1908-19

ENGINEERING DEPARTMENT

FORTY-SECOND ANNUAL REPORT

OF THE

CITY ENGINEER

BOSTON

FOR THE YEAR 1908

CITY OF BOSTON
PRINTING DEPARTMENT
1909

ENGINEERING DEPARTMENT

FORTY-SECOND ANNUAL REPORT

OF THE

CITY ENGINEER

BOSTON

Compliments of

William Jackson,

City Engineer.

CITY OF BOSTON
PRINTING DEPARTMENT
1909

ANNUAL REPORT

OF THE

ENGINEERING DEPARTMENT

FOR THE YEAR 1908-1909.

ENGINEERING DEPARTMENT, CITY HALL,
BOSTON, February 1, 1909.

HON. GEORGE A. HIBBARD,
Mayor of the City of Boston:

SIR,— The following report of the expenses and operation of this department for the year ending January 31, 1909, is submitted.

The duties of the City Engineer include the designing and superintending of the construction of new bridges, retaining walls, city wharves and such other public engineering works as the City Council may authorize; the making of such survey plans, estimates, statements and descriptions and taking such levels as the city government or any of its departments or committees may require; the custody of all surveys and plans relating to the laying out, locating anew, altering, widening or discontinuing of streets, and the new engineering construction for all departments of the city. He shall be consulted on all work where the advice of a civil engineer would be of service. The office of the City Engineer was established by ordinance on October 31, 1850, and by chapter 449 of the Acts of 1895.

The following is a statement of engineering expenses from February 1, 1908, to January 31, 1909:

Amount of department appropriation for 1908–1909	$80,000 00
Revenue	98 07
Total	$80,098 07
Amount expended for 1908–1909	78,081 56
Unexpended balance	$2,016 51

STATEMENT OF EXPENDITURES, DEPARTMENT APPROPRIATION.

(As per Auditor's Report, page 59.)

Salaries:		
Engineer, William Jackson (paid as Acting Superintendent of Street Department, April 6 to 13, 1908, inclusive)	$5,866 67	
Assistant engineer, draughtsmen and assistants	66,326 14	
		$72,192 81
Traveling expenses		1,232 87
Automobile repairs, supplies and storage		847 38
Instruments, tools and repairs		797 98
Horse-keeping		701 50
Telephone service		540 87
Blueprinting and photographing		455 85
Stationery		416 50
Printing		272 05
Binding and plans		226 40
Books and papers		161 56
Washing and small supplies		159 74
Typewriting		37 34
Furniture and office expenses		20 81
Messenger service		17 90
		$78,081 56

ABOLISHMENT OF GRADE CROSSINGS.

Congress Street.

Expenditures from February 1, 1908, to January 31, 1909:

Items of expenditure:	
Auditing	$13 38
Expended previous to 1908	1,672,011 36
	$1,672,024 74

Dorchester Avenue.

Expenditures from February 1, 1908, to January 31, 1909:
Items of expenditure:

Land-taking		$1,620 01
Expended previous to 1908		1,054,487 26
		$1,056,107 27

Dudley Street.

Expenditures from February 1, 1908, to January 31, 1909:
Items of expenditure:

Land damages	$5,325 73	
Relocating water pipes	5,158 42	
Expert services	100 00	
Auditing	65 00	
		$10,649 15
Expended previous to 1908		183,853 95
		$194,503 10

East Boston.

Expenditures from February 1, 1908, to January 31, 1909:
Items of expenditure:

Paving, fences, etc.	$5,354 43	
Land damages	3,028 95	
Engineering	1,306 04	
Apprizal services	1,445 00	
Inspection	595 00	
Relocating water pipes	325 28	
Advertising	12 40	
		$12,067 10
Expended previous to 1908		363,158 02
		$375,225 12

Freeport, Walnut and Other Streets.

Expenditures from February 1, 1908, to January 31, 1909:
Items of expenditure:

Land damages	$29,950 00	
Apprizal services	5,855 00	
Photographs	50 50	
		$35,855 50

ATLANTIC AVENUE BRIDGE.

Expenditures from February 1, 1908, to January 31, 1909:
Items of expenditure:

Draw machinery	$853 69	
Drawtenders' house	401 52	
Legal expenses	393 75	
		$1,648 96
Expended previous to 1908		537,615 96
		$539,264 92

BOYLSTON STREET BRIDGE.

Appropriation		$60,000 00
Expenditures from February 1, 1908, to January 31, 1909:		
Items of expenditure:		
Rebuilding bridge	$54,872 45	
Engineering	3,303 28	
Alteration of parapet	720 00	
Paving, etc.	652 53	
New parapet stones	304 17	
Printing	63 04	
Inspection	57 50	
Advertising	27 03	
		$60,000 00

CHELSEA STREET BRIDGE.

Appropriation		$75,000 00
Expenditures from February 1, 1908, to January 31, 1909:		
Items of expenditure:		
Draw pier and footbridge	$8,636 18	
Removing old draw	1,185 00	
Engineering	204 50	
Inspection	168 00	
Advertising	55 60	
Printing	41 44	
Photographs	4 50	
		10,295 22
Unexpended balance February 1, 1909		$64,704 78

CONGRESS STREET BRIDGE.

Appropriation		$35,000 00
Expenditures from February 1, 1908, to January 31, 1909:		
Items of expenditure:		
Rebuilding bridge	$6,413 32	
Draw machinery	2,975 00	
Engineering	410 00	
Inspection	280 00	
Printing	58 57	
Advertising	53 42	
Photographs	18 00	
		10,208 31
Unexpended balance February 1, 1909		$24,791 69

HUNTINGTON AVENUE BRIDGE.

Appropriation		$55,000 00
Expenditures from February 1, 1908, to January 31, 1909:		
Items of expenditure:		
Engineering	$394 84	
Advertising	16 90	
Photographs	6 00	
		417 74
Unexpended balance February 1, 1909		$54,582 26

NORTHERN AVENUE AND SLEEPER STREET.

Expenditures from February 1, 1908, to January 31, 1909:		
Items of expenditure:		
Draw span and spans 1, 2, 3	$68,861 81	
Draw machinery	35,421 61	
Sea wall at docks 2 and 3	32,478 07	
Flooring draw span and spans 1, 2, 3,	19,700 36	
Paving, fences, etc.	14,887 51	
Engineering	8,471 04	
Power plant and drawtenders' house	4,745 40	
Draw foundation and South Boston abutment	4,248 00	
Sea wall at dock 1	3,506 28	
Inspection	3,230 60	
Rent of office	376 70	
Light and power	335 27	
Advertising	235 99	
Land-taking	226 28	
Printing	197 96	
Telephone	38 20	
		$196,961 08
Expended previous to 1908		565,218 61
		$762,179 69

MASSACHUSETTS AVENUE BRIDGE.

Appropriation		$40,000 00
Expenditures from February 1, 1908, to January 31, 1909:		
Items of expenditure:		
Rebuilding bridge	$19,079 24	
Engineering	1,244 48	
Printing	62 90	
Inspection	56 00	
Advertising	50 08	
		20,492 70
Unexpended balance February 1, 1909		$19,507 30

BRIDGES.

The annual inspection of all highway and foot bridges has been made, together with special examinations when notified by the Deputy Superintendent of Bridges of the progress of repairs.

The management of all the bridges and draws between Cambridge and Boston, by the Acts of 1898, chapter 467, is vested in a board of two commissioners, which has charge of the following seven bridges, viz.: Brookline Street, Cambridge, Cambridge Street, Harvard, North Harvard Street, Prison Point, and Western Avenue to Cambridge; one-half the cost of the maintenance of these bridges is paid by each of these cities.

Four bridges have been removed during the year: Elmwood Street Bridge, Keyes Street Bridge, Linden Park Street Bridge, all over Stony brook, and Southampton Street, west of Midland Division, N. Y., N. H. & H. R. R.

In the list of bridges those marked with a star (*) are over navigable waters, and are each provided with a draw, the openings of which are shown in a table in Appendix A.

I.— BRIDGES WHOLLY SUPPORTED BY BOSTON.

Agassiz road, in the Fens.
Allston Bridge, over Boston & Albany R. R., Brighton.
Arborway Bridge, in Arborway, over Stony brook.
Ashland street, over Providence Division, N. Y., N. H. & H. R. R., West Roxbury.
Athens street, over Midland Division, N. Y., N. H. & H. R. R.
* Atlantic avenue, over Fort Point channel.
Audubon road, over Boston & Albany R. R.
Baker street, at Brook Farm, West Roxbury.
Beacon street, over outlet to the Fens.
Beacon street, over Boston & Albany R. R.
Bennington street, over Boston, Revere Beach & Lynn R. R., East Boston.
Berkeley street, over Boston & Albany R. R.
Bernier Street Footbridge, in the Riverway.
Berwick Park Footbridge, over Providence Division, N. Y., N. H. & H. R. R.
Blakemore street, over Providence Division, N. Y., N. H. & H. R. R., West Roxbury.
Bolton street, over Midland Division, N. Y., N. H. & H. R. R.
Boylston street, in the Fens.
Boylston street, over Boston & Albany R. R.
Bridle path, over Muddy river, in the Riverway.

* Broadway, over Fort Point channel.
Broadway, over Boston & Albany R. R.
Brookline avenue, over Boston & Albany R. R.
Brooks street, over Brooks street, Brighton.
Byron street, over Boston, Revere Beach & Lynn R. R.
* Castle Island Footbridge, from Marine Park, South Boston, to Castle Island.
Charlesgate, over Boston & Albany R. R., in the Fens.
Charlesgate, over Ipswich street, in the Fens.
* Charlestown Bridge, from Boston to Charlestown.
* Chelsea Bridge, South, over South channel, Mystic river.
* Chelsea street, from East Boston to Chelsea.
Circuit drive, over Scarboro' pond, in Franklin Park.
Columbia road, over Old Colony Division, N. Y., N. H. & H. R. R.
Columbia road, over Shoreham street.
Columbus avenue, over Boston & Albany R. R.
* Commercial point, or Tenean, Dorchester.
Commonwealth avenue, in the Fens.
* Congress street, over Fort Point channel.
Cottage Farm Bridge, over Boston & Albany R. R., Brighton.
Cottage Street Footbridge, over flats, East Boston.
Dartmouth street, over Boston & Albany R. R. and Providence Division, N. Y., N. H. & H. R. R.
* Dorchester avenue, over Fort Point channel.
* Dover street, over Fort Point channel.
Ellicott arch, in Franklin Park.
Fen Bridge, in the Fens.
Ferdinand street, over Boston & Albany R. R.
Florence street, over Stony brook.
Forest Hills entrance, in Franklin Park.
Gainsborough Street Footbridge, over Providence Division, N. Y., N. H. & H. R. R.
Gold street, over Midland Division, N. Y., N. H. & H. R. R.
Huntington avenue, over Boston & Albany R. R.
Hyde Park avenue, over Stony brook.
Ipswich street, over waterway, in the Fens.
Irvington Street Footbridge, over Providence Division, N. Y., N. H. & H. R. R.
* L street, over Reserved channel, South Boston.
Leverett Pond Footbridge, in Leverett Park.
* Malden Bridge, from Charlestown to Everett.
Massachusetts avenue, over Boston & Albany R. R.
Massachusetts avenue, over Providence Division, N. Y., N. H. & H. R. R.
* Meridian street, from East Boston to Chelsea.

* Mount Washington avenue, over Fort Point channel.
Neptune road, over Boston, Revere Beach & Lynn R. R.
Newton street, over Providence Division, N. Y., N. H. & H. R. R.
Northern avenue, over Fort Point channel.
Public Garden Footbridge.
Scarboro' Pond Footbridge, in Franklin Park.
Shawmut avenue, over Boston & Albany R. R. and Providence Division, N. Y., N. H. & H. R. R.
Southampton street, east of Midland Division, N. Y., N. H. & H. R. R.
Summer street, over A street, South Boston.
Summer street, over B street, South Boston.
Summer street, over C street, South Boston.
* Summer street, over Fort Point channel.
* Warren Bridge, Boston to Charlestown.
West Rutland Square Footbridge, over Providence Division, N. Y., N. H. & H. R. R.
Winthrop Bridge, from Breed's Island to Winthrop.
Wood Island Park Footbridge, over Boston, Revere Beach & Lynn R. R.

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

Bellevue street, over Muddy river, in the Riverway.
Bernier Street Footbridge, over Muddy river, in the Riverway.
Brookline avenue, over Muddy river, in the Riverway.
Central avenue, from Dorchester to Milton.
* Chelsea Bridge, North, over North channel, Mystic river.
* Granite Bridge, from Dorchester to Milton.
Huntington avenue, over Muddy river, in the Riverway.
Longwood avenue, over Muddy river, in the Riverway, and over Boston & Albany R. R.
Milton Bridge, from Dorchester to Milton.
* Neponset Bridge, from Dorchester to Quincy.
* North Beacon street, from Brighton to Watertown.
Spring street, from West Roxbury to Dedham.
* Western avenue, from Brighton to Watertown.

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

Albany street, over Boston & Albany R. R. freight tracks.
Ashmont street and Dorchester avenue, over Old Colony Division, N. Y., N. H. & H. R. R.
Austin street, over Boston & Maine R. R., Charlestown.

Bennington street, over Boston & Albany R. R., East Boston.
Blue Hill avenue, over Midland Division, N. Y., N. H. & H. R. R., Mattapan.
Boston street, over Old Colony Division, N. Y., N. H. & H. R. R.
Brookline street, from Brighton to Cambridge.
Brookline street, over Boston & Albany R. R.
Cambridge Bridge, from Boston to Cambridge.
* Cambridge street, from Brighton to Cambridge.
Cambridge street, over Boston & Maine and Boston & Albany Railroads.
Chelsea Bridge, over Boston & Maine R. R., Charlestown.
Curtis street, over Boston & Albany R. R., East Boston.
Dorchester avenue, over Old Colony Division, N. Y., N. H. & H. R. R.
Everett street, over Boston & Albany R. R., Brighton.
* Harvard Bridge, from Boston to Cambridge.
Harvard street, over Midland Division, N. Y., N. H. & H. R. R., Dorchester.
Maverick street, over Boston & Albany R. R., East Boston.
Norfolk street, over Midland Division, N. Y., N. H. & H. R. R., near Dorchester station.
Norfolk street, over Midland Division, N. Y., N. H. & H. R. R., near Mattapan station.
* North Harvard street, from Brighton to Cambridge.
Oakland street, over Midland Division, N. Y., N. H. & H. R. R., Mattapan.
Perkins street, over Boston & Maine and Boston & Albany Railroads, Charlestown.
Porter street, over Boston & Albany R. R., East Boston.
Prescott street, over Boston & Albany R. R., East Boston.
* Prison Point Bridge, Charlestown to Cambridge.
Saratoga street, over Boston & Albany R. R., East Boston.
Southampton street, over Old Colony Division, N. Y., N. H. & H. R. R.
Summer street, over freight tracks, N. Y., N. H. & H. R. R.
Sumner street, over Boston & Albany R. R., East Boston.
Webster Street Footbridge, over Boston & Albany R. R., East Boston.
West Fourth street, over Old Colony Division, N. Y., N. H. & H. R. R., South Boston.
* Western avenue, from Brighton to Cambridge.

IV.— BRIDGES SUPPORTED BY RAILROAD CORPORATIONS.

1st.— Boston & Albany R. R.

Albany street, over passenger tracks.
Harrison avenue.
Market street, Brighton.
Tremont street.
Washington street.

2d.— Boston & Maine and Boston & Albany Railroads.

Main street, Charlestown.
Mystic avenue, Charlestown.

3d.— Boston & Maine R. R., Eastern Division.

Wauwatosa avenue, East Boston.

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

Everett street, East Boston.

5th.— New York, New Haven & Hartford R. R., Midland Division.

Broadway.
Dorchester avenue.
Fifth street.
Fourth street.
Morton street, Dorchester.
Second street.
Silver street.
Sixth street.
Third street.
Washington street, Dorchester.

6th.— New York, New Haven & Hartford R. R., Old Colony Division.

Adams street.
Cedar Grove Cemetery.
Freeport street.
Medway street.
Savin Hill avenue.

7th.— New York, New Haven & Hartford R. R., Providence Division.

Albany street.
Baker street, West Roxbury.
Beech street, West Roxbury.

Bellevue street, West Roxbury.
Berkeley street.
Broadway.
Canterbury street, West Roxbury.
Castle square.
Centre and Mt. Vernon streets, West Roxbury.
Columbus avenue.
Dartmouth street.
Dudley avenue, West Roxbury.
Gardner street, West Roxbury.
Harrison avenue.
Park street, West Roxbury.
Washington street.

V.— Bridge Supported by the Metropolitan Park Commission.

Mattapan Bridge, Dorchester to Milton.

VI.— Bridge Supported by the Charles River Basin Commission.

* Craigie temporary bridge.

Recapitulation of Bridges.

I.	Number wholly supported by Boston	75
II.	Number of which Boston supports that part within its limits	13
III.	Number of which Boston pays a part of the cost of maintenance	33
IV.	Number supported by railroad corporations:	
	1. Boston & Albany R. R.	5
	2. Boston & Maine and Boston & Albany R. R.,	2
	3. Boston & Maine R. R., Eastern Div.	1
	4. Boston, Revere Beach & Lynn R. R.	1
	5. N. Y., N. H. & H. R. R., Midland Div.	10
	6. N. Y., N. H. & H. R. R., Old Colony Div.	5
	7. N. Y., N. H. & H. R. R., Providence Div.	16
V.	Number supported by the Metropolitan Park Commission	1
VI.	Number supported by Charles River Basin Commission	1
	Total	163

Agassiz Road Bridge (in the Fens).

This bridge was built in 1887 of brick and stone masonry. It is maintained by the Park Department and is in good condition.

Albany Street Bridge (over the Boston & Albany R. R. Freight Tracks).

The original structure was built in 1856–57, and rebuilt in 1867–68. The present bridge was built in 1886–87, and is maintained in part by the City of Boston and in part by the Boston & Albany R. R. An entire new floor system should be built for this bridge during the coming season. The floor beams and their connections with the trusses are in very bad condition and it is probable that some of the lower chord bars and diagonals are somewhat reduced in section.

Allston Bridge (over the Boston & Albany R. R., Brighton).

This is an iron bridge, built in 1892. The ironwork above the floor should be cleaned and painted and the sidewalk planking and boxing about the bottom chords should be renewed.

Arborway Bridge (over Stony Brook, in Arborway, near Forest Hills Station).

This is a wooden bridge resting on abutments of vulcanized spruce piles. The stringers and underplanking are of vulcanized hard pine. When this bridge was built, in 1893, it was assumed that within ten years the channel of Stony brook would be improved at this point, and a temporary structure was all that was deemed necessary. Some of the piles are now badly decayed and the tops of the stringers are poor. During the past year a new deck has been laid and some of the stringers have been strengthened. The bridge is maintained by the Park Department.

Ashland Street Bridge (over Providence Division, New York, New Haven & Hartford R. R., West Roxbury).

The present structure is of iron and was built in 1875. With the exception of the fences the bridge is in fair condition.

Ashmont Street and Dorchester Avenue Bridge (over Old Colony Division, New York, New Haven & Hartford R. R.).

This is a wooden bridge formerly maintained by the railroad company. It was lengthened on the Boston side in

1895, and now the city maintains 75 feet of the northerly part. The bridge is in fair condition.

Athens Street Bridge (*over Midland Division, New York, New Haven & Hartford R. R.*).

