feet undone. The concrete structure forming the centre wall of the dam and the support for the discharge-pipes is completed for 1,383 linear feet of trench, and partially so for 100 feet, leaving 244 feet of open trench in which the masonry work remains to be done. 7,218 cubic yards of concrete have been laid, and the upper face of the wall has been plastered with double layers of Portland cement mortar.

The roll-way and a portion of the overflow are built, and the foundation of the gate-house is completed to the surface of the ground. In all, 2,286 cubic yards of stone and brick masonry (exclusive of concrete) have been laid.

18,500 cubic yards of the dam embankment are in place, and about 20,000 cubic yards of loam have been piled up ready for removal. In accordance with an arrangement between the Boston Water Board and the Park Commissioners, the road-bed for a spur track connecting the Hopkinton Branch railroad with the valley of the Cold Spring brook has been graded, and will be used for removing the loam excavated from the basin to the Back Bay park. This track will be extended from time to time to cover the whole area to be cleaned.

The cost of construction of Basin 4, to Jan. 1, 1883, including the cost of plant on hand, is $162,469.35. The cost of removal of loam, including cost of steam-excavator, and of grading 2,900 feet of track, is $10,963.92.

There were, on an average, during the summer and fall, 225 men and 30 horses employed on the work. At present there is a small force at work finishing the excavation of the trenches and quarrying stone for rubble masonry.

For reasons given in my last report to the Water Board, I am of the opinion that it would be advantageous to the city to finish this work as it has heretofore been conducted,— by day's labor.

Miscellaneous.

Plans have been made showing the results of surveys and borings during the month of March, in the vicinity of the

present dams at the outlet of Lake Cochituate, for the purpose of determining the most suitable location for a new dam.

About 120 feet of 48-inch pipe have been laid near Commonwealth avenue, under the channel of the pond in the Back Bay park. The pipe is supported by a pile foundation consisting of spruce piles driven in pairs at distances apart of 5½ feet crosswise and about 6 feet lengthwise of the trench, and capped crosswise with 10 × 10-inch spruce caps 8 feet 6 inches long. The sides of the trench in which the pipe is laid, are composed of 4-inch tongued and grooved sheeting.

All of the gates and hydrants connected with the distribution system of the City proper have been located, and new and more accurate plans, on a scale of 100 feet to an inch, have been made, showing the actual location of all the water-pipes, gates, hydrants, etc.

The distributing mains of the Sudbury and Cochituate works have been extended about seven miles during the year.

C. — IMPROVED SEWERAGE.

In last year's report I stated that the appropriation then available for this work was insufficient to complete it in accordance with the original plan, as modified by subsequent additions and alterations. A little later I submitted to the Committee on Improved Sewerage an estimate of the further sum needed, and the reasons why it was required.

This statement was incorporated by the committee in their request made to the City Council April 17, 1882, for an additional appropriation of $1,500,000. This amount having been voted by orders dated May 12, 1882, is now available for the prosecution of the work. I am happy to say that the cost of construction during the past year, and the present condition of the work, give every assurance that the appropriation is now ample to cover all reasonable expense of completing the system in a substantial manner in accordance with the plans. Satisfactory progress towards completion has been made during the past year. A detailed account of it will be found in Mr. Clarke's report. I shall therefore merely present a brief summary of the present state of the work, and of what is required to complete it.

A natural division of the whole system is into four principal parts, viz. : —

1. The main and intercepting sewers which convey the sewage of the city to the pumping-station.
2. The pumping-station at which the sewage is raised.
3. The outfall sewer by which the sewage is conveyed from the pumping-station to Moon Island.

4. The reservoir at Moon Island in which the sewage is to be stored, and from which it is to be emptied into the sea during the early ebb-tide.

1. About three-quarters of all the intercepting sewers, which it is proposed to build within the city, are practically finished and in condition for service. By the simple raising of valves, already built into the city sewers, near their outlets, the sewage from the greater part of the city could now be diverted and made to flow to the pumping-station. Extensions of these sewers are now in progress, and can be continued as required, without interfering with the use of portions already built. These extensions will, in the future, almost without exception, be built in crowded thoroughfares and in filled land, where very many unforeseen obstacles will be encountered, requiring constant variations in location and in methods of construction.

It would not be wise, and is not necessary, to hurry this work; and, to accomplish it successfully, without serious inconvenience to abutters and the public, will require that it shall be entirely within the control of the city, and be managed by city superintendents.

2. The pumping-station, also, is practically in condition for service. The sewage could now be raised at this point without interfering with the erection of permanent buildings and other minor details of work which are yet to be done. It was supposed that the interests of the city would be best served by the use of the sewers and pumps now completed, to divert the sewage of the city from those points where it is most troublesome into Dorchester bay, where, in the opinion of those most competent to judge of the matter, its temporary discharge would create no nuisance. Apprehension of danger to certain districts, however, arose, and the following act was obtained from the Legislature, May 26, 1882: —

Be it enacted by the Senate and House of Representatives in General Court assembled, and by authority of the same, as follows: —

Section 1. No part of the contents of the main sewer now or hereafter to be constructed, running south-easterly from the direction of Charles river, in the city of Boston, shall be discharged at or near the shore of the Calf Pasture, so called, in Dorchester bay, or at any place in Boston harbor, or vicinity, except at Moon island. The supreme judicial court, or any justice thereof, upon the petition of not less than ten taxable inhabitants of the city of Boston, may restrain, by injunction or otherwise, any violation of the provisions of this act.

It will be seen that the act is prohibitory, and that the sewage can be discharged nowhere except at Moon island.

The Leavitt pumping-engines were first started July 26, 1882, and have each been run for short periods at intervals since. While it has, of course, been impossible to fully test them with sewage, it may be said that, in the opinion of experts, from observation of their appearance and performance, they will amply fulfil all requirements as to capacity, duty, and durability, and will prove to be admirably adapted to their work.

By the terms of the contract under which they were furnished it was stipulated that the contractors should maintain the engines and repair any defects which might be developed in running them during a probationary period of twelve months after their completion. Also, that the city might retain, during that time, five per cent. of the contract price, to guarantee the performance of said requirements. As the effect of the act, just cited, was to postpone indefinitely the beginning of said period of probation, it was thought for the interest of the city to release the retained percentage and obtain in its place a bond by which the contractors, in consideration of said present release, agreed to extend the period of probation to January 1, 1885, and to return said percentage, on demand from the city, at any time within said period, should any contingency arise to require it. This arrangement was concluded October 12, 1882, and is thought to innure to the advantage of both parties.

3. Fair progress has been made during the past year in constructing the outfall sewer from the pumping-station to Moon island. From the pumps to the tank-sewers the force-mains are already in place. The tank-sewers which connect these with the tunnel under Dorchester bay are partly constructed, and can be finished during the coming season. The tunnel will be completed early in the summer. It is entirely excavated, and nearly the whole of it is now lined with brick-work. It is a matter for congratulation that this piece of work has been successfully accomplished. While it would not have been attempted had there been doubts of its feasibility or that difficulties would be encountered which could not be surmounted, yet such work, from its nature, is always somewhat uncertain, and, until the last foot is penetrated, there are possibilities of meeting demoralized rock, open seams, excessive amounts of water, etc., which may cause serious delay and expense. These contingencies being now impossible, the tunnel may be said to be an assured success, and to afford the best and most economical route for reaching the point of discharge. From the end of the tunnel the outfall sewer has been constructed towards Moon island, as far as is considered at present ex-

pedient; should it be thought wise to permit further time for settlement of the embankment from Squantum to the island before building the permanent masonry structure on it, a temporary conduit can be built during the coming year, so as not to delay the use of the system.

