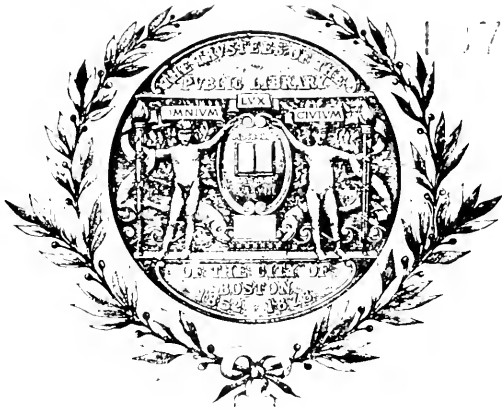


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CITY OF



BOSTON.

EIGHTEENTH ANNUAL REPORT

OF THE

CITY ENGINEER,

FOR THE YEAR 1884.

OFFICE OF THE CITY ENGINEER, CITY HALL,
BOSTON, February 20, 1885.

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 1884 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, or Main Drainage.)

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, 1884, to January 1, 1885: —

Amount expended from department appropriation for 1883-84.	\$7,828 24
Amount expended from department appropriation for 1884-85	21,971 39
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Total expended from department appropriations,	\$29,799 63

Condition of department appropriation: —

Amount of appropriation for financial year, 1884-85	\$32,000 00
Amount expended to January 1, 1885	21,971 39
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Unexpended balance, January 1, 1885	\$10,028 61

CLASSIFICATION OF EXPENSES.

Salaries of City Engineer, assistants, draughtsmen, transit-men, levellers, rod-men, etc.	\$26,899 75
Engineering instruments and repairs of same	127 55
Drawing paper, and all materials for making plans	355 59
Stationery, printing stock, note books, postage, etc.	292 03
Reference library, binding books and photographs of work	319 23
Printing	79 12
Travelling expenses (including horse-keeping, repairs on vehicle, etc.)	726 49
New buggy	225 00
Furniture, cases for plans and books	338 50
Blue Process printing (including cost of new apparatus)	204 51
Incidental expenses, and all other small supplies	231 86
	<hr/>
Total	\$29,799 63

The number of persons employed and paid from the department appropriation was, on the first of January, 1884 (including the City Engineer), 19. 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.

During the past year four of the tide-water bridges have been either wholly or partially rebuilt; these were the Warren, Meridian street, North Beacon street and Cambridge street.

One new inland bridge, the Franklin street foot-bridge over the Boston and Albany R.R. at Allston, has been built, and the Boylston street arch-bridge over the Back Bay Park water way in process of construction at the date of the last report, has been completed. By an arrangement made between the Boston & Albany R.R. Co. and the City, iron bridges, with granite masonry abutments and wing-walls, have been constructed at the railroad crossings on Brookline avenue and Beacon street. These structures are built by the railroad corporation, and it also assumes the cost of them. The plans for the structures and the workmanship on them are subject to the approval of this department.

The repairing of the tide-water bridges has been done by day's labor under the supervision of this department. Mr. S. S. Lewis was retained as superintendent of repairs by the Committee on Bridges, a position he has now held for five years. His compensation was the same as last year; the carpenters were paid \$2.50 per day, and the laborers \$2.00 per day.

The spruce lumber required for repairs was furnished by Mr. John W. Leatherbee, who was again the lowest bidder, making eight consecutive years that he has obtained the contract.

His contract price for 1883 was \$15.75 per M. and for 1884 \$15. per M. Under his 1883 contract he has furnished 9,614 feet B.M., and under his 1884 contract he has furnished 254,189 feet B.M. A supplementary contract was made with him for 116,621, feet B.M., of kyanized spruce; the price paid was \$24.10 per M. delivered on cars.

The painting of the tide-water bridges has been done by day's labor, Mr. E. B. Perry being employed as foreman, as for the two previous years. The rates of pay of the foreman,

painters and laborers, were the same as last year. Work was commenced June 18th, and continued until Oct. 6th, during which time seven bridges were painted and several others had considerable work done upon them. Paint stock was furnished by Dexter Brothers, the lowest bidders. Total cost of labor was \$2,252.50; of materials, tools, etc., \$678.16.

The total cost of ordinary repairs on the tide-water bridges as made under the direction of this department, was \$30,340.34.

During the several years past the repairs of the inland bridges (in charge of the Superintendent of Streets) have been done by day's labor, under the supervision of this department. On Sept. 22, last, the Superintendent notified me that he would attend to these repairs, and since that date he has done so.

The total cost of the repairs made under the direction of this department upon the inland bridges, to Sept. 22, was \$3,467.09.

The records of the number of vessels passing through the draw-ways, time of passage, kind of vessels, etc., as kept by the superintendents of the several tide-water bridges, have been tabulated, and the totals are given in the summary, which will be found in Appendix A.

The usual annual examination (required by Section 5 of the ordinance relating to the City Engineer's department) 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 additions have been made, viz. :—the Franklin street foot-bridge, over the Boston & Albany Railroad at Allston station, the bridge on Beacon street, and the bridge on Brookline avenue, over the same railroad; one has been taken from the list, the Muddy River bridge on Brookline avenue, which has been removed and the opening spanned by it filled with earth.

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.

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

- Beacon street, over outlet to Back-Bay pond.
 Beacon street, over Boston & Albany Railroad.
 Berkeley street, over Boston & Albany Railroad.
 Berkeley street, over Boston & Providence Railroad.
 Blakemore street, over Boston & Providence Railroad,
 Ward 23.
 Boylston street, over outlet to Back-Bay pond.
 *Broadway, over Fort Point Channel.
 Broadway, over Boston & Albany Railroad.
 Brookline avenue, over Boston & Albany Railroad, 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 pond.
 *Congress street, over Fort Point Channel.
 Dartmouth street, over Boston & Albany and Boston &
 Providence Railroads.
 *Dover street, over Fort Point Channel.
 *Federal street, over Fort Point Channel.
 Ferdinand street, over Boston & Albany Railroad.
 Franklin street foot-bridge, over Boston & Albany Rail-
 road.
 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.
 West Rutland square foot-bridge, over Boston & Provi-
 dence 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	39
II.	Number of which Boston supports the part with- in 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	<hr/> 93

I. —BRIDGES WHOLLY SUPPORTED BY BOSTON.

ASHLAND-STREET BRIDGE (OVER BOSTON & PROVIDENCE RAILROAD, WARD 23).

The abutments of this bridge have needed repointing for several years. The bridge should be sheathed and new wheel guards provided the coming season; otherwise it is in good condition and has not required any repairs during the year.

ATHENS-STREET BRIDGE (OVER NEW YORK & NEW ENGLAND RAILROAD).

This bridge has been stripped of its wood-work and the iron girders have been cleaned and painted. Those portions of the wood-work which were sufficiently sound were replaced and new stock was used for the remainder.

The fences were also painted and the entire bridge is now in good order.

Total cost of repairs, \$269.83.

BEACON-ENTRANCE BRIDGE (OVER BOSTON & ALBANY RAILROAD).

This bridge is in charge of the Park Commissioners and is not yet opened for public travel. It is in good condition.

BEACON-STREET BRIDGE (OVER OUTLET OF BACK-BAY POND).

The iron-work needs painting, and new sheathing will be required the coming season. No repairs have been made upon the structure by this department during the year, and with the exception noted is in good order.

BEACON-STREET BRIDGE (OVER BOSTON AND ALBANY RAILROAD)

Is being built by the Boston & Albany Railroad Company under the supervision of this department.

The abutments, wing-walls and iron-work portion of the bridge are completed and the wood-work will be finished in a short time.

BERKELEY-STREET BRIDGE (OVER BOSTON & ALBANY RAILROAD).

Attention has been called in former reports to the insufficient strength of this bridge for the travel of the thoroughfare upon which it is located. It requires careful supervision in order that any signs of dangerous weakness may be detected and provision made at once for the removal of defective portions.

The floor timbers have been in use for many years, and although they were put in good condition in 1878, when the bridge was extensively repaired, the flooring should be removed and the timbers and hangers carefully examined the coming season.

Total cost of repairs, \$120.47.

BERKELEY-STREET BRIDGE (OVER BOSTON & PROVIDENCE RAILROAD)

Is in fair condition. The iron-work, particularly over the main tracks of the railroad, should be cleaned and painted.

Total cost of repairs by the department, \$478.79.

BLAKEMORE-STREET BRIDGE (OVER BOSTON & PROVIDENCE RAILROAD, WARD 23).

The masonry of the abutments should be repointed, otherwise the bridge is in good condition. No repairs have been made upon it the past season.

BOYLSTON-STREET BRIDGE (OVER BACK BAY WATER-WAY).

The spandrel and wing-walls of this bridge have been completed since the last report.

The entire structure has been cleaned and pointed and is in excellent condition.

The Park Commissioners have charge of this structure, which is used at present only for railroad and teaming purposes in connection with the park work.

*BROADWAY BRIDGE (OVER FORT POINT CHANNEL).

The draw-pier has been repaired by renewing its plank surface, and the floor stringers where necessary. The face of the pier on the channel side has also been partially replanked. The roadway has been newly sheathed where required, and slight repairs have been made on the sidewalks.

The wood pavement on the column section on the South Boston side of the channel has been a source of considerable trouble on account of its expansion by freezing when saturated with water. Twice the pavement has been so much disturbed as to necessitate closing the bridge to travel, and once it was in such bad condition that the travel was maintained at considerable risk. The preventive measures adopted and described in the report for 1882 have proved inadequate to remedy the difficulty, and as the pavement is badly broken up and the timber gutters are in bad condition, it is recommended that the iron floor and wood pavement be removed and replaced by a timber floor with plank wearing surface similar to that on the column section of the Boston end of the bridge.

The sidewalks on the draw, and also on the spans adjoining the draw, are in poor condition and will require renewal at an early date.

Total cost of repairs, \$4,131.72.

BROADWAY BRIDGE (OVER THE BOSTON & ALBANY RAILROAD)

Is in good condition with the exception that it needs painting. One roadway has been sheathed.

Total cost of repairs, \$134.98.

BROOKLINE-AVENUE BRIDGE (OVER BOSTON & ALBANY RAILROAD).

This is a new iron bridge with granite abutments and wing-walls and was constructed by the Boston & Albany Railroad Company under the supervision of this department.

It is practically completed but not open for travel, as the roadway filling and surfacing is unfinished.

*CHARLES-RIVER BRIDGE (FROM BOSTON TO CHARLESTOWN).

Quite extensive repairs have been made upon portions of this bridge. The draw has been provided with a new under floor, the sides of the water-way have been partially replanked, the surface of the easterly pier has been wholly replanked, and a building, together with the machinery for moving the draw by steam-power, are now in process of erection.

The draw foundation continues to settle, and one set of rail stringers rests upon wedges which have to be frequently adjusted. The engine and machinery formerly used on the

Warren Bridge have been transferred to this bridge. Some modification of the machinery was necessary to fit it for use in moving this draw, and the arrangement is considered a temporary one as it is supposed that radical changes will be required in the bridge in a short time. The necessity for having at times greater power to move the draw than a horse could furnish made the application of steam-power unavoidable.

The side bulkheads, roadway and sidewalk pavements are in poor condition.

Total cost of repairs, \$3,866.76.

*CHELSEA BRIDGE (SOUTH) (OVER SOUTH CHANNEL MYSTIC RIVER).

This bridge has been painted, the draw sheathed and small repairs made, and is now in good condition.

Total cost of repairs, \$1,521.14.

*CHELSEA-STREET BRIDGE (FROM EAST BOSTON TO CHELSEA)

Has been painted and small repairs made.

The fixed portions of the bridge are in good condition. The draw is very narrow and old, and is seldom used for the passage of vessels; it is, however, kept in running order by renewing at intervals the decayed or weak portions, and by a continuance of this process it can probably be kept in safe condition for some years.

Total cost of repairs, \$258.28.

COLUMBUS-AVENUE BRIDGE (OVER BOSTON & ALBANY RAILROAD).

The wood-work of this bridge has been entirely removed and the iron work thoroughly cleaned and painted.

The portions of the wood-work which were in good condition have been replaced, and new material has been used for the remainder.

There are two guys from an adjacent telegraph pole which are attached to the upper chord of two of the main trusses; these guys should be removed, as such attachments should not be permitted.

The bridge is now in excellent condition.

Total cost of repairs, \$1,731.67.

*COMMERCIAL POINT, OR TENEAN BRIDGE (WARD 24),

Is in fair condition. The roadway has been newly sheathed and slight repairs made to the draw.

Total cost of repairs, \$158.16.

COMMONWEALTH-AVENUE BRIDGE (OVER WATER-WAY, BACK BAY).

The iron-work needs painting, otherwise the bridge is in good condition. It is not yet used for public travel, as the grading of the avenue has not been completed. No repairs have been made upon it the past year.

*CONGRESS-STREET BRIDGE (OVER FORT POINT CHANNEL)

Has been painted, the draw-piers have been replanked and newly stringered with kyanized spruce lumber, the draw sheathing removed twice, one boiler thoroughly repaired, and the usual minor repairs made.

The fender piers are in poor condition, and a number of spur-shore piles need refitting. The fences were put in fair condition before they were painted, but they will need further repairs in a short time.

Total cost of repairs, \$6,635.61.

DARTMOUTH-STREET BRIDGE (OVER BOSTON & ALBANY AND BOSTON & PROVIDENCE RAILROADS).

With the exception of resheathing the roadway no repairs have been made.

The bridge is in good condition.

Total cost of repairs, \$317.48.

*DOVER-STREET BRIDGE (OVER FORT POINT CHANNEL).

The draw roadways have been resheathed and kyanized spruce lumber has been purchased for planking one pier.

This work should be done in the spring and some other small repairs made.

The bridge is in fair condition.

Total cost of repairs, including new lumber for pier, \$1,425.02.

*FEDERAL-STREET BRIDGE (OVER FORT POINT CHANNEL).

The repairs on this bridge have consisted in sheathing the draw roadways twice, painting the buildings, and renewing and strengthening certain portions of the wood-work of one main truss of each draw.

The new trucks purchased last year have been put in use, and the old ones are being repaired.