This is an iron bridge built in 1874. The sidewalks and deck planking should be renewed and the bridge should be painted.

Atlantic Avenue Bridge (*over South Terminal Station Yard and Fort Point Channel*).

The bridge was completed and opened to travel August 12, 1907. On the Boston approach is a steel viaduct about 450 feet in length, consisting of a series of short plate girder and I-beam spans of the deck type. The bridge over the railroad yard consists of two steel plate girder spans and two steel truss spans, all except one plate girder span being through spans. Fort Point channel is crossed by one truss span, a plate girder span, an I-beam span and a draw span, all being deck structures built of steel. The draw span is a swing or turntable draw, 184 feet long on center line, operated by electricity and compressed air. On the approaches and across Fort Point channel the bridge is 50 feet in width; over the railroad yard the width is 60 feet. The bridge is in good condition.

Audubon Road Bridge (*over the Boston & Albany R. R.*).

This is a steel plate girder bridge, built in 1893–94, and is maintained by the Park Department. The sidewalk planking should be renewed and some of the roadway stringers should be replaced. The ironwork should be cleaned and painted at the same time.

Austin Street Bridge (*over Boston & Maine R. R., Charlestown*).

This is a steel plate girder deck bridge with steel floor beams supporting a wooden flooring, built under the decree of the Superior Court abolishing the Austin street grade crossing. It was built in 1903–07 by the Boston & Maine Railroad Company and is over the railroad location. The bridge has fourteen spans resting on stone piers; it is 50 feet wide and has one 10-foot plank sidewalk and a roadway 39 feet wide, paved with stone blocks. Part of this bridge was opened to travel May 6, 1903, being connected to the Cambridge end by temporary structures. The entire bridge

was opened to travel September 17, 1907. The surface of the bridge is maintained by the city, the remainder by the railroad company. The fences should be repaired and painted; otherwise the bridge is in good condition.

Baker Street Bridge (at Brook Farm, West Roxbury).

This is a wooden stringer bridge of about 15 feet span. It is in fair condition.

Beacon Street Bridge (over Outlet of the Fens).

This bridge was built in 1880–81, and had up to 1901 a wooden floor for the roadway. At the latter date a new floor was built, consisting of 18-inch steel I-beams incased in Portland cement concrete, and the roadway was paved with hard pine blocks, treated by the creo-resinate process. The bridge is now in good condition.

Beacon Street Bridge (over Boston & Albany R. R.).

This is an iron bridge, built in 1884–85, widened in 1887–88, and the central roadway further widened in 1890 for the convenience and at the expense of the street railway company. Attention has been called for several years to the condition of this bridge, especially below the flooring. The wooden stringers are badly decayed and the underplanking is in very poor condition. An entire new flooring should be put on this bridge at once and the ironwork thoroughly cleaned and painted. When this is done the stringer seats should be carefully examined and strengthened where necessary.

Bellevue Street Bridge (over Muddy River, in Riverway).

This is a segmental masonry arch of 44 feet span and 15 feet rise. It was built in 1893 by the park departments of Boston and Brookline and is maintained jointly by them.

Bennington Street Bridge (over Boston & Albany R. R., East Boston).

This is a steel plate girder bridge built by the railroad company in 1906 under the decree of the Superior Court abolishing the grade crossings in East Boston. The surface of the bridge is maintained by the city and the rest of the structure by the railroad company. It is in good condition.

Bennington Street Bridge (over Boston, Revere Beach & Lynn R. R.).

This bridge is made up of two independent parts; the old part is of iron, built in 1889; the new part is of steel, built in 1902. The bridge should be painted, the boxing at the girder of the south roadway should be renewed and the deck planking needs repairing.

Berkeley Street Bridge (over Boston & Albany R. R. and Providence Division, New York, New Haven & Hartford R. R.).

The bridge over the tracks of the Boston & Albany R. R., which is maintained by the city, was originally built for the Boston Water Power Company, and accepted by the city in 1869. The present structure over these tracks is a through plate girder bridge and was built in 1891.

Plans are now in preparation for the rebuilding of the floor system of this bridge, the Boston Elevated Railway Company joining in this work, and when the structure is rebuilt it will be of sufficient strength to carry the heavy street car traffic.

The bridge over the tracks of the N. Y., N. H. & H. R. R. was built in 1899 and is maintained by that company. It is expected that this bridge will be strengthened for heavy car traffic at the same time that the city bridge is rebuilt.

Bernier Street Footbridge (over Bridle Path, in Riverway).

This is a semicircular masonry arch of 38 feet 4 inches span. It was built in 1893 and is maintained by the Park Department.

Bernier Street Footbridge (over Muddy River).

This is a segmental masonry arch of 52 feet span and 14 feet rise. It was built in 1893 by the park departments of Boston and Brookline and is maintained jointly by them.

Berwick Park Footbridge (over Providence Division, New York, New Haven & Hartford R. R.).

This is an iron footbridge, erected in 1894. The iron stairs and piers were new, but the trusses and floor beams were those built for Franklin street in 1883. The woodwork has been renewed during the past year and the steel work cleaned and painted.

Blakemore Street Bridge (over Providence Division, New York, New Haven & Hartford R. R.).

This is an iron bridge, built in 1881–82. New lower planking should be put in and the whole bridge should be cleaned and painted.

Blue Hill Avenue Bridge (over Midland Division, New York, New Haven & Hartford R. R.).

This is a steel bridge built by the N. Y., N. H. & H. R. R. in 1903 and is over the railroad location. The surface of the bridge is maintained by the city, the remainder by the railroad company. The steel work is very rusty in places, and the bridge should be painted and the sidewalk planking should be patched; otherwise it is in good condition.

Bolton Street Bridge (over Midland Division, New York, New Haven & Hartford R. R.).

This is a wooden bridge, originally built in 1889 and rebuilt in 1905. The upper woodwork needs renewal.

Boston Street Bridge (over Old Colony Division, New York New Haven & Hartford R. R.).

This is a plate girder bridge, built in 1900 in connection with the abolishment of the grade crossing on Dorchester avenue. The surface of the bridge is maintained by the city and the rest of the structure by the railroad company. The south sidewalk and the boxing around the girders need repairing, and the bridge should be painted; otherwise it is in good condition.

Boylston Street Arch Bridge (in the Fens).

This is a stone arch bridge, built in 1881. It is in good condition, with the exception of coping, which should be repointed without further delay.

Boylston Street Bridge (over Boston & Albany R. R.).

(See page 45.)

Bridle Path Bridge (over Muddy River, in the Riverway).

This is a masonry bridge of three arches; the central arch is elliptical in form, with a span of 30 feet and a rise of 9 feet 6 inches; the side arches are semicircular, 15 feet in

diameter. It was built in 1894 and is maintained by the Park Department. It is in good condition.

Broadway Bridge (over Fort Point Channel).

The draw was built in 1874–75 and the supports for the draw landings are iron columns. The rest of the bridge is built of steel on masonry piers, and was rebuilt in 1901–04. The gates have been painted and ordinary repairs made. The steel work over Foundry street, the plate girders and part of the fencing should be painted. Some of the track and wheels below the draw need renewal and the planking on the pier, waterway and the boxing at the trusses need repairing; otherwise the main part of the bridge is in good condition. The draw is old and too light for heavy travel and should be rebuilt within two years.

Broadway Bridge (over Boston & Albany R. R.).

The old bridge, built in 1880–81, was replaced in 1900 by the present bridge. New sidewalks have been built during the past year, and the ironwork under the walks and the fences has been cleaned and painted. The whole bridge, however, should be painted and the lower planking of the roadways renewed.

Brookline Avenue Bridge (over Boston & Albany R. R.).

This is an iron bridge, built in 1884. The railings will need painting next year; otherwise the bridge is now in good condition.

Brookline Avenue Bridge (over Muddy River, in the Riverway).

This is a semicircular masonry arch of 15 feet span. It was built in 1892 by the park departments of Boston and Brookline and is maintained by them jointly.

Brookline Street Bridge (from Brighton to Cambridge).

This is a wooden trestle bridge, built on a pile foundation in 1906, and is in care of the Commissioners for Boston and Cambridge Bridges; the city pays one-half the cost of maintenance. It was built as a temporary structure, with the expectation that it would be replaced by a permanent bridge within ten years. As the bridge is now three years old the construction of the permanent bridge should be commenced within a year or two. Additional scuppers are needed at both ends of the bridge. It is in good condition.

Brookline Street Bridge (over Boston & Albany R. R.).

This is a steel plate girder bridge, on steel trestles, with wooden floor and wearing surface, built in 1906. The surface of the bridge is maintained by the city and the rest of the structure by the railroad company. It is in good condition.

Brooks Street Bridge (near Faneuil Station, Brighton).

This is a steel bridge, with a concrete and asphalt floor, built in 1902. The fencing has been painted. The bridge should be painted and the roadway surface should be repaired.

Byron Street Bridge (over Boston, Revere Beach & Lynn R. R.).

This is a wooden bridge, built in 1889. The sidewalks have been rebuilt. The stringers and bulkheads are in poor condition and the bridge needs a general overhauling.

Cambridge Bridge (from Boston to Cambridge).

The new bridge was completed in the fall of 1907, the formal dedication having taken place July 31. Since December 21, 1907, the bridge has been maintained by the Commissioners for the Boston and Cambridge Bridges, and the city pays one-half of the cost of maintenance. The structure is in good condition and needs only the yearly cleaning and customary touching up of the paint, which has been made unsightly in spots on account of the seepage of water. It is of the utmost importance that this bridge should be kept properly painted in order that it may not be deteriorated by rust.

Cambridge Street Bridge (from Brighton to Cambridge).

This is a wooden pile bridge with a wooden leaf draw. The Boston end was rebuilt in 1884. The draw, sidewalk on Boston end and the Cambridge end of the bridge were rebuilt in 1890. The bridge is in the care of the Commissioners for the Boston and Cambridge Bridges, and the city pays one-half the cost of maintenance. The bridge is in poor condition and needs extensive repairing. The waterways need replanking, especially under the Boston leaf of the draw, where the piling needs additional securing; some of the piles are in poor condition and need renewal; the deck planking has been repaired in spots many times and should be entirely renewed and additional stringers added;

one draw arm needs renewal; the fender guards need repairing. The support to the drawtenders' house needs strengthening, and a boat should be provided. Both channel caps and several stringers resting on them need renewal.

Cambridge Street Bridge (over Boston & Maine and Boston & Albany Railroads, Charlestown).

This is a through steel truss bridge of four spans, built in 1901 by the Boston & Maine R. R. The surface is maintained by the city, the remainder by the railroad company. The steel work is very rusty. The bridge should be painted and the sidewalk planking should be repaired.

Castle Island Footbridge (from Marine Park to Castle Island).

This is a temporary footbridge, built in 1892, and is maintained by the Park Department. It connects the Marine Park with Castle Island, and is furnished with a draw, so that if desired by the United States authorities the island can be cut off from the mainland. The draw has been painted and repairs have been made on the planking. The fences should be painted and more planking should be renewed. The bridge is in fair condition.

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

This is an iron bridge and was built in 1876. The city maintains the part within its limits. The roadway planking and some of the stringers need renewal and the fences need painting.

Charlesgate Bridge (over Boston & Albany R. R., in the Fens).

This is an iron bridge, built in 1881–82, and is maintained by the Park Department. The railings need painting and some slight repairing should be done at the end of one of them.

Charlesgate Bridge (over Ipswich street, in the Fens).

This is a deck plate girder bridge with a buckle plate floor, built in 1900–01. The roadway is paved with asphalt and the sidewalks with artificial stone. The bridge should be painted and the ornamental railings repaired.

Charlestown Bridge (from Boston to Charlestown).

This bridge was opened to public travel November 27, 1899, and superseded the old Charles River Bridge, which was built in 1785–86.

The present bridge over the river consists of ten spans of the deck plate type, each 85 feet long, and a swing or turntable draw 240 feet 6 inches long.

The bridges over Water street and over the railroad tracks each consist of two spans of steel I-beams, with brick arches turned between the beams.

The entire bridge and the drawtenders' house should be painted, the floor of the draw repaired and new dolphins provided.

Chelsea Bridge (over Boston & Maine R. R.).

This is an iron bridge, built by the Boston & Maine Railroad Company in 1894, and is over the railroad location. The surface of the bridge is maintained by the city, the remainder by the railroad company. Repairs have been made on the sidewalk planking. The wheel guard is too low and narrow; the fences and sidewalk planking need repairing and the bridge needs painting; some of the track stringers begin to show decay. Otherwise the bridge is in good condition.

Chelsea Bridge, North (over North Channel, Mystic River).

The city maintains the part within its limits. The original structure was built in 1802–03. The piles under the main bridge were driven in 1880. The upper part of the bridge, the draw and draw foundations were built in 1895. The drawway was widened to 60 feet in 1900, the draw foundation being enlarged, the draw lengthened and the draw piers built. A new truck has been furnished and miscellaneous repairs made. The sidewalk and roadway planking on the draw need renewal and some stringers should be added. The steel floor beams should be strengthened and new machinery should be provided; several truck wheels need renewing; an additional bearing should be provided at the skew end; the sides of the waterway need extensive repairing; the entire bridge should be painted; the track stringers and the fences should be repaired; the old fender guards are in poor condition.

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

This is a pile bridge with an iron draw. The original bridge was built in 1802–03. The piles of the present bridge were driven and the draw was built in 1877. That part of the bridge above the girder caps was rebuilt at a higher grade and the draw was raised in 1895. Repairs are needed on the track and draw rest. Where the rebuilding of 1895 joins the old work repairs are needed on both sides of the bridge. The draw is too light for the present travel; the bridge should be rebuilt.

Chelsea Street Bridge (from East Boston to Chelsea).

This bridge was destroyed by the Chelsea fire of April 12, 1908, and foot travel is maintained over a temporary structure. (See page 54.)

Circuit Drive Bridge (over Searboro' Pond, in Franklin Park).

This is an elliptical masonry arch of 30 feet span and 6 feet 3 inches rise. It was built in 1893 and is maintained by the Park Department.

Columbia Road Bridge (over Old Colony Division, New York, New Haven & Hartford R. R.).

This is a deck plate girder bridge of two equal spans, one over the tracks of the N. Y., N. H. & H. R. R., and the other over Old Colony avenue, and was built in 1902. The roadway is paved with Canton brick, cement grout joints, and laid on hard pine planking. The sidewalks are badly cracked and should be put in good condition. The whole bridge should be painted at once.

Columbia Road Bridge (over Shoreham street).

This bridge was built in 1902. It is a two-span steel beam structure, with brick and concrete arches turned between the beams; the roadway is paved with Canton brick laid with cement grout joints. The sidewalk is of artificial stone. The girders and all the exposed steel work are rusting badly and should be painted this year not only for appearance but to prevent the corrosion of the structure.

Columbus Avenue Bridges (over Boston & Albany R. R. and Providence Division, New York, New Haven & Hartford R. R.).

The bridge over the Boston & Albany R. R. was built in 1876–77 and is maintained by the city. In 1899 the bridge

was shortened 11 feet at its south end and a pier built in place of the old south abutment. Some painting has been done during the past year, and the bridge is now in fair condition.

The bridge over the tracks of the N. Y., N. H. & H. R. R. was built in 1899 and is maintained by that company.

Commercial Point or Tenean Bridge (Dorchester).

This is a wooden pile bridge with a wooden leaf draw. The piles were driven in 1875. The draw and upper part of the bridge were rebuilt in 1901. The fencing should be repaired and painted. The bridge is otherwise in fair condition.

Commonwealth Avenue Bridge (in the Fens).

This is an iron bridge and was built in 1881–82. It has been sheathed during the past year and is now in good condition, with the exception of the paint; the whole bridge should be painted. It is maintained by the Park Department.

Congress Street Bridge (over Fort Point Channel).

This is a wooden pile bridge, with an iron turntable draw on a stone foundation, and was built in 1874–75. The upper part of the bridge and the draw span have been repaired during the year and it is expected that the draw pier will be put in good condition the coming season. (See page 55.)

Cottage Farm Bridge (over Boston & Albany R. R., Brighton).

The present bridge was built in 1895–96. With the exception of the plate girders on the outside lines of the bridge and some special construction under the sidewalks, the superstructure is composed of 20-inch steel beams, filled between with brick arches and Portland cement concrete, on which is a wearing surface of Sicilian rock asphalt. The intown girders should be painted. The bridge is in good condition.

Cottage Street Footbridge (over Flats, East Boston).

This is a wooden pile bridge, built in 1889, for foot travel. It was extensively repaired in 1905. As the filling at the southerly end of the bridge had been carried out for quite a distance, about 400 feet of the bridge have been removed. The sheathing needs repairing and the fences should be painted.

Craigie Temporary Bridge.

This is a wooden pile bridge built by the Charles River Basin Commission to accommodate travel during the construction of the Charles River Dam. It was opened to travel July 2, 1905. It is in the care of the commission and is in good condition.

Curtis Street Bridge (over Boston & Albany R. R., East Boston).

This is a through steel plate girder bridge, built by the railroad company in 1906 under the decree of the Superior Court abolishing the grade crossings in East Boston. It was opened to travel December 29, 1906. The surface of the bridge is maintained by the city and the rest of the structure by the railroad company. The bridge is in good condition.

Dartmouth Street Bridges (over Boston & Albany R. R. and Providence Division, New York, New Haven & Hartford R. R.).

The bridge over the Boston & Albany R. R. was built in 1878–79 and is maintained by the city. Very extensive changes were made in this bridge in 1899 by the railroad companies, necessitated by the new location of the tracks of the N. Y., N. H. & H. R. R. leading to the South Station and the abandoning of the tracks connecting this road with the Boston & Albany R. R. Some of the hangers and the bottom flanges of the floor beams over the main tracks have been reduced in section so materially by the corrosive action of the fumes from the locomotives that it will be necessary to rebuild portions of this bridge within the next two years. The bridge over the tracks of the N. Y., N. H. & H. R. R. was built in 1899 and is maintained by the railroad company. The asphalt surface at its northerly end is poor.

Dorchester Avenue Bridge (over Fort Point Channel).

This is a wooden pile bridge, with a double retractile iron draw, and was rebuilt in 1891–92. The entire bridge should be painted. The sidewalk planking and a few curb stringers on the draw should be renewed, the sills and planking on the wharves, waterway and piers need renewal and additional supports are needed under the house; some of the spurshores have begun to decay and should be refitted; the waterway should be repaired, the gates should be rebuilt and the wreckage among the piling should be removed.

Dorchester Avenue Bridge (over Old Colony Division, New York, New Haven & Hartford R. R.).

This is a steel bridge, built in 1900, over the new location of the N. Y., N. H. & H. R. R. The surface of the bridge is maintained by the city and the rest of the structure by the railroad company. The bridge should be painted; the sidewalk planking and boxing around the girders need repairing; otherwise the bridge is in good condition.

Dover Street Bridge (over Fort Point Channel).

This was originally a wooden pile bridge, built in 1805, rebuilt in 1858–59, and again in 1876. In 1893–94, upon the abolition of the grade crossing of the Old Colony R. R., the present iron structure, resting on masonry piers, was built. Miscellaneous repairs have been made. The sidewalk planking on the draw needs renewal; the bridge should be painted; some new track is needed for the draw; the rack should be adjusted in order that the draw may be reversed; the concrete of the draw foundation pier should be repaired and the other piers should be repointed; the planking on the wharves is in poor condition and the greater part should be renewed. The waterway needs repairing. The sidewalk needs resurfacing.