4. The new contractors have prosecuted the construction of the reservoir on Moon island with great energy during the past year, and there is every assurance that the structure will be put in condition for service during the coming season, although the completion of minor portions of the work may extend into next year. The outlet sewer section, through which the sewage accumulated in the reservoir, will be discharged at high-tide into the current setting out of the harbor between Moon and Long islands, is yet to be built. Plans and specifications for it are prepared, and it is expected that it will be contracted for in March or early April of this year. It is not certain that it can be wholly built during the present season; but the use of the rest of the system need not be delayed until its completion.

From the foregoing statements it will be seen that the intercepting system of sewerage is at present in condition for use up to and including the point where the sewage is raised high enough to be discharged into the outer harbor, and that beyond this point it can probably be put in condition for use within a year. Extension and perfection of the system may continue for a year or two longer. The work, as a whole, and in its parts, is known to be durable and efficient, and no doubts are entertained that it will accomplish the good results which have been claimed for it.

The total appropriation for improved sewerage is $5,253,000. The gross expenditure to Jan. 1, 1883, including that for preliminary surveys, has been $3,389,104.07, leaving a balance of $1,863,895.93.

Below are given extracts from the report of Mr. E. C. Clarke, principal assistant-engineer of this work, which relate in detail the operations of the past year, and items of interest connected with them.

Extracts from Mr. Clarke's Report.

The following is the customary annual statement, showing, in tabulated form, the different sections of sewers already built or in process of construction, with the size and extent of each, the lengths built prior to and during the past year, whether done by contract or otherwise, and the builder's name.

TABULAR STATEMENT OF PROGRESS—

Section.	Locality.
1. Main	In Camden st., from Huntington ave. to Tremont st. . . . .
2. Main	In Camden st., from Tremont st. to Washington st. . . . .
3. Main	In Washington st., and E. Chester park, from Camden st. to Albany st.
4. Main	In E. Chester-park extension, from Albany st. to Magazine st. . . .
4½. Main	In E. Chester-park extension, from Magazine st. to Clapp st. . . . .
5. Main	In Clapp and Mt. Vernon sts., from E. Chester park, to O.C. R.R. .
6. Main	In Mt. Vernon-st. extension, from O.C. R.R. to Old Harbor Point . .
1. West Side	In Camden, Falmouth, Dalton, and Hereford sts., from Huntington ave. to Beacon st. . . . .
2. West Side	In Beacon st., from Hereford st. to Charles st. . . . .
3. West Side	In Charles st., from Beacon st. to Cambridge st. . . . .
1. East Side	In Albany st., from E. Chester park, to Dover st. . . . .
2. East Side	In Albany st., Lehigh st., and O.C. R.R. freight-yards, to Federal st. .
3. East Side	In Federal st., from O.C. R.R. freight-yards, to Summer st. . . . .
4. East Side	In Atlantic ave., from Summer st. to Belcher lane . . . . .
1. Stony Brook . . .	In Tremont and Cabot sts., from Camden st. to Ruggles st. . . . .
2. Stony Brook . . .	In Cabot, Hampshire, Elmwood, Ruggles, and Tremont sts., about Stony Brook . . . . .
1. South Boston . .	In Ninth st., from H. st. to N. st. . . . .
3. South Boston . .	In Von Hillern st., Locust st., Washigton ave., and Hyde st., from Mt. Vernon st. to Dorchester ave. . . . .
4. South Boston . .	In Dorchester ave., from Hyde st. to B. st. . . . .
5. South Boston . .	In Dorchester ave. and Foundry st., from B. st. to First st. . . . .
Roxbury Canal .	In Albany st. and E. Chester park, from Northampton st. to Roxbury Canal . . . . .
Chester Park . .	In E. Chester park, from Albany st. to Harrison ave. . . . .
Pumping-Station .	Connecting Main Sewer and Filth-Hoist and Engine-Wells and Salt-Water Conduit . . . . .
1. Outfall Sewer . .	From Pumping-Station to Dor. Bay Tunnel . . . . .
2. Outfall Sewer . .	Tunnel under Dorchester Bay { Excavation . . . . . / Brick lining . . . . .
3. Outfall Sewer . .	Squantum Neck to Moon Island . . . . .
	Totals . . . . .

IMPROVED SEWERAGE CONSTRUCTION.

Size in feet and inches.	Length in feet.	Built prior to Jan. 1, 1882.	Built Jan. 1, 1883.	Built by
7 ft. 8 in.	1675.5	1675.5	1675.5	P. J. Condon.
8 ft. 5 in.	1390.5	1390.5	1390.5	P. J. Condon.
8 ft. 5 in.	1795.	1795.	1795.	John Cavanagh.
9 ft.	2506.5	2506.5	2506.5	Charles Linehan and City.
9 ft.	1894.	1894.	1894.	City.
9 ft. . . . . 10 ft. 6 in.	3381.	3381.	3381.	Hoblitzell, Condon, and Hoblitzell and City.
10 ft. 6 in.	4088.	4088.	4088.	Clinton Beckwith, and J. V. Quackenbush.
4 ft. 9 in. × 5 ft. 6 in. .	4282.	4282.	4282.	City.
4 ft. 9 in. × 5 ft. 6 in. 4 ft. × 4 ft. 6 in. . .	5043.	5013.	5013.	City.
4 ft. × 4 ft. 6 in	1832.	1832.	1832.	Thomas McCann.
5 ft. 8 in.	4524.5	4524.5	4524.5	A. H. Delameter & Co., and R. A. Malone.
5 ft. × 4 ft. . . . . 5 ft. × 3 ft.	2331.5	650.	2331.5	City.
2 ft. 8 in. × 4 ft. 6 in. .	2108.	. . . . .	2108.	City.
2 ft. 8 in. × 4 ft. 6 in. .	2032.	. . . . .	250.	City.
4 ft. 8 in.	2135.	2135.	2135.	Myles Tierney.
5 ft. × 4 ft. 6 in. . . 2 ft. × 3 ft. . . . . 15 in. pipe	4500.	4500.	4500.	City.
3 ft. 2 in.	2717.5	2717.5	2717.5	Stephen Connolly & Co., and City.
6 ft. . . . . 4 ft. 9 in. × 5 ft. 6 in. 4 ft. 6 in. × 3 ft. . .	3739.	3739.	3739.	Charles Linehan.
4 ft. 9 in. × 5 ft. 6 in. .	3350.	3350.	3350.	Hoblitzell, Condon, and Hoblitzell and City.
3 ft. × 5 ft.	2820.	. . . . .	600.	City.
4 ft. 6 in. . . . . 6 ft.	620.	620.	620.	City.
4 ft. 6 in.	725.	. . . . .	725.	City.
10 ft. 6 in. . . . . 9 ft. . . . . 5 ft. 6 in.	602.	507.	602.	City.
Double 8 ft. × 16 ft. . .	1250.	. . . . .	Partial. 818.	City.
Abt. 10 ft. 6 in.	(7004.)	(5913.)	(7004.)	
7 ft. 6 in.	7004.	844.	5012.	R. A. Malone.
11 ft. × 12 ft.	5989.	600.	1322.	W. C. Poland & Son and C. W. Parker & Co.
. . . . .	74335.	52044.5	63212.	

An examination of the foregoing table shows that a considerable amount of sewer construction has been completed during the past year, and that extensions of the intercepting sewers located in the streets of the city proper have been chiefly constructed by the city under its own superintendents.

This is due to the fact that such construction is now confined to crowded thoroughfares, in which peculiar management is required to prevent serious obstruction to travel and the business of abutters, and also because these operations being principally carried on in filled land, beds of dock-mud, old walls, wharves, and other obstacles are continually encountered, which require a frequent variation in the methods of construction, which could not be foreseen and provided for in the specifications of a contract. This will be understood from the following account in detail of the operations during the year upon different sections of the work.

Section Two, East Side.