Both of the draws are in bad condition; during the summer unusual signs of weakness were noticed, and it became necessary to make quite extensive repairs upon the trusses. Much more extensive repairs will be required to keep the draws in safe condition for use another year. The fixed portions of this bridge are also in poor condition. It was built originally in 1827-8, rebuilt and widened in 1857-8, and again rebuilt and widened in 1872-3. Piles driven at each of these dates remain in use, and a large part of the floor laid in 1857-8 is still in place although in very poor condition.

The sidewalk and roadway pavement and the fences require frequent repairs to keep them in safe order.

The bridge, as a whole, is in such poor condition that it would be better economy to replace the present wooden draws with new ones of iron, and renew such portions of the fixed portion as require attention, than it would be to keep them in repair for another year.

The new draws when built should occupy the full width of the bridge, instead of being ten feet narrower as at present, and it would be desirable to apply steam-power to one of them if not both. It will not be necessary, in case these improvements are made, to stop travel over more than one-half of the width of the bridge at a time.

Total cost of repairs, \$2,175.37.

FERDINAND-STREET BRIDGE (OVER BOSTON & ALBANY RAILROAD).

No repairs have been made upon this structure by this department. It is in fair condition.

FRANKLIN-STREET FOOT-BRIDGE (OVER BOSTON & ALBANY RAILROAD AT ALLSTON STATION)

Is in good order. No repairs have been made.

HUNTINGTON-AVENUE BRIDGE (OVER BOSTON & ALBANY RAILROAD)

Is in good condition. No repairs have been made by this department.

*MALDEN BRIDGE (FROM CHARLESTOWN TO EVERETT).

The under floor of the draw roadway has been partially renewed and re-covered with new sheathing, the draw-pier repaired and the bridge painted. The concrete sidewalk is not in good order although it has been temporarily repaired. It should be renewed in the spring.

The draw is an old structure and defective in the design of some portions of it, but is in fair condition. The fences will need repairs in a short time.

Total cost of repairs, \$1,687.92.

*MERIDIAN-STREET BRIDGE (FROM EAST BOSTON TO CHELSEA).

This bridge was in such poor condition that it was deemed advisable to rebuild rather than repair it.

An appropriation of \$57,000 was made by the City Council for the purpose of rebuilding and widening the structure from 39 to 50 feet, and the work was advertised for proposals in August. A contract was made with the lowest bidder, Mr. Wm. A. Kenrick, of Boston, on August 23. The bridge was closed to all through-travel Oct. 2, and opened for foot passengers Nov. 18, and for teams Dec. 8.

In addition to widening the bridge from 39 to 50 feet, the old part has been nearly all rebuilt above the pile-caps. The draw has been raised three feet, otherwise no change has been made in it. The bridge adjoining the draw at each end has been built to a corresponding height, and slopes to the grade of the old bridge at the rate of one and one-half feet per one hundred.

By raising the draw the difficulty in moving it, due to the formation of ice upon the wheels and track in winter, is obviated, the track being now above any ordinary tide.

Hard-pine timber has been used in all renewals of and additions to the structure with the exception of the bridge floor, for the larger portion of which kyanized spruce planks were specified and used where the delay in furnishing them did not render necessary the substitution of hard-pine. The bridge floor is covered with a layer of Trinidad asphalt one-

fourth of an inch thick, over which is placed a layer of coal-tar concrete one and one-half inches thick; a layer of paving gravel about five inches in thickness, upon which is laid a granite block pavement, completes the roadway. The old curb-stones were reset, and the sidewalks when completed are to be of coal-tar concrete. The work was not sufficiently advanced before the commencement of extreme cold weather to warrant the covering of the sidewalk planking with the tar concrete, and this work has been postponed until warm weather.

The bridge now has two sidewalks, each 7 feet in width, and a roadway 36 feet in width. A double track for horse-cars has been laid the entire length of the fixed portion of the bridge, but over the draw a single track has been substituted for the former double track. By this arrangement it is now possible to keep snow upon the draw when there is sleighing, and teams can go over it without crossing a railroad track.

The contract price for the work was \$38,098.64, and \$35 per M. for new stringers to replace old ones. When the bridge was stripped the stringers were found in much worse condition than had been anticipated, and a larger number of new stringers were required than had been estimated upon. The cost of the work will therefore exceed the amount as shown by the estimate when the contract was awarded, but will be, at least, \$6,000 less than the original estimate and appropriation.

In connection with this improvement the wharf upon which the office and stable were located has been rebuilt and enlarged, and repairs amounting practically to a renewal of the track and wheels of the draw have been made.

The amount paid on account of work done to January 1, was \$34,138.34, but, as a final settlement has not yet been made with the contractor, the total cost cannot be given.

Total cost of ordinary repairs, \$421.13.

*MT. WASHINGTON-AVENUE BRIDGE (OVER FORT POINT CHANNEL).

A new fence has been built on one side of this bridge, the draw has been newly sheathed and the bridge painted. The remainder of the fence is in poor condition and will soon require rebuilding; otherwise the entire structure is in good order.

Total cost of repairs, \$1,445.23.

NEWTON-STREET BRIDGE (OVER BOSTON & PROVIDENCE RAILROAD).

The roadway needs sheathing, and the iron-work painting. No repairs have been made the past year.

PUBLIC GARDEN FOOT-BRIDGE.

A special report was made to the Committee on Common and Public Grounds on May 21st, stating that the wood-work of this bridge was in such a general state of decay as to require renewal. The estimated cost of doing this work, together with the pointing of the masonry of the abutment and piers, was given at \$800.

No repairs of any account have been made upon the bridge since the above date, and the wood-work is in very bad and unsafe condition.

SHAWMUT-AVENUE BRIDGE (OVER BOSTON & ALBANY RAILROAD).

The roadway has been sheathed. The bridge is in good condition.

Total cost of repairs, \$176.45.

SWETT-STREET BRIDGES (OVER SOUTH-BAY SLICES).

No repairs have been made upon these bridges.

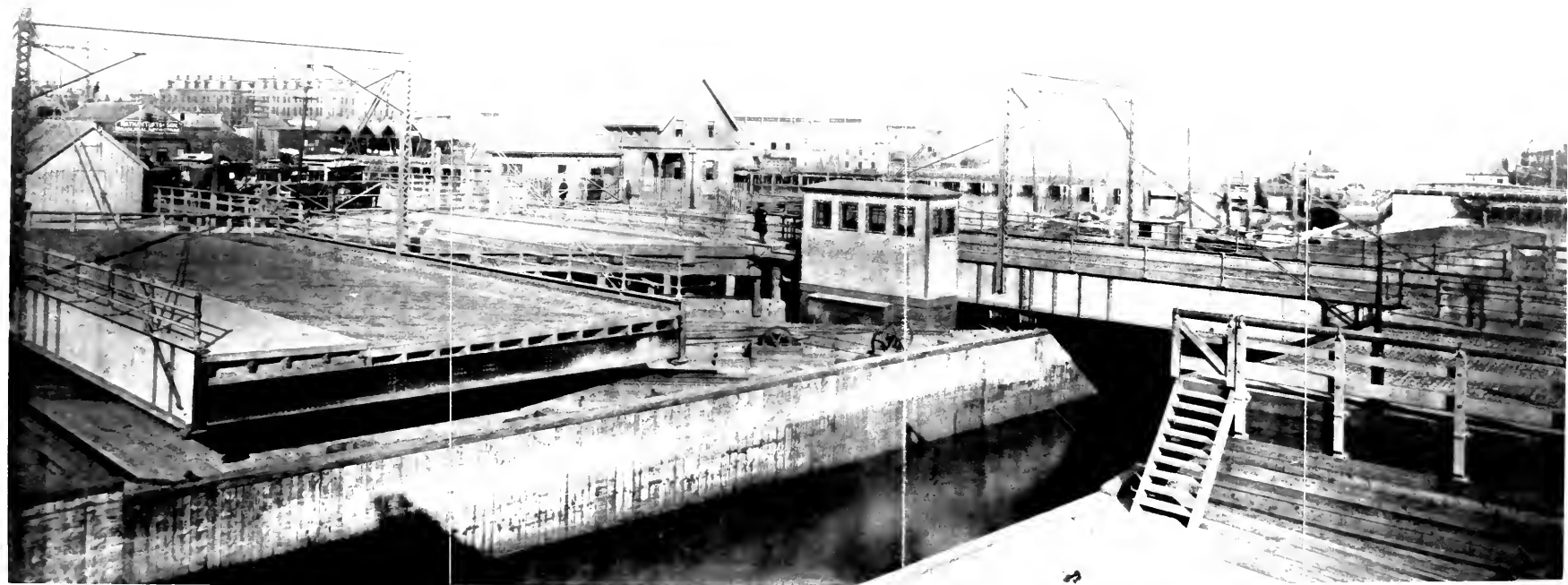
The abutment wings are in poor condition, otherwise these structures are in fair condition.

*WARREN BRIDGE (FROM BOSTON TO CHARLESTOWN).

The work of rebuilding Warren Bridge, which was commenced in 1883, has been completed in accordance with the description given in the report for last year. A convenient building for the use of the Superintendent and his assistants, with boiler-room attached, has been built at an expense of \$2,400,00.

The draws are of the mitre or retractile pattern, and are two in number.

They are placed side by side, occupying, with the exception of 7 feet space between them, the entire width of the main bridge, which is 80 feet.



At the draws the roadway of the main bridge is divided into two, each 24 feet 9 in. wide in the clear, one of which roadways, together with a sidewalk, is carried by each draw.

Each draw is composed of two non-continuous plate-girder spans, one of which bridges the channel through the bridge, and the other, extending back from the channel, over the draw foundation, is supported on the same by trucks placed upon steel rails.

When the draw is in position for travel the span over the channel is supported at the front end on bearings provided on the main bridge, the other end being attached to, and supported by, rear span by means of a pin connection.

When the draw is in motion or run off, the front end of the channel-span is supported by suspension-rods passing over Samson-posts on rear span, to the back end of this span, proper counterbalances of cast-iron being provided where necessary.

When the channel through the bridge is to be opened for the passage of vessels each draw is run back on the rails provided on the draw foundation, until it occupies a position at one side of the channel, the line of motion being at about 45° with the centre line of the bridge, and both draws being run to the same side of channel.

The accompanying view of these draws shows one draw in position for travel, and the other run back to give open channel through the bridge.

The motive power for the draws is steam, in addition to which attachments for either hand or horse power are provided, to be used in case of accident to the steam plant.

Steam is furnished from two boilers located in the bridge superintendent's building on the bridge pier, one boiler being kept in reserve. Steam from the boiler is brought in a covered pipe to the engine-house, which is located on the draw-foundation, between the two draws. In the basement of the engine-house are two double-cylinder reversing engines, one for each draw, the unequal travel of the draws, made necessary by a slight skew of the channel through the bridge, requiring the running of the draws independently of each other.

The engines are so arranged that, in case of accident to either, the other can be used for running the draws in turn.

Each engine is connected, by means of a line of shafting, to a horizontal drum located under the draw, the shaft of the drum being placed at right angles with the line of motion of the draw, and the middle of the drum being on a line passing through the centre of gravity of the draw, as referred to its line of motion. On either side of the drum is placed a

sheave, the distance between the sheaves being a little greater than the total movement of the draw. Wire-rope is connected to the drum, and passes over each sheave to a point on the draw, where it is connected to it by an adjustable fastening.

By turning the drum the draw is moved.

The starting, reversing, and brake levers for the engines, are situated in the channel end of the engine-house, and in its upper story, the floor of which is at about the same grade as the roadway of the bridge.

From his position at these levers the engineer operates and controls the draws, and has full view of their movements and the passage of vessels through the bridge. Each draw is provided with a latch which can only be operated from inside the engine-house.

The weight of a draw is about 90 tons, and it can be easily moved at the rate of 60 feet in 20 seconds, and be stopped at will while at this rate of speed.

A steam capstan for assisting vessels through the bridge, is situated on the bridge pier, and is supplied with steam from the before-mentioned boilers.

The draws, and the machinery for working them, were built from designs furnished by this department.

The draws were built by the Boston Bridge Works, the machinery by Cook, Rymes, & Co., Charlestown, the boilers by the Atlantic Works, East Boston, and the steam capstan by the American Ship Windlass Co., Providence, R.I.

The whole apparatus works well, and gives general satisfaction.

The water-way for vessels through the bridge, and the piers above and below, are faced with plank placed vertically, and extending six feet below low water, thereby turning the current in the direction in which the vessels are to be moved, and allowing them to be moved easily. In building the bridge it was impossible to provide a passage-way in the direct course of the current.

The work of completing the portion of the bridge near the passenger-station and entrance to the freight-yards of the Fitchburg Railroad was delayed by the desire of that corporation to avoid the inconvenience of cutting off the entrance to the freight-yard during the rebuilding. As finally arranged, the work in front of their premises was done by the railroad, at an increased cost to the city. The final settlement has not yet been made with the railroad.

The payments on account of the work, including land damages, and all payments to January 1, 1885, have been \$367,720.08.

WEST CHESTER-PARK BRIDGE (OVER BOSTON & ALBANY
RAILROAD.)

The roadway has been sheathed, the under floor will soon require renewal, and the concrete sidewalks are in poor condition.

Advantage should be taken of these necessary repairs to change the longitudinal crown of the bridge, and of the approaches to an easier and more natural curve. This can be done now at a small expense, as but one building has been erected adjoining the bridge.

Total cost of repairs \$159.01.

WEST CHESTER-PARK BRIDGE (OVER BOSTON & PROVIDENCE
RAILROAD).

No repairs have been made, and the bridge is in good condition.

WEST RUTLAND-SQUARE FOOT-BRIDGE (OVER BOSTON &
PROVIDENCE RAILROAD)

Should be painted next season. It is in good condition, and no repairs have been made.

WINTHROP BRIDGE (FROM BREED'S ISLAND TO WINTHROP).

The sidewalk has been rebuilt, and small repairs made. The roadway will need sheathing early in the spring.

Total cost of repairs \$140.52.

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

*CAMBRIDGE-STREET BRIDGE (FROM WARD 25 TO
CAMBRIDGE).¹

The portion of this bridge maintained by the City of Boston has been rebuilt.