Ellicott Arch Bridge (in Franklin Park).

This is a semicircular masonry arch of 17 feet 6 inches span. It was built in 1889 and is maintained by the Park Department.

Everett Street Bridge (over Boston & Albany R. R., Brighton).

This is an iron bridge, built in 1891 by the Boston & Albany Railroad Company. The bridge has been cleaned and painted during the year. New floors have been laid on the roadway and sidewalks, and the bridge is now in good condition.

Fen Bridge (in the Fens).

This bridge was built in 1891–93. It is in good condition.

Ferdinand Street Bridge (over Boston & Albany R. R.).

This is an iron bridge, built in 1892. In 1899 this bridge was shortened about 3 feet at its southerly end and the

old south abutment replaced by a brick pier. The bridge has been cleaned and painted and new sidewalks built. The angle seats were found to be in so poor a condition that it was not deemed safe to rest the new stringers on them. By raising the surface of the walk about 2 inches the stringers were placed on the upper flanges of the sidewalk brackets.

Florence Street Bridge (over Stony Brook).

This is a wooden stringer bridge of about 15 feet span, and is in fair condition.

Forest Hills Entrance Bridge (in Franklin Park).

This bridge was built in 1894–95. It is maintained by the Park Department and is in good condition.

Gainsborough Street Footbridge (over Providence Division, New York, New Haven & Hartford R. R.).

This is an iron footbridge, erected in 1904. It should be painted.

Gold Street Bridge (over Midland Division, New York, New Haven & Hartford R. R.).

This bridge was built in 1895, replacing a footbridge which was built in 1890; the sidewalk planking should be renewed, the fences need repairing, the bridge should be painted and the walls need some pointing; otherwise the bridge is in good condition.

Granite Bridge (from Dorchester to Milton).

This is a wooden pile bridge, with a wooden leaf draw. The city maintains the part within its limits. The bridge was originally built in 1837. The draw and the adjoining bay were repaired in 1907; the remainder of the bridge is in poor condition and should be rebuilt, and the abutment should be repaired.

Harvard Bridge (from Boston to Cambridge).

This is an iron bridge with an iron turntable draw, and was built in 1887–91. This bridge is in the care of the Commissioners for the Boston and Cambridge Bridges, and the city pays one-half the cost of maintenance.

The roadway of the fixed spans was repaired in 1901–02 and a wooden block paving laid. In 1905 the asphalt walks were replaced by 3-inch hard pine and the railings were painted. The roadway stringers on the draw span and the lower planking are in very bad condition. The stringers are those put in when the bridge was built, and only a small amount of patching has been done to the lower planking. Attention has been called to the condition of the floor for several years, and now it has reached a state where it is not safe for the heavy loads which pass over it. It is recommended that a new deck be put on at once. The draw fender pier should be replanked and the entire bridge painted. During the past year the masonry piers have been repointed.

Harvard Street Bridge (*over Midland Division, New York, New Haven & Hartford R. R., Dorchester*).

This is a steel bridge, built in 1904, under an agreement between the city and the N. Y., N. H. & H. R. R. Co. It needs painting, but is otherwise in good condition.

Huntington Avenue Bridge (*over Boston & Albany R. R.*).

This is one of the oldest bridges in the city, having been built in 1872. An appropriation has been made for building a new bridge and plans are in progress for a deck plate girder bridge incased in concrete.

Huntington Avenue Bridge (*over Muddy River*).

This is a semicircular masonry arch of 15 feet span. It was built in 1893 and is maintained by the park departments of Boston and Brookline.

Hyde Park Avenue Bridge (*over Stony Brook*).

This is a stringer bridge of 19 feet 9 inches clear span measured at right angles, and was built in 1904. It is in good condition.

Ipswich Street Bridge (*over Waterway, in the Fens*).

The bridge was built in 1898, and is in good condition, except the railings, which should be painted.

Irvington Street Footbridge (*over Providence Division, New York, New Haven & Hartford R. R.*).

This is an iron footbridge and was built in 1892. An examination of this bridge made in the spring of 1908 showed

that the diagonal truss members where they were connected with the bottom chord were so badly corroded as to render the bridge unsafe for travel. These were at once strengthened, a new floor laid and the whole bridge cleaned and painted. The bridge is now in good condition.

L Street Bridge (over Reserved Channel, South Boston).

This is a wooden pile bridge with an iron retractile draw. It was built in 1892. Some of the piling in the fender guards and under the 6-foot walk needs renewal; the bridge should be painted; the draw should be redecked; the planking on the waterways, piers and wharves needs repairing; additional stringers are needed near the engine house and the asphalt walks need repairing.

Leverett Pond Footbridge (in Leverett Park).

This is a segmental masonry arch of 24 feet span and 5 feet 5 inches rise. It was built in 1894, and is maintained by the Park Department.

Longwood Avenue Bridge (over Muddy River and Boston & Albany R. R.).

The original wooden structure was built in 1857, and rebuilt in 1877. The present masonry arches were erected in 1899 by the park departments of Boston and Brookline, and are maintained jointly by them.

Malden Bridge (from Charlestown to Everett).

This is a wooden pile bridge, with a retractile steel draw, and was rebuilt in 1900–01. The paving has been repaired and other ordinary repairs have been made; the planking on the draw needs renewal and about 50 feet of fence should be built on the wing of the abutment at the Charlestown end. The bridge should be painted, the walks resurfaced and some of the capsills on the pier renewed. The bridge is otherwise in good condition.

Massachusetts Avenue Bridge (over Boston & Albany R. R.).
(See page 66.)

Massachusetts Avenue Bridge (over Providence Division, New York, New Haven & Hartford R. R.).

This is an iron bridge, built in 1876. The woodwork was renewed in 1901 and the ironwork cleaned and painted.

The roadways carrying street cars have been strengthened during the year by the Boston Elevated Railway Company. The other roadway and the sidewalks should have new floors, and the whole bridge should be painted.

Mattapan Bridge (from Dorchester to Milton).

This is a three-arch bridge of Melan construction, with granite facing. It was built in 1902 by the Metropolitan Park Commission and is maintained by it. The arches are semicircular, two spans being 14 feet and one 50 feet; the bridge has one 56-foot roadway and two 12-foot sidewalks. It is in good condition.

Maverick Street Bridge (over the Boston & Albany R. R., East Boston).

This is a through steel plate girder bridge, built by the railroad company in 1906 under the decree of the Superior Court abolishing the grade crossings in East Boston. The surface of the bridge is maintained by the city and the rest of the structure by the railroad company. The fence should be painted. The bridge is in good condition.

Meridian Street Bridge (from East Boston to Chelsea).

This is a wooden pile bridge, with a wooden turntable draw on a pile foundation. The original structure was built in 1858. It was rebuilt soon afterwards, and was widened and rebuilt in 1884, excepting the draw, which was built in 1875–76. The chords of the draw were rebuilt in 1896. The main part of the bridge was strengthened for the use of heavy electrics in 1906, and the draw was repaired and strengthened in 1907. The draw should be adjusted. The roadway planking, the waterways and the pier are in very poor condition. The bridge should be rebuilt within two years.

Milton Bridge (from Dorchester to Milton).

The city maintains the part within its limits. The original structure is very old. It was widened in 1871–72. The older part of this bridge was built of stone, and the widening is an iron structure on stone columns. The westerly sidewalk was rebuilt on new iron girders and floor beams in 1900. The old planking on the bridge should be uncovered and examined and it will probably need renewal. The bridge should be painted and the sidewalk planking on the downstream side of the bridge should be renewed, the fence

should be refastened, the fascia needs repairing and one of the capstones over the first waterway is cracked.

Mt. Washington Avenue Bridge (over Fort Point Channel).

This is a wooden pile bridge with an iron draw. It was built in 1854, and rebuilt in 1870–71. It has been closed to travel since the summer of 1904 and will probably be entirely removed during the coming season.

Neponset Bridge (from Dorchester to Quincy).

The city maintains the part within its limits. The original structure was built in 1802, and the present one in 1877; the draw and upper woodwork of the bridge and piers are in poor condition; the bridge should be rebuilt at once.

Neptune Road Bridge (over Boston, Revere Beach & Lynn R. R.).

This is an iron bridge, built in 1887–88, and is maintained by the Park Department. The sidewalk planking needs patching and the bridge should be painted.

Newton Street Bridge (over Providence Division, New York, New Haven & Hartford R. R.).

This is an iron bridge, built in 1872. It was cleaned and painted in 1902 and a new deck put on. The fences are poor and the angle seats for the roadway stringers are somewhat reduced in section. This bridge is one of the oldest in the city but can probably be maintained in safe condition for five years longer if the deck is kept in good condition and the angle seats strengthened.

Norfolk Street Bridge (over Midland Division, New York, New Haven & Hartford R. R., near Dorchester Station).

This is a steel bridge, built in 1905, under an agreement between the city and the N. Y., N. H. & H. R. R. Co. The bridge should be painted and the adjoining temporary fences should be replaced by permanent ones. The bridge is in good condition.

Norfolk Street Bridge (over Midland Division, New York, New Haven & Hartford R. R., near Mattapan Station).

This is a through lattice girder bridge, and was built by the railroad company in 1902. The surface of the bridge is maintained by the city and the rest of the structure by the

railroad company. The sidewalk planking needs repairing; otherwise the bridge is in good condition.

North Beacon Street Bridge (from Brighton to Watertown).

The city maintains the part within its limits. This is a wooden pile bridge with a wooden leaf draw. The original structure was built in 1822, and the present one in 1884. The bridge is in poor condition. It should be rebuilt without a draw.

North Harvard Street Bridge (from Brighton to Cambridge).

This bridge was originally built in 1662, and was rebuilt, except the piling, in 1879; the draw was built in 1891. The bridge is in the care of the Commissioners for the Boston and Cambridge Bridges; the city pays one-half the cost of maintenance. The bridge is in very poor condition, and the building of a new bridge should be commenced at once.

Oakland Street Bridge (over Midland Division, New York, New Haven & Hartford R. R.).

This is a new steel plate girder bridge, built by the railroad company in 1902 under the decree of the Superior Court abolishing the grade crossing at this point. The surface of the bridge is maintained by the city and the rest of the structure by the railroad company. The bridge should be painted and the sidewalk planking renewed.

Perkins Street Footbridge (over Boston & Maine R. R. and Boston & Albany R. R., in Charlestown).

This bridge was built in 1900 and opened to travel February 2, 1901; it has two spans of wooden stringers and one of steel Pratt trusses. The surface is maintained by the city, the rest of the structure by the railroad companies. Some of the plate treads were very much worn and have been replaced by wood. The fencing should be repaired and the bridge painted; otherwise the bridge is in good condition.

Porter Street Bridge (over Boston & Albany R. R., East Boston).

This is a through steel truss bridge, built in 1906–07 by the railroad company under the decree of the Superior Court abolishing grade crossings in East Boston. The surface of the bridge is maintained by the city and the rest of the structure by the railroad company. It is in good condition.

Prescott Street Bridge (over Boston & Albany R. R., East Boston).

This is a new through steel plate girder bridge, built by the railroad company in 1906–07 under the decree of the Superior Court abolishing grade crossings in East Boston. The surface of the bridge is maintained by the city and the rest of the structure by the railroad company. It is in good condition.

Prison Point Bridge (from Charlestown to Cambridge).

This bridge includes a steel draw and its landings and was built in 1907. The original bridge was built in 1833. The bridge is in the care of the Commissioners for the Boston and Cambridge Bridges, and the city pays one-half the cost of maintenance. The main shaft needs readjusting and the lower box should be held more securely in its proper position; the machinery should be housed in, a new drawtenders' house should be provided and part of the old pier should be rebuilt.

Public Garden Footbridge.

This is an iron bridge and was built in 1867. The entire woodwork of this bridge should be renewed this season if it is proposed to keep the present structure in service. If nothing more is done at the present time, such of the stringers as are in poor condition should be replaced at once.

Saratoga Street Bridge (over Boston & Albany R. R., East Boston).

This is a through steel plate girder bridge, built in 1907 by the railroad company under the decree of the Superior Court abolishing grade crossings in East Boston. The surface of the bridge is maintained by the city and the rest of the structure by the railroad company. It is in good condition.

Scarboro' Pond Footbridge (in Franklin Park).

This is an elliptical masonry arch of 40 feet span and 8 feet 3 inches rise. It was built in 1893 and is maintained by the Park Department.

Shawmut Avenue Bridge (over Boston & Albany R. R. and Providence Division, New York, New Haven & Hartford R. R.).

The original bridge built in 1871 was removed and a new through plate girder bridge erected in 1904. The bridge is in good condition but should be painted.

Southampton Street Bridge (over South Bay Sluice).

This is a wooden bridge, built in 1875 as a temporary structure. It is in very poor condition and should be rebuilt.

Southampton Street Bridge (over Old Colony Division, New York, New Haven & Hartford R. R.).

This is a steel plate girder bridge, built in 1901-02. The surface is maintained by the city, the rest of the structure by the railroad company. The deck planking and boxing around the girders need renewal and the bridge should be painted; otherwise it is in good condition.

Spring Street Bridge (from West Roxbury to Dedham).

This is a stone bridge. The city maintains the part within its limits. The piers and arches were pointed in 1905 and granite copings, surmounted by iron railings, built on both sides of the bridge. The part within the city's limits is now in good condition, but the railings should be painted the coming summer.

Summer Street Bridges (over A, B and C Streets).

These bridges were built in connection with the abolition of the grade crossing on Congress street, and were opened to travel in 1900. The bridge over A street is a steel deck plate girder structure, with a paved roadway of granite blocks and asphalt sidewalks.

The bridge over B street is a through plate girder structure, with a paved roadway of granite blocks and asphalt sidewalks.

The bridge over C street is a two-span steel beam structure, with brick and concrete arches turned between the beams; the roadway is paved with granite blocks and the sidewalks with asphalt.

Considerable painting has been done on these bridges during the past year and they are now in good condition.

Summer Street Bridge (over Fort Point Channel).

This bridge was built in 1899-1900, in connection with the abolition of the grade crossing on Congress street. It is a four-span deck plate girder bridge, resting on masonry piers, with two retractile draws over a 50-foot channelway. The roadway of the fixed spans has a granite block paving, and the sidewalks have asphalt wearing surfaces. The whole

structure is in good condition, but should be painted during the year and new lower deck laid on the draw spans.

Summer Street Bridge (over New York, New Haven & Hartford R. R. Freight Tracks).

This bridge was built in 1900, in connection with the abolition of the grade crossing on Congress street, and is maintained by the city and the railroad company, the former maintaining the wearing surface and the latter maintaining the rest of the structure. It has four spans, consisting of three through trusses each, and has a granite paved roadway and asphalt sidewalks. The whole bridge has been painted by the railroad company and is now in good condition with the exception of the sidewalks. New walks should be built or the present walks resurfaced.

Sumner Street Bridge (over Boston & Albany R. R., East Boston).

This is a new through steel plate girder bridge, built by the railroad company in 1908 under the decree of the Superior Court abolishing the grade crossings in East Boston. The bridge was opened to travel of all kinds June 22, 1908. The surface of the bridge is maintained by the city and the rest of the structure by the railroad company.

Warren Bridge (from Boston to Charlestown).

This is a wooden pile bridge, with a double retractile iron draw. The present structure was built in 1883-84. Half the draw has been redecked and miscellaneous repairs have been made. Some of the piles under the wharf are broken; the fender guards on the Charlestown side are in poor condition, and repairs are needed on the deck planking of the main bridge; the planking on the waterway, wharves and in draw pit need repairing; the landing shoes should be set; the sidewalk on the westerly side of the bridge, city ends, should be extended about twenty feet, and the concrete sidewalks should be repaired; the curb on the draw should be realigned, and some of the fence posts need renewal.

Webster Street Footbridge (over Boston & Albany R. R., East Boston).

This is a new through steel truss bridge, built by the railroad company in 1908 under the decree of the Superior Court abolishing the grade crossings in East Boston. The surface

of the bridge is maintained by the city and the rest of the structure by the railroad company.

West Fourth Street Bridge (over Old Colony Division, New York, New Haven & Hartford R. R).

In 1893–94 the grade crossing of the Old Colony R. R. on this street was abolished, and an iron bridge built, extending from the end of Dover Street Bridge, at the South Boston side of Fort Point channel, to the easterly line of Foundry street. The surface is maintained by the city, the rest of the structure by the railroad company. The planking around the middle trusses needs renewal, the bridge needs painting and the sidewalk plank needs patching.

West Rutland Square Footbridge (over Providence Division, New York, New Haven & Hartford R. R.).

This is an iron footbridge, built in 1882. It is now in fair condition, with the exception of the stair treads, which are badly worn.

Western Avenue Bridge (from Brighton to Cambridge).

The present bridge was built in 1879–80 and the draw in 1891. It is in the care of the Commissioners for the Boston and Cambridge Bridges, and the city pays one-half the cost of maintenance. New stringers have been put beside the draw arms on the Cambridge side. The deck planking on the Cambridge side needs renewal. The Boston end is in poor condition, the channel cap and some of the piles and stringers need renewal, the draw needs adjusting, the side beams need refastening, the piers, fender-guards and waterways need repairing and the headers on both leaves of the draw need renewal.

Western Avenue Bridge (Brighton to Watertown).

The city maintains the part within its limits. This is a wooden pile bridge, with an iron draw, and was rebuilt in 1892–93. Only minor repairs have been made; the Boston end of the draw should be raised; the draw should be adjusted; and the bearings under the ends of the girders should be renewed; the planking and capsills on the piers and along the waterways should be repaired; some of the spurshores are broken and should be refitted; the sidewalk planking and deck planking on draw and main bridge need renewal, also some of the planking on the draw foundation, and the bridge

should be painted this year; some of the piles in the fender guard are in poor condition.

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

This is a pile bridge without a draw. It was originally built in 1839; it was rebuilt in 1851, and was extensively repaired in 1870 and has been repaired many times since. The abutment at the Winthrop end needs pinning up, as there has been some settlement; the bulkhead at the Boston end, some of the outside bolsters and the roadway planking are in very poor condition. Some of the piles are somewhat eaten by worms; the piles in deep water should be examined by a diver, and additional piles may be needed. The waterway should be partially filled, and the bridge should be rebuilt of a shorter length.

Wood Island Park Footbridge.

This is a steel footbridge, built in 1898–99, and connects Prescott street, East Boston, with Wood Island Park, spanning the tracks of the Boston, Revere Beach & Lynn R. R. The bridge has been painted and is now in good condition.

Bridges wholly Supported by Railroad Corporations.

Harrison avenue Bridge, over the Boston & Albany R. R. is in poor condition and should be rebuilt. The other highway bridges maintained by the several railroad companies are in good or fair condition.

SURVEYING DIVISION.

The work of the Surveying Division during the past year has consisted of the making of such surveys and plans as have been required by the several city departments, and giving lines and grades of public streets when requested by abutters intending to build.

* Forty-five petitions requesting that catch-basins should be constructed were reported upon to the Sewer Division.

* Sixty-five plans of streets showing proposed locations for future catch-basins were furnished on request of the Sewer Division.

* Fifty-three catch-basins were staked out on request of the Sewer Division and duplicate sketches showing locations of spikes, ties, etc., were furnished.

* Measurements have been obtained on 106 streets for the Sewer Division, for the purpose of making sewer assessments.

* One hundred and fifty-four plans of proposed underground pipes, conduits, etc., were examined for the Sewer Division, and locations for proposed future catch-basins were marked on plans.