This section extends from Dover street through Albany to Lehigh street, at which point it enters private land, and crosses the freight and switch yards of the Boston and Albany and Old Colony Railroad Companies to Federal street near the bridge. In Albany and Lehigh streets are the tracks of the Albany street Freight Railway Co., which are used by the stone and lumber yards on Albany street, but especially by the Hinckley Locomotive Works, to convey locomotives to and from their shops. It was considered questionable whether these tracks could be maintained for service during building operations. In the railroad yards are about forty lines of rails in constant use, which it was very important should not be disturbed. The whole section traverses filled land, underlaid by beds of mud from 5 to 20 feet deep below the bottom of the sewer, which is itself several feet below the level of low tide. The sewer is oval, 5 feet high, and required piling for its support. It was built partly of wood, lined with two inches of concrete, and partly of brick-work resting on a solid cradle of wood six inches thick. At different points obstructions in the shape of old walls and wharves were encountered, which admitted sea-water freely to the trench, so that, as a rule, work could only progress during low stages of the tide.

As stated in last year's report, work began on this section in September, 1881. Travel upon the streets was not interrupted, and with considerable difficulty the freight railway tracks were supported and maintained. As it would have been impossible to have had an open trench through the Albany

and Old Colony yards without interfering with their traffic, operations at this point were carried on entirely below the surface. The tracks were supported by stringers, and the spaces between them floored over. By the use of special machinery all the earth excavated and refilled, as well as all materials for construction, were conveyed by tracks suspended below the floor. The trench was well braced, and its sides protected by lag sheeting, which, together with the piles driven to support the sewer, were all put in place without encroaching upon the surface. It is believed that not a single train was delayed, nor any inconvenience caused by these operations.

A large regulating apparatus, similar to the one of which a plan was given in the report for 1880, was put in this section. The chamber containing it is located on Albany street, just north of Dover street. The apparatus will control the flow of the entire east-side intercepter above this point, thus doing away with the necessity of separate small regulators for each city sewer. By this means, during heavy rain-storms, the amount of water coming from the higher districts of the central and northerly portions of the city can be reduced to any extent, and the sewer left free to receive rain from the districts south of Dover street, where the cellars are apt to be inundated at such times. At this section connections are made with the Oswego-street and Harvard-street main city sewers, and also with the Dover-street sewer. The former two outlets have been supplied with chambers containing new tide-gates, similar to those shown in last year's report.

Dover-street Connection.

According to the usual practice in such cases, the Dover-street sewer would have been connected with the intercepter at or near the point in Albany street where their two locations intersect. But it was found, in examining the city sewers with reference to our connections with them, that the main in Dover street was not in condition to be intercepted at any point west of Harrison avenue. Between that street and its outlet it is a rectangular wooden structure, 5×6 feet, located on the north side of the street, close to a stone retaining-wall, and surrounded by loose stone ballast. It is considerably broken, so that the tide-water, which follows the wall and ballast, has free access to the sewer at high tide, and would flow into the intercepting sewer and so reach the pumps. From Harrison avenue westwardly the sewer is of brick, and is believed to be tight. A set of tide-gates are already built at this point. Accordingly, the connection was

made with the brick sewer west of the tide-gates, and a three-feet oval brick branch sewer built from this point to convey the sewage to the intercepting sewer at Albany street. The distance is about 575 feet, and some difficulty was experienced in finding a practicable line free from old walls and wharves and the water which follows them. The sewer was finally located on the line of the southerly sidewalk, on which side are no permanent buildings, so that the minimum of inconvenience was caused, and travel on the street was not impeded. The work was done during June, July, and August, and is now complete in condition for service.

Section Three, East Side.

This section extends in Federal street, from near the bridge, to the beginning of Atlantic avenue at Summer street, a distance of 2,108 feet. The street is occupied by double horse-railroad and single freight-railway tracks, and beneath its surface are one sewer, two water, and two gas pipes. Beds of mud extend from 5 to 20 feet below the bottom of the new sewer and dock-walls, and timber structures were frequently encountered. A location on the east side of the street was found to be most practicable, and the sewer was built by methods which left the roadway open for travel. By flooring over the trench at intervals, passages were maintained through the excavating machine to the yards and wharves bordering Fort-Point channel. The freight-railway tracks were shifted towards the centre of the street, and were used during the day for the passage of horse-cars in one direction. Bricks, cement, and other materials were piled on the outer edges of both sidewalks where they would cause least inconvenience, and always so as to leave a clear passage-way four feet wide. Endeavors were made to cause the least possible annoyance to corporations and individuals; and, in general, these efforts seemed to be appreciated and reciprocated by the public, so that complaints were rare. The work was chiefly built during the autumn, and consists of an oval sewer 4 feet 6 inches by 2 feet 8 inches in diameter, with an 8-inch brick arch and 2-inch brick invert, resting on a solid plank cradle 4 inches thick, supported for a part of its length on piles. Connections have been made with the Federal-street and Summer-street city sewers, and chambers with new tide-gates built to protect these connections.

Section Four, East Side.

This is a continuation of the preceding section. Construction of it began in November, and, unless the season should

prove unusually severe, may be continued throughout the winter. It extends in Atlantic avenue from Summer street to Belcher lane. The sewer is oval, 4 feet 6 inches by 2 feet 8 inches in diameter. It is located on the westerly side of the street, near to the centre line of old Broad street before the widening. It was hoped that, by adopting this location, the head and side walls of many of the docks which formerly extended to Broad street would be avoided, and also the tide-water which would be sure to follow such structures. Although this hope has not been fully realized, it is probable that less serious obstacles have been met with than would have been found on the easterly side of the avenue, and the filling being less recent is more compact and more impervious to water. The location adopted may interfere somewhat with the traffic of the large warehouses on the same side of the avenue; but, by using special precautions, a clear passage-way for teams has thus far been maintained, and no reasonable causes for complaint have been given. This section will intercept the Congress-street, Pearl-street, and Central-wharf sewers, and by its subsequent extension furnish the outlet for the sewage from the east side of the north end of the city to Hanover street.

Chester–park Sewer.

As stated in last year's report, a section of sewer, called Roxbury-canal sewer, was built to intercept all the sewage which formerly flowed into Roxbury canal above East Chester park. The city sewer in Chester park that was thus intercepted was a three feet square wooden box, somewhat out of shape, and had settled, probably on account of the building of the main sewer near to and below it, so that it was a little lower at Albany street than the new sewer with which it connected. In the interest of good sewerage for the district it was thought best to at once extend a brick sewer to replace the present wooden one between Albany street and Harrison avenue. This has been done by an arrangement with the Sewer Department. Work began in September, and was completed by the end of the year. The sewer is circular, 4 feet 6 inches in diameter, about 730 feet long, and is supported on piling for three-quarters of its length. It connects at its east end with a bell-mouth connection chamber, and at its west end with brick sewers in Harrison avenue and in Chester park west of the avenue.

Section Five, South Boston.

This is an extension from Section 4, which ended on Dorchester avenue, just south of the Old Colony Railroad. Two

routes from this point, by which to reach Foundry street, were considered. By one, the sewer, turning to the left through private land, passed under the road-beds of the Old Colony and N.Y. & N.E. Railroad Companies, and then under the freight yard of the former company. The other, keeping in Dorchester avenue, passed under both railroads, and turned into Foundry street at its junction with the avenue. The latter route, though somewhat longer, was finally adopted, as avoiding land damages and possible injury to buildings. Considerable difficulty was encountered in passing under the abutments of the bridge on Dorchester avenue, over the N.Y. & N.E. Railroad. These were underlaid by running sand, and the northerly abutment, which had been built without mortar, had to be taken down over the sewer. The bridge, however, was not endangered, nor was travel over it interrupted. The sewer is of brick, oval, 5 feet high. Where it passes under the N.Y. & N.E. tracks its shape has been somewhat altered, keeping the top arch lower, so that if it ever should be desirable to lower the road-bed for a few feet under the bridge, this can be done without interfering with the sewer. Work on this section began in September, and will probably continue during the winter. The city sewers intercepted by it are those in B street, Fourth street, and First street.