The old bridge was entirely removed, and replaced with a new one built with oak-piles, hard-pine timber, hard-pine lower floor, with spruce sheathing. The width was increased

¹ The bridge was closed to travel from September 19 to October 20.

from 24 to 31½ feet, the new draw, however, being the same width as the old one, namely, 21 feet. One sidewalk, 5 feet wide, has been provided, and the same style of draw as the old one, has been built.

The work of rebuilding was let to Alexander McInnis, the lowest bidder, for \$4,249.95.

Total cost of the work, including inspection, etc., \$4,465.91.

Total cost of ordinary repairs, \$228.35.

CENTRAL-AVENUE BRIDGE (OVER NEPONSET RIVER, DORCHESTER LOWER MILLS).

A part of the roadway has been sheathed. The sidewalk floor will need attention. The bridge is in good condition.

Total cost of repairs paid by the City of Boston, \$78.41.

*CHELSEA BRIDGE (NORTH) (FROM THE MYSTIC RIVER CORPORATION'S WHARF TO CHELSEA).

The roadway has been sheathed, and the usual small repairs made. The bridge is in good condition.

Total cost of repairs, \$448.82.

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

The roadway has been sheathed, and small repairs made. The fences are in poor condition, and should be replaced in the spring. The under-floor is not in the best condition, but will probably last a few years longer. The draw and draw-pier are in good condition.

Total cost of repairs, \$504.30.

*GRANITE BRIDGE (FROM WARD 24 TO MILTON).

The roadway has been sheathed, and small repairs made. The bridge is in good condition.

Total cost of repairs, \$150.02.

LONGWOOD-AVENUE BRIDGE (FROM WARD 22 TO BROOKLINE).

No repairs have been made by this department. The bridge is in fair condition.

MATTAPAN BRIDGE (FROM WARD 24 TO MILTON).

No repairs have been made. The bridge is in fair condition.

MILTON BRIDGE (FROM WARD 24 TO MILTON).

Only trifling repairs have been made, and the bridge is in good order.

*NEPONSET BRIDGE (FROM WARD 24 TO QUINCY).

The roadway has been sheathed, and small repairs made. The flaps to the draw are in poor condition, and the draw-piers require small repairs; otherwise the bridge is in good condition.

Total cost of repairs, \$429.37.

*NORTH BEACON-STREET BRIDGE (FROM WARD 25 TO WATERTOWN).

The part of the bridge maintained by the City of Boston has been rebuilt throughout, of substantially the form and dimensions of that replaced. The part of the bridge maintained by Watertown was rebuilt last year.

In rebuilding, oak piles, hard-pine timbers and floor-plank, and spruce sheathing or wearing-surface of roadway, was used. A sidewalk 5 feet wide was built, and a small pier provided for the convenience of passing vessels.

The work of rebuilding was done by Messrs. Young, Ryan, & Hayes, for \$4,784.88. The bridge was closed to travel from the 2d to the 28th day of October.

Total cost of the work, including inspection, etc., \$5,002.70. Total cost of ordinary repairs, \$2.50.

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

The city of Cambridge repaired the portion of the bridge which it maintains, and closed it to travel while so doing. Advantage of this was taken, and the half of the draw maintained by Boston was rebuilt, and the bridge put in good condition. The draw-pier was repaired, and a buoy has been set in place. The bridge is in good condition.

Total cost of repairs, \$1,748.11.

SPRING-STREET BRIDGE (FROM WARD 23 TO DEDHAM)

Is in good condition. No repairs have been made.

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

The roadway has been slied, and small repairs made on the draw. The bridge is in fair condition.

Total cost of repairs, \$436.20.

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

Only small repairs have been made, and the condition of the bridge remains as reported last year, namely, the abutment in bad condition, and the bridge safe for travel, but extremely inconvenient for the passage of vessels.

Total cost of repairs, \$66.27.

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

ALBANY-STREET BRIDGE (OVER BOSTON & ALBANY RAILROAD).

The condition of this bridge was fully described last year; no change for the better has occurred. During 1883 extensive repairs were made which gave an opportunity to examine the condition of the iron-work. At that time it was not in such condition as to absolutely condemn the structure as dangerous, but it is approaching that point, and it should be stripped and carefully examined during the coming season. No repairs have been made. The condition of the abutments has been described in previous reports. They are in very bad condition.

*CANAL BRIDGE (FROM BOSTON TO CAMBRIDGE).

*PRISON-POINT BRIDGE (FROM CHARLESTOWN TO CAMBRIDGE).

*WEST-BOSTON BRIDGE (FROM BOSTON TO CAMBRIDGE).

In charge of Commissioners. See City Doc. No. 8, for report on their condition.

DORCHESTER-STREET BRIDGE (OVER OLD COLONY RAILROAD).

No repairs have been made. The bridge is in fair condition.

IV. — BRIDGES SUPPORTED BY RAILROAD CORPORATIONS.

Norfolk-avenue Bridge, on the New York & New England Railroad, reported in dangerous condition last year, has been rebuilt.

Beech-st. Bridge, and the bridge on Centre and Mt. Vernon sts., over the Boston & Providence Railroad, remain in the bad condition reported last year.

On the Boston & Albany Railroad, Harrison-ave., Washington-st., and Tremont-st. bridges are rapidly deteriorating for want of proper cleaning and painting. On the Old Colony Railroad, Commercial-st. bridge trusses have no side-bracing, and the trusses of Adams-st. bridge are sagged out of line and level. On the Boston & Providence Railroad, Centre-st., or Hogg bridge, needs painting and general repairs, and the fences on Dudley st., Beech st., Park st., and Mt. Vernon st. are in bad condition. On Dorchester-st. bridge, on the New York & New England Railroad, a very weak splice in a stringer was noticed.

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

A wooden foot-bridge over the Boston & Providence Railroad, connecting the two parts of Camden st., was built some years since, presumably by the railroad. The supports of the bridge are within the lines of the railroad location. The steps leading to the bridge are within the lines of the street, which is only laid out, as such, to the railroad location on each side. The bridge is a temporary structure, and it was supposed that it would be allowed to remain but a short time. It has not been removed, and is used to a considerable extent by the public. It already shows signs of deterioration, and should be carefully looked after.

MISCELLANEOUS WORK AND CONSTRUCTIONS IN 1884.

ATLANTIC-AVENUE SIDEWALK.

The sidewalk on the water side of Atlantic avenue between the solid wharves, is a pile structure, built in 1869-70. The portion between the Eastern packet pier and T wharf, about 220 feet in length, and 24 feet in width, has been rebuilt above the stringers. It is covered with kyanized spruce plank 6 inches thick, then from 8 to 12 inches of gravel, and paved with brick.

Total cost, not including the brick paving, \$1,919.78.

RAISING GRADE OF BROOKLINE AVENUE AND BEACON STREET.

On July 15 the B. & A. R.R. Co. began work on the bridge on Brookline avenue to span its tracks. This bridge has been completed, and the one on Beacon street nearly so. The company began filling on Brookline avenue, August 27, and continued until October 13, when the breaking of the Muddy-river conduit occurred, by which two men lost their lives. The conduit having been repaired, the work of filling was resumed December 4, and continued until January 21, when it was discontinued on account of the work being done by the sewer department not being far enough advanced to allow of the completion of the filling. On October 4 the 48-inch main water-pipe on Beacon street was broken by the dropping of a large block of granite which was being lowered into its place in the westerly abutment of the new bridge being built by the B. & A. R.R. Co. over its tracks. The break occurred at 9.30 A.M., and the water was not shut off until 11.30 A.M. The escaping water washed away the road-bed so that all travel on the railroad was stopped from 9.30 A.M. to 12.30 P.M.

BULKHEAD AT FIRST AND Q STREETS, SOUTH BOSTON.

Plans and specifications for a pile bulkhead on East First street, near Q street, were made, and the work of building the wooden structure was let to Mr. F. G. Whitecomb, the lowest bidder. The bulkhead is about 350 feet in length,

and from 9 to 18 feet in height. It is built with spruce piles and plank, and is anchored to a row of piles driven in the rear with $1\frac{1}{4}$ -inch iron rods. The bulkhead is ballasted with broken stone from the Dorchester-bay tunnel of the Main Drainage Works.

Cost of wooden bulkhead	\$1,814 60
“ moving ballast	1,594 50
	<hr/>
Total cost	\$3,409 10

PROPOSED NEW BRIDGE TO CAMBRIDGE.

The design shown in the accompanying plate is for a bridge across the Charles river, opposite West Chester park, Boston, and between the Harbor Commissioners' lines on either side of the river, a distance of about 2,155 feet.

The bridge is to be 70 feet wide, excepting at the draw, which is to be 50 feet wide.

Commencing at the Harbor Commissioners' line, at the Boston side of the river, the bridge, for a distance of about 200 feet, is to be a wooden-pile structure, with stone paving, it being thought best, in view of the probability of the extension of the Charles-river embankment, to cover the space to be occupied by it by a structure of a somewhat temporary character.

From the end of this 200 feet of pile bridge to the Harbor Commissioners' line on the Cambridge side of the river the bridge will consist of iron spans supported on stone piers, and the bridge will be a deck-bridge, with the exception of the draw, which will have two main trusses above the floor.

The proposed grades and elevations of the roadway of the bridge are as follows:—

	Feet.
At Beacon street opposite West Chester park	17
At 300 ft. from Beacon street, .33 ft. rise per 100 ft.	18
Then about 100 ft., 3.00 ft. rise per 100 ft.	21
Then about 166 ft., 2.70 ft. rise per 100 ft.	25.5
Then level at 25.5 for about 1,600 ft.	
Then about 196 ft., 2.30 ft. per 100 ft. fall to	21
at the Harbor Commissioners' line at the Cambridge side.	

The general piers will be of stone masonry on pile foundations, the piles to be cut off at 3 feet below low water, and to be enclosed by sheet-piling.

The top of the coping of the piers will be at grade 13

feet, and stone bearing-blocks will be placed under girder-bearings, bringing the lowest point of the iron-work of the main girders at grade 16 feet.

The draw foundation will be circular in shape, and of stone masonry, resting on a foundation of piles filled between with cement concrete, the concrete extending to hard bottom. The piles and concrete are to be encased in a curb of sheet-piling.

The fixed spans of the bridge will be generally in alternate spans of about 75 feet and 105 feet, 75 feet of the longer span to be carried by independent girders, supported by cantilevers from adjacent spans.

The iron-work of each fixed span will be made up of four main girders carrying iron floor-beams and projecting brackets for the support of the sidewalks, the whole to be thoroughly braced and connected, and provided with proper expansion-joints.

The main girders will be of the plate-girder type, and will vary in depth from 5 feet to 8 feet, the under side of each girder being arched 3 feet.

The flooring of the entire roadway will consist of hard-pine stringers supporting two courses of spruce plank; the under course to be 4 inches thick, treated by the kyanizing process, and the upper course to be 2 inches thick.

The sidewalks will be made of hard-pine stringers, carrying a walk of white-pine plank, or tar concrete, as may be desired, the walks to be guarded by heavy cast-iron curbs, provided with draining scuppers.

Railings for the sidewalk are to be of wrought-iron, of ornamental pattern.

The draw, which is to span two channels, each 36 feet wide, will have two main trusses of the pin-connected type, and will be carried on a wrought-iron turn-table of improved construction. It is to be operated by steam-power; and a suitable building for the machinery, and for quarters for the bridge men, is to be provided.

The clear head-room between the water at grade 12 feet, and the under side of the bridge will range from 4 feet at pier to 7 feet at mid span. Under the draw this head-room will be increased to 12 feet.

The special features of this design may be mentioned as follows:—

General low elevation of the roadway of the bridge and consequent easy grades on it and its approaches.

The location of the iron-work of the bridge practically beyond the reach of high water.

The head-room under the bridge; this being such as to

give free passage for row and racing boats at all stages of high water.

The construction of the iron-work of the fixed spans. The iron is mostly concentrated in a few heavy members, which are readily inspected, cleaned, and painted. The number of adjustable members is reduced to a minimum.

It is believed that, for the conditions here required for a bridge, this type of construction would be stiffer under loads, and could be kept in good order with less attention and expense than a skeleton structure, with its large number of small and adjustable parts, and more or less complicated joints.

COMMONWEALTH-AVENUE EXTENSION.

The final estimate of filling under the contracts of April 29, 1880, and May 26, 1881, was made May 7, 1884. The total amount deposited on Commonwealth avenue, Brookline avenue, Ipswich and Jersey streets, was 39,804 $\frac{1}{4}$ squares at \$3.20 per square. As this filling was done under an agreement with owners of the adjoining lands, a statement of the amount of filling upon the lands of each party is here given.

Public park, Back Bay	10,458 $\frac{3}{4}$ squares.
Commonwealth avenue and adjacent streets	39,804 $\frac{1}{4}$ "
Boston Water-Power Co.	26,326 $\frac{3}{4}$ "
Trustees Beacon-street lands	12,544 "
" Park-entrance lands	11,674 $\frac{1}{8}$ "
A. A. Marcus, and Executors D. N. Skillings	688 "
Total	101,495$\frac{7}{8}$ "

January 22, the B. & A. R.R. Co. began to dump loam on the avenue, this loam being brought from Basin 4, Ashland. The total amount of loam deposited on the avenue was 1,496 squares.

The spreading of this loam upon the areas to be planted was begun June 9, and completed November 28.

The manner of treating the ground was the same as that followed upon the Back-bay park, viz. : the ground was first graded to a sub-grade and then covered with a layer of marsh-mud brought from the park, to a depth of six inches ; this was covered with a coating of oyster-shell lime, and then the loam was spread to a depth of 2 feet.

COPLEY-SQUARE CURB.

A contract, dated December 1, 1883, was made with Emery & Small, for furnishing and laying a granite curbing around Copley square.

The curbing is 18 inches deep, and is 10 inches wide. The outer face is cut on a curve of 8 inches radius, and all exposed surfaces are of 8-cut work.

The curbing is laid on a continuous foundation of concrete 3 feet deep and $2\frac{1}{2}$ feet wide, composed of American hydraulic cement, sand, and broken stone, in the proportion of 1, 2, and 5.

The curbing was cut during the winter months, and laid early in the spring of 1884, being completed May 19th.

The length of the curbing is 823 feet, and the cost of the work was \$3,394.

DALTON-STREET FILLING.