Two hundred and thirty-one notices of contracts to lay artificial stone sidewalks were received, lines and grades were marked, the work measured when completed and reported upon to the Street Department. In eighty-eight cases the Street Department was notified that the existing edgestones should be reset preparatory to the laying of artificial stone.

Fifty-nine notices of the completion of repairs to artificial stone sidewalks were received, the work measured and reported upon to the Street Department.

Thirty petitions to make sidewalk openings for areas, bulkheads, etc., were received from the Street Department and reported upon.

One hundred and ten requests for edgestone were examined and the amount required reported upon to the Street Department.

Sidewalk grades for forty-one streets were furnished engineers and architects for plans of twenty-three new buildings.

Six plans of streets were made for sidewalk assessments on

* This work was performed jointly by the Engineering and Street Laying-Out Departments.

request of the Street Department. Data was also furnished the Street Department for sidewalk assessment on four estates.

Fifteen hundred and seventy orders were attended to for the Paving Division; these consisted of staking out new streets for construction, giving lines and grades for repairs and reconstruction of old streets, testing lines and grades after completion of work, and measuring the amount of work performed and making plans showing quantities to be assessed upon abutting owners.

Estimates for grade, land and building damages and cost of construction were furnished the Street Commissioners on thirty-five streets.

The lines and grades of twelve streets, for which the Street Commissioners were petitioned for authority to open as private ways, were examined and reported upon.

* Fifty-two miscellaneous reports were made to the Sewer Division.

Twenty-nine miscellaneous reports were made to the Street Department.

The following table gives the comparative annual amounts of paving work measured by the Surveying Division of the Engineering Department for fifteen years:

YEAR ENDING JANUARY 31.	Feet of Edge-stone Set.	Square Yards Block Stone Paving and Crossings.	Square Yards Round Stone Paving.	Square Yards Brick Paving.	Square Yards Artificial Stone.	Square Yards Coal Tar Concrete.	Square Yards Asphalt Paving.
1895	23,487	12,007	5,175	6,168	3,962	11,738	1,406
1896	129,383	60,472	32,940	68,701	12,296	183	1,297
1897	120,158	64,952	24,976	68,178	13,471	2,971	394
1898	154,718	100,414	36,658	94,003	13,599	4,019	27
1899	76,991	56,541	14,249	43,930	11,652	1,619	.....
1900	86,354	60,803	17,323	48,946	14,221	789	16
1901	264,982	161,428	61,356	147,863	16,541	489	2,377
1902	245,410	188,041	30,324	131,487	15,565	698	.....
1903	104,133	135,310	5,077	59,051	14,119	25	.....
1904	60,555	65,474	4,815	29,078	12,806	248	62
1905	30,899	54,455	184	16,268	9,906	196	.....
1906	67,114	65,132	1,264	27,544	12,981	3,551	.....
1907	140,878	101,118	17,390	82,044	20,135	3,716	.....
1908	52,380	76,216	3,386	30,339	16,635	1,926	.....
1909	1,743	6,706	742	1,423	14,846	83	.....

* This work was performed jointly by the Engineering and Street Laying-Out Departments.

Table showing the amount of paving work measured by the Surveying Division for the year ending January 31, 1909, by districts:

DISTRICTS.	Linear Feet Artificial Stone Curb.		Square Yards Artificial Stone Sidewalk.		Linear Feet of Edgestone.	Square Yards Block Stone Paving.	Square Yards Round Stone Paving.	Square Yards Brick Paving.		Square Yards Coal Tar Concrete.	Square Yards Tarvia.
	Old.	*New.*	*Old.*	*New.*	*Old.*	*Old.*	*New.*	*Old.*	*New.*		
City Proper	.....	8	10	1,429	79	404	.....	41	.....	.....	.....
South Boston	.....	.....	.....	70	788	2,174	.....	671	.....	.....	.....
East Boston	.....	.....	.....	96	.....	.....	.....	.....	.....	.....	11,875
Charlestown	.....	.....	.....	.....	823	2,453	.....	568	.....	.....	.....
Roxbury	.....	.....	398	3,231	53	1,675	.....	65	78	.....	.....
Dorchester	100	.....	383	7,727	.....	.....	.....	.....	.....	47	29,663
West Roxbury	.....	.....	.....	732	.....	.....	742	.....	.....	36	.....
Brighton	.....	.....	26	7,444	.....	.....	.....	.....	.....	.....	.....
Totals	100	8	817	14,029	1,743	6,706	742	1,345	78	83	41,538

Table showing the amount of paving work measured by the Surveying Division for the year ending January 31, 1909, by months:

MONTHS.	Linear Feet Artificial Stone Curb.		Square Yards Artificial Stone Sidewalk.		Linear Feet of Edgestone.	Square Yards Block Stone Paving.	Square Yards Round Stone Paving.	Square Yards Brick Paving.		Square Yards Coal Tar Concrete.	Square Yards Tarvia.
	Old.	*New.*	*Old.*	*New.*	*Old.*	*Old.*	*New.*	*Old.*	*New.*		
1908.											
March	.....	.....	.....	4	.....	.....	.....	.....	.....	.....	.....
June	.....	.....	44	783	79	26	.....	41	.....	.....	.....
July	.....	.....	416	2,816	45	387	.....	.....	78	.....	29,663
August	.....	.....	158	1,016	788	1,740	.....	671	.....	.....	.....
September	100	.....	149	1,638	831	4,119	742	633	.....	.....	.....
October	.....	.....	44	2,908	.....	.....	.....	.....	.....	.....	.....
November	.....	8	4	1,875	.....	.....	.....	.....	.....	47	.....
December	.....	.....	.....	2,864	.....	434	.....	.....	.....	36	11,875
1909.											
January	.....	.....	2	125	.....	.....	.....	.....	.....	.....	.....
Totals	100	8	817	14,029	1,743	6,706	742	1,345	78	83	41,538

Surveys and plans have been made for the taking of land for school purposes on Melrose street, Fayette street and Ferdinand street, city proper, where the Abraham Lincoln School is to be built; on Joy street and South Russell street, city proper; on Cedar street, Roxbury; on Pleasant street, Dorchester, an addition to the Edward Everett Schoolhouse site; on Grove street, West Roxbury; and on Walk Hill street, West Roxbury, an addition to the Francis Parkman Schoolhouse site.

A plan was made for the Hospital Department, showing its property on the easterly side of Albany street.

A plan was made for the Fire Department, showing a lot proposed to be purchased at the corner of Walk Hill street and Wenham street, West Roxbury.

At the request of the Mayor plans were made of the Winthrop School property on Tremont street and of the School Committee headquarters on Mason street.

Plans were made for the revision of the grades on Ash street and Bennett street, city proper, occasioned by the construction of the new elevated structure.

Plans were made for the revision of the grades of five streets, in connection with the abolition of grade crossings on the line of the Old Colony Railroad, between Harrison square and Neponset.

Two plans have been made for the Trustees of the Franklin Foundation relating to their property on Appleton street and Berkeley street, city proper.

Petitions for the registration of land in the Land Court are referred to the Mayor whenever the City of Boston is an interested party.

These cases are examined by the Law Department and the Surveying Division of the Engineering Department for the purpose of protecting the city's interests.

During the year sixty-seven such cases have been investigated.

There were 129 accident and other plans made for the Law Department.

In connection with the Surveying Division there have been 1,124 titles examined, 756 deeds and 342 plans copied from the Registry of Deeds.

Thirty-four hundred and fourteen blue prints have been made during the year.

List of plans of takings for sewerage works filed during the year ending February 1, 1909:

ROXBURY.

Brookline avenue. Plans showing the takings from Brookline avenue to Avenue Louis Pasteur.

WEST ROXBURY.

Anson street and Mark street. Plan showing taking between Anson and Mark streets at railroad land.

Anson street and Mark street. Plan showing takings to be discontinued between Anson and Mark streets in railroad land.

Dale street brook. Plan showing takings from Beech street, across James street and Poplar street.

Fairview street outlet. Plan showing takings from Fairview street, at Mendum street, across Boston & Providence Railroad to South street.

Grew avenue. Plan showing taking in Grew avenue from Canterbury street southerly.

Hewlett street brook. Plan showing takings from Farquhar street to Mozart street.

The following sectional plans made under the Board of Survey Act have been filed during the year:

T-31 T-50 T-51	Roxbury	3
W-51 W-52 W-68 W-69 W-70 W-71 X-91 X-93 Ee- 8 Ee- 9 Ee-10	Dorchester	11
Y-90 Y-96 Dd- 5	West Roxbury	3
	Carried forward	17

Brought forward		17
G–72, G–89, G–90, G–91, G–92, G–93, N– 8, N– 9, N–10	Brighton	9
Total		26

The following sectional plans made under the Board of Survey Act have been refiled during the year:

U– 9	South Boston	1
M–67, M–98	Roxbury	2
T– 96, T–100, U– 91, W– 10, X– 1, X– 21, X– 52, X– 53, X– 54, X– 68, X– 69	Dorchester	11
N–29, N–30, N–32, O– 6, O–44, O–45, O–56, O–57, O–58, O–64, O–65	Brighton	11
Total		25

Twenty-eight assessment plans were made for the Street Commissioners.

Forty-seven plans and profiles, representing a total length of five miles, showing buildings, property owners' names, established grades, area of land taken, or to be taken, for street widenings, relocations, or to be laid out, were completed for the Street Laying-Out Department.

The following list gives the number of orders attended to for property owners, builders and the various city departments from February 1, 1908, to February 1, 1909:

Street lines given	533
Street grades given	251
Street Department, Paving Division	1,570
*Street Department, Sewer Division	369
Street Department, Street Cleaning and Watering Division	4
Building Department	2
Law Department	194
Street Commissioners	227
Engineering Department	114
Park Department	5
Police Department	19
Schoolhouse Commission	11
City Messenger Department	2
Cemetery Department	1
Fire Department	1
Wire Department	3
Insane Hospital Department	2
Transit Commission	10
Hospital Department	1
Mayor	2
Trustees of the Franklin Foundation	2
	3,323

There are on file with the Surveying Division 34,366 indexed plans.

* This work was performed jointly by the Engineering and Street Laying-Out departments.

There are also 3,692 lithographed plans in the office at Old Court House not included in the foregoing list, viz.:

Lithographed maps of	Dorchester, made in 1869	. . . .	33
"	" " " 1880	. . . .	121
"	" West Roxbury, made in 1873	. . . .	8
"	" Fort Hill, made in 1866–69	. . . .	77
"	" Church street district, made in 1868	. .	168
"	" Washington street widening (parts 1, 2, 3), made in 1860	. . . . .	1,186
"	" Washington street extension, made in 1869,		324
"	" North street, made in 1859	. . . .	44
"	" Stony brook, drainage area	. . . .	10
"	" Boston, made in 1866–67	. . . .	98
"	" Boston, made in 1888	. . . .	30
"	" Suffolk street district, made in 1869	. .	7
"	" South Boston, made in 1880	. . . .	60
"	" Roxbury, made in 1880	. . . .	81
"	" burnt district	. . . . .	63
"	" Mt. Hope Cemetery	. . . . .	20
"	" Winthrop Farm	. . . . .	49
"	" Hanover avenue	. . . . .	44
"	" Muddy river	. . . . .	41
"	" Pemberton square, courthouse site	. .	195
"	" East Newton street, lots on, sold by auction, made in 1888	. . . . .	42
"	" public lands in South Boston, sold by auction, made in 1885	. . . . .	82
"	" public lands in South Boston, sold by auction, made in 1888	. . . . .	8
"	" Boylston street, old Public Library lot	. .	17
"	" public lands in South Boston, sold by auction, made in 1882	. . . . .	136
"	" Boston Directory map, made in 1886	. .	60
"	" Boston, scale 1,600 feet to an inch, made in 1890	. . . . .	83
"	" Boston, scale 800 feet to an inch, made in 1891, colored plans	. . . . .	5
"	" Boston proper, scale 500 feet to an inch, made in 1894	. . . . .	10
"	" Exhibit No. 1, City Surveyor's Report, 1893,		35
"	" Exhibit No. 2, City Surveyor's Report, 1893,		65
"	" Exhibit No. 3, City Surveyor's Report, 1893,		96
"	" High street, public lands sold by auction	.	16
"	" Beacon Hill, State House site	. . .	38
"	" Harrison avenue, Savage Schoolhouse lot, auction plan	. . . . .	57
"	" Boston proper, showing changes in street and wharf lines from 1795 to 1895	. .	198
			3,607

MISCELLANEOUS WORK AND CONSTRUCTION.

BOSTON CONSUMPTIVES' HOSPITAL.

Changes were made in the plan of the service road which was, at the beginning of the year, being graded under a contract with Peter F. Connolly, dated November 1, 1907, and a settlement was made with Mr. Connolly under which he was paid, on an estimate dated April 28, 1908, the sum of $1,052.56 for work already done and his contract was closed.

New plans and specifications were then prepared and on June 22, 1908, a contract was made with B. F. Carroll of Brookline for building the road, including subgrading, excavation for water pipe, building drains for surface water and surfacing the road. The work is not yet completed.

A 12-inch water pipe has been laid in the service road and two fire hydrants set; connections were made for supplying the power house, the cottage and main hospital building. The excavation for the pipe and the backfilling of the trenches were done under Mr. Carroll's contract and the rest of the work was done by the Water Department. The length of the 12-inch pipe is 1,343 feet, including that laid in 1907.

An 8-inch water pipe was laid from the main in River street, near the old mansion house, to supply the stables, the day camp and the cottage hospital. On account of this work there was laid 753 feet of 8-inch pipe and two fire hydrants at a cost for laying of $404.61. The work of laying the pipe was done by the Hub Construction Company under its contract dated July 27, 1908. The pipe was furnished by the city. This work was completed on August 13.

A plan has been made for rebuilding the drain between River street and the Neponset river, which serves as an outlet for the new drain in the service road. The present drain is inadequate.

BOYLSTON STREET BRIDGE, OVER THE BOSTON & ALBANY RAILROAD.

Boylston Street crosses the main line of the Boston & Albany Railroad at the extremely sharp skew of 71 degrees; that is, the angle made between the center lines of the street and the railroad location is only 19 degrees; and while the location is but 60 feet wide, the distance across the location,

measured along the center line of the street, is 176 feet, or nearly three times the width of the location. The street is 80 feet wide.

When the first Boylston Street Bridge was built in 1888, no part of the railroad location was available for piers, nor for erecting false work, and it was necessary to make the bridge in one span and to provide for its erection by other than usual means. Furthermore, the extreme skew, the width of the street and the omission of a truss on the center line of the street prohibited the use of top lateral bracing. The problem was solved by the late John E. Cheney, then the Assistant City Engineer of Boston, who designed the structure with two double pin-connected pony trusses of 216 feet span. Each part of the double truss was in reality a truss in itself; and the two parts, placed 6 feet apart on centers, were so connected together as to constitute a structure rigid in itself, requiring no outside bracing for its support. The design was notable in being one of the longest pony truss spans in existence. The span of 216 feet was divided into 16 panels of 13 feet 6 inches each; the depths of truss varied from 9 feet 4 inches at the ends to 24 feet at the middle, the top chord being curved and the bottom chord being straight.

The floor beams were double plate girders, tied together at the top and bottom flanges by latticing and tie plates, and having the webs connected at intervals by diaphragms. The floor beams extended beyond the trusses, forming brackets for the support of the sidewalks. The connections of the floor beams to the trusses were so designed as to distribute the loads from the beams equally to the two halves of each main truss, and were made by pins passing through the beams and through small girders connecting the double posts of the trusses. The principal floor beams were nearly 80 feet long over all and had a span, between supporting pins, equal to the distance apart of the main trusses, center to center, viz., 54 feet 1 inch. The depth of these principal beams back to back of angles was 3 feet 8 inches. On account of the skew most of the floor beams were placed with one end on an abutment, some of these beams being so short as to require anchorage to the abutment masonry.

All stringers were of hard or yellow pine; the lower course of roadway planking was 3-inch hard pine, the roadway wearing surface was 2-inch spruce and the sidewalk plank was $1\frac{1}{2}$-inch hard pine.

In the trusses of the original bridge steel was used for main members for the first time in any bridge built for the

City of Boston. The top chords, end posts, all eyebars 4 inches wide and over, chord pins and rollers were made of Bessemer steel. All other parts of the trusses, the entire floor system and the bottom lateral bracing were made of wrought iron.

The general design and detailed drawings for the bridge were prepared by the Engineering Department of the City of Boston under Mr. Cheney's direction. The construction of the bridge superstructure was let to the Boston Bridge Works, Inc., the price paid under the contract being $46,490.90. An account of the building of the original bridge will be found in the twenty-second annual report of the City Engineer (for 1888).

In 1906 the Boston Elevated Railway Company received permission to strengthen the bridge to carry fifty-ton cars. The design made by Prof. Charles M. Spofford for that company was to insert at each side of the bridge a truss between the city trusses, provide eleven new floor beams at mid-panel points and thus support a strip of floor to include the car tracks and extend nearly from parapet to parapet. The loads carried by this street railway bridge are completely separated from the loads carried by the city bridge, and the trusses of one bridge, with the portions of the floor carried by it, are perfectly free to deflect independently of the other bridge. Under contract with the Boston Elevated Railway Company the street railway bridge was built by the Boston Bridge Works, Inc., in 1907, the work being done under the supervision of the City Engineer.

When the southerly half of the old bridge was stripped in October, 1907, preparatory to the erection of the street railway structure, the old metalwork was cleaned of scale and rust and its condition was found to be much worse than had been expected from an examination made in the summer of 1906, and showed in a striking way that the usual examination of such a bridge from below is by no means real inspection and cannot be relied upon to determine the true condition of a bridge in which corrosion is well under way. The worst effects of corrosion were generally found at the easterly end of the bridge over and near track No. 1, which is the outward bound express track of the Boston & Albany Railroad. This track is also used by switch engines in making up trains in the railroad yard just east of the bridge. The total train movements beneath the structure is between five hundred and six hundred on each week day, and about eighty on Sunday; and frequently the switch engines will

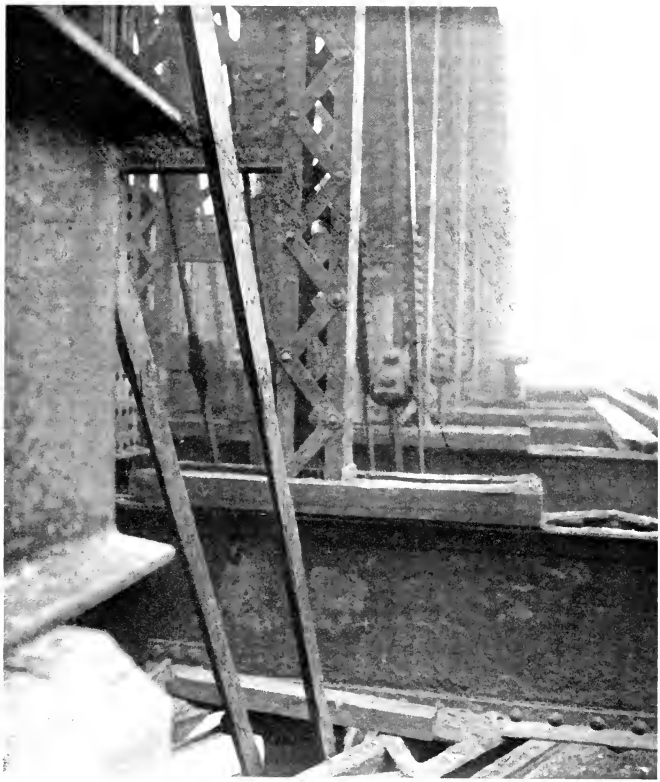


FIG. 7.—BOYLSTON STREET BRIDGE. TYPICAL CORRODED DIAGONAL OF ORIGINAL TRUSSES.

stop underneath the bridge, discharging steam and smoke which hang for a considerable time just under the bridge floor.