Salt-water Conduit.

This structure at the pumping-station, 5½ feet in diameter, designed to bring salt water to the condensers and pumps, has been completed during the year, and is ready for service, except for a little dredging, which must be done in the dock in front of its inlet.

Main and Intercepting Sewers.

To this account is charged the expense of maintaining, at intervals, a small force, consisting of a foreman, one carpenter, and four laborers, who take care of the sewers already built, maintain the tide-gates in a state of maximum efficiency, clean and slush penstocks, flushing-gates, and other iron-work, remove gravel which gets into the sewers around man-hole covers, and construct any minor details of work omitted for any cause when the sewers were built. It was found necessary, for the convenient and safe working of the penstocks and flushing-gates already built into the sewers, to provide them with counterbalancing apparatus. Eight sets of these were furnished by Cook, Rymes, & Co.,

of Boston, under a contract dated Jan. 12, 1882, and they were put in place by the party above referred to. In all, this party has been employed about eight months during the past year.

Filth-hoist.

This necessary part of the system, situated at the end of the main sewer, and through which the sewage flows before reaching the pumps, has been completed, and put in condition for service during the past year. The foundations and chambers, extending from 17 feet below low tide to 18 feet above that elevation, were chiefly built during 1881. Last summer the superstructure, consisting of a granite-stone building, 30 by 37 feet, was erected, under the supervision of the City Architect. Two iron penstock gates, 7 feet by 6 feet 6 inches each, have been built in place. These serve to divert the flow of sewage through the screens on either side of the structure, leaving the other free for examination or repairs. They can be protected in front by stop-planks, for which grooves are provided. The gates are counterbalanced, and are worked up and down by hydraulic pressure from the city water main, acting through cylinders and pistons. This pressure is sufficient to move them freely; but to start them, when down with a head of water against them, an hydraulic-force pump has been added, by which the initial pressure can be increased to any extent. Behind each gate are a pair of screens, or filth-cages, formed of vertical bars of iron, with one-inch spaces, through which the sewage will flow, and by which dead animals, pieces of cloth, wood, and other solid matters likely to clog the pump-valves, will be intercepted. The cages are counterbalanced, and are raised for the removal of their contents, and again lowered by steam-power. Steam has been brought under ground from the boiler-house for this purpose. A pair of steam radiators will keep the building warm in winter. The cages, with their engines and gearing, were furnished and put in place by the Coffin Valve Co., under a contract dated Feb. 20, 1882.

Pumping-station.

A considerable part of the work for the year has been performed at this locality, which properly includes the filth-hoist just referred to. Under the direction of the City Architect work has begun on constructing the permanent buildings, including engine, boiler, and coal-houses. These are built chiefly of granite block stone obtained from the old Beacon-Hill reservoir. This department pays the city from

$5.00 to $7.00 a yard for the stone, and also pays for its conveyance to Old-Harbor Point. The coal-house is already built and roofed in, needing only its windows and internal fittings to make it complete. The walls of the boiler-house are about finished, and those of the engine-house will be soon started. For re-dressing the stones, a yard and sheds, connecting with a spur-track of the Old Colony Railroad, are in operation. Two additional steel boilers, making four in all, have been furnished and set in place by Kendall & Roberts of Cambridgeport. The four boilers have been connected to form one battery, and, with their pipes, have been suitably covered. Two pair of double-acting feed-pumps are in place and connected, also two double-acting salt-water pumps for pumping salt-water for the condensers from the salt-water conduit into a tank. The boiler-house, with all its apparatus, may be said to be in running order.

In the engine-house the two Leavitt engines have been put in complete condition for service, and each of them has been run sufficiently, with pure water, to demonstrate their efficiency. They have been protected from the danger of rust and are waiting the time for actual work. The foundations for the Worthington engines and pumps have been completed, and these machines will be put in position during the coming year. A large bilge-pump, for clearing the galleries and pump-wells of the engine-house, is in place, and has been utilized during the year to keep the main and intercepting sewers free from water by pumping all which leaks into them.

Nine cast-iron gates, with their hoisting-engines and gearing, have been set in place here during the past year. They were furnished by the Coffin Valve Co., under a contract dated December 3, 1881. Eight of them, 6 feet 3½ inches by 4 feet 9½ inches, control the flow of sewage to the pump-wells and one, 3 feet 9½ inches square, admits salt-water from the salt-water conduit. To warm the engine-house and machinery and prevent water of condensation forming on the engines, a system of steam-pipes and radiators has been put in by the Walworth Manufacturing Co., at a cost of about $1,300. The 48-inch cast-iron force-mains, which arrived last winter, and which connect the Leavitt pumps with the tank-sewers at the pipe-chamber, have been laid in place and jointed during the past season. About 180 hard pine stop-planks, of different sizes, for use in the pipe-chamber and about the various gates and wells, have been fitted, ironed, and painted or oiled, ready for use. The salt-water conduit has been completed, and the portion of sea-wall at its end is built. Further extensions of this wall and the wharf outside of it remain to be constructed.

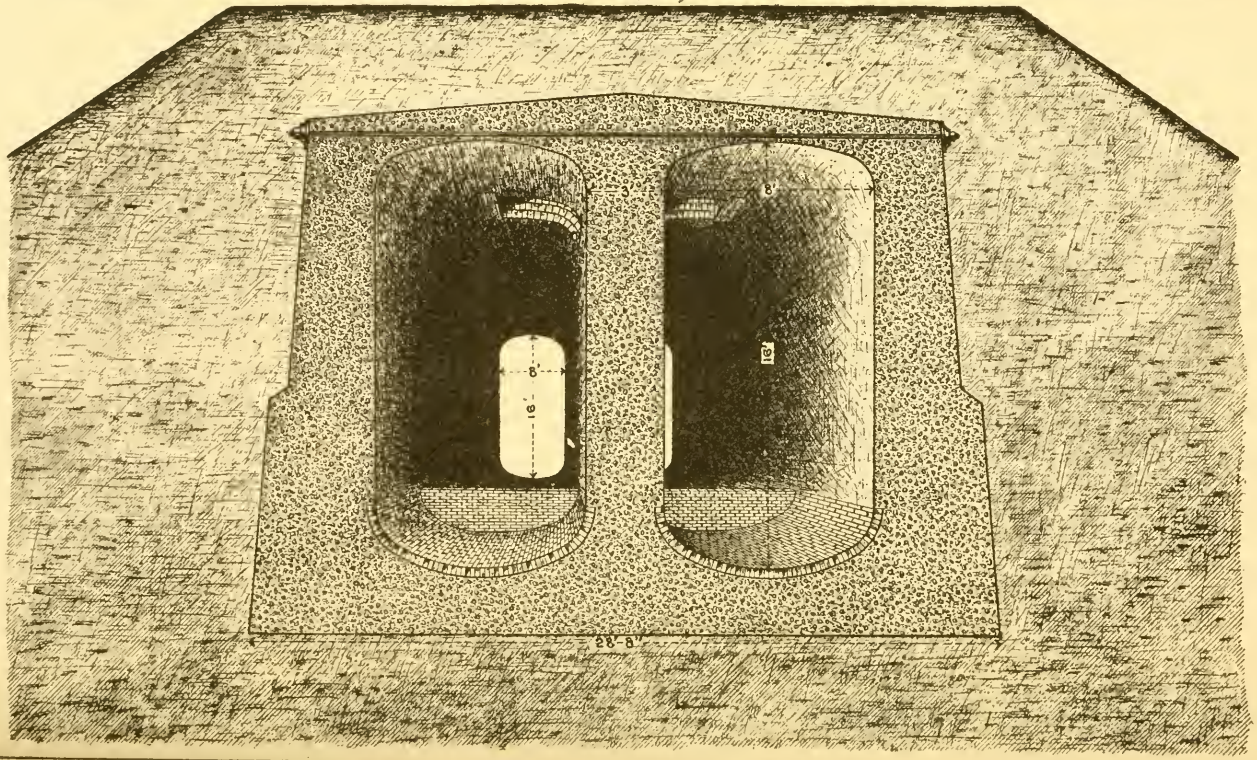
CITY OF BOSTON—IMPROVED SEWERAGE.