Under the agreement with the B. & A. R.R. Company, before referred to (Commonwealth-ave. Ext'n, p. 27), that company began filling Dalton street on January 11th, and completed the same on November 25th. The total amount of filling deposited on the street was 1,924 squares, at \$3.50 per square.

EAST BOSTON FERRIES.

Estimates, detailed plans, specifications, and contract for rebuilding the slips, building a wharf, and a foundation for a drop for the South Ferry, Boston side, have been furnished. Lines and grades have been given for the construction of the work; but it has not been superintended by this department.

Plans have also been made for a partial rebuilding of the slips of the South Ferry on the East Boston side.

HUNTINGTON-AVENUE EXTENSION.

The contract made with Hugh Nawn, in 1883, was completed, and the final estimate made on December 20, 1884. The portion of the avenue between Tremont street and Longwood avenue was immediately opened to travel. The Metropolitan R.R. Co. have laid their tracks through the whole length of the extension, and have been running cars over it since September 29th, although the part of the avenue between Longwood avenue and Parker street has never been opened to travel, and is not in a safe condition for travel.

IN GENERAL.

The usual large amount of work of a miscellaneous character has been done during the year. Under this head may be classed the following:—

PLANS, SPECIFICATIONS, AND INSPECTION.

- For Machinery for new draws for Warren bridge.
- Repairs of boiler-room, Mystic Pumping-station.
- Wrought-iron water-pipe, Brookline-avenue bridge.
- New raising-gear, Prison-point draw.
- Remodelling of park building, City Point.
- Gates for Muddy river gate-house.
- Gates for Dam No. 4 and Farm Pond, Boston Water Works.

SPECIFICATIONS AND INSPECTION.

- Brookline-avenue bridge, over Boston & Albany R.R.
- Beacon-street bridge over Boston & Albany R.R.

INSPECTION DURING ERECTION.

- For New Steel boilers, Mystic Pumping-station.
- Franklin-street foot-bridge, Allston.

PLANS AND SPECIFICATIONS.

- For Sumner-street foot-bridge, East Boston.
- Miscellaneous iron-work, Main Drainage Pumping-station.
- Propagating house, West Roxbury park.
- Telford road, Humboldt avenue.
- Paving on West Boston bridge.

INSPECTION AT SHOPS.

- For East shaft pumping-machinery, Main Drainage Works.

DESIGNS.

- For New bridge to Cambridge.
- Laying out of Massachusetts avenue.
- Park gate-house and shelters.

ESTIMATES.

- For Iron bridge, Back Bay.
- Railroad bridge over Brook street.
- Abolishing grade crossings of Old Colony R.R. at Dorchester avenue and Dover street.
- Enlarging the dock at Fort-Hill wharf for the Board of Health.

B. — WATER — WORKS

Sudbury-river Reservoirs, Farm Pond, and Lake Cochituate.

On January 1, 1884, reservoirs Nos. 2 and 3 on the Sudbury river were entirely empty, Reservoir No. 1 and Farm pond contained but a small supply, and Lake Cochituate was ten feet below high-water mark or but 3.21 feet above the conduit invert, and temporary pumping machinery was in operation to furnish a supply to the city. A heavy rain and thaw between the 8th and 12th of the month quickly filled the reservoirs on the Sudbury river, so that on the 30th of January Reservoirs Nos. 1 and 2 were full and overflowing, and on February 8, Reservoir No. 3 reached high-water mark. Lake Cochituate rose slowly during the month of January, and pumping from the lake into the conduit ceased on the 14th, but during the month of February 1,094,300,000 gallons were sent to the lake from the Sudbury river, and its surface rose rapidly, so that on March 1, water was wasted at the outlet dam.

From March 1 to August 15 all of the reservoirs remained at or near high-water mark. Reservoir No. 2 fell rapidly from August 15 to October 15, being drawn upon for the city's supply, and on the latter date was practically empty; water was then drawn from Reservoir No. 3, and on November 23 its surface was 3.88 feet below the crest of the dam.

Reservoirs 2 and 3 filled during the month of December, and on December 22 both were full and waste was commenced at dam No. 1.

Lake Cochituate fell slowly from August 1 to November 24, when its surface was 4.40 feet below high water. Since December 23 the lake has slowly risen and is now, January 1, 1885, 2.93 feet below high-water mark.

Farm pond was kept full until the middle of July when its surface was lowered about 2.5 feet to grade, 146.50, where it has since remained.

Mystic Lake.

Mystic lake was 7.72 feet below high-water mark on January 1, 1884, but it filled during the month and waste was commenced on January 26, and continued without interruption until June 8.

The lake remained full until September 1, after which date its surface fell, and during the month of November stood about 3.50 feet below high water. In December the lake again filled, and on December 23d waste began at the outlet and has continued to the present time.

Consumption.

The daily average consumption of water from the combined works has been as follows:—

	From Sudbury and Cochituate Works.	From Mystic Works.	Total.
January . . .	32,162,300	8,019,100	40,181,400
February . . .	24,598,000	6,349,500	30,947,500
March . . .	23,711,900	6,337,100	30,049,000
April . . .	21,505,700	5,242,100	26,747,800
May . . .	23,708,500	5,800,000	29,508,500
June . . .	26,184,600	6,245,600	32,430,200
July . . .	25,409,000	6,312,300	31,721,300
August . . .	25,065,200	6,088,400	31,153,600
September . . .	26,389,500	6,411,150	32,800,650
October . . .	25,022,850	5,834,200	30,857,050
November . . .	22,954,250	5,119,700	28,073,950
December . . .	24,234,800	6,330,800	30,565,600
Averages . . .	<u>25,090,500</u>	<u>6,209,700</u>	<u>31,300,200</u>

The daily average consumption from the Sudbury and Cochituate works has been 23.6% less than during the year 1883, and that of the Mystic works 9% less. The daily average consumption from the combined works has been 8,630,200 gallons or 21.6 per cent. less than during the year 1883, and smaller than that of any year since 1877.

The daily average consumption per head of population has been 68 gallons from the Sudbury and Cochituate works, 71 gallons from the Mystic works and 68.6 gallons from the combined supplies.

The total consumption of the Sudbury and Cochituate works has been 9,183,112,300 gallons, of which amount the Sudbury river works have furnished 6,110,600,000 gallons, or 66.5 per cent., as follows:—

	Amount sent to Chestnut-Hill Reservoir.	Amount sent to Lake Cochituate.	Total.
January . . .	697,000,000		697,000,000
February . . .	265,400,000	1,094,300,000	1,559,700,000
March . . .	312,500,000		312,500,000
April . . .	228,800,000		228,800,000
May . . .	268,400,000		268,400,000
June . . .	414,500,000	168,400,000	582,900,000
July . . .	430,100,000	152,000,000	582,000,000
August . . .	406,100,000	1,600,000	407,700,000
September . . .	442,200,000		442,200,000
October . . .	432,900,000		432,900,000
November . . .	363,900,000		363,900,000
December . . .	432,500,000		432,500,000
Totals . . .	4,694,300,000	1,416,300,000	6,110,600,000
Daily av. . .	12,825,900	3,869,700	16,695,600

HIGHLAND HIGH-SERVICE WORKS.

At the Highland pumping-station the average daily quantities pumped during each month have been as follows:—

January,	2,482,000	July,	2,415,000
February,	2,352,800	August,	2,306,000
March,	2,370,500	September,	2,589,000
April,	2,191,700	October,	2,453,000
May,	2,329,000	November,	2,366,850
June,	2,648,950	December,	2,510,500

The daily average for the year has been 2,418,000 gallons, a decrease of 16.8 per cent. from that of the year 1883.

WASTE OF WATER.

The work of preventing the waste of water throughout the city which was commenced during the year 1883 has been continued during the past year and there has been a steady reduction in the consumption. The saving effected is shown by the following table, which gives the daily average consumption per inhabitant during the past two years on the Sudbury and Cochituate works:—

	Consumption—Gallons, per head, per day.		Saving effected.	
	1883.	1884.	Gal. per day.	Percent- age.
January	97.8	88.4	9.4	9.6
February	92.0	67.5	24.5	26.6
March	95.8	65.0	30.8	32.1
April	85.8	58.8	27.0	31.5
May	89.8	64.6	25.2	28.1
June	93.3	71.2	22.1	23.7
July	102.4	68.9	33.5	32.7
August	103.2	67.7	35.5	34.4
September	93.2	71.1	22.1	23.7
October	81.9	67.3	14.6	17.8
November	79.6	61.5	18.1	22.7
December	83.0	64.9	18.1	21.8
Averages	91.5	68.0	23.5	25.6

It will be seen from the above that the daily average consumption for the past year has been 68.0 gallons per inhabitant, a reduction of 23.5 gallons, or 25.6 % from that of the previous year. Sixty-three Deacon meters were purchased early in the year, and as soon as the weather would permit were placed in service. The total number of meters in use is now sixty-nine; these have been in constant operation during the past season, and the results obtained by their use have been very satisfactory.

A number of leaks have been discovered and repaired in the street mains and services, and the meters have shown the districts where the services of the house-to-house inspectors could be used to the best advantage. The system will be more effective when sidewalk stopcocks shall have been placed on the service pipes, and as 5,000 of these have been ordered, the work of setting them will be begun early in the spring.

MYSTIC-VALLEY SEWER.

The treatment of the sewage from the tanneries in the Mystic valley has been continued under the same system as for the two previous years.

In consequence of the increase in the quantity of sewage, the works have been extended. Two additional settling tanks of larger size and improved design have been built, and a new ditch about 1,400 feet in length excavated between the tanks and the discharge outlet. Experiments have been made during the year with a large Farquhar low-pressure

filter to determine the practicability of filtering the sewage; but the experiments have not thus far been successful.

Experiments have also been made to determine the practicability of utilizing the sewage for agricultural purposes. The results obtained seem to show that the material obtained from the settling tanks has some value for this purpose, and all of the land available at the pumping-station has been graded in readiness for further experiments during the coming year.

FARM-POND CONDUIT.

At the date of the last annual report the work of construction was in progress on two contracts. Mr. G. H. Cavanagh was building a pile and timber trestle across the pond, and Messrs Parker and Sylvester were filling into the pond from the trestle on the line of the conduit.

Mr. Cavanagh's contract was completed on April 24, at a cost of \$26,054.35 and Messrs. Parker and Sylvester completed the filling on August 29, having deposited 59,010 cubic yards of material at a cost of \$27,672.70. On August 20 a contract was made with G. M. Cushing of New York for building a conduit 3,760 feet in length between the upper and lower gate-houses.

Work to the amount of about \$10,000 has been done under this contract, and the contract will be completed during the coming season.

BASIN NO. 4.

The work upon this reservoir has so far advanced that the reservoir will be partially filled during the coming spring.

The work remaining to complete the reservoir consists of between 10,000 and 12,000 cubic yards of material in the embankment of the dam, the superstructure of the gate-chamber, the wash-wall on the inner slope of the dam, soiling, etc.

The work will be finished during the present year.

MISCELLANEOUS.

The bridging of the Boston and Albany Railroad, at Brookline avenue, and the consequent raising of the grade of the street between Beacon street and Burlington avenue, necessitated the raising of a 40-inch supply main. The pipe was raised and supported by a pile trestle 990 feet in length. The trestle has also been used by the railroad company in

filling the street. The water is to be carried over the bridge in two wrought-iron pipes 28 inches in diameter. The 48-inch main in Beacon street will be raised in a similar manner during the coming season.

The distributing mains of the Sudbury and Cochoituate works have been extended about 11.3 miles and 4,300 feet or 4 and 6-inch pipes have been replaced by pipes of larger diameter.

On the Mystic works 4,600 feet of the wrought-iron and cement pipe have been replaced with cast-iron mains.

C. — IMPROVED SEWERAGE.

MAIN DRAINAGE WORKS.

By January 1, 1884, the greater portion of the Main Drainage works was in such a state of completion as to permit its use for disposing of the sewage from a large part of the city. Since that date the then unfinished portions of the intercepting sewers have been built, and the system as contemplated may be said to be practically completed.

A little work in connection with alteration of some old sewers and house-drains to adapt them to connect with the intercepting system is yet under way. The grounds and roadways at the pumping-station and at Moon Island will require some work during the coming season, and dwellings for employés are yet to be erected. In the appended extracts from Mr. Clarke's report will be found a brief statement of the work which has been done during the past year, and I shall principally confine myself to an account of the working of the system since it has been in operation, and of the results derived from it so far as they have been noted.

The new system was designed and built in order to do away with two evils, inherent in the old system.

These were :

First. The daily damming up by the tide of the common sewers, so that for much of the time there was no current in them and the air was compressed and driven to find an outlet by the house-drains and other openings.

Second. The discharge of the sewage, to cause nuisances, at many points on the shores of the city in the immediate vicinity of population.

The first of these evils has been corrected by the new system. The old sewers now have a continual flow independent of the stage of tide, as is known by frequent observations, and also from the testimony of drain-layers, who formerly were only able to enter house pipes into the sewers when

the latter were empty at low-water, but now can make such connections at any time.

The new system has also remedied the second evil. From the moment that any of the city sewers were connected with an intercepting-sewer, its sewage, which had before discharged at the old outlet, was diverted, and has since been conveyed to Moon Island and emptied into the outer harbor at that point.

During the past year, therefore, nearly all of the sewage produced in the city south of Charles River has been discharged at Moon Island. During heavy rains or freshets, when more water was flowing in the old sewers than could be pumped, the surplus has escaped through tide-gates at the old outlets. This occasional and temporary discharge of dilute sewage at the old outlets has not, apparently, caused any nuisance. Examinations and inquiries concerning the condition of the shores and docks at the sewer outlets have shown that in places where the water used to be continually foul it has become pure, bad odors have ceased, and fish have returned to points where none had been seen for years. It has been generally remarked that the bad smells which for several years have, at times, been prevalent over the South End and Back Bay districts were not noticed last summer.

It has never been claimed for the new system that it would dispose of all rain-water during storms, or prevent flooding of cellars which are below tide-level. An attempt was made, however, to partially relieve the flooding of cellars by admitting more rain-water from sewers draining low districts, than from those draining areas where the cellars and basements are above high-water. The most trouble from flooding has heretofore been experienced in the districts drained by the Dover-street, Dedham-street, and Church-street sewers; accordingly these sewers were connected with the intercepting sewers by large openings which are never closed.