The floor beams at the east end of the bridge were the parts found to be in the most dangerous condition. Although built before the days of modern street cars and designed only for a uniform load of eighty pounds per square foot and a single twenty-ton wagon, these floor beams were called upon to support two car tracks, each carrying cars up to twenty-six tons in weight, in addition to the usual and frequent highway traffic at each side of the roadway. If these wrought-iron beams had been as good as new they would have been subjected, under this loading, to unit stresses of about 15,000 to 16,000 pounds per square inch in tension. It was found, however, that the beams in the worst condition had corroded to such an extent that their webs, originally $\frac{3}{8}$ inch thick, were reduced to $\frac{3}{16}$ of an inch, the outstanding legs of their flange angles were reduced from an original thickness of $\frac{1}{2}$ inch to about $\frac{1}{8}$ of an inch, and the lattice bars connecting the flanges of the two halves of these double-webbed beams were either entirely eaten off or were so thin that they could be broken with the blows of a light hammer. The condition of one of these beams is shown in the accompanying view (Fig. 1). The wooden stringers rested upon the top flanges of the beams, and in a number of cases the outstanding legs of the top flange angles were broken entirely off at the track stringers as a result of the pounding administered by the heavy street cars. In addition to the pounding, corrosion is more rapid at a point like this, as the continual bending of the metal under the passage of the street cars tends to flake off the rust-scale as fast as formed and expose fresh metal to corrosion. In at least one instance a diaphragm connecting the two halves of a floor beam was so badly rusted that it was broken entirely through, leaving either half of the floor beam to carry the load which should have been distributed over both halves.

In the trusses the eastern portion naturally showed the greater corrosion. The bottom chord bars were some distance below the flooring and were less subject to corrosion from locomotive fumes, although they showed the effect of blast action from the locomotives. These bars in most cases were corroded less than $\frac{1}{8}$ of an inch on each exposed surface, and as they were originally thicker than the diagonals the percentage of metal lost in the chord bars was on the whole considerably less than that of the diagonal bars.

The locomotive fumes would rise to the underside of the floor planking and the stringers would keep the gases pocketed there and prevent them from being blown away, consequently the worst condition of corrosion of the trusses was found in the web members just beneath the planking; here in a large number of cases from $\frac{1}{8}$ of an inch to $\frac{3}{16}$ of an inch of metal had been eaten away from the exposed surface. Post channels whose webs were originally nearly $\frac{7}{16}$ of an inch in thickness had been rusted until the webs were not more than $\frac{1}{8}$ of an inch thick and their tie plates and latticing were badly rusted also. Many eyebars having an original thickness of $\frac{3}{4}$ of an inch were found with minimum thicknesses of $\frac{7}{16}$ of an inch, $\frac{3}{8}$ of an inch and even less, and as their edges as well as their sides were corroded the loss of section in a number of the diagonals was as high as 50 per cent to 60 per cent, reaching in one case a loss of 70 per cent. (See Fig. 2.)

In addition to the corrosion the city bridge had to be still further weakened by the cutting apart of some of the metalwork, and as its condition was such that it was deemed unsafe for further traffic the bridge was ordered closed to travel and extensive reconstruction was determined upon as an imperative necessity.

In connection with the destruction of the original Boylston Street Bridge, it should be noted that the amount of headroom beneath such a bridge has an important influence upon corrosion. At this bridge, as is the case of many of our city bridges over railroads, the headroom from top of rail to clearance line of the bridge was only about 15 feet and with such low headroom the corrosive action of the locomotive fumes has generally been comparatively rapid. On the other hand, at many bridges where the headroom is 18 feet the effect of the gases under substantially similar conditions of time and railroad traffic have generally been less marked.

The Boston Elevated Railway Company desired to resume street car traffic across the bridge at the earliest possible moment and to put into service cars weighing forty-two tons; and as it would take some time to get an appropriation from the city for rebuilding the original structure, and still further time before the work of rebuilding could be begun in the field, the scheme of putting a permanent floor on the street railway bridge was abandoned and the Boston Elevated Railway Company proceeded to lay temporary tracks on its bridge as far as it extended. Near the abutments the tracks were to be carried by the city bridge and, as the old city floor beams were

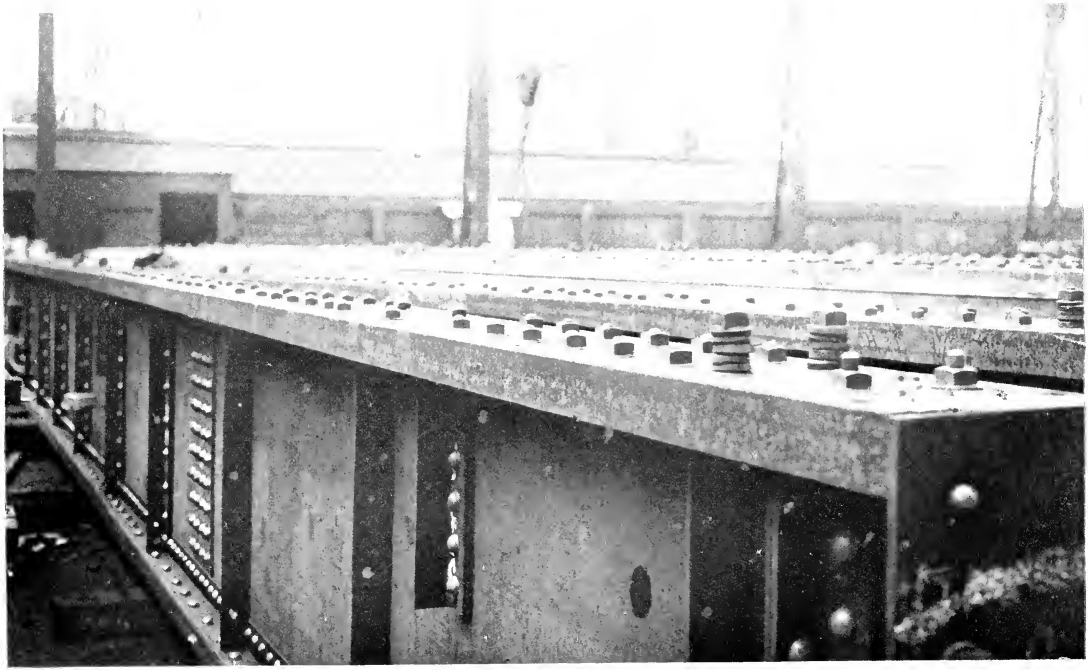


FIG. 3.—BOYLSTON STREET BRIDGE. TYPICAL FLOOR BEAM FOR NEW CITY BRIDGE BEFORE CONCRETING

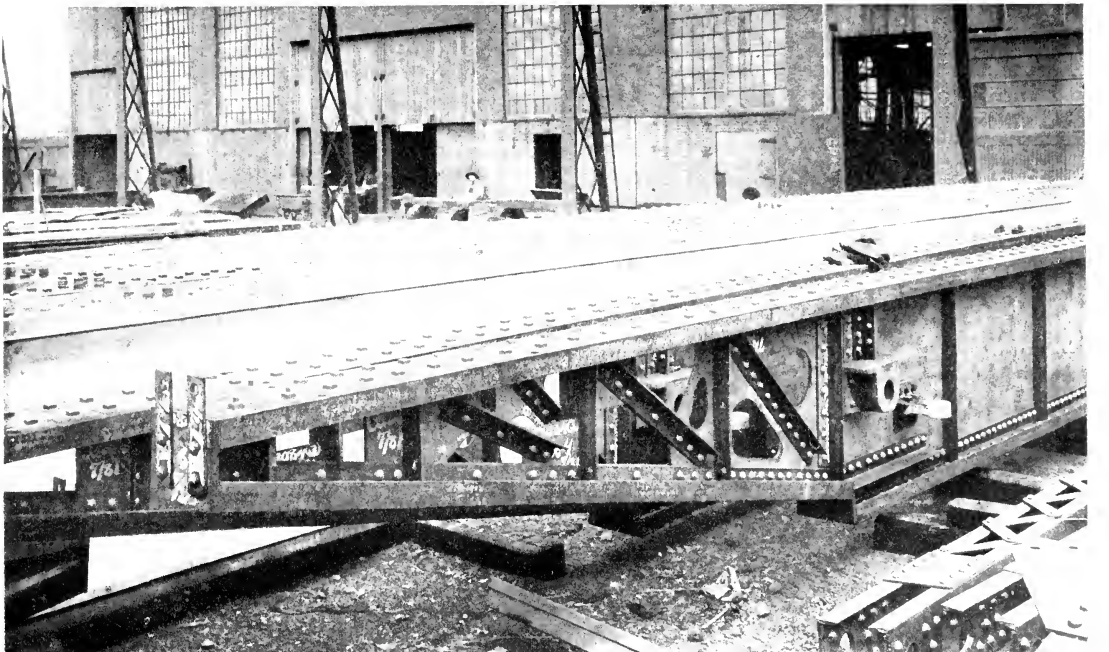


FIG. 4 — BOYLSTON STREET BRIDGE. BRACKET END OF TYPICAL FLOOR BEAM OF NEW CITY BRIDGE BEFORE CONCRETING

insufficient to support these tracks, a temporary construction of I-beams was put in at each end of the bridge.

The temporary track construction consisted of track stringers and supplementary stringers of wood upon which was laid a 3-inch plank floor about 20 feet wide for the length of the bridge, a substantial fence being provided at each side of this floor. On top of this planking T-rails were laid at an elevation considerably above that of the rails in the former bridge, the rails being above the tops of the parapet stones. No attempt was made to provide for team travel by laying flooring up to the top of the rails.

The street railway structure was completed and a temporary track was opened to travel on November 20, 1907, and during the whole work travel had been maintained upon both sidewalks. From November 20, 1907, until the work of erecting the city structure was begun in July, 1908, foot travel was continued on both sidewalks and all of the car travel of Boylston street crossed the bridge on the temporary tracks, but no team travel was allowed, and the Elevated Railway Company maintained a flagman at all times to prevent teams from attempting to cross the temporary floor.

In anticipation of the closing of the bridge to all travel during the work of reconstruction by the city, the Boston Elevated Railway Company secured a location, and in June, 1908, laid temporary tracks from Boylston street to Massachusetts avenue through Hereford and Newbury streets. All car travel was diverted to this temporary route soon after July 1, 1908, just before the rebuilding of the old city bridge was begun.

Rebuilding of the City Bridge.

The old city bridge was condemned and closed to team travel in October, 1907. On April 2, 1908, the city government of Boston appropriated the sum of $60,000 for the rebuilding of the city's bridge. Meantime plans for the work had been prepared by the Engineering Department, and bids had been called for, to be received on April 3. On that date the contract for rebuilding was let to the Boston Bridge Works, Inc., the lowest bidder, for the sum of $52,800. The work of rebuilding provided for raising all trusses so that they should be well above the floor and should thereby be protected in the future from further destruction by locomotive fumes. The top chords of the old trusses which were in good condition were retained, but the posts, diagonals and bottom chords were entirely renewed. The

floor beams of the street railway bridge were hung to their longitudinal girders by riveted hangers, while the new floor beams for the city structure were hung by eyebar hangers. The metal work for the city structure below the floor was protected, so far as possible, by concrete, although it was found to be impracticable to so protect the eyebar hangers and the bottom lateral bracing. Provision has been made for the easy renewal of these latter members when necessary. The new city floor beams are plate girders, 3 feet 11 inches deep back to back of angles, their ends being cantilevered to form brackets for the support of the sidewalks. Upon the top and bottom flanges of these beams were placed channels solely for the protection of the metal work of the beam, no dependence whatever being placed upon these channels as carrying stress. These channels are 12 inches wide and have a web $\frac{1}{2}$ inch thick. As the bottom channels have to resist only the blast of the locomotives it is thought that they will last for a great many years, perhaps for the whole life of the present structure. The top channels, on the other hand, are in a position where they will be subjected to locomotive fumes as well as to moisture which will work through the wooden flooring; these top flanges carry the wooden stringers of the bridge, which fact will hasten their destruction; consequently, the top channels are not riveted to the floor beams, but are attached to the top flanges by brass bolts in such manner that they may be readily replaced by new channels when necessary.

Figures 3 to 6 show the concrete protection of the floor beams while the same was being put in place at the yard of the Boston Bridge Works. In the first (Fig. 3) is seen part of a beam with the top channel bolted in place and with holes through the stiffener angles for the rods which are to support the reinforcing metal.

Figure 4 shows the bracket end of one of these beams with its open web.

Figure 5 shows the process of concreting the beams as well as the method of placing the reinforcing metal. One-half inch steel bars are run through the holes in the stiffener angles at the top, bottom and middle of the beam on each side of the web. To these $\frac{1}{2}$-inch bars are wired sheets of Kahn ribbed metal of 6-inch mesh.

Concrete, consisting of one part Portland cement, two parts sand and four parts fine broken stone, is being placed on one side of the beam while the latter is lying on its side. Although not called for in the specifications, the surface of the concrete was finished practically as a granolithic surface and an excel-

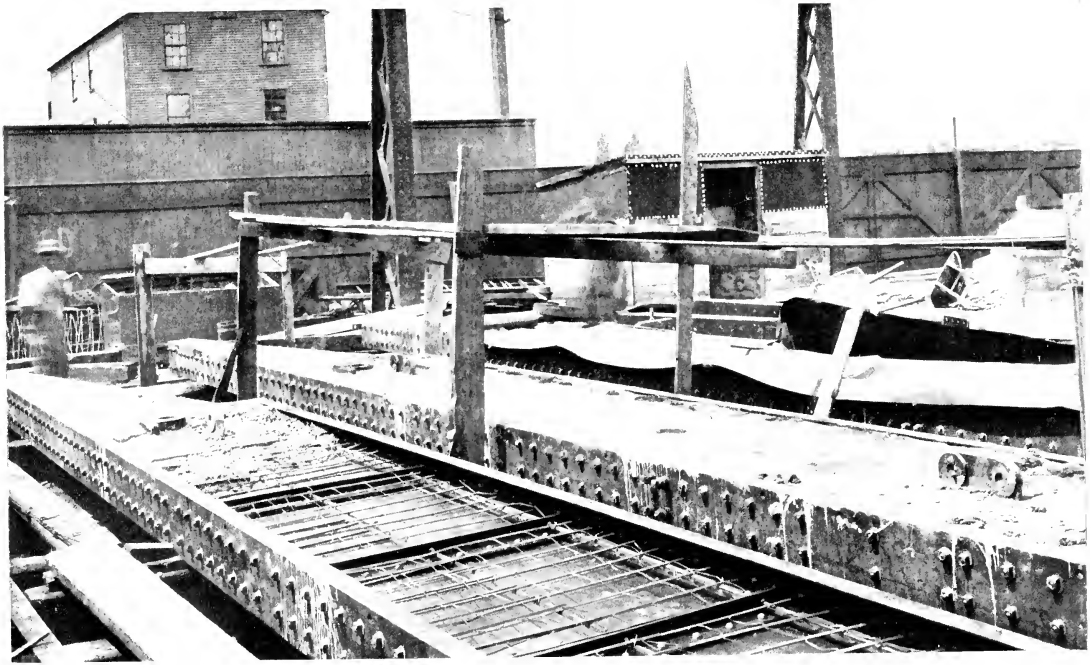


FIG. 5.—BOYLSTON STREET BRIDGE. PLACING CONCRETE PROTECTION ON WEBS OF NEW CITY FLOOR BEAMS.

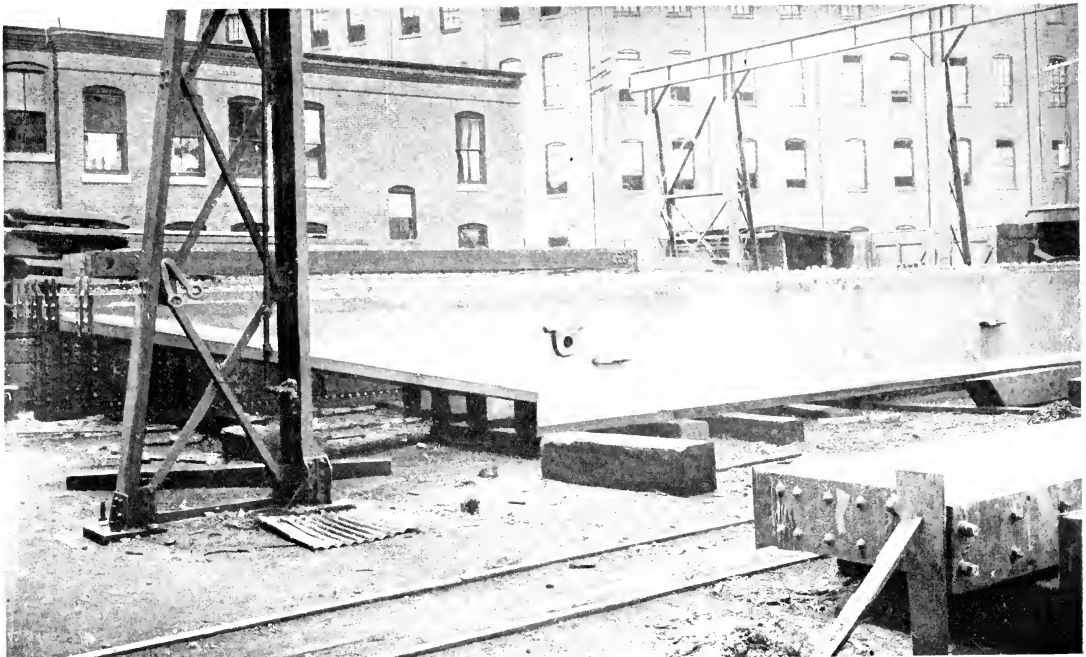


FIG. 6.—BOYLSTON STREET BRIDGE. NEW CITY FLOOR BEAM WITH CONCRETE PROTECTION COMPLETED

lent job of concreting was obtained. In this view will be noticed castings projecting from the concrete at about mid-height of the web of the floor beams. These castings are to receive the bottom lateral bracing, which is to be attached to them by means of pins in order that the bracing may be readily renewed when corroded. It was desirable to have the castings made of some metal which would be noncorrosive, as the castings themselves could not be renewed without breaking into the concrete and exposing the web of the floor beam. Several types of composition castings were considered and finally it was decided to use a casting consisting of aluminum, zinc and a small proportion of copper. This composition is patented, has a tensile strength equal to that of ordinary bronze and is probably less liable to corrosion on account of its small percentage of copper. This metal is known as macadamite and is made by the United States Macadamite Metal Company of Brooklyn, N. Y.