SECTIONAL VIEW OF TANK SEWER.

SCALE OF FEET.

Henry M. Wightman
City Engineer

SCALE OF METRES.



Heliotype Printing Co 211 Tremont St Boston

The channel connecting the city dock at this point with the main ship channel of Dorchester bay became somewhat shoaled with mud during the year, and was dredged, without cost to the city, down to twelve feet below low water, by the Old Harbor Pier Co., under the provision of their contract, by which the channel is to be maintained without charge until the completion of the pier now building by them for the city. About 12,000 yards of gravel filling has been received from the Old Colony Railroad, and used in grading about the pumping-station grounds. A telephone-wire now connects the pumping-station with City Hall and several department yards in the city.

Section One, Outfall Sewer.

On this section, commonly called Old-Harbor Pier, extending from the pumping-station to the tunnel, work has not progressed as rapidly as could have been desired. The contractors have completed the sea-wall at the outer end of the pier by building 226 yards of cut-stone masonry and 324 yards of concrete. They have also put in place during the season 4,060 yards of filling, 1,915 yards of ballast, 4,367 tons of rip-rap, and 180 piles. Except immediately about the tunnel-shaft, the pier is filled to about grade 18, and about 36,000 yards of filling are needed to complete it. The stone pipe-chamber at the westerly end of the pier was finished by the city early in the year, and a temporary wooden sluice-way from it constructed, which was used to discharge water while testing the Leavitt engines.

In July the city began building the tank-sewers, to extend about 1,250 feet, from the pipe-chamber to the tunnel shaft, and about 800 feet of the lower half of this structure was completed and protected by the end of the season. Two machine concrete mixers have been procured, and will be used next season. The general character of the tank-sewers will be understood from the accompanying plate. As will be seen, they consist of a monolithic structure of concrete, forming two conduits, each 16 feet high by 8 wide. The bottom portion, up to the straight walls, is formed of Rosendale cement, sand, and pebbles, in the proportion of each, respectively, of 1, 2 and 5. Above this elevation, for the outer side-walls, the same proportion is maintained; but the cement used is a mixture of 1 part Portland and 2 parts Rosendale. For the concrete forming the centre wall and arches only Portland cement is used. The best Rosendale, and very fine ground, slow-setting Portland cements were procured for the work. The concrete is rammed thoroughly in courses which are bonded to-

gether. Man-holes of brick, and low dams to intercept street detritus, will be built at intervals of about 300 feet. The arches are tied, as shown, by 1½-inch wrought-iron rods, spaced five feet apart.

These sewers are to have gates at their ends, so that the sewage can be turned through either or both of them.

Section Two, Outfall Sewer.

This section includes Dorchester-bay Tunnel, and extends under Dorchester bay from Old-Harbor Pier to about the middle of Squantum Neck, a distance of 7,004 lineal feet. Fair progress has been made during the year; and, as none of the uncertain contingencies always affecting this class of work are now to be feared, there is no doubt of the successful completion of the tunnel during the coming summer. At the beginning of last year 87 feet remained to be excavated between the east and middle shafts, and 1,004 feet between the middle and west shafts. At the former point the headings met January 24, and at the latter June 22. No appreciable error in alignment or elevation was found to exist, which was very satisfactory, considering the difficulties experienced in transferring lines 160 feet down shafts filled with steam-pipes, causing heated currents of air and incidental errors of refraction. Lining the excavation with brick-work began March 10, and has continued with little delay since. Projecting portions of rock have been trimmed off, so that a solid brick lining, twelve inches thick, laid in courses, is always obtained. The shape and size of the excavation is quite irregular. In places considerable rock has to be trimmed off, so that the lining may be built to its proper line and thickness; at other points there are cavities outside of the lining large enough to hold a cart. All spaces between the lining and the sides of the rock excavation are solidly filled with masonry, principally brick-work. The amount of backing thus required to make solid work averages about three-quarters of a yard per lineal foot. Jan. 1, 1883, 1,994 lineal feet remained to be lined, or about 28 per cent. of the whole tunnel, besides portions of two shafts. At the average rate of progress, this will be completed by June of the present year.

The maximum amount of water noted flowing into the tunnel was about 64,000 gallons per hour. This, however, has now decreased to about 52,000 gallons, owing, perhaps, to some silting of the crevices in the rock through which it comes. In putting in the lining, iron pipes are built into the brick-work wherever necessary, to furnish outlets for the

water, which would otherwise wash out the mortar. These pipes can eventually be plugged or capped. It is not expected that in this manner the water will be prevented from entering the tunnel when empty, since the head at such times, as shown by a pressure gauge, is about 60 pounds per inch, or sufficient to force it through a brick wall, however carefully laid. But when in use the head of the sewage inside the tunnel will be in excess of that of the water outside, and, the pressure being outwards, no leakage inwards will occur.

Some experiments were made to determine to what extent the porosity of the brick lining could be destroyed by silting from without. An iron pipe, extending up one shaft, was connected at its lower end with the pipes built through the brick-work, and water containing clay, cement, and fine sawdust, was forced outside of the lining. The finer portions of these materials came through the lining, and in places the leakage was materially reduced. Holes of apparent size were calked with lead. By this means the leakage into the inclined portion of the tunnel, about 800 feet long, was reduced from about 2,200 gallons an hour to about 500. It was not considered practicable, however, except at considerable expense, to thus materially reduce the quantity of water coming in; and, in view of its slight importance in respect to the use of the tunnel, the attempt was given up. A large mining pump is to be provided at the east shaft, by which the tunnel can be cleared of water at any time in the future, should it prove necessary. At present, to economize in pumping, the completed portion of the tunnel, east of the middle shaft, has been isolated by means of a thick masonry bulkhead, and allowed to fill with water.

To ensure the good quality of all bricks and cement used in building the tunnel the contract provides that these materials shall be purchased from the city at fixed prices. The delivery of the two million bricks, furnished the city by Stoddard & Hellier, under their contract of May 21, 1881, was completed during last year. Another million was obtained from the Brewer Brick Co., of Bangor, under a contract dated August 1, 1882, and three million more have been contracted for, and in part delivered, by the Bay State Brick Co. Cement has been purchased from F. O. Norton, of New York, and Waldo Brothers, of Boston. In all, to January 1, 1883, there has been used in building the tunnel, 5,310,000 bricks, and 15,573 casks of cement.