This plan has met with marked success. No cases of flooding during rain-storms or at high tide in those districts have been reported since the sewers were connected, and many cellars which used often to be filled several feet deep with water are known to have been perfectly dry during the past year.

The main and intercepting sewers have been inspected on foot, or by floating through them in boats, and have been found to be in good condition. The atmosphere in them is reasonably pure and their sides are generally clean. Their inclinations are very flat, there being but from two to three feet fall in a mile, but the sewage flows with sufficient ve-

locity to prevent deposits accumulating. Most of the city sewers, when intercepted, were found to contain deposits of sewage sludge varying from a few inches to several feet deep. This sludge has all gone into the intercepting sewers and has been conveyed to the pumping-station.

The filth-hoist, at the lower end of the main sewer, has been in continual operation during the past year. At this place, all matters of an inch diameter and upwards, contained by the sewage, are screened out and removed. The average daily yield of the cages is about 16 cubic feet. During rain-storms this amount is sometimes increased tenfold on account of the cleaning out of deposits which have lodged in the city sewers. For a time these matters were buried, but, as the quantity proved to be too great to make this a satisfactory disposition of them, a small press was procured by which the surplus water is pressed out of them, after which they are burned under the boilers in the pumping-station boiler-room. This is a safe and expeditious way of getting rid of them and does not appear to injuriously affect the fires.

The permanent buildings at the pumping-station have been completed during the year, and the temporary wooden structures, which protected the engines, have been removed. Some floors and inside finish are yet to be put in place. The two high-duty Leavitt pumping-engines and the two storm-duty Worthington pumping-engines are in condition for efficient service, and all of them have been run more or less during the year. Any one of them is able to pump the ordinary flow of sewage, and they have a combined capacity of about 125,000,000 gallons a day, raised 35 feet high. Under ordinary circumstances one of the Leavitt engines is kept running, and easily controls the flow of sewage. Should it rain, and additional pumping capacity be needed, the second Leavitt engine is, by preference, started; if still more capacity is needed one or both of the Worthington engines are started. When the amount of water arriving by the sewer decreases the Worthington engines are first stopped. No defect has been noticed in the performance of any of the engines or pumps. The average daily amount of sewage pumped in dry weather has been about 23,500,000 gallons.

The amount of sewage pumped is, probably, over 15 per cent. in excess of that due to the city water supply of the districts whose sewage is intercepted. The excess comes from several sources. Among these are: the Jamaica Pond Aqueduct water; private water supplies of dwellings, breweries, and other manufacturing establishments; soil water, which leaks into sewers and house-drains; salt-water used in sugar

refineries and all other places, and tide-water which leaks into some of the old sewers. A large quantity of this tide-water comes from the Central-street sewer and its branches. These sewers are in bad condition, and should be rebuilt, as, also, should the Canal-street sewer and some of its branches, which are too low to be properly intercepted. The new tide-gates, put at the outlets of the old sewers, work in a satisfactory manner, and the amount of water which leaks through them is insignificant. The gates, however, require constant care to keep them in good condition.

The boiler-house, boilers, feed and other pumps, coal-house, bins, coal-room, wharf and other appurtenances of the pumping-station seem to satisfactorily fulfil the purposes for which they were designed, so far as can be determined by their use for the past year. The various offices, sheds, store and dwelling-houses at the pumping-station stand principally upon leased land adjoining the city lot. These buildings must soon be removed, and it will be necessary to build some permanent dwellings for the employés. It is expected that a lot of land near to the pumping-station can be acquired for this purpose.

The deposit-sewers, which convey to the west shaft of the tunnel under Dorchester bay the sewage received from the force mains of the pumps, accomplish very fully the purpose for which they were built. They are over 1,200 feet long, and were purposely made very large in order that the flow through them should be very sluggish and matters in suspension should be deposited before reaching the tunnel. All of the sludge which was emptied from the city sewers into the interceptors passed through the pumps and settled to the bottom of these deposit sewers. Fully 2,000 cubic yards of sludge were thus intercepted, and nothing but the lightest kind of flocculent mud remained in suspension long enough to reach the tunnel. In the last annual report it was stated that the best means of disposing of the sludge accumulated in the deposit-sewers had not yet been ascertained. Since then a method has been devised and put in operation by which the sludge is made to flow through pipes from the deposit sewers into a large tank built on a pile foundation beside the channel to the pumping-station. Scows are laid alongside the tank, and upon opening the gates in its side the sludge flows into the scows and is carried outside of the harbor and dumped.

As the tunnel is 140 feet under Dorchester bay, and is always full, it cannot be examined, but it is known to be unobstructed. This is ascertained by measurements of the loss of head required to pass known quantities of sewage

through it in certain times. For the first few months of 1884, before many of the city sewers were intercepted, a comparatively small amount of sewage was pumped, especially at night. At such times the velocity of flow through the tunnel was very slight, often less than half a foot a second. At present the ordinary velocity of flow is generally less than one foot a second. As the sewage takes from two to four hours to pass through the tunnel, at these slow velocities, slight deposits doubtless occur there.

The tunnel was not regularly flushed until after it had been in use for eight months. At that time it was estimated that about two feet deep of soft sludge had been deposited in it. It was then flushed by pumping with the four pumps simultaneously by which means a velocity of $3\frac{1}{2}$ feet a second was maintained in it for some hours. A quantity of sludge was thus flushed out and washed down to the reservoir. Similar flushing is now resorted to about once in two weeks, tide-water being supplied to the pumps when the quantity of sewage is insufficient.

Although it is probable that by such methods the tunnel can be kept reasonably clean, it does not seem to me to be safe to leave it with no possible means of access. As has been stated in former reports a large mining-pump capable of emptying the tunnel in 48 hours has been purchased and is to be set up at the east shaft, ready for use in any emergency. As the tunnel can first be filled with clean salt-water, this water can be pumped into Dorchester bay without causing any offence. Should any emergency arise which makes it advisable to empty the tunnel, during that operation, the sewage of the city must be permitted to empty at the old sewers outlets, unless the special statute, which prohibits its being even temporarily pumped into the sea at Old Harbor Point, can be repealed.

The outfall-sewer, from Squantum to Moon Island, is in good condition. That portion of it which consists of a tight wooden flume, supported on piling outside of the embankment, shows no signs of weakness, but is considered a temporary expedient and, after some years, when the embankment shall be safe from any further settlement, should be replaced by a masonry sewer.

The reservoir has proved to be of sufficient size for present needs. It will hold 25,000,000 gallons and, as the sewage is only stored for about 10 hours, between the end of one discharge and the beginning of another, the total daily storage capacity, not including that of the sewers, is about 60,000,000 gallons. Under ordinary circumstances the basins seldom fill to more than one-half their depth. No difficulty has been

experienced in keeping the basins reasonably clean. A thin deposit of light mud accumulates on the bottom, which is easily swept into the discharge-sewers. Incrustations, or organic matter, which form on the sides are washed off by jets of salt-water from hydrants provided for the purpose. The machinery for opening and closing the gates works well, and the buildings seem to answer the purpose for which they were designed. It will be desirable to erect on the island some dwellings for the workmen employed there.

The effect of discharging the whole sewage of the city at this one point has been watched with great interest. Beside other waste products, each day's supply of sewage contains over 200 tons of fecal matter. The outlet sewers extend about 500 feet into the sea and between the embankment covering them and the island is a cove of still water. A foot or more of sludge has been deposited in this cove by eddies.

To the south of the outlet, for a distance of about 1,000 feet, an inch deep of mud is apt to accumulate on the beach between low and half-tide levels. This latter deposit is, from time to time, washed away by the waves. No trace of the sewage has been noticed on other parts of Moon Island, nor on any other of the shores or islands of the harbor.

By the expenditure of \$25,000, a bulkhead can be built which will prevent the return of the sewage to the points now affected by it. It is also possible that sufficient relief may be afforded by some gates which have just been placed at the outlet-sewer's mouths. Although the reservoirs have been emptied at about the beginning of ebb-tide, the low discharge and outlet-sewers themselves were only emptied slowly as the tide fell. The action of the gates, before referred to, will be to retain the last million gallons of sewage, containing the scourings of the reservoir, until the succeeding time of discharge, during the early ebb-tide.

Some odor of sewage is noticed about the outlet during discharge. Probably this cannot be avoided. The color of the sewage can be plainly seen as it joins the current on its way out of the harbor. After advancing about a mile, and before reaching Rainsford Island, it becomes so diluted that its presence can no longer be detected, although it is known that it travels some three miles farther.

Complaints that the smell of the sewage has been perceived by residents of Squantum Head have been investigated. On three days only, when the wind was blowing in that direction, was the odor said to have been noticed. If it was noticed, it probably was due to the deposits in the cove before referred to, and it is hoped that all cause for complaint can be removed.

The expenditures for 1884 amounted to \$745,389.77, which, with previous payments, makes a total expenditure of \$5,168,456.01 and leaves a balance from the appropriation of \$84,543.99.

EXTRACTS FROM MR. CLARKE'S REPORT.

The following is the customary annual statement, showing, in tabular form (pp. 42-43), the different sections of sewers, with the size and extent of each, the length built prior to and during the past year, whether done by contract or otherwise, and the builder's name.

The table is final, in so far as sewer construction contemplated when the work was first designed, and covered by the appropriation made for it, is concerned. The table shows that 9250.5 lineal feet of sewers have been built during the past year, and that to complete the whole main drainage system has required the building of a total length of about 17.5 miles of sewers. Of these about 9 miles have been built by contract and about 8.5 miles by day's labor under superintendents selected by the City Engineer. Some account, in detail, of the work done during the past season is herewith submitted.

SECTION 5. WEST SIDE.

This sewer, which forms a part of the West Side interceptor, extends from Charles street to Causeway street, passing through Leverett, Brighton, and Lowell streets, a distance of 1,773 lineal feet. The sewer is oval, 4 feet 6 inches high and 2 feet 8 inches wide, between Causeway and Minot streets, and 3 feet wide between Minot and Charles streets. The arch is of brick masonry, 8 inches thick, and the bottom consists of a 4-inch wooden cradle lined with 4 inches of brick work. The city sewer in Lowell street, which was a large flat-bottomed wooden scow, was too low to be intercepted. It was accordingly abandoned, and all branch sewers and house drains were connected directly with the intercepting-sewer. To facilitate making these connections the intercepting-sewer was located exactly on the line of the old sewer. The top planks of the latter were removed, but its side timbers were retained, and the new sewer was built between them. The flow of sewage was maintained during construction, through channels above the floor of the old sewer but below the bottom of the new one, which was supported on timber saddles. Six-inch slants were built into the new sewer to facilitate any future new house drain connections; they are 25 feet apart on each side of the sewer.

Two new tide-gate chambers, each with a double pair of tide-gates were built on this section. One of them was on the Leverett and the other on the Lowell street sewer. Work on this section began February 12, and continued to its completion on June 15. The total cost of the sewer was \$32,744.78.

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.
4. West Side	In Charles st., from Cambridge st. to Leverett st.
Brimmer Street	In Charles, Pinckney, and Brimmer sts., from Beacon st. to Revere st.
5. West Side	In Brighton, Leverett, and Lowell sts., from Charles st. to Cause- way sts.
6. West Side	In Causeway st., from Lowell st. to Prince 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-yard to Summer st.
4. East Side	In Atlantic ave., from Summer st. to Central st.
1. Stony Brook	In Tremont and Cabots 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.
2. South Boston	In Lowland, Burnham, and Ninth sts., from Hyde st. to H st.
3. South Boston	In Von Hillern st., Locust st., Washington 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 street to First st.
Roxbury Canal	In Albany st. and E. Chester park, from Northampton st. to Roxbury Canal
E. Chester Park	In E. Chester park, from Albany st. to Harrison ave.
Dover Street	In Dover st., from Albany st. to Harrison ave.
Sundry City Sewers re- built . . . . .	. . . . .
Pumping-Station	Connecting Main Sewer and Filth-Hoist, and Engine-Wells and Salt- Water Conduit
1. Outfall-Sewer	From Pumping-Station, to Dorchester Bay Tunnel
2. Outfall-Sewer	Tunnel under Dorchester Bay.
3. Outfall Sewer	Squantum Neck to Moon Island
	{ Brick Sewers, 1,938 ft. { Wooden Plume, 4,196 ft. { Discharge Sewers, 1,003 ft.
Outlet-Sewer	From Reservoir to Outlet
	Totals

IMPROVED SEWERAGE CONSTRUCTION.

Size in feet and inches.	Length in feet.	Built prior to Jan. 1, 1884.	Built Jan. 1, 1885.	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. × 5 ft. 8 in. .	1856.5	1856.5	1856.5	John Cavanagh.
9 ft.	2505.	2505.	2505.	Charles Linchan and City.
9 ft.	1894.5	1894.5	1894.5	City.
{ 9 ft. }	3381.	3381.	3381.	Hoblitzell, Condon, and Hoblitzell and City.
{ 10 ft. 6 in. }				
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. }	5043.	5013.	5043.	City.
{ 4 ft. × 4 ft. 6 in. . . . }				
4 ft. × 4 ft. 6 in.	1832.	1832.	1832.	Thomas McCann.
3 ft. × 4 ft. 6 in.	2186.	1400.	2186.	City.
{ 2 ft. × 3 ft. }	1456.5	1456.5	1456.5	City.
{ 3 ft. × 4 ft. 6 in. . . . }				
{ 2 ft. 8 in. × 4 ft. 6 in. }	1775.	. . . . .	1775.	City.
{ 3 ft. × 4 ft. 6 in. . . . }				
2 ft. 8 in. × 5 ft.	1796.	. . . . .	1796.	City.
5 ft. 8 in.	4524.	4524.	4524.	A. H. Delameter & Co. and R. A. Malone.
{ 5 ft. × 4 ft. }	2331.5	2331.5	2331.5	City.
{ 5 ft. × 3 ft. }				
2 ft. 8 in. × 4 ft. 6 in. .	2176.	2176.	2176.	City.
2 ft. 8 in. × 4 ft. 6 in. .	2983.	2983.	2983.	City.
4 ft. 8 in.	2135.	2135.	2135.	Myles Tierney.
{ 4 ft. × 4 ft. 6 in. . . . }	4229.	4229.	4229.	City.
{ 5 ft. × 4 ft. 6 in. . . . }				
{ 2 ft. × 3 ft. }				
{ 15 in. pipe }				
3 ft. 2 in.	2717.	2717.	2717.	Stephen Connolly & Son and City.
3 ft. × 4 ft. 6 in.	3374.5	200.	3374.5	City.
{ 6 ft. }	3739.	3739.	3739.	Charles Linchan.
{ 4 ft. 9 in. × 5 ft. 6 in. }				
{ 4 ft. 6 in. × 3 ft. . . . }				
4 ft. 9 in. × 5 ft. 6 in. .	3352.	3352.	3352.	Hoblitzell, Condon, and Hoblitzell and City.
3 ft. × 5 ft.	2810.	2810.	2810.	City.
{ 4 ft. 9 in. }	620.	620.	620.	City.
{ 6 ft. }				
4 ft. 6 in.	734.	734.	734.	City.
2 ft. × 3 ft.	588.	588.	588.	City.
.	2245.	556.	2245.	City.
{ 10 ft. 6 in. }	640.	640.	640.	City.
{ 9 ft. }				
{ 5 ft. 6 in. }				
8 ft. × 16 ft.	2518.	2518.	2518.	City.
7 ft. 6 in.	7160.	7160.	7160.	R. A. Malone.
{ 11 ft. × 12 ft. }	7137.	7137.	7137.	W. C. Poland & Son and C. W. Parker & Co.
{ 6 ft. × 6 ft. }				
{ 8 ft. 6 in. × 8 ft. and 8 ft. 6 in. × 12 ft. }				
10 ft. 10 in. × 12 ft. . .				
.	92351.5	83101.	92351.5	

SECTION 6. WEST SIDE.