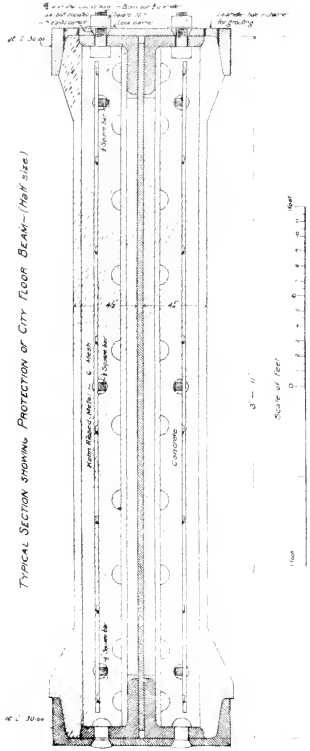
Figure 6 shows one end of a floor beam in which the concreting has been completed. Here will be seen two of the aluminum castings for the connection of the bottom lateral bracing as well as the iron casting which is to receive the pin of the eyebar hangers. As this latter casting is of relatively thick metal and projects only slightly beyond the concrete, it was thought unnecessary to make this casting of composition metal.

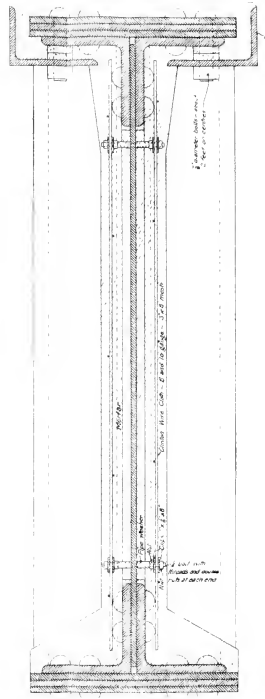
The drawing marked Fig. 7 shows further details and a comparison of the methods used for the protection of the city and street railway floor beams with concrete.

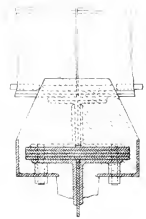
On the city floor beams the concrete protection was made $4\frac{1}{4}$ inches thick on each side of the web. The steel reinforcement, consisting of Kahn rib metal of 6-inch mesh, was placed about $1\frac{1}{2}$ inches in from the face of the concrete and was wired to the $\frac{1}{2}$-inch square bars running longitudinally through the top, bottom and middle of the stiffener angles. The stiffeners were spaced at regular intervals to accommodate standard widths of reinforcing metal. At the tapered ends of the beams, acting as sidewalk brackets, the rods were continued but the Kahn metal omitted and a lattice web used which allowed good bond between the concrete slabs on the two faces of the bracket. The bottom flange channel, used mainly to resist blast action of the locomotives, was riveted to the flange angles with countersunk rivets in the hope that the countersunk heads, being less exposed to the blast, would last longer than buttonheads. The countersunk heads were not chipped. At the top flange the protecting channel was bolted to the flange

angles with brass bolts before the concreting was done. To guard against possible electrolytic action between the brass and steel, $\frac{3}{4}$-inch diameter bolts were used in $\frac{15}{16}$-inch diameter holes, the holes in the channel were countersunk on the top side, the space surrounding the bolts was filled with elastic cement and lead washers were used between the brass nuts and the top surface of the channel. The beams were concreted while lying on the side, as shown in Fig. 5. After the beams had been concreted they were allowed to stand for some time in the bridge shop yard in an upright position, as shown in Fig. 6, and while the moisture was drying out of the concrete the latter would shrink away from the top flange to a slight extent. This action had been foreseen and provision made for grouting the top flanges after the concrete had set. Holes 1 inch in diameter had been drilled every 4 feet near the outer edge of the channels and grout was poured in through a long-nosed funnel under a head of some 6 or 8 inches. Grout consisting of two parts Portland cement and one part sand was first tried, but without success, as it would not flow properly. Neat Portland cement grout was next tried and found to flow freely for a distance of 6 or 8 feet each side of the grouting hole. The top channel was removed from some of the beams while the latter were at the yards of the Boston Bridge Works, and in all cases where neat Portland cement grout had been used the grouting was successful, the voids in the concrete having been well filled.

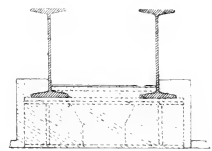
During the rebuilding of the city's bridge the Boston Elevated Railway Company decided to place a concrete protection upon the floor beams of the street railway structure, and at the request of that company the design for the protection was made by the Engineering Department of the city, the details being shown in Fig. 7. In order not to add too much dead weight to these beams it was decided to make the concrete only 2 inches thick on each side of the web and to incase each stiffener angle. The whole of the top flange and the top side of the bottom flange was protected. No protection was provided for the underside of the bottom flange, partly on account of limited headroom, but more especially because it was thought that the protection could not be held in place owing to the blast from locomotive stacks, the tops of which come within a few inches of the beams, and also because of the likelihood of the concrete or mortar cracking at the edges of the flange and exposing the reinforcing metal to corrosion. Slabs or pieces of mortar falling upon passing trains would be a

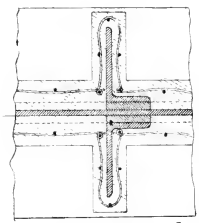




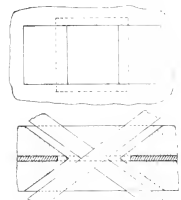


PROTECTION OF STREET RAILWAY STRINGER SEATS
(Quarter Size)

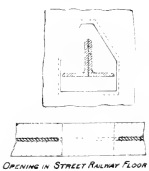




HORIZONTAL SECTION OF STREET RAILWAY FLOOR BEAM
SHOWING STIFFENER PROTECTION
(Half Size)



OPENING IN STREET RAILWAY FLOOR BEAM
FOR LATERAL RODS CONNECTING CITY FLOOR BEAMS
(Half Size)



OPENING IN STREET RAILWAY FLOOR BEAM
FOR STRUT CONNECTING CITY FLOOR BEAMS
(Quarter Size)

CITY OF BOSTON - ENGINEERING DEPARTMENT

BOYLSTON STREET BRIDGE

OVER THE BOSTON AND ALBANY RAILROAD.

CONCRETE PROTECTION OF FLOOR BEAMS.

Scales, one-half and one-quarter size

November 30, 1908.

FIG. 7. BOYLSTON STREET BRIDGE. DRAWING SHOWING CONCRETE PROTECTION OF FLOOR BEAMS

source of danger to passengers within the cars, as has been shown by experiences elsewhere. To hold the concrete protection in place at the top flanges, rivets were cut from the outer gauge lines at intervals of about 2 feet and angles were bolted to the underside of the flange, a clearance of 1 inch being provided between the angles and the edges of the flange plates, and an equal or greater clearance being allowed at the underside of the flange. The concrete at each side of the web was held by Clinton wire cloth, 3-inch by 8-inch mesh, eight and ten gauge wires, held by ¼-inch bolts through the web, holes for the bolts being drilled in the field and the bolts being provided with threads, double nuts, clips and pipe washers at each end to hold the wire cloth in proper position. A wire cloth reinforcement was placed around each stiffener angle and wired to the reinforcement on the web. Wooden forms were provided on each side of the beams reaching from the bottom to the reinforcement angles at the top flange. Openings through which concrete was placed were left just under the top flange.

The concrete protection of the street railway floor beams was really a mortar protection; mortar consisting of one part Portland cement and two parts sand being used for the web protection and a grout made of one to one Portland cement and sand being poured in and around the top flange after the web protection had been put in place. All of the work in connection with the protection of the street railway floor beams was necessarily done in the field as it was not feasible to remove these beams from the bridge. As their protection is of lighter construction than that of the city's beams, and was placed under considerable difficulty owing to the constant passing of trains beneath the bridge, it may be less durable than that of the city floor beams. The results obtained upon the street railway beams were very satisfactory, however; to all appearances the concrete is sound and continuous, without cracks or serious voids, the contact with the steel is good and it is hoped that the protection will perform satisfactory service for many years. The only steel now exposed to corrosion anywhere beneath the floor is the lateral bracing and the channel-shaped stringers in the city's bridge and the track stringers on the railway bridge and the floor beam hangers of both bridges, none of which can be conveniently protected and all of which, except perhaps the hangers of the railway floor beams, are easily removed and renewed.

The contract with the Boston Bridge Works, Inc., provided for the erection of the new city bridge within a

period of sixty days under a penalty of $100 for each day's delay, with a corresponding bonus for each day that the time of erection was shortened. The work of erection was completed in fifty days, the contractor earning thereby a bonus of $1,000. In addition to the construction of the bridge superstructure, competitive bids were received and contracts made with Frank A. Foster for the reconstruction of the abutment parapets and with John T. Shea for paving and regulating the adjacent street. The work was completed September 2, 1908. The total amount expended for construction, engineering and inspection was $60,000.

CHELSEA STREET BRIDGE, EAST BOSTON TO CHELSEA.

The bridge, with the exception of the Chelsea end, was destroyed in the Chelsea fire of April 12, 1908, and the Boston & Albany Railroad Bridge was also partially destroyed. The War Department ordered that both bridges when reconstructed should have waterways 60 feet in width. General plans were made for rebuilding the bridge and were approved by the War Department. Detail plans and specifications were made for building the ends of the draw pier and a temporary footbridge with a movable span, and a contract was made July 18 with W. H. Ellis, the lowest bidder, for doing the work for $6,831; this work was completed January 15, 1909. Another contract was made November 4, 1908, with W. H. Ellis, the lowest bidder, for building the draw foundation and the bridge at both ends of the draw; about 50 per cent of this work has been completed. Plans are being made for a new swing bridge.

CONGRESS STREET BRIDGE.

As soon as Northern Avenue Bridge was opened to travel the work of rebuilding Congress Street Bridge was begun, under a contract made with William L. Miller, dated September 14, 1908. The paving and flooring of the fixed spans were removed and such of the main stringers and bolsters as were found to be in poor condition were also removed. A careful examination by a diver showed that the oak piles were generally in such good condition that it was unnecessary to drive but four new ones. Such of the main piles as were decayed at the top were spliced out with new material and all loose spurshores were refitted. A few bolsters, all of the sidewalk stringers and about 60 per cent of the roadway stringers were replaced with new hard pine timber of the same cross-section as in the old bridge; new 3-inch side-

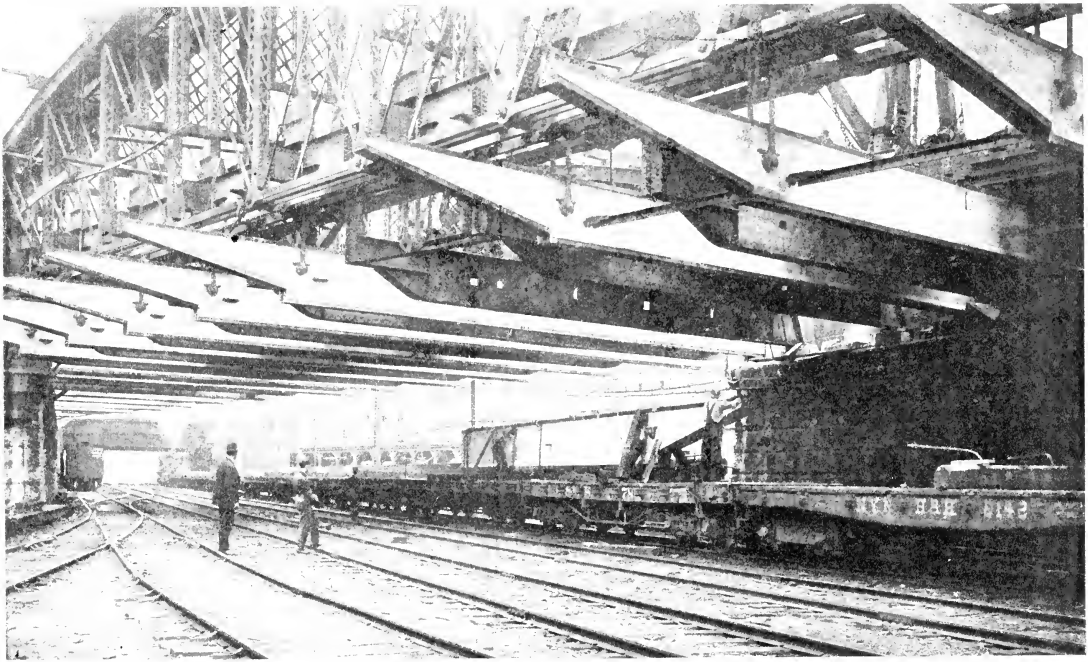


FIG. 8.—BOYLSTON STREET BRIDGE. GENERAL VIEW OF BRIDGE FROM BELOW. NEW CITY FLOOR BEAMS BEING PUT IN PLACE.

FIG. 9.—BOYLSTON STREET BRIDGE. GENERAL VIEW OF COMPLETED BRIDGE

walk planking and new 6-inch roadway planking were also laid and all curb and bulkhead timbers renewed, the cross-section of the bridge remaining substantially the same as before. All of the above hard pine timber was treated with two heavy coats of Cabot's Conservo. The flooring of the roadway was waterproofed with four thicknesses of roofing felt thoroughly mopped with pitch.

The roadway was paved with new granite block laid with pitch and pebble joints, and while the best results cannot be expected from this kind of a joint laid in very cold weather, still it is believed that a much better surface has been obtained than if only gravel joints had been used. New hard pine fences and roadway gates have been built, and the old shelters on the sidewalks have been thoroughly repaired and painted. New asphalt sidewalks will be laid as early in the spring as the weather will admit.

Under the same contract the temporary bridge, between Congress Street and Summer Street bridges, was removed, and the steel work of the sidewalk on the Summer Street Bridge was restored. The asphalt sidewalk will be relaid as early in the spring as satisfactory work can be done. The area covered by the temporary bridge has been carefully examined by divers and all material found above the surface of the bottom, as it existed at the time the temporary bridge was built, has been removed to the satisfaction of the engineering officer representing the Secretary of War in this district.

The moving machinery of the draw has been thoroughly repaired, new upper and lower tracks have been cast and set in molten lead, the center pivot cleaned and adjusted and all parts of the turntable put in good working order. The upper and lower planking of the roadway of the draw has been renewed and the whole draw span left in such condition that with ordinary repairs it is believed that it can be kept in satisfactory working order for at least ten years. The bridge was closed to travel from October 28, 1908, to January 26, 1909.

During the coming year the draw fender pier will be repaired, the balance of the appropriation remaining being sufficient for the purpose.

DEER ISLAND BOUNDARY WALL.

This work has been finished. The Atlas Construction Company completed the work under its contract on July 30. No settlement has as yet been made with the contractor.

On June 30, 1908, a contract was made with the W. A.

Murtfeldt Company, the lowest bidder, for building an extension of the wall at its westerly end to the half-tide contour. This extension is 90 feet in length and of the same character as the rest of the wall with a heavy post 4 feet square in plan at the end of the wall. It was completed on October 17, at a cost of $1,488.

EAST BOSTON GRADE CROSSINGS.

Mr. James Doherty completed the work to be done under his contract dated September 30, 1907, for paving on Sumner and Orleans streets and Murray court, on April 10, at a cost of $1,971.16.

Mr. Doherty also completed on April 10 the work to be done under his contract dated October 30, 1907, for paving on Sumner and Bremen streets, at a cost of $5,999.07.

On April 22, 1908, a contract was made with Robert Eagar, Jr., for the completion of the grading and paving on Sumner street between Bremen and Orleans streets. This work was finished on July 9, at a cost of $3,766.34.

The bridge on Sumner street and the paving were so far completed that the street was opened to travel of all kinds on June 22, 1908.

The footbridge on Webster street was finished early in the summer. The approaches to this bridge on Webster street were repaved, the work being completed on July 9.

This completed the work to be done by the city so far as authorized by the decree of the Superior Court.

The following is a short history of the official action taken to carry out this improvement.

The first official action looking towards the abolishment of grade crossings in East Boston was the passage of an order by the City Council on February 19, 1874, requesting the Mayor to petition the General Court for the passage of an act changing the location of the Eastern and Boston & Albany railroads so as to prevent the crossing at grade of Marion, Prescott, Porter, Maverick, Sumner and Webster streets by the tracks of said corporations.

The petition was presented to the Legislature of that year and resulted in the passage of chapter 53 of the Acts of 1874, approved May 22, 1874. This act referred the petition of Samuel C. Cobb, Mayor of Boston, to the Board of Railroad Commissioners with instructions "to consider and report to the next General Court what change, if any, should be made in the locations of said railroads in the City of Boston, or what change, if any, should be made in any highway in said

city, or what measures of any kind whatever can or ought to be taken for the purpose of obviating the present crossing of the said streets in said city at grade by the tracks of said railroad corporations; and also a plan for the equitable apportionment between any railroad corporations interested, the City of Boston, and any persons or corporations interested of the expense of any change of grade or location either of the railroads or any highway, or the carrying out of any measures which in the judgment of the Board may be required by considerations of public safety and convenience."

In compliance with this act the Board of Railroad Commissioners held hearings on October 14 and 23, 1874. A plan and estimate of cost prepared by the City Engineer, dated September 28, 1874, were submitted by the City of Boston; this plan provided for deflecting the lines of the two railroads at the crossing of Chelsea creek and relocating them on the easterly side of the island, so as to run along the water front and across the flats to and around Jeffries' Point and then connect with the existing terminal grounds at their easterly end.

The Board of Railroad Commissioners in its annual report of January, 1875, approved of the above plan and submitted an act which provided for carrying out the improvement in accordance with the plan. This act authorized the railroad companies to relocate their tracks on request of the Mayor and aldermen, the taking of land and the apportionment of the cost between the railroad companies and the city by a special commission to be appointed by the Supreme Judicial Court under chapter 372 of the Acts of 1874, which chapter was the general act relating to railroads; if the companies did not relocate within six months after such request of the Mayor and aldermen the latter could proceed under the general railroad law to compel them to do so. The proposed act also provided that the city might levy the amount assessed upon it upon the estates east of the existing location of the railroads in the same manner as betterments are assessed for highway improvements.

The Legislature passed an act, chapter 214 of the Acts of 1875. This act was substantially the same as that recommended by the Railroad Commissioners except that the section of the latter was omitted which provided for action compelling the railroad companies to relocate in case they did not do so within six months after being requested to do so by the Mayor and aldermen.

During the year 1875 the Boston, Revere Beach & Lynn Railroad was built, which brought a further complication into the situation.

On the 22d of November, 1875, the City Council passed an order appointing a special committee to confer with the Eastern, the Boston & Albany and the Boston, Revere Beach & Lynn railroad companies and ascertain upon what terms they were willing to co-operate with the city in changing the location of their tracks as provided by the recent act of the General Court, and the committee was to also report whether any additional legislation is necessary in order to secure the relocation of the tracks.

On December 13, 1875, the above committee recommended the passage of an order that the Mayor be authorized to request the three railroad companies to relocate their tracks in accordance with the plan made by Joseph P. Davis, City Engineer, dated September 28, 1874. The Mayor acted as requested. The Eastern Railroad Company on December 27, 1875, and the Boston, Revere Beach & Lynn Railroad Company on January 31, 1876, replied, declining to relocate. These communications were referred to the Committee on Paving, who reported on March 6, 1876, that further action was inexpedient, which report was accepted.

Nothing further appears to have been done concerning these grade crossings for several years.

On November 24, 1884, an order was passed by the City Council for the construction of a footbridge over the railroad tracks at Sumner street in accordance with a plan dated July 14, 1884, filed in the office of the City Engineer. Nothing was done under this order.

On February 3, 1887, the Common Council referred to its committee on legislative affairs an order requesting the Mayor to petition the Legislature for an act changing the location of the Boston & Maine Railroad (that company having acquired control of the Eastern Railroad) and the Boston & Albany Railroad in East Boston, so as to prevent the crossing of streets at grade. There is no further record of action under this order.