But one serious accident has occurred on this section during the past year, which was the falling of a cage with a man on it, at one of the shafts. The man recovered sufficiently

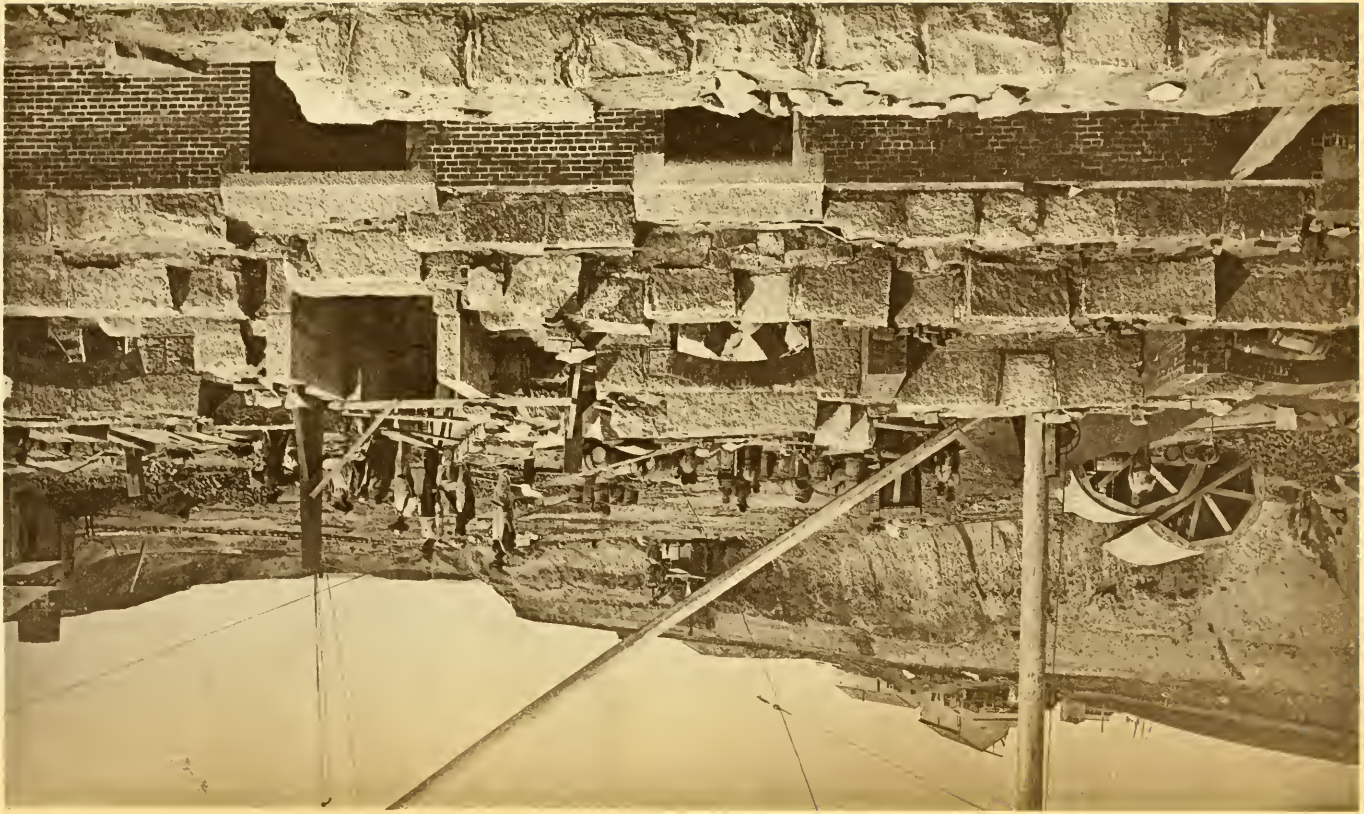
to return to work, but soon after died, whether as a result of his previous injuries was not ascertained.

Section Three, Outfall and Moon-island Reservoir.

The contract for this section of work was relet Dec. 28, 1881, to C. W. Parker & Co., and has been prosecuted with energy since. Active operations began January 25, and have continued throughout the year. Included in the contractor's plant were one steam-shovel, two steam-dredges, and three locomotives. On Squantum Neck 844 feet of 11×12 feet of outfall sewer are now built; also, a chamber connecting this sewer with the end of Dorchester-bay Tunnel. At the same point a connection has been built for the future high-level sewer, should one ever be needed. The walls of this chamber form foundations for a house, and it will furnish an opportunity for putting in and taking out boats and the ball to be used in flushing the tunnel. From Squantum to Moon island, a distance of nearly a mile, the embankment for carrying the outfall sewer has been partly constructed, and protected on its sides with ballast and riprap. In places this embankment is thirty feet high, and has been filled nearly to grade. The mud under a portion of it has been displaced at points, but not so generally as was anticipated. As an experiment, an attempt was made to hasten this action by exploding dynamite cartridges under the embankment. No results of magnitude were obtained; but the experiment demonstrated the resistance of the mud to displacement and the probable stability of the embankment.

At Moon island two low discharge sewers, 8×8½ feet and 8×12 feet, respectively, and the outfall sewer, 11×12 feet, have been nearly completed; also, an outfall chamber, turbine well and engine, boiler, and coal-house foundations. The easterly wall of the sewage reservoir is finished and the northerly wall nearly so; portions of the other retaining and division walls have been built.

Beginning with last year, the practice has been followed of constantly taking photographs, by the cheap dry-plate process, of all points of interest in connection with this contract. These not only furnish an interesting record of the progress of construction, and the methods and machinery used, but may prove of great value as affording indisputable evidence to be used in any possible future disagreement with the contractors concerning the character or condition of the work at any time. Heliotype reproductions of two of these photographs are given, merely as affording a good general idea of the character and magnitude of the work.



The work done at this point during the past year includes the furnishing and putting in place of about 117,000 yards of earth, 7,000 yards of ballast, 22,000 tons of riprap, 2,200 yards of brick masonry, 8,600 yards of rubble masonry, and 3,000 yards of concrete. The value of this, in round numbers, is $250,000, of which nearly $50,000 is retained by the city as security (in addition to the bond) for the satisfactory completion of the whole contract. The stones for the cut-stone masonry used on this section are furnished by the city, and are obtained from the Cape Ann Granite Co., under a contract dated Dec. 14, 1881.

One fatal casualty has occurred at this point during the year.

Office and Miscellaneous.

The cement-room has been kept busy testing all cement purchased by the city, or procured by contractors for use on the work. Dealers, being now acquainted with the rigorous character of these tests, rarely offer any but superior articles, and in some instances manufacturers select and grind especial qualities for this department. 20,365 barrels of Rosendale cement purchased by the city have been tested and accepted, and 3,183 barrels of Portland cement. For contractors, 13,375 barrels of Rosendale cement have been accepted. 1,000 barrels of Rosendale, and 849 of Portland cement have been tested for the Park Department, and 50 of Portland for the covered channel. Tests have also been made for the water-works, and a few for private parties who wished to avail themselves of the city's facilities in this respect. Two lots of Portland cement, and four of Rosendale, submitted during the year, have failed to come up to our standard. Experiments on the transverse strength of concrete were made to determine the proper proportions to be used in building the tank-sewers. Various other experimental tests have also been made.

The branch office at Squantum has been maintained during the year, and will be necessary until the completion of the reservoir and tunnel. Office work at this point and at the main office in the city has included the preparation of plans and contracts for future work, making calculations, working up estimates and force accounts, keeping books, etc. Draftsmen are at present employed upon a full set of record plans, in detail, to furnish a complete record of all work built in connection with the system.

D. — PARKS.

For the purpose of making this report a complete record of the work of this department, the following statement, which, with the exception of some slight omissions and additions, was made to the Park Commissioners, and printed in their report to the City Council, is given : —

"*Filling.*

"The filling of the territory between Beacon street and the Boston & Albany Railroad, under the contracts of April 29, 1880, and May 26, 1881, which was in progress at the beginning of the year, was completed November 24, with the exception of a small amount, which cannot be done until other work on the park is farther advanced. The several owners of the land filled have accepted the work, with the understanding that the railroad company shall furnish any filling that may be hereafter needed to complete the work, at the same price as heretofore.

"There have been no payments during the year for filling on the park under the contract of April 29, 1880 ; the amount done has been small, and cannot be accurately stated until the completion of the final estimate and apportionment, work on which is now in progress.

"Under an arrangement with the Boston & Albany Railroad Company, 3,107 squares of filling have been deposited on the westerly boundary road, between the Beacon-entrance Bridge and Boylston street, of which amount 222 squares were brought from a point on the line of the railroad just west of the Newton station ; the balance, 2,885 squares. has been brought from the company's bank at Riverside, since the completion of the filling north of the railroad.