This section forms the upper portion of the west-side intercepting-sewer, and extends in Causeway street from Lowell street to Prince street, a distance of 1,796 lineal feet. Causeway street is, one of the most crowded thoroughfares of the city. It contains two lines of track for horse-railroad cars, and one for freight cars. On its north-westerly side are the depots of three railroads with no outlet for their passengers and freight except into this street. The tracks of another railroad cross the street. The territory traversed by the street is all made land, consisting of loose materials filled upon a mud bottom.

It was with considerable apprehension of trouble that work was begun on this section in the middle of last June. The most difficult feature of the work was the necessity of so conducting it that travel should not be seriously impeded. Owing to the skill and care of the Superintendent, Mr. Carson, and his subordinates, and to the appliances used for handling the earth and other materials, the whole sewer was built within four months, without closing any portion of the street to travel, and with the minimum of inconvenience to the public. At street crossings and entrances to railroad yards, work was carried on below timber platforms, or bridges, which replaced the street surface. The manner in which the work was conducted reflected great credit upon those in charge of it, and elicited eulogiums from the railroad officials and others most nearly affected by it. No complaints of injury to private interest were received, and unavoidable inconvenience was accepted with great good will. In crossing the Boston and Maine Railroad tracks the excavating machine, with its engine, was so elevated as to leave head room for the passage of trains.

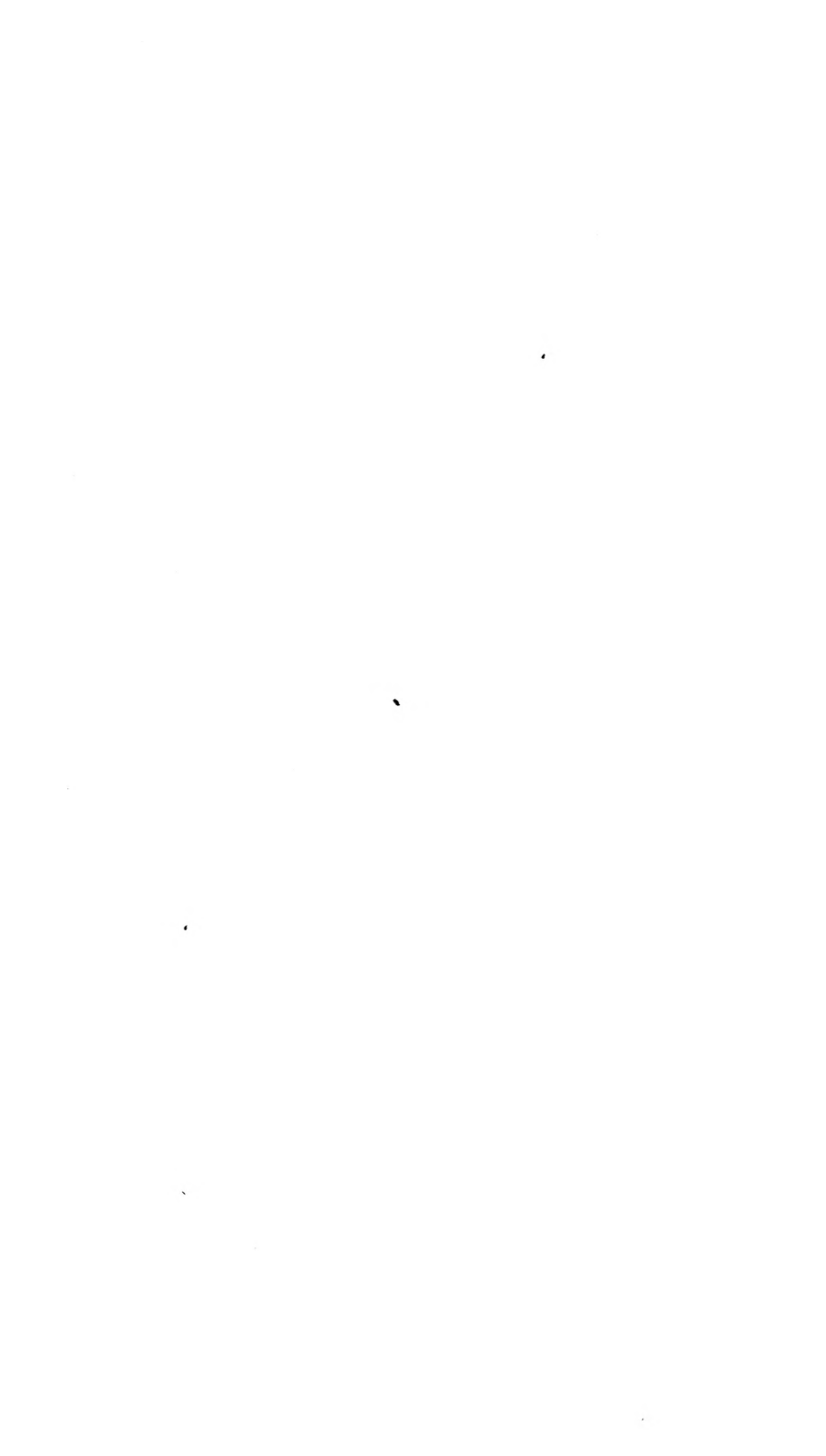
The sewer is oval, and was designed to be 4.5 feet high and 3 feet wide. As a precaution it was built 6 inches higher so that, should slight unequal settlements occur, the bottom may be brought to its true grade without lessening the desired size of sewer.

The sewer is built of brick, resting on a timber cradle. Its inclination is 1 foot in 2,000, and at its upper extremity its bottom is about 4 feet above low-water, which is the highest elevation of any portion of the intercepting-sewer system.

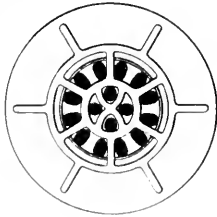
Many of the city sewers in Causeway street were too low to be intercepted. They were, accordingly, abandoned, and their house-drains were connected immediately to the intercepting-sewer. The sewers in cross streets were, with two exceptions, high enough to be intercepted. These exceptions were the Friend-street and the Canal-street sewers. The former was rebuilt at a higher elevation from Causeway street to Traverse street. Although but 510 feet long, it consisted of a rectangular wooden scow, 3.5 × 3 feet in dimensions, being much too large for the amount of sewage which it was intended to convey. It was reconstructed by placing a 12-inch vitrified pipe within it, near its top, and packing around and below the pipe with gravel.

The Canal-street sewer is a large rectangular wooden scow 4 × 4 feet in diameter. Its bottom is at about the elevation of mean low-water, and it is seldom free from considerable deposits of sludge. To have designed the new sewer system, with a view to intercepting this sewer, would have necessitated lowering the main and intercepting sewers, throughout their whole extent, about four feet, and would also have required that the whole body of sewage should be lifted four feet higher. As the additional expense so incurred, would have been many times that of rebuilding the city sewer, it was intended to leave it for the present, expecting that it would some day be rebuilt at a higher elevation and could then be intercepted.

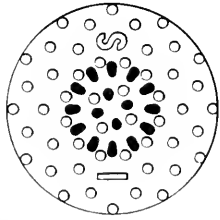
So much complaint, however, was received concerning the nuisance created by this sewer, at its outlet, that it was thought best, as a pallia-



MAN HOLE COVER

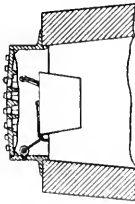


BOTTOM VIEW



TOP VIEW

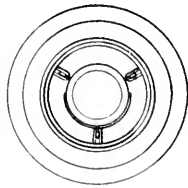
SECTION SHOWING PAIL



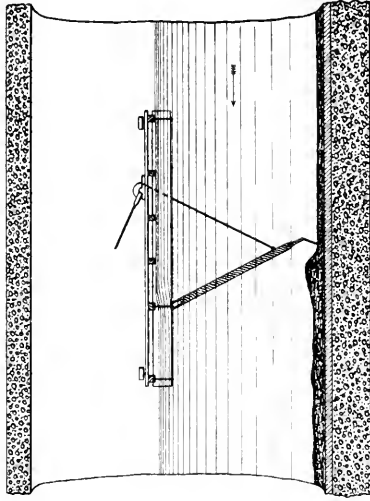
SECTION



PLAN

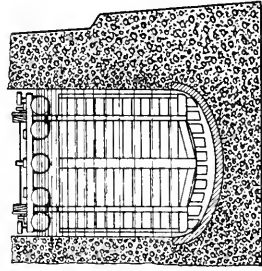


PERFORATED COVER AND CATCH PAIL FOR MAN HOLES ON MAIN AND INTERCEPTING SEWERS.



LONG. SECTION OF DEPOSIT SEWER, SHOWING SCRAPER.

CROSS SECTION OF DEPOSIT SEWER AND END VIEW OF SCRAPER.



FLOATING SCRAPER FOR SCRAPING AND FLUSHING SLUDGE FROM DEPOSIT SEWERS.

tive measure, to cut off the old outlet, and to connect the sewer, near its top, with the intercepting-sewer. This method, while it keeps out tide-water and permits a constant flow of sewage, does not prevent the accumulation of deposits, and renders its occasional removal more difficult. There seems to be no remedy for this state of affairs except to rebuild the sewer and some of its branches.

SECTION 2. SOUTH BOSTON.

This section extends, in Lowland street and Ninth street, from the Old Colony R.R. at Hyde street to H street, a distance of 3,374.5 lineal feet. Work began on it in November, 1883, and continued throughout the winter and to completion in August, 1884.

Between Old Harbor street, and G street, for a distance of about 800 feet the sewer crossed a beach which was several feet below the elevation of high tide. No coffer-dam or other protection was used in this place, but construction was carried on only when the tide was down. When the sea rose it overflowed and filled the trench. When the tide went down the water in the trench was let off to the pumps at the pumping-station, through the connecting intercepting sewer, and work was again resumed. The sewer was built by the city under Mr. H. A. Carson as Superintendent. It is of brick 3×4.5 feet in diameter. Its total cost was \$44,707.37.

MISCELLANEOUS CONSTRUCTION.

In addition to the foregoing certain minor items of sewer construction have been accomplished during the past year. The Nashua-street sewer, formerly discharging at Minot street, has been diverted and turned into the west side interceptor at Lowell street, by building 281 feet of sewer in Minot street. The Fruit-street sewer, which was too low to be intercepted, was rebuilt and raised for a distance of 489 feet, east of Charles street; 212 feet of the Livingstone-street sewer and 197 feet of the Endicott-street sewer were similarly rebuilt. So also was a sewer in Mt. Vernon street.

Repairs have been made to several city sewers into which tide water was found to leak freely. Among the sewers so repaired were those in Otis place, Chestnut street, Atlantic avenue, and Albany street.

During the past season the main and intercepting sewers have been ventilated at their man-holes by the method indicated on the accompanying plate. New ventilating covers were provided of the pattern shown. The perforations are quite large, so that they are not liable to become stopped up. As an additional precaution the holes taper considerably, being larger below than they are on top. To prevent road detritus and miscellaneous rubbish from falling into the sewers, catch pails are suspended below the covers to receive whatever may fall through the holes. The pails are of galvanized iron, well coated with tar; they can be lifted out, emptied and replaced, as occasion demands. These new covers and pails were put in the man-holes during the autumn, and no defect in this method of ventilation has yet been observed. The air in the sewers (never very offensive) has been improved without any complaint of offence from the man-holes, having been received. It is thought that if similar methods of ventilation should be adopted for the city sewers the amount of sand and dirt which now falls into them through their man-hole covers, and thus reaches the main drainage sewers, would be much lessened.

The new city sewer in Durginville, just east of the N. Y. and N. E. Railroad has been connected with the main sewer, and a chamber containing regulating apparatus to control the flow from the former sewer has been built.

PUMPING-STATION.

A considerable amount of work has been done at this point, during the past year. The permanent stone engine-house, built under the supervision of the City Architect has been completed, with the exception of a little finish, and the temporary wooden structure which has served to protect the engines has been taken down and removed. The lower galleries in the engine-house and the floor about the Worthington engines were paved with brick by this department. The floor of the boiler-house has also been paved, and a track laid in front of the boilers on which to run the coal-cars. The pockets or bins in the coal-house have been altered and strengthened, and scales for weighing the coal have been provided. A trestle supporting a coal run has been built which extends from the coal-house out to and upon the wharf. This trestle is 27 feet high and 301 feet long. It is 10 feet wide throughout most of its length and 20 feet wide at its extremity where the coal is unloaded from the vessels. The trestle was painted with two coats of metallic paint.