Chapter 428 of the Acts of 1890, approved June 21, 1890, was a general act provided for the abolishment of grade crossings.

On January 19, 1891, a committee was appointed by the City Council to consider and report on the question of the abolishment of grade crossings in East Boston.

On October 5, 1891, the Board of Aldermen passed a resolution that in the opinion of the Board the Mayor and aldermen should petition for the appointment, under the general grade crossing act, of a commission to consider the abolishment of the grade crossings in East Boston.

On October 19, 1891, the Mayor communicated to the aldermen the opinion of the Corporation Counsel that the above order was informal and inoperative. No further action appears to have been taken that year.

On January 14, 1892, a committee was appointed by the City Council to consider and report a plan for the abolition of grade crossings in East Boston.

February 23, 1892, a petition was received by the City Council from the East Boston Trade Association for the abolishment of grade crossings.

On October 31, 1892, the Board of Aldermen passed a resolution stating that in the opinion of the Board a petition should be presented by the Mayor and aldermen to the justices of the Superior Court for the appointment of a commission to proceed with the abolishment of grade crossings in East Boston.

From this time until final action was taken the matter was constantly under consideration.

A plan was made, dated November, 1893. This provided for carrying the streets over the Boston & Maine and the Boston & Albany railroads in the existing locations of the latter, with the exception of Marginal street, which was to be widened without change of grade; Bremen street was to be extended from Sumner street to Marginal street; Webster, Sumner and Maverick streets were to be carried over the railroads; Neptune road was to be extended to Eagle square, passing over the railroads and over Bremen street, Eagle square and Chelsea street being raised to meet the new grade at Neptune road; Bennington and Saratoga streets were to be discontinued where they crossed the railroad; Curtis street was to be raised to go over the railroad and on the westerly side of the railroad the street was to be deflected to the north to run in a direct line to Chelsea Street Bridge; Pope street was to be extended southerly to Bennington street.

May 7, 1894, the East Boston Company petitioned the City Council for action.

In 1894 the Mayor petitioned the General Court for authority to abolish the crossings and his action was indorsed by the Board of Aldermen December 17, 1894.

Chapter 491 of the Acts of 1895 provided for the abolishing of the grade crossings in East Boston upon petition of the Mayor and Board of Aldermen to the Superior Court praying for such action, and upon the submission of plans, profiles and estimates of the probable cost the court should give hearings and appoint a commission which should consider the matter and report a recommendation. The city

was to do the work. The commission was to determine what portion of the cost should be paid by private parties, the balance to be paid, 65 per cent by the railroad companies, 25 per cent by the Commonwealth and 10 per cent by the City of Boston. If any railroad company should decide to abandon its location it was not to be assessed. This act was approved June 5, 1895.

In 1895 a plan was prepared by the City Surveyor of Boston for relocating the Boston & Maine and the Boston & Albany railroads. This plan provided for the railroads being deflected from their existing locations at Chelsea creek, between Curtis and Moore streets, by a location running to the flats and parallel to the latter, thence around the easterly end of Wood Island and southwesterly across the flats in a line parallel to the existing line to Jeffries' Point at a point in line with Sumner street, thence curving northwesterly to the present terminal. The Boston, Revere Beach & Lynn Railroad was to be raised to pass over Saratoga street and then deflected to the south of its present location and run across the flats to meet the other roads and then to run in conjunction with them, but on the easterly side of them, to its present wharf. The City Engineer submitted an estimate of the cost of this plan on July 29, 1895, and on the same date the Board of Aldermen passed an order that the City Solicitor submit the petition of the Mayor and aldermen to the Superior Court for the abolishment of the grade crossings in accordance with chapter 491 of the Acts of 1895.

The next plan prepared was dated April, 1896. By this plan the two westerly railroads were to be deflected just north of Curtis street, carried through Curtis and Harmony streets and under Pope, Chaucer, Saratoga and Bennington streets, which were to be raised for short distances, to the flats, then curved southerly to the westerly side of the Boston, Revere Beach & Lynn Railroad near Neptune road, thence to run parallel to the latter. The Boston, Revere Beach & Lynn Railroad was to be deflected to the east for a short distance to give a better entrance to its tunnel, which was not to be changed. The other railroads were to be continued by another tunnel to their present terminal crossing, no street to be crossed at grade except Marginal street. It was necessary by this plan to raise Maverick and Everett streets so as to pass over all the railroads.

A plan dated June 12, 1896, was the same as the last described, except that all the railroads were to be carried through an enlargement of the present Boston, Revere Beach & Lynn Railroad tunnel. This necessitated a long

curve south of Marginal street to enable the two westerly railroads to reach their terminal.

On July 27, 1896, the Mayor sent a communication to the Board of Aldermen submitting the plans of April, 1896, and recommending their approval. The matter was referred to a committee, but nothing further appears to have been done that year.

During 1897 no official action appears to have been taken except the appointment by the Board of Aldermen of the usual committee on March 22.

January 13, 1898, the Common Council ordered its president to petition the Legislature for "such legislation as may be necessary for the abolition of the grade crossings in East Boston," and on February 24 the Common Council appointed a committee to appear before the committee of the Legislature and urge legislative action. No further action appears to have been taken that year.

On January 30, 1899, the Board of Aldermen ordered "that the City Engineer be directed to prepare plans and estimates of the cost of such alterations of all the crossings of railroads and public ways in that part of Boston called East Boston as will avoid crossings at grade, in accordance with the provisions of chapter 491 of the Acts of 1895."

March 13, 1899, the Board of Aldermen ordered that the Mayor be requested to instruct the Corporation Counsel to appear before the Legislature and favor such legislation as will provide for a commission to consider the abolition of grade crossings in East Boston. As a result chapter 390 of the Acts of 1899 was passed and approved May 23, 1899. This act provided that upon petition filed by the Mayor and aldermen of the City of Boston for the abolition of the grade crossings of the Boston & Maine and the Boston & Albany railroads in East Boston the Superior Court may appoint a commission to determine whether said grade crossings or any of them should be abolished or the use thereof changed or regulated.

If the commission should determine that the public interests required the abolition of the grade crossings the commission was to prescribe the manner and limits within which alteration of the grades of Curtis, Saratoga, Bennington, Maverick, Sumner and Webster streets shall be made by lowering the tracks of the said railroads within the limits thereof and by carrying said streets over said tracks. Prescott and Porter streets were to be carried over the tracks or over the tracks and Bremen street; Saratoga and Bennington streets could be carried over the tracks on one bridge. The cost was to

be apportioned, 20 per cent to the City of Boston, 30 per cent to be paid by the Commonwealth and 50 per cent to be paid by the railroad companies.

Under this act either of the railroad companies might abandon its location by giving notice to the court within two months after the report of the commission, and the decision of the commission shall not be enforced against said company.

Changes in the grades of the railroads required the approval of the Railroad Commission.

On May 25, 1899, the Board of Aldermen passed an order petitioning the Superior Court for the appointment of a commission under the above act.

On October 27, 1899, Messrs. George W. Wiggin, William B. French and Edward P. Bishop were appointed by the Superior Court as commissioners under the act.

Numerous hearings were held but little was accomplished so far as the public was informed until the year 1901.

There seems to have been some dissatisfaction with the limitations of the Act of 1899, for on July 16, 1900, chapter 462 of the Acts of 1900 was approved. This was an amendment of the previous act and provided that under certain conditions the commission might require the relocation of the Boston & Maine and the Boston & Albany railroads.

During the year 1901 several plans were submitted. The first plan of which there is any record was dated July 9, 1901, and was substantially the same as the one finally adopted, the chief difference being that in the former the connection of Bremen street with Curtis street was not discontinued, and Prescott street was to be carried by a bridge over all of the tracks of the freight yard. This plan provided for lowering the grade of the railroad tracks to Grade 10 above city base from Curtis street to Sumner street and the carrying over the railroad by bridges and the raising of the grade of Curtis, Saratoga, Bennington, Prescott, Porter, Maverick and Sumner streets, and the raising of the grade of the approaches to those streets on Bremen and Orleans streets. Webster and Marginal streets were to be discontinued between the lines of the railroad locations.

As a result of the amendment of the act passed in 1900 several of the former plans were taken up again with modifications.

The plan dated October 1, 1901, made some unimportant changes in that of April, 1896, before described.

A plan dated November 11, 1901, differed from that of July 9, 1901, by providing for carrying Webster street over

the railroads and building a new street running diagonally through the block from the junction of Webster and Orleans streets to Marginal street.

The plan of November 15, 1901, was the same as that of October 1, 1901, except for a slight change at Everett street in the length of street in which the grade was changed.

In the same way the plan of November 22, 1901, was a slight modification of the plan of June 12, 1896.

The plan dated December 1, 1901, followed that of June 12, 1896, except that the point of departure of the proposed line from the existing one was just south of Curtis street and the line across the upland was in Swift street instead of Harmony street.

The plan of January, 1902, provided for a relocation of the Boston & Maine and Boston & Albany railroads. The line ran through Harmony street as in the plan of April, 1896, crossed the Boston, Revere Beach & Lynn Railroad, which was to be raised to pass over the other two railroads. The line cut through the high ground on Wood Island Park and ran across the flats to the shore at Jeffries' Point, then followed the shore outside of Marginal street to the existing terminal. The old locations of the two westerly railroads were to be abandoned between the point of deflection near Curtis street and Marginal street. The Boston, Revere Beach & Lynn Railroad was to be raised so as to pass over the other railroads at all crossings and also over Maverick, Everett and Marginal streets.

The plan of February, 1902, provided for relocating through Harmony street as in previous plans, but by this plan the line was to pass under the Boston, Revere Beach & Lynn Railroad near Wood Island Park and follow the location of the latter through its tunnel, while the Boston, Revere Beach & Lynn Railroad was to curve westerly between Porter and Gove streets, pass under Cottage street, which was to be raised, to the location of the Boston & Maine Railroad, which it was to follow to a new ferry landing. All streets crossed were to be raised to pass over the railroad; Everett and Maverick streets were to be carried over the new location of the Boston & Albany Railroad.

The next plan was dated January, 1903. The line was the same as on the plan of April, 1896, from Chelsea creek to a point south of Wood Island Park, where it curved to the west and ran diagonally across the marsh and flats to the existing location; Orleans, Maverick and Sumner streets were to be carried over the railroads.

Fourteen plans differing more or less from each other have

been briefly described, but the one finally adopted by the commission was the sixth in order of time with some slight modifications.

The statute was further amended by chapter 144 of the Acts of 1903, approved March 10. This act extended the time during which the railroad companies might continue to use the old location, in case of relocation, from three to six years, and also removed the restriction as to the time in which the commission was required to report.

The matter was under consideration by the commission for more than four years and during that time there was considerable impatience shown by the citizens of East Boston, as evidenced by numerous orders and resolutions of the City Council urging action or asking for reports of progress and reasons for delay.

The commission finally submitted its report to the Superior Court on February 11, 1904, accompanied by a plan.

The court issued its decree ordering the work to be done in accordance with the report of the commission on May 13, 1904.

The plan called for the depression of the tracks of the Boston & Albany Railroad beginning at the southerly side of Chelsea creek and descending until the grade of the top of the rail is 10 feet above city base at a point a short distance south of Curtis street; this grade continues to near Maverick street where a further depression to Grade 9.75 is made, continuing at that grade until Sumner street is passed. The grade then rises until it meets the old grade near Clyde street.

The Boston & Maine Railroad Company abandoned its location.

Curtis, Saratoga, Bennington, Prescott, Porter, Maverick and Sumner streets were all carried over the tracks by bridges of steel with concrete and asphalt floors, the bridges being supported by abutments of concrete masonry. The grades of these streets and the approaches to them on other streets were raised so as to leave a clear headroom above the rails of 16 feet at all the bridges except at Maverick and Sumner streets where the headroom is 15 feet 6 inches.

Those portions of Decatur, Webster and Marginal streets within the location of the railroad were discontinued, while Prescott and Porter streets were laid out across the railroad from Bremen street to Frankfort street.

A footbridge of steel was built on Webster street, the approaches thereto being by stairs from the old grade of the street at each end of the bridge.

Bremen street at its junction with Curtis street was not raised but instead a new street was laid out parallel with and

adjacent to Curtis street from Bremen street to Chelsea street. This street was later discontinued and to take the place of it another street named Beck street was laid out through land of the Standard Oil Company from Bremen street to Chelsea street a short distance south of Curtis street.

All of the streets were constructed with granite curbstones and paved gutters; the roadways of Curtis street, Bremen street, except on the approaches to Maverick and Sumner streets, Saratoga street, except where previously paved, Bennington street, Orleans street, except on the approaches to Maverick and Sumner streets, Neptune road, Prescott street, Porter street, Everett street and Murray court were surfaced with Telford macadam 12 inches thick; the sidewalks of these streets were surfaced with broken stone, except that where brick sidewalks previously existed these were restored.

The other streets changed were surfaced with granite blocks on gravel base for the roadways and brick pavement on the sidewalks.

Fences were of cedar posts with three 2-inch by 6-inch spruce rails.

Considerable changes in sewers, gas and water pipes and electric wire conduits were required.

All work on the railroad and the building of the bridges was done by the Boston & Albany Railroad Company. That company under agreement with the city also did nearly all of the subgrading of streets. All other work on the streets was done by the city except that done by the various public service corporations on their own constructions.

Work was begun soon after the issuing of the decree by the Superior Court and was continued without interruption until completed in July, 1908.

Long Island Wharf.

Plans and specifications were made for building a new wharf on the northwest side of Long Island, Boston Harbor, for the Pauper Institutions Department, and a contract was made June 12, 1908, by the Pauper Institutions Department with Lawler Brothers for building the wharf. The work was completed December 17, 1908, at a cost for contract work of $13,279.75. Another contract was made July 17, 1908, with Lawler Brothers for removing the old wharf and building part of the runway. This work was completed December 4, at a cost of $1,700.

The old wharf was 142 feet long; the new wharf is 300 feet long and is 140 feet wide at its outer end. It is built of oak

piles, hard pine lumber and kyanized spruce planking and has two Winter patent drops and a breakwater.

MASSACHUSETTS AVENUE BRIDGE, OVER THE BOSTON & ALBANY RAILROAD.

The original bridge was an iron structure built in 1876. In 1907, after thirty-one years' service, the metalwork had corroded to such an extent from the action of the locomotive fumes that the bridge was declared unsafe for heavy street car traffic and unsuitable for the highway traffic to which it was subjected. Its condition was such that the City Engineer recommended its immediate rebuilding, and in 1908 the sum of $40,000 was appropriated for the purpose. Plans for a new bridge were prepared by this department.

The letting of the contract for the rebuilding of the bridge was delayed to enable the work to be done under the legislative acts of 1906 and 1908, by which the street railway company and the Boston & Albany Railroad Company might be called upon to share in the expense of the work, and to this end a petition was presented by the city to the Board of Railroad Commissioners. In August an agreement was entered into between the City of Boston, the Boston & Albany Railroad Company, the Boston Elevated Railway Company and the West End Street Railway Company which permitted the city to do such work upon the bridge as the Board of Railroad Commissioners might direct, without waiting for the appointment by the Superior Court of a special commission to apportion the cost of the work and without waiving any of the rights of the city in the matter of the apportionment of cost between itself and the public service corporations named.

Bids for rebuilding the bridge were received by the City Engineer, after public advertisement, on September 10, 1908, and a contract was made with the New England Structural Company of Boston, the lowest bidder, to do the work for the sum of $22,342. The contract provided for the completion of the work on or before December 15, 1909, and stipulated that the erection of the work in the field should be done within a period of thirty calendar days under a penalty of $100 per day for each day that the period of erection exceeded thirty days, with a corresponding bonus for each day that the time of erection was shortened. The work of erecting the bridge was begun at noon of November 11, 1908, and was completed prior to noon of December 7, 1908, the time occu-

pied being twenty-six days, or four days less than the stipulated time, the contractor earning thereby a bonus of $400. Throughout the progress of the work foot travel was maintained upon one sidewalk and street car travel was maintained upon one car track, the street railway company having laid and used a temporary track on the westerly side of the roadway until the easterly permanent track was ready for use; but team travel was shut off of the bridge from November 11 to December 7, 1908. Street car travel was resumed on both permanent tracks on December 5, 1908.

The new bridge, like the original structure, is a deck plate girder bridge, 90 feet wide by 70½ feet long, and is built on a slight skew. It has two sidewalks each 15 feet wide and a roadway 60 feet in width carrying two car tracks. The new bridge is built upon the old abutments and its surface is at substantially the same elevation as the original bridge, slight changes in grade having been made to offset settlements which had occurred in the abutments of the original bridge and in the street adjacent thereto. Some resurfacing of the street adjacent to the bridge and the reconstruction of the abutment parapets were thereby made necessary.

The steel superstructure consists of eleven main girders, spaced 9 feet apart on centers, to which are framed transverse floor beams consisting of 12-inch I-beams, spaced 3 feet 3 inches apart on centers. Throughout the work the steel was made of unusual thickness in order that it may still be strong enough after future loss by corrosion. As the bridge was to be erected in freezing weather it did not seem feasible to protect the steel work with concrete, and instead it was coated with a covering of special asphalt mopped over all metal surfaces to a thickness of about one-tenth of an inch. So far as known this is a new departure in the protection of steel.

The underflooring of the bridge is long leaf yellow pine, 6 inches thick in the roadway and 4 inches thick in the sidewalks. The tops of the girders, which are slightly below the surface of the wooden underflooring, are covered to the floor level with asphalt mastic. The whole surface of the underflooring is waterproofed with layers of roofing felt laid in asphalt. The roadway surface is creoresinate wood block pavement; the sidewalk surfacing is paving brick. Curbs are of cast iron and the sidewalk railings are the standard iron bridge railing.

The total cost of the work, including the bridge structure, street resurfacing, engineering and inspection, was $28,059.82.

MERIDIAN STREET BRIDGE.

The work remaining to be done by Jones & Meehan under their contract of August 7, 1907, which, as mentioned in the last annual report, was postponed till the spring of 1908, was not done, as it would necessitate the closing of part of the bridge, which was not deemed advisable, as the Chelsea fire of April 12 had destroyed Chelsea Street Bridge, leaving Meridian Street Bridge as the only line of travel between East Boston and Chelsea. The contract was terminated October 17, 1908, the total payments to the contractor by the city being $6,724.66.

NORTHERN AVENUE AND SLEEPER STREET.

The work of building Northern avenue and Sleeper street, as required by chapter 381 of the Acts of 1903, has been carried on during the year and the portion from Atlantic avenue across Fort Point channel and along Sleeper street was turned over to the care of the Superintendent of Streets and opened to public travel October 26, 1908.

During the past year the erection of the steel work of the draw and fixed spans of the bridge over Fort Point channel under the contract with the New England Structural Company has been completed. The flooring of these spans, including the granite pavement of the roadway of the fixed spans, under a contract with Jones & Meehan, has also been completed. Under a contract dated August 31, 1908, Jones & Meehan have laid asphalt sidewalks on the bridge, but final payment on this work has not been made at the date of this report. The railings on the bridge and the roadway gates were built by the W. A. Snow Iron Works under two contracts dated April 15, 1908, and June 28, 1908, respectively, and final payments have been made. It was decided to operate the draw span of this bridge, weighing about 1,300 tons, wholly by compressed air; the end lifts are operated at a pressure of 200 pounds and the turning engines at a reduced pressure of 80 pounds per square inch. February 15, 1908, a contract was made with the Ingersoll-Rand Company for furnishing two air compressors with automatic attachments for starting and stopping. These were subsequently installed by the Walworth Construction and Supply Company, which company on February 21 of the same year entered into a contract for the fabrication and erection of the turning and lifting mechanism of this span, and the work has been completed.