"In May 341 squares of filling were deposited by the same company, for the purpose of closing the opening in the easterly boundary road left for the flow of water into and out of the park.

"The price paid per square for the filling is $3.20, the same as last year.

"*Beacon-entrance Bridge over B. & A. R.R.*

"The foundations of the abutments and wing-walls of this bridge were completed in 1881. The masonry above the foundations was commenced on Jan. 5, 1882, and completed June 12. The abutments and wing-walls were constructed entirely from stone from the Beacon-Hill reservoir.

"A contract was made, May 5, 1882, with David H. Andrews for building and erecting the iron bridge. He completed his contract September 30.

"The grading of the approaches has been so far completed that the bridge is in use for teaming purposes, and it is proposed to run the gravel trains over it, for completing the unfilled portions of the approaches on the north side of the railroad.

"*Boston & Albany Railroad Bridge over Park Water-way.*

"The work of building the piers, abutments, and wing-walls of this bridge, which was under contract to I. A. Sylvester, was finished March 20.

"The iron bridge, a portion of which had been temporarily placed on timber trestle-work, was put in its proper position on the masonry, and the work upon it completed March 26.

"Since the completion of the city's portion of the bridge the railroad company has widened it, making a five instead of three-track bridge. The entire bridge-seat is now occupied, and the structure has a more finished appearance.

"*Boylston-street Arch Bridge, over Park Water-way.*

"Considering the complicated nature of the structure, satisfactory progress has been made upon it. The erection of the centring was commenced April 10 and completed June 16.

"Owing to delay in the delivery of the stones for the faces of the arch, the setting of them was not commenced until July 20. The work has been actively prosecuted since that date, and the arch proper has been completed. The spandrel-walls and backing for the wing-walls and "tourelles," on the easterly side of the bridge, have been completed, and when the weather is suitable similar work on the westerly side of the bridge is now being done.

"The brick portion of the arch is four feet in thickness at the springing line and two and one-half feet at the crown, and in its construction 700,000 bricks were used.

"The extrados of the arch has been coated with asphalt, to prevent percolation of water through the brick-work.

"*Commonwealth-avenue Bridge.*

"This bridge was built under the direction of the Committee on Streets, as it is the street-bridge carrying Commonwealth avenue over the park water-way.

"The abutments and wing-walls were completed at the date

of the last report, and the iron superstructure was under contract to be finished on or before February 1. Owing to delay on the part of the contractors the bridge was not finally completed until May 27.

"*Excavation of Water-way.*

"The work of excavating and forming the shores of the water-way through the Beacon Entrance of the park, which was in progress at the beginning of last year, was continued during the spring, and completed as far as the Boylston-street arch bridge. May 19 the old channel crossing the boundary road between the railroad and the Boylston entrance was closed by filling it with gravel, and the flow of water since that date has been through the new water-way.

"The steam-dredge was launched March 17, and four scows soon afterwards. The dredge began work April 15, and was kept constantly employed until December 2, when work was stopped by ice forming in the basin and preventing the movement of scows. Since that date the dredge and scows have had such repairs made upon them as were rendered necessary by the season's service, and are ready for work as soon as the ice breaks up in the spring.

"The work of the past season has consisted in excavating and forming the shores of the new channel southerly from Boylston street. When the material excavated was gravel, it was used for building an embankment on the shore line of the channel, while the mud excavated was deposited in the rear of this embankment. In this manner about 4,000 linear feet of shore line has been formed, and the channel between the banks excavated to grade 0.

"The dredging plant has proved itself to be both efficient and economical. The cost per cubic yard, dredged and put in place, averages less than 20 cents. The efficiency of the dredging plant could be increased by the use of a small tug-boat for moving the scows. Plans for a boat of this kind are in progress, and will soon be submitted to your Board for approval.

"*Embankment Wall.*

"Under this head is included the retaining-walls between the Commonwealth-avenue and Beacon-entrance bridges, and between the Beacon-entrance and Boylston-street arch bridges, also the retaining-walls adjoining the Boylston-street arch.

"The wall between Commonwealth-avenue and Beacon-

entrance bridges is completed, with the exception of the parapet.

"The foundation of the wall between the Beacon-entrance and Boylston-street arch bridges has been built to grade lines, 3 feet below the proposed surface of the ground in front of the wall.

"The foundations for portions of the walls adjoining the Boylston-street arch bridge were built in connection with the arch foundations.

"The wall is built upon one general plan, the foundations consisting of pile-work to grade 7, and hydraulic cement concrete to grade lines, 3 feet below the ground surface, in front of the wall. The wall proper is built of seam-faced granite, irregularly coursed, and backed with rubble-work. It has a curved batter on the face, and the parapet is to have a coping of red granite.

"*Granite Curb and Fence.*

"The granite curb to carry an iron fence, which is to form the street boundary around the section of the Beacon-entrance between Commonwealth avenue and Beacon street, and between Commonwealth avenue and the railroad, has all been delivered by the contractor.

"The foundations for the posts which support the curb are completed.

"The posts are about 11 feet apart, and each has a hydraulic cement concrete foundation resting upon four piles.

"The total length of curb is 1,476 feet, and of this 1,220 feet have been set. The setting of the remainder will be completed within a few weeks, and the whole will then be in readiness for the iron fence.

"*Grading and Loam.*

"In August work was begun on grading the slopes between the drive-ways and the shores of the water-way. The portion of the Beacon-entrance between Beacon street and Commonwealth avenue has been graded to the sub-grade, so that the slopes are ready for putting on the loam. Between Commonwealth avenue and the railroad the slope on the easterly side of the water-way is ready for loaming, while on the other slopes considerable work has been done. As soon as spring opens the whole of the Beacon-entrance will be ready for the loam, the grading of the slopes being now in progress when the weather permits.

"In order to obtain the large quantity of loam needed for the park, the construction of a spur-track, leading from the

Hopkinton Branch Railroad into the new water-works basin No. 4, in Ashland, was decided upon.

"The length of the spur-track from the railroad to the valley of the basin is 7,139 feet, and the length of track required in the valley is 4,626 feet. The grading of the road-bed was commenced October 9, and completed November 18. The location required 600 feet of trestle-work, which was commenced October 26, and as portions of it were 30 feet in height, and the work was several times interrupted for want of timber, it was not completed until December 28, too late for track-laying, as the ground was frozen to quite a depth.

"Arrangements have been made with the Boston & Albany Railroad Company for transporting the loam from Ashland to the park, and 20,000 cubic yards are now piled beside the track road-bed in the valley.

"A contract has been made for the rails to be delivered on or before February 15, and the ties have been secured. As soon, therefore, as spring opens, the track can be completed, and the transportation of the loam commenced.

"*Covered Channel of Stony brook.*

"The wooden conduit connecting the gate-chamber with Charles river was so far completed on July 2 that the water of Stony brook was allowed to run through it instead of into the park.

"The large automatic-acting wooden gates, to control the height of water in the park, and permit the flow of Stony brook into it in time of freshets, were hung and adjusted by September 5. The iron sluice-gate, to control the flow of salt-water into the park, through the wooden conduit, has also been completed, and the setting of it was finished December 9.

"Work upon the gate-house superstructure was prosecuted during the late fall and early winter, and the walls are completed and ready for the roof.

"With the exception of the roof, doors, and windows, and other small details in connection with the gate-chamber superstructure, the work of building the "Covered Channel of Stony brook" is now completed.

"*Covered Channel of Muddy river.*

"The length of this channel, if built on the line originally proposed, will be about 3,300 feet. The work was begun October 2, and 1,369 feet in length are now completed.

"It is built mainly of wood in a similar manner to the

covered channel of Stony brook, but is much larger, and has a cement concrete key at the crown of the arch. The concrete key was adopted, as the crown of the arch was above the line of mean high water, and would be liable to decay if made of wood. The form of the conduit is elliptical. It is 11 feet in height and 9 feet in width.