The roadway extending 4,000 feet across Calf Pasture marsh, from the Old Colony Railroad to the pumping-station, has been put in good condition and the spur track, which for some years has been located there, has been removed. The road was ballasted with twelve inches of road metal of material which had been excavated from the tunnel and was brought in scows from the middle shaft. The road was surfaced with gravel brought from Moon Island.

The dwelling and store-house, formerly occupied by the contractor for building the tunnel, has been altered and refitted and is now used as a dwelling and boarding-house by the superintendent and other employés at the engine-house. The large store-house near the wharf has been shingled and put in good condition for storing the engine to be set up at the east tunnel shaft.

The grounds and banks about the pumping-station have been graded and loamed. For this purpose 5,779 cubic yards of loam, excavated and stored while building the reservoir, were brought from Moon Island and 3,159 cubic yards were purchased from the Old Colony Railroad and delivered in cars by them. For surfacing roadways and walks about the pumping-station, 623 cubic yards of gravel were brought from Moon Island.

SECTION 1, OUTFALL.

This section, commonly called Old Harbor Pier, has been finished during the past season. The last man-holes on the deposit sewers have been built, and the banks covering the sewers have been graded, loamed and seeded. The ballasted slope on the south side of the embankment, which was in rough condition, has been neatly finished. An ornamental brick shaft-house, designed by the City Architect for the west shaft, has been built in place.

The deposit-sewers, have very thoroughly accomplished their function of arresting suspended matters and preventing them from reaching the tunnel. Many of the city sewers contained large deposits of sludge which were emptied into the intercepting-sewers as soon as connection was made between them. This sludge was carried by the intercepting and main sewers to the pumping-station, where it passed through the pumps and force mains and settled to the bottom of the deposit-sewers. Comparatively heavy matters, such as gravel and sand, settled almost at once at the west end of the sewers; road detritus was carried a little farther, and only a very light semi-fluid precipitate was found at the easterly or farther end of the sewers.

The easiest and least expensive way of cleaning out this deposit was long considered. Finally the following plan was adopted. A large

wooden tank was built near the end of the pier, just outside of its south slope, about 120 feet from the sewers. It is supported on piles, its floor being 3 feet above high-water and 1 foot below the bottom of the sewers. One end of the tank is connected with the deposit-sewers by two 6-inch iron pipes; the other end is connected with the chamber about the west tunnel shaft by a 12-inch pipe. By means of stop-planks the surface of water is made to stand a foot or two higher in the deposit sewers than it does in the shaft-chamber. Circulation is thus established from the deposit-sewers through the 6-inch pipes into the tank, and thence through the 12-inch pipe to the shaft, and a part of the sewage goes to the tunnel through this by-pass.

The 6-inch pipes leave the deposit sewers near their bottom, and the sewage which enters the pipes draws sludge along with it and again deposits it in the still water of the tank. The dimensions of the tank are: width, 10 feet; height, 15 feet; length, 50 feet. It will hold about 150 yards of sludge. It has, on its seaward side, three gates with cast-iron nozzles, 12 inches in diameter, projecting from them. When the tank is full of sludge a scow is laid alongside it and the nozzles are connected with the interior of the scow by canvas tubes. The gates are then opened and the sludge flows from the tank into the scow.

In order to draw down to the 6-inch pipes the sludge which has been deposited at the upper ends of the sewers scrapers are used. These consist of floating rafts, made of 12-inch hollow iron tubes, to the bottoms of which are hung wooden aprons a little less in width than the sewers. The aprons are weighted so that their lower edges, which are provided with broad iron teeth, sink somewhat into the sludge. The current in the sewers carries the whole apparatus down stream and the sludge is scraped and flushed before it.

SECTION 2, OUTFALL.

On this section, commonly called Dorchester Bay Tunnel, work during the past year was limited to some removal of machinery, structures and rubbish, from about the shaft. Rock formerly excavated from the tunnel and deposited about the middle shaft has been dug out or dredged and utilized as ballast on other portions of the work. The pump to be set up at the East shaft has been stored pending some arrangements in regard to the site it is to occupy.

As the tunnel has been full of sewage during the whole year it could not be entered for examination. To ascertain whether permanent deposits of sediment were accumulating in it some tests have been made. These tests were based upon the following laws:—

The flow through the tunnel is produced by the difference in water level at its two ends:

The amount of this difference is a measure of the resistance which the tunnel offers to the flow of sewage:

If the tunnel is partly obstructed by deposits, the resistance, and also the difference in water level at its two ends, will be greater than if it is clean.

The tests showed that some deposits accumulated in the tunnel during dry weather, when the volume of sewage pumped is slight and the flow through the tunnel is correspondingly sluggish. When, however, the velocity of flow is greatly increased, by running four pumps at the same time, these deposits are removed. The tests are not sufficiently exact to prove that the tunnel is absolutely clean after flushing, but they do show that the residuum left in it, if any, is insignificant in amount.

SECTION 3, OUTFALL, AND MOON ISLAND RESERVOIR.

During the past season the contractors for this section, Messrs. C. W. Parker & Co. have finished about all of the work required under their contract. This work has included completing the laying of cut-stone coping on the reservoir, grading embankments and roadways, loaming and seeding down slopes and other miscellaneous items.

In addition to what was done by the contractors a small force has been employed by the city for doing sundry items of work not covered by the contract. The most important of these are as follows: —

The wooden flume between Squantum and Moon Island has received a second coat of paint and has been tightened at all places where it leaked. All pile braces broken by the ice, last winter, have been replaced and the flume is now in very good condition.

A rotary force-pump was set up in the engine-house, early in the year, and was used for washing down the reservoir. Its suction-pipe extended to a well sunk in the beach near low-water mark, from which salt-water can be drawn at all stages of the tide. About 2,000 feet of 4 and 6 inch force-pipe have been laid to and within the reservoir basins, and 23 hydrants have been connected at convenient points.

This rotary pump has not proved satisfactory, and has been returned to the parties who furnished it, they agreeing to refund the money paid for it; a contract for a new pump has been made with the Deane Pump Co. For procuring a fresh-water supply, a ditch has been formed and sodded, surrounding the elevated portion of the island, to catch the rain-water flowing from it, and conduct it into the large cistern built last year. A smaller cistern has been built on the top of the hill, and connected with the engine-house by a 2-inch pipe.

It was found that after each semi-daily discharge from the reservoir, about 4 feet in depth of sewage was held back by the tide in the low discharge and outlet sewers. This sewage escaped slowly as the tide fell. The current being sluggish at low water, some of the sewage found its way to the beaches and flats in the immediate vicinity of the outlet, and suspended matter was deposited there. To obviate this evil two large wooden gates, each 9 × 12 feet, have lately been put in near the outlet, and hereafter, the discharge from the sewers will be stopped at the same time as that from the reservoir. The machinery and fittings for these gates were furnished by the Coffin Valve Co., for the sum of \$425. A wooden building has been erected over these gates, and a more permanent and substantial one would be desirable.

The original design of the works contemplated two 6 × 6 feet iron penstock gates at the end of the outfall-sewer which brings the sewage to the reservoir. As these would not be essential to the proper working of the sewer until the reservoir should be extended in size, a saving has been made by substituting for them two small wooden gates, which will suffice for all present needs.

Recording-gauges have been provided which register, continuously, the height of sewage in the upper and lower sewers. By these records it can be learned whether the night workmen have been vigilant and have strictly complied with their instructions in regard to opening and closing the different sewer-gates.

The force employed by the city has also done much miscellaneous work, such as removing old buildings, clearing grounds, grading, building roadways and fences, sodding, etc.

By the ordinary dry weather flow of sewage the reservoir is filled less than half full between the times of discharging it, and at all times, thus far, it has proved to have ample size. The temporary wooden flume was designed with reference to the nominal capacity of the pumps, which is so much exceeded in practice that, when all four pumps are running, a combination of conditions (including negligence on the part of the

employé's at Moon Island), is possible which might overload the flume and injure it. The probability of such an accident occurring can be avoided by putting in at the reservoir gate-house a gauge, recording the height of sewage at the connection chamber at Squantum, or by establishing telephonic connection between the pumping-station and Moon Island.

The discharge of the reservoir is begun from one to one and a half hours after high water, the exact time depending upon the height of the tide. The bulk of the sewage is discharged within about one-half hour, after which the basins are washed by the rapid discharge into them of large volumes of sewage previously stored in the upper sewer. This cleansing operation is assisted by laborers who stir up with scrapers any sludge which may have accumulated at the back of the reservoir. The sides of the reservoir are, from time to time, washed down with streams from the hydrants before referred to. Not much smell is noticed from the reservoir itself.

The sewage is discharged from the outlet with great velocity, which carries it out into favorable currents. Being lighter than the sea water, it remains at the surface, and after half an hour covers an area more than half a mile in diameter. The limits of this sewage are plainly marked both by its color and because the sewage contains enough grease to still its waves. Dilution takes place very rapidly, so that one hour after its discharge nearly every trace of the sewage has disappeared. At this time it is in the channels of the lower harbor where are swift currents, and it still has from three to four hours to go out with the tide.

D. — PARKS.

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

BACK BAY.

Gravel Filling. — There have been no written contracts made for filling during the past year, but a final settlement has been made for the work done under the contract of April 29, 1880. The amount paid was \$9,208.32. The total amount of filling paid for by the Park Department under this contract was 10,459 squares.

During the year a considerable amount of gravel has been required for grading around the Boylston Arch, and for forming the shores of the water-way. This gravel has been furnished by the Boston & Albany Railroad Company, as it has been needed, for \$3.50 per square. The amount used was 7,111 squares.

Grading and Loaming. — The transportation of loam from the water-works, Basin 4, at Ashland, was continued until September 22, and there have been delivered 77,659 cubic yards of loam and 12,093 cubic yards of muck. This latter has been composted with 468 cords of stable manure, in readiness for use on the grounds.

As early in the season as it was practicable the grading of the slopes and areas to be covered with loam was commenced, and this material was delivered by the cars as close to the prepared areas as it could be. The rehandling of a large amount of the loam was in this way avoided, and, by extending the railroad tracks entirely around the park on the boun-

dary roads, the loam not required for use during the past season has been piled at points convenient for future disposal.

The areas now graded and loamed for planting comprise 329,000 square feet, or 24% of the surface, which is to be treated in this manner; of this area 114,000 square feet have already been planted.

In connection with this work the Joint Standing Committee on Streets authorized the grading and loaming of the open areas on the Commonwealth avenue extension. The plans for this grading have been furnished by Mr. Olmsted, and the work has been completed in accordance with them.

The excavation of the marsh to the established grades has been continued, and 227,000 square feet, or 27% of the whole area, has been excavated and resodded at the new grades.

Excavation of Water-Way. — The dredging plant, consisting of the dredge, tug-boat, and five scows has been in continuous use during the season.

The excavation of the water-way and the formation of its gravel shores have been actively prosecuted, and 15,500 linear feet, or 58% of the whole length, are completed. The mud and other materials dredged from the water-ways have been used to fill the low areas to be flooded in times of freshets, and in other places where it could be used to advantage.

The area of the channel now excavated comprises 823,000 square feet, or 65% of the whole.

The total amount of material handled by this plant during the year was 70,891 cubic yards, of which 62,621 cubic yards were dredged from the water-way. The cost per cubic yard was 18 $\frac{9}{10}$ cents.

Boylston Bridge. — At the beginning of the year this structure was incomplete, so far as the wing and spandrel walls were concerned; but the arch was finished and the centring had been struck. A sufficient quantity of the red granite grout was obtained in the spring to build the unfinished portions of the walls; the stone-work and brick intrados have since been cleaned and pointed, and the entire structure, together with the connecting embankment and wing-walls, is now completed.

Granite Curb and Fence. — The curb around the triangular area at the junction of Commonwealth avenue and Jersey street has been set, and the area surrounded by it has been graded and covered with loam ready for planting. The railing around the planted areas on the Beacon Entrance has been painted.

Covered Channel, Stony Brook. — This work was completed in 1883, with the exception of some minor details pertaining to the gate-chamber. These details, such as windows, floor-gratings, etc., it is not desirable to complete until the work on Back Bay is further advanced, when the building can be better protected from malicious damage.

The gate-chamber and conduit have been in constant use since their completion in providing for the flow of Stony brook and regulating the height of water in the basin, and fulfil perfectly the objects of their construction.

Covered Channel, Muddy River. — A description of this channel is given in the report for 1883. The wooden conduit section was completed in the fall of 1883, and was immediately used to convey the flow of Muddy river to the Charles-river basin. It was continuously in use until the 13th of October, 1884, when the accident happened which has rendered its use since undesirable.

The conduit was in perfect condition until the latter part of July, when the Sewer Department commenced building a sewer in Brookline avenue, on its northerly side, and within a few feet of the side of the conduit.

The trench for this sewer was not braced in such a manner as to properly protect the conduit from injury, nor was the bracing left in, in most parts of it, and no care was taken in backfilling it: as a result of these operations, the entire length of the wooden conduit section of the Muddy-river channel in this avenue was injured by spreading, on account of the practical removal of its side support.

Although the attention of the Sewer Department was called to this matter, and a change was made by it in the manner of doing the work, the change was not sufficient to prevent the injury, although it served to modify it.

When this conduit was built it was expected that some change of form would take place if the grade of the avenue was ever raised, and its section was made such as to provide for it without serious injury; but it was not anticipated that the operations of another department would so injure the structure as to practically destroy its ability at certain points to resist the additional pressure of the filling.

The length of the injured section is about 2,345 feet, and of this about 300 feet have been repaired, and the remainder temporarily braced, at a cost of \$5,758. The cost of repairing the remainder will be about \$15,000, and an appropriation will have to be made for this purpose, and for completing the work on the gate-chamber, and for filling the right of way across the land of the Boston and Roxbury Mill Corporation.

The substructure of the gate-chamber was completed in October, and the connection conduit between the gate-chamber and the Back Bay water-way has also been completed as far as practicable.

The work of building the superstructure was commenced on October 24, and it is now substantially completed. This building was designed by City Architect Vinal, and is constructed of brick and sandstone.

BUSSEY PARK AND ARNOLD ARBORETUM.

The principal work done at this park during the past season has been in connection with the drive-way connecting Centre and South streets. After the grading and drainage were completed, and the road-bed was ready for ballasting, it was found that there was not stone enough on the ground or in the old walls to complete the work. By permission of the Harvard College authorities an old quarry on the Bussey farm, outside the limits of the park, but conveniently near to it, was reopened, and from it a sufficient quantity of stone has been obtained to complete the drive-way and adjacent walks.