"Under the Boston & Albany Railroad location, for a length of 129 feet, the conduit is built entirely of hydraulic cement concrete; the section of the mass of concrete through which it runs measures 13 feet wide and 15 feet high.

"As far as built the conduit rests everywhere on sand or gravel; but, with the exception of the bottom and top, it is surrounded by peat. There has been less change of form than was expected to occur, considering the size of the conduit and character of material in which it is built.

"*In General.*

"The building of a wharf on the river side of Beacon street, and the dredging of a channel to it from the river, have largely reduced the cost of delivery of stone required for the various structures in the park by substituting delivery by water for that by rail.

"A storage-yard has been established at the Westland entrance. An area 100 ft. × 116 ft. has been enclosed by a high board-fence; one side of the area is occupied by sheds for the storage of tools and machinery which would be injured by exposure to the weather; an office for a time-keeper, who acts as store-keeper, has been located in one corner, and the remainder of the area is used for general storage purposes.

"In addition to the supervision of the above work, surveys and complete plans showing the area of land taken from each owner by the proposed Improvement of Muddy river, and surveys and plans of East Wood island and land for parkway, purchased for East Boston park; also, surveys and plans of estates adjoining the Bussey Farm and Arnold Arboretum, and record plans of the land taken for park purposes in this locality, have been made for the Commissioners."

The table giving the number of vessels passing through the draw-bridges controlled by the City of Boston, during the year 1882, will be found in Appendix A.

The table showing the width of draw-opening in the bridges over tide-water in this city is given in Appendix B. The openings have all been re-measured for this report.

HENRY M. WIGHTMAN,
City Engineer.

APPENDIX A.

DRAW-TENDERS' REPORTS.

Giving the Number of Vessels passing through the Drawbridges controlled by the City of Boston during the year 1882.

Name of Bridge.	Steamers.			Sailing Vessels.			Tugs.			All Others.			Total No. of Vessels.			No. of Draw Openings.
	By Day.	By Night.	Total.	By Day.	By Night.	Total.	By Day.	By Night.	Total.	By Day.	By Night.	Total.	By Day.	By Night.	Total.	
Broadway	21	13	34	2,781	991	3,772	1,747	294	2,041	219	58	277	4,768	1,356	6,124	4,530
Cambridge-street ...	....	....	....	322	50	372	506	71	577	30	3	33	858	124	982	607
Charles-river.....	48	36	84	3,777	1,609	5,386	2,246	341	2,587	589	123	712	6,660	2,109	8,769	6,711
Chelsea (North)....	113	12	125	798	111	909	1,383	212	1,595	282	103	385	2,576	438	3,014	2,090
Chelsea (South)....	7	....	7	1,052	136	1,188	1,814	204	2,018	408	32	440	3,281	372	3,653	2,503
Chelsea-street.....	....	....	....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Commercial-Point ..	....	....	....	.....	.....	.....	.....	.....	.....	5	.....	5	5	.....	5	5
Congress-street.....	163	91	254	5,120	1,547	6,667	7,502	1,267	8,769	1,679	508	2,187	14,464	3,413	17,877	12,980
Dover-street	23	13	36	2,305	798	3,103	1,616	291	1,907	182	39	221	4,126	1,141	5,267	4,102

Essex-street	1	....	1	391	30	421	540	30	570	32	1	33	964	61	1,025	660
Federal-street	22	12	34	2,780	955	3,735	1,943	327	2,270	374	116	490	5,119	1,410	6,529	5,169
Granite	....	....	....	70	28	98	88	7	95	.....	.....	.....	181	12	193	139
Malden	16	....	16	312	44	356	694	87	781	103	17	120	1,125	148	1,273	803
Meridian-street	106	10	116	989	49	1,038	2,266	64	2,330	821	24	845	4,182	147	4,329	2,801
Mt. Washington ave.	36	15	51	3,744	1,072	4,816	4,547	650	5,197	1,099	214	1,313	9,426	1,951	11,377	8,201
Neponset	....	....	....	118	19	137	114	4	118	2	.....	2	234	23	257	141
No. Beacon-street	....	....	....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
No. Harvard-street	....	....	....	107	18	125	192	34	226	23	3	26	322	55	377	239
Warren	43	39	82	2,441	1,954	4,395	1,228	265	1,493	440	110	550	4,152	2,368	6,520	5,506
West. ave. to Camb.	....	....	....	294	47	341	473	66	539	27	5	32	794	118	912	565
West. ave. to Wat'n	4	....	4	42	22	64	20	1	21	27	.....	27	93	23	116	113
Canal	39	19	58	1,540	955	2,495	265	71	336	294	78	372	2,138	1,123	3,261	2,783
Prison-Point	21	2	23	228	149	377	51	20	71	92	15	107	398	180	578	499
West Boston	21	33	54	378	499	877	402	558	960	108	145	253	909	1,235	2,144	1,567
Total	684	295	979	29,589	11,083	40,672	29,637	4,864	34,501	6,836	1,594	8,430	66,775	17,807	84,582	62,714

APPENDIX B.

TABLE,

Showing the Widths of Openings for Vessels in all Bridges provided with Draws, in the City of Boston.

JANUARY, 1883.

NAME OF BRIDGE.	LOCATION.	NUMBER OF OPENINGS.	WIDTH.	
			Feet.	In.
Boston & Maine R.R.	Boston to Charlestown	1	35	7
" " "	Over Miller's River	1	35	8
Broadway	Over Fort Point Channel	1	43	4
Cambridge-st.	Ward 25 to Cambridge	1	29	11
Canal	Boston to East Cambridge	1	35	9
Charles-river	Boston to Charlestown	1	35	9
Chelsea (South Channel)	Charlestown to Chelsea	1	38	7
" (North ")	" " "	1	44	6
Chelsea-st. (East Boston side)	East Boston to Chelsea	2	32	9
" (Chelsea side)	" " "		34	8
Commercial-Point	Ward 24	1	24	2
Congress-st. (Boston side)	Over Fort Point Channel	2	43	3
" (South Boston side)	" " "		43	8
Dover-street	" " "	1	36	0

Eastern R.R.	Boston to Charlestown	1	35	8
"	Over Miller's River	1	35	5
Essex-st.	Ward 25 to Cambridge	1	30	10
Federal-st.	Over Fort Point Channel	1	36	0
Fitchburg R.R.	Boston to Charlestown	1	36	0
" " (for teaming freights)	" " "	1	36	5
Grand Junction R.R.	Ward 25 to Cambridge	1	32	0
" " "	East Boston to Chelsea	1	34	4
Granite	Ward 24 to Milton	1	30	9
Lowell R.R. (freight)	Boston to East Cambridge	1	35	8
" " (passenger)	" " "	1	36	0
Malden	Charlestown to Everett	1	43	0
Meridian-st. (East Boston side)	East Boston to Chelsea	2	58	11
" (Chelsea side)	" " "		59	0
Mt. Washington ave. (Boston side)	Over Fort Point Channel	2	42	2
" " " (So. Boston side)	" " "		42	4
Neponset	Ward 24 to Quincy	1	31	1
New York & New England R.R. (Boston side)	Over Fort Point Channel	2	40	4
" " (So. Boston side)	" " "		40	7
" "	Over South Bay	1	30	0
North Beacon-st.	Ward 25 to Watertown	1	30	0
North Harvard-st.	Ward 25 to Cambridge	1	31	4
Old Colony R.R.	Over Fort Point Channel	1	35	9
" "	Ward 24 to Quincy	1	35	11
Prison-Point	Charlestown to Cambridge	1	35	7
Warren	Boston to Charlestown	1	35	9
West Boston (Boston side)	Boston to Cambridge	2	35	7
" (Cambridge side)	" " "		36	0
Western ave.	Ward 25 to Cambridge	1	31	0
"	Ward 25 to Watertown	1	29	5