The length of the drive-way which has been completed is 2,690 feet, and of the walks, 4,970 feet.

The equipment for road-building consists of a steam-engine and stone-crusher, two grooved rollers, a water-cart, etc.; and, unless more work is to be done the next season than has been laid out for the past, it will not be necessary to increase it.

During the winter a small force is kept to work in the quarry, and the walls and gate-posts at the Centre and South street ends of the completed drive-way are being built.

WEST ROXBURY PARK.

The topographical survey of this park has been completed and a plan made. The work has been very thoroughly done, and has taken more time than was anticipated; but the advantage of having an accurate and reliable plan will fully compensate for the time and money expended in making it.

In addition to making the topographical survey and plan, surveys and plans have been made of a number of estates, and permanent boundary posts and lots have been located and set wherever the property lines were not well defined by other landmarks.

A small force of laborers has been employed in doing the grading for the new shelter buildings, preparing ground for a nursery, and cutting down fruit and other objectionable trees.

Shelter buildings have been erected at different points in the park. One is located on Scarborough Hill, one on the high ground near the junction of Glen road with Blue Hill avenue, and another near the junction of Glen road with Walnut avenue. The buildings are each 40 ft. × 20 ft. and were built by day's labor from a design furnished by Mr. H. H. Richardson.

A propagating-house, 36 ft. × 54 ft., has been built on the Thomas estate, in close proximity to the mansion-house, which is now occupied in part as the office of the Landscape Architect Advisory, Mr. F. L. Olmsted, and his assistants, and in part as a residence by his principal assistant, Mr. Fischer. An area of about one acre adjoining the propagating-house has been prepared for a nursery.

MARINE PARK, SOUTH BOSTON.

The building on the Smith estate, formerly occupied as a studio, has been removed from its position at the water edge to a location on P street, between Broadway and Fourth street, and has been practically rebuilt, so as to provide a waiting-room and shelter for ladies and children.

The unsightly places caused by the removal of buildings have been filled and graded, so that the grounds are now safe as well as sightly. The low, sandy portion of the grounds between Fifth and Sixth streets, and extending to the beach, has been covered with clayey material; and in the spring, by rolling, will be smooth and easy to walk and play upon.

In all 1,966 $\frac{4}{10}$ squares of clayey material and gravel have been deposited upon this park, at a cost of \$3.50 per square, cart measurement.

A temporary fence has been erected on the proposed street line of the park, and the old plank benches have been distributed throughout it for the convenience of visitors.

WOOD-ISLAND PARK, EAST BOSTON.

A contract was made September 20, 1884, with Mr. John F. Barry, to fill the drive-way from Bennington street to the Revere Beach Railroad. Mr. Barry commenced work on September 24, and has delivered and deposited in place 5,819 squares of filling between that time and January 1, at his contract price of \$3.35 per square, bank measurement.

The drive-way is 100 feet in width, and has been filled in such a manner as generally to retain the slopes upon the land of the city. A wooden sluice-way was built through the drive-way, to prevent damage, or a nuisance which might be caused by damming the tidal estuary crossed by the drive-way.

Plans are now being prepared for bridging the Revere Beach Railroad, and estimates of cost can be submitted when required by your Board.

CHARLES-RIVER EMBANKMENT.

In June an application was made to the State Board of Harbor and Land Commissioners for a license for the construction of the sea-wall, and for doing the other work required in connection with this improvement.

Some questions arose in relation to the compensation for land and for displacement of tide-water, and also in regard to the end connec-

tions of the sea-wall, which were not finally settled until December. Although late in the season it was deemed advisable to advertise the work for proposals, to be received on December 16. At that date seven proposals were received, ranging from \$153,635, the lowest, to \$265,700, the highest.

A contract was made with the lowest bidders, Messrs. Parker & Sylvester; and, although it was not anticipated that they would commence the work before spring, they now propose to begin in a very short time, if the weather will permit.

The work consists of building a sea-wall from the southerly side of Canal bridge to the northerly side of West Boston bridge, on the lines defined in chapter 92 of the Acts of the Legislature of 1884, of building boat-landings or piers at the two angles of the wall between the bridges, of filling the areas enclosed by this wall, and of removing to or below low-water mark the existing walls and filling where they project beyond the lines of the new wall.

The wall is to be built of granite masonry laid in mortar. The foundation is to be generally a wooden platform; but, where the surface of the ledge-rock is too high to allow a pile foundation, split stone, or other suitable masonry foundation, is to be substituted.

Compensation for tide-water displacement is to be made by dredging the filling required from the Charles-river basin at places acceptable to the Board of Harbor and Land Commissioners, it being understood that the Board will designate areas from which gravel can be obtained.

The table giving the number of vessels passing through the drawbridges controlled by the City of Boston, during the year 1884 will be found in Appendix A.

The table giving the number of vessels passing through the drawbridges controlled by the City of Boston during the years 1881, 1882, 1883, and 1884, will be found in Appendix B.

The table showing the widths of draw-openings in the bridges over tide-water in this city is given in Appendix C. The openings have all been remeasured 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 1884.

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.....	25	11	36	2,747	1,158	3,905	1,497	208	1,705	216	29	245	4,485	1,406	5,891	4,479
Cambridge-street.....	.....	.....	.....	348	46	394	731	147	878	273	178	451	1,352	371	1,723	853
Charles-river.....	38	19	57	3,363	1,488	4,851	1,779	286	2,065	419	87	506	5,599	1,880	7,479	6,141
Chelsea (North)....	126	48	174	775	91	866	1,442	278	1,720	281	152	433	2,624	569	3,193	2,153
Chelsea (South)....	12	6	18	1,104	121	1,225	2,192	417	2,609	796	216	1,012	4,104	760	4,864	3,346
Chelsea-street.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	6	.....	6	6	.....	6	4
Commercial-Point....	.....	.....	.....	.....	.....	.....	.....	.....	.....	11	.....	11	11	.....	11	11
Congress-street.....	254	104	358	4,474	1,534	6,008	5,762	1,360	7,122	1,533	727	2,260	12,023	3,725	15,748	10,817
Dover-street.....	24	13	37	2,173	840	3,013	1,359	203	1,562	283	31	314	3,839	1,087	4,926	3,787

APPENDIX B.

DRAW-TENDERS' REPORTS.

Giving the Number of Vessels passing through the Drawbridges controlled by the City of Boston, during the Years 1881, 1882, 1883, and 1884.

Name of Bridge.	STEAMERS.				SAILING VESSELS.				TUGS.				ALL OTHERS.				TOTAL NO. OF VESSELS.			
	1881.	1882.	1883.	1884.	1881.	1882.	1883.	1884.	1881.	1882.	1883.	1884.	1881.	1882.	1883.	1884.	1881.	1882.	1883.	1884.
Broadway	20	34	34	36	4,201	3,772	3,530	3,905	2,040	2,041	1,843	1,705	180	277	136	245	6,441	6,124	5,543	5,891
Cambridge-street	6	..	..	..	411	372	398	394	691	577	1,187	878	70	33	1,025	451	1,178	982	2,610	1,723
Charles-river	46	84	60	57	5,868	5,386	5,089	4,851	2,681	2,587	2,446	2,065	741	712	537	506	9,336	8,769	8,132	7,479
Chelsea (North)	63	125	95	174	910	909	848	866	1,447	1,595	1,784	1,720	446	385	562	433	2,866	3,014	3,289	3,193
Chelsea (South)	2	7	17	18	1,380	1,188	1,122	1,225	1,912	2,018	2,192	2,609	365	440	502	1,012	3,659	3,653	3,833	4,864
Chelsea-street . . . . .	..	..	..	..	..	..	..	..	..	..	3	..	..	..	..	6	..	..	..	6
Commercial-Point . . . . .	..	..	..	..	..	..	..	..	..	..	..	..	9	5	6	11	9	5	6	11
Congress-street	216	254	329	358	7,818	6,667	6,024	6,008	7,778	8,769	8,625	7,122	1,643	2,187	4,021	2,260	17,455	17,877	18,999	15,748
Dover-street	26	36	32	37	3,447	3,103	2,695	3,013	1,871	1,907	1,658	1,562	229	221	233	314	5,573	5,267	4,618	4,926
Essex-street	99	1	1	..	443	421	441	437	718	570	1,237	904	42	33	932	427	1,302	1,025	2,611	1,768

APPENDIX.

Federal-street	20	34	34	36	4,204	3,735	3,588	3,934	2,203	2,270	2,126	1,931	400	490	256	319	6,827	29	6,004	6,220
Granite . . . . .	. . . . .	. . . . .	. . . . .	. . . . .	104	98	69	94	132	95	120	132	. . . . .	. . . . .	. . . . .	. . . . .	236	193	189	226
Malden	28	16	. . . . .	. . . . .	393	356	308	424	735	781	894	853	135	120	445	238	1,291	1,273	1,647	1,515
Meridian-street	88	116	29	27	928	1,038	886	1,054	2,123	2,330	1,869	2,225	767	845	904	803	3,906	4,329	3,688	4,109
Mt. Washington ave.	26	51	76	65	5,375	4,816	4,533	4,693	4,879	5,197	5,196	4,603	1,050	1,313	1,939	1,845	11,330	11,377	11,744	11,206
Neponset . . . . .	. . . . .	. . . . .	. . . . .	. . . . .	135	137	130	156	92	118	126	134	. . . . .	2	10	. . . . .	227	257	263	290
No. Beacon-street . . . . .	. . . . .	. . . . .	. . . . .	. . . . .	. . . . .	. . . . .	. . . . .	. . . . .	. . . . .	. . . . .	. . . . .	. . . . .	1	. . . . .	4	. . . . .	1	. . . . .	4	. . . . .
No. Harvard-street . . . . .	. . . . .	. . . . .	. . . . .	. . . . .	136	125	106	119	241	226	937	452	21	26	823	440	401	377	1,866	1,011
Warren	39	82	61	54	4,877	4,395	4,186	4,095	1,685	1,493	1,204	1,144	603	550	322	354	7,204	6,520	5,773	5,647
West. ave. to Cambridge	2	. . . . .	. . . . .	. . . . .	384	341	348	355	654	539	1,136	821	70	32	1,024	467	1,110	912	2,508	1,643
West. ave. to Watertown	2	4	. . . . .	2	48	64	29	61	37	21	35	36	18	27	22	9	105	116	86	108
Canal	4	58	34	34	3,043	2,495	2,550	2,506	423	336	352	334	162	372	313	455	3,673	3,261	3,249	3,329
Prison-Point	4	23	21	26	346	377	278	244	48	71	68	80	47	107	108	75	445	578	475	425
West Boston	38	54	42	28	1,136	877	1,073	986	1,341	960	1,434	1,359	181	253	313	165	2,696	2,144	2,862	2,538
Totals	770	979	865	952	45,587	40,672	38,231	39,420	33,734	34,501	36,472	32,669	7,180	8,430	14,443	10,835	78,271	84,582	90,011	83,876

APPENDIX C.

Table showing the Widths of Openings for Vessels in all Bridges provided with Draws, in the City of Boston, January, 1885.

NAME OF BRIDGE.	LOCATION.	NUMBER OF OPENINGS.	WIDTH.	
			Feet.	In
Boston & Maine, R.R.	Boston to Charlestown .	1	35	6
“	Over Miller's River .	1	35	7
Broadway .	Over Fort Point Channel .	1	43	3
Cambridge-st.	Ward 25 to Cambridge .	1	30	4
Canal .	Boston to East Cambridge .	1	35	10
Charles-river .	Boston to Charlestown .	1	36	0
Chelsea (South Channel)	Charlestown to Chelsea .	1	38	8
“ (North “)	“ “ .	1	44	0
Chelsea-st. (East Boston side)	East Boston to Chelsea .	2	33	0
“ (Chelsea side)	“ “ .	1	34	3
Commercial-Point	Ward 24 .	1	24	0
Congress-st. (Boston side)	Over Fort Point Channel .	2	43	4
“ (South Boston side)	“ “ .	1	43	8
Dover-st.	“ “ .	1	36	0
Eastern R.R.	Boston to Charlestown .	1	35	9
“	Over Miller's River .	1	35	6
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	4
Grand Junction R.R.	.	.	.	.	.	.	Ward 25 to Cambridge	1	32	0
"	.	.	.	.	.	.	East Boston to Chelsea	1	34	6
Granite	.	.	.	.	.	.	Ward 24 to Milton	1	30	11
Lowell R.R. (freight)	.	.	.	.	.	.	Boston to East Cambridge	1	35	8
" (passenger)	.	.	.	.	.	.	"	1	36	0
Malden	.	.	.	.	.	.	Charlestown to Everett	1	43	4
Meridian-st. (East Boston side)	.	.	.	.	.	.	East Boston to Chelsea	2	59	0
" (Chelsea side)	.	.	.	.	.	.	"	2	59	0
Mt. Washington ave. (Boston side)	.	.	.	.	.	.	Over Fort Point Channel	2	42	2
" (So. Boston side)	.	.	.	.	.	.	"	2	42	3
Neponset	.	.	.	.	.	.	Ward 24 to Quincy	1	31	1
New York & New England R.R. (Boston side)	.	.	.	.	.	.	Over Fort Point Channel	2	40	7
"	"	"	"	(So. Boston side)	.	.	"	2	40	7
"	"	"	"	Channel closed	.	.	Over South Bay	1	30	0
North Beacon-st.	.	.	.	.	.	.	Ward 25 to Watertown	1	30	4
North Harvard-st.	.	.	.	.	.	.	Ward 25 to Cambridge	1	31	10
Old Colony R.R.	.	.	.	.	.	.	Over Fort Point Channel	1	36	0
"	.	.	.	.	.	.	Ward 24 to Quincy	1	35	11
Prison-Point	.	.	.	.	.	.	Charlestown to Cambridge	1	35	7
Warren	.	.	.	.	.	.	Boston to Charlestown	1	36	4
West Boston (Boston side)	.	.	.	.	.	.	Boston to Cambridge	2	35	8
" (Cambridge side)	"	2	36	0
Western ave.	Ward 25 to Cambridge	1	31	3
"	Ward 25 to Watertown	1	30	0

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