A contract for building a drawtenders' house and a power house combined was awarded to Jones & Meehan June 4, 1908, and was completed about three months later.

The portion of the avenue on the South Boston side for a length of about 500 feet easterly from Fort Point channel and the part of Sleeper street southerly from the avenue have been paved with granite blocks, edgestone set and brick sidewalks laid. This work was done under a contract with Jones & Meehan, dated September 30, 1907. The catch-basins and outlet drains required for the area paved have been built by the Sewer Division of the Street Department. As the lines of the tracks of the New York, New Haven & Hartford Railroad Company have not been laid in the avenue this portion has not been opened to public travel.

A contract was made with William L. Miller, dated April 17, 1908, for building sea walls on the northerly line of the avenue at the heads of docks Nos. 2 and 3 and for a timber bulkhead between the walls at pier No. 3. The work under this contract is so far advanced that it will be completed early in the spring. As soon as the water pipes are laid in the avenue a contract will be made for paving and doing the other work remaining to be done, so that the street can be opened to travel for its entire length before the close of the present year.

STREETS.

Preliminary surveys, working plans and specifications were prepared and forwarded to the Street Department for the construction of 9 assessment streets, for repaving 18 streets and for constructing artificial stone sidewalks in 9 streets; surveys have been made, levels taken and preliminary plans prepared for 15 assessment streets and for repaving 8 streets; the necessary surveys were made and grades for street railway tracks determined in 19 streets.

A survey was made, levels taken and study prepared for a flight of iron steps from the Charlestown Bridge to Water street; plans and specifications were made for a concrete retaining wall and board fence in Terrace street at the Park brewery; a list was prepared giving the character, length and areas of the surfaces of 46 streets; preliminary estimates have been made of the cost of repaving 34 streets and for constructing 42 streets.

The street book, giving lengths and areas of pavements in accepted streets and public alleys, has been corrected to February 1, 1908, and is now being brought up to February 1, 1909.

WATERWORKS.

The amount of work done by contract in the Water Department has largely increased during the past two years; this has added materially to the work of the Engineering Department, involving as it does not only the necessary studies, preparation of plans, specifications, etc., but the supervision of the work done and the making of estimates for payment.

During the past year the number of these contracts numbered thirty-seven.

The 48-inch low service main laid last year from Tremont street through Prentiss street and Longwood avenue to Brookline avenue was extended in Longwood avenue to connect at Muddy river with the 48-inch line laid by the Metropolitan Water and Sewerage Board from Coolidge Corner, Brookline; this new feed greatly strengthens the supply to the city and will still further strengthen it when the Metropolitan Board extends the 48-inch pipe from Coolidge Corner to Chestnut Hill Reservoir, as it proposes to do early in the coming season.

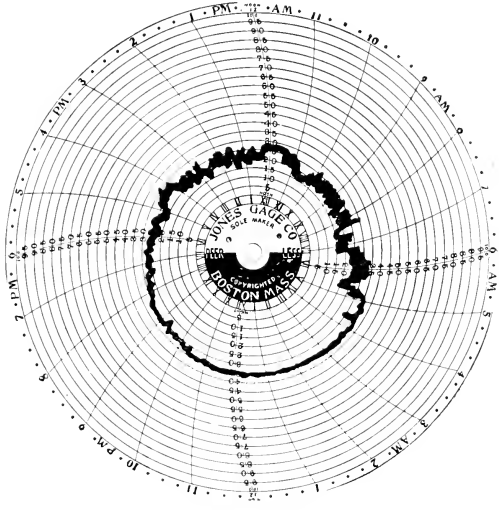
Two lines of flexible pipe were laid to improve the harbor service. One, between Long Island and Rainsford Island, a 4-inch pipe, 3,534 feet in length, to replace a pipe of the same size laid in 1895; and the other, between Moon Island and Long Island, a 12-inch pipe, 3,231 feet long, to supplement a 6-inch line laid in 1895, which for several years past has been too small to furnish a satisfactory supply for Long, Rainsford, Gallop's and Lovell's islands and for Fort Warren; the effect of putting this 12-inch line into service is shown on opposite page by gauge dials from Long Island taken before and after the line was turned on.

The flexible pipes were laid in a trench 5 feet deep by means of a long chute extending from the deck of a lighter to the bottom of the trench, the lighter being pulled ahead as each pipe was jointed. The pipes were tested for leakage before the trench was refilled and again after refilling, and the actual leakage found, under 85 pounds pressure, in the two lines after the completion of the work was as follows:

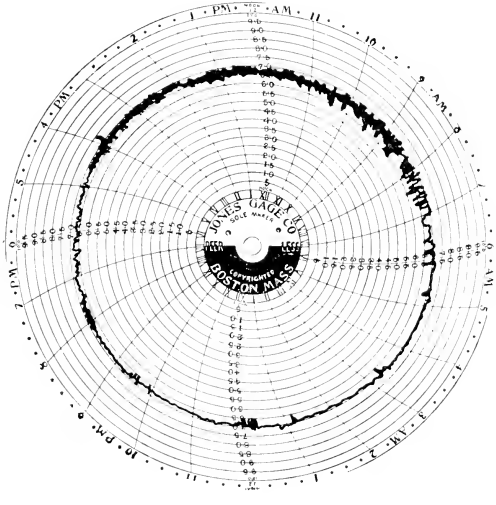
3,534 linear feet, 4-inch, Long to Rainsford, 0.086 cubic feet per minute.
3,231 linear feet, 12-inch, Moon to Long, 0.036 cubic feet per minute.

The 20-inch and 30-inch low service and 16-inch high service mains on Warren Bridge are in a very unsafe location, the 30-inch and 16-inch pipes being particularly a source of anxiety, as they have already failed several times by pulling

GAUGE DIALS FROM LONG ISLAND SHOWING INCREASE PRESSURE DUE TO 12-INCH LINE LAID BETWEEN MOON AND LONG ISLANDS



December 8, 1908.



January 17, 1909.

apart. They are laid under the flooring of the bridge with six 90° bends, the unbalanced pressures from which can only be transferred by rods and struts to the wooden bridge structure, which was built in 1883–84. On account of the age of the bridge there is nothing sufficiently substantial to fasten to and the result is frequent and dangerous movements of the pipes. The low service pipes have not been in use under usual conditions since 1898, when the state began to supply water to the city and the pressure in Charlestown was raised about 15 pounds above that in the city proper. It has, however, been necessary to put them in service a number of times when one or more of the regular supply mains have been out of commission. In the event of a very serious fire in the downtown district an effective head might only be maintained through their use, and the ability to obtain a supply from the northern low service of the Metropolitan waterworks by means of these pipes would be invaluable in time of conflagration or serious accident by making available the large storage of Spot pond at a time when such help was vital.

The 16-inch pipe on the Warren Bridge is the only feed for the high service district of Charlestown and its failure would destroy high service in that section. I recommend that a tunnel large enough to carry a 36-inch and a 16-inch pipe be built under the Charles river in the neighborhood of Warren Bridge; the approximate cost of this work is $100,000.

East Boston is supplied by the Metropolitan Water and Sewerage Board through two lines of 24-inch pipe crossing Chelsea creek from Chelsea to East Boston. These pipes, laid in 1871 and 1900, are laid on the bottom of the creek and are entirely exposed above low water mark on each shore; their location is particularly dangerous on the Chelsea shore, where the pipes lie in a dock about 200 feet long and 100 feet wide, closely built up on each side; at one point a brick building, 62 feet high, is located within 43 feet of the nearest pipe, and on the opposite side of the dock a wooden building, 28 feet high, is 43 feet distant from the pipes. These buildings are very inflammable and in the event of their destruction by fire at a time when the tide was low the water pipes would be in great danger from falling walls and from heat. The safety of this supply is further imperiled by the weakened condition of the mains, owing to electrolysis; the actual conditions found in the pipes are described as follows on page 136 of the sixth annual report of the Metropolitan Water and Sewerage Board: "Examination of the pipes showed that they were badly disintegrated; at one point a hole was cut clear through

the pipe while making the examination, causing a leak which had to be plugged."

A new and independent supply main for East Boston should be laid without delay.

The "double high" service of West Roxbury comprises substantially that part of the territory above grade 170. The supply for this service is pumped by the Metropolitan Water and Sewerage Board at a pumping station formerly operated by the City of Boston, on Washington street, near Metropolitan avenue. The water is delivered by the pumps directly into the mains and thence into a standpipe on Mt. Bellevue in the southerly end of the district; from this standpipe the system extends about 1½ miles in a westerly and more than 4 miles in a northerly direction and for about 2¾ miles of the distance through a single line of pipe. The water supply under these conditions is very unreliable. I recommend for the purpose of guarding the supply that a second standpipe be built in the northerly part of the system and that more storage be provided on Mt. Bellevue.

The storage for the high service supply of the city is limited to Fisher Hill Reservoir, built by the city in 1887 and containing when full 15,000,000 gallons, and to a reservoir in Newton, on Waban Hill, containing 13,500,000 gallons, a total quantity of water sufficient for about a day's supply, while there is a high service storage reservoir containing 41,400,000 gallons for the municipalities north of the city to safeguard a daily consumption of but 9,000,000 gallons daily. This condition of the City of Boston high service supply is not in accord with conservative practice; an accident might occur to the pumping machinery at Chestnut Hill of such a nature that repairs could not be made in a day's time. I recommend that a storage reservoir or reservoirs be built on the high service system, large enough to hold at least six days' supply for the entire high service of the city. This reservoir is of such importance to the city that if the Metropolitan Board for any reason cannot construct it the city should do so, especially as in the event of its construction by the state the city would have to pay for 80 per cent of the cost of construction.

The daily average consumption of water in the city during the past year was 98,379,300 gallons, or 158 gallons per capita; of this amount at least one-third is preventable waste, due to leaks which it is possible to locate and to improper use of water. For several years past no serious attempt has been made to restrict waste, and the water takers have lost sight of the fact that water is a commodity of value and

Average Stated Monthly Heights, in Feet, above City Base, to which Water Rose at Different Stations, on the Boston Water Works.

1908	Engine House No. 5 Sudbury Street	Engine House No. 6 East Street	Engine House No. 10 South Boston	Boston Water Department Yard No. 730 Mount Vernon Street, Roxbury	Engine House No. 22 Fourth and Hamilton Streets, South Boston	Engine House No. 34 Webster Avenue, Brighton	Engine House No. 42 Bunker Hill Street, Charlestown	Engine House No. 5 Warren Street, East Boston	City Hall, High Service	Engine House No. 24 Quincy Street, Dorchester, Dorchester High Service	Engine House No. 25 Lenox Street, Roxbury, Roxbury High Service	Engine House No. 29 Chestnut Hill Avenue, Brighton, Brighton High Service	Water Department Yard Gilson Street, Rochester
Hour	a.m. p.m.	a.m. p.m.	a.m. p.m.	a.m. p.m.	a.m. p.m.	a.m. p.m.	a.m. p.m.	a.m. p.m.	a.m. p.m.	a.m. p.m.	a.m. p.m.	a.m. p.m.	a.m. p.m.
January	114.8 114.8	117.1 117.0	116.2 116.4	117.5 117.5	109.7 109.7	122.2 122.0	111.4 111.4	110.9 110.9	109.5 109.5	109.8 110.1	111.2 111.2	114.5 114.5	114.8 114.8
February	114.1 114.1	116.4 116.4	115.6 115.6	116.8 116.8	109.1 109.1	121.5 121.5	110.8 110.8	110.3 110.3	108.9 108.9	109.2 109.2	110.6 110.6	113.9 113.9	114.2 114.2
March	114.1 114.1	116.4 116.4	115.6 115.6	116.8 116.8	109.1 109.1	121.5 121.5	110.8 110.8	110.3 110.3	108.9 108.9	109.2 109.2	110.6 110.6	113.9 113.9	114.2 114.2
April	114.1 114.1	116.4 116.4	115.6 115.6	116.8 116.8	109.1 109.1	121.5 121.5	110.8 110.8	110.3 110.3	108.9 108.9	109.2 109.2	110.6 110.6	113.9 113.9	114.2 114.2
May	114.1 114.1	116.4 116.4	115.6 115.6	116.8 116.8	109.1 109.1	121.5 121.5	110.8 110.8	110.3 110.3	108.9 108.9	109.2 109.2	110.6 110.6	113.9 113.9	114.2 114.2
June	114.1 114.1	116.4 116.4	115.6 115.6	116.8 116.8	109.1 109.1	121.5 121.5	110.8 110.8	110.3 110.3	108.9 108.9	109.2 109.2	110.6 110.6	113.9 113.9	114.2 114.2
July	114.1 114.1	116.4 116.4	115.6 115.6	116.8 116.8	109.1 109.1	121.5 121.5	110.8 110.8	110.3 110.3	108.9 108.9	109.2 109.2	110.6 110.6	113.9 113.9	114.2 114.2
August	114.1 114.1	116.4 116.4	115.6 115.6	116.8 116.8	109.1 109.1	121.5 121.5	110.8 110.8	110.3 110.3	108.9 108.9	109.2 109.2	110.6 110.6	113.9 113.9	114.2 114.2
September	114.1 114.1	116.4 116.4	115.6 115.6	116.8 116.8	109.1 109.1	121.5 121.5	110.8 110.8	110.3 110.3	108.9 108.9	109.2 109.2	110.6 110.6	113.9 113.9	114.2 114.2
October	114.1 114.1	116.4 116.4	115.6 115.6	116.8 116.8	109.1 109.1	121.5 121.5	110.8 110.8	110.3 110.3	108.9 108.9	109.2 109.2	110.6 110.6	113.9 113.9	114.2 114.2
November	114.1 114.1	116.4 116.4	115.6 115.6	116.8 116.8	109.1 109.1	121.5 121.5	110.8 110.8	110.3 110.3	108.9 108.9	109.2 109.2	110.6 110.6	113.9 113.9	114.2 114.2
December	114.1 114.1	116.4 116.4	115.6 115.6	116.8 116.8	109.1 109.1	121.5 121.5	110.8 110.8	110.3 110.3	108.9 108.9	109.2 109.2	110.6 110.6	113.9 113.9	114.2 114.2
Year	114.1 114.1	116.4 116.4	115.6 115.6	116.8 116.8	109.1 109.1	121.5 121.5	110.8 110.8	110.3 110.3	108.9 108.9	109.2 109.2	110.6 110.6	113.9 113.9	114.2 114.2
January	114.1 114.1	116.4 116.4	115.6 115.6	116.8 116.8	109.1 109.1	121.5 121.5	110.8 110.8	110.3 110.3	108.9 108.9	109.2 109.2	110.6 110.6	113.9 113.9	114.2 114.2
February	114.1 114.1	116.4 116.4	115.6 115.6	116.8 116.8	109.1 109.1	121.5 121.5	110.8 110.8	110.3 110.3	108.9 108.9	109.2 109.2	110.6 110.6	113.9 113.9	114.2 114.2
March	114.1 114.1	116.4 116.4	115.6 115.6	116.8 116.8	109.1 109.1	121.5 121.5	110.8 110.8	110.3 110.3	108.9 108.9	109.2 109.2	110.6 110.6	113.9 113.9	114.2 114.2
April	114.1 114.1	116.4 116.4	115.6 115.6	116.8 116.8	109.1 109.1	121.5 121.5	110.8 110.8	110.3 110.3	108.9 108.9	109.2 109.2	110.6 110.6	113.9 113.9	114.2 114.2
May	114.1 114.1	116.4 116.4	115.6 115.6	116.8 116.8	109.1 109.1	121.5 121.5	110.8 110.8	110.3 110.3	108.9 108.9	109.2 109.2	110.6 110.6	113.9 113.9	114.2 114.2
June	114.1 114.1	116.4 116.4	115.6 115.6	116.8 116.8	109.1 109.1	121.5 121.5	110.8 110.8	110.3 110.3	108.9 108.9	109.2 109.2	110.6 110.6	113.9 113.9	114.2 114.2
July	114.1 114.1	116.4 116.4	115.6 115.6	116.8 116.8	109.1 109.1	121.5 121.5	110.8 110.8	110.3 110.3	108.9 108.9	109.2 109.2	110.6 110.6	113.9 113.9	114.2 114.2
August	114.1 114.1	116.4 116.4	115.6 115.6	116.8 116.8	109.1 109.1	121.5 121.5	110.8 110.8	110.3 110.3	108.9 108.9	109.2 109.2	110.6 110.6	113.9 113.9	114.2 114.2
September	114.1 114.1	116.4 116.4	115.6 115.6	116.8 116.8	109.1 109.1	121.5 121.5	110.8 110.8	110.3 110.3	108.9 108.9	109.2 109.2	110.6 110.6	113.9 113.9	114.2 114.2
October	114.1 114.1	116.4 116.4	115.6 115.6	116.8 116.8	109.1 109.1	121.5 121.5	110.8 110.8	110.3 110.3	108.9 108.9	109.2 109.2	110.6 110.6	113.9 113.9	114.2 114.2
November	114.1 114.1	116.4 116.4	115.6 115.6	116.8 116.8	109.1 109.1	121.5 121.5	110.8 110.8	110.3 110.3	108.9 108.9	109.2 109.2	110.6 110.6	113.9 113.9	114.2 114.2
December	114.1 114.1	116.4 116.4	115.6 115.6	116.8 116.8	109.1 109.1	121.5 121.5	110.8 110.8	110.3 110.3	108.9 108.9	109.2 109.2	110.6 110.6	113.9 113.9	114.2 114.2
Year	114.1 114.1	116.4 116.4	115.6 115.6	116.8 116.8	109.1 109.1	121.5 121.5	110.8 110.8	110.3 110.3	108.9 108.9	109.2 109.2	110.6 110.6	113.9 113.9	114.2 114.2
January	114.1 114.1	116.4 116.4	115.6 115.6	116.8 116.8	109.1 109.1	121.5 121.5	110.8 110.8	110.3 110.3	108.9 108.9	109.2 109.2	110.6 110.6	113.9 113.9	114.2 114.2
February	114.1 114.1	116.4 116.4	115.6 115.6	116.8 116.8	109.1 109.1	121.5 121.5	110.8 110.8	110.3 110.3	108.9 108.9	109.2 109.2	110.6 110.6	113.9 113.9	114.2 114.2
March	114.1 114.1	116.4 116.4	115.6 115.6	116.8 116.8	109.1 109.1	121.5 121.5	110.8 110.8	110.3 110.3	108.9 108.9	109.2 109.2	110.6 110.6	113.9 113.9	114.2 114.2
April	114.1 114.1	116.4 116.4	115.6 115.6	116.8 116.8	109.1 109.1	121.5 121.5	110.8 110.8	110.3 110.3	108.9 108.9	109.2 109.2	110.6 110.6	113.9 113.9	114.2 114.2
May	114.1 114.1	116.4 116.4	115.6 115.6	116.8 116.8	109.1 109.1	121.5 121.5	110.8 110.8	110.3 110.3	108.9 108.9	109.2 109.2	110.6 110.6	113.9 113.9	114.2 114.2
June	114.1 114.1	116.4 116.4	115.6 115.6	116.8 116.8	109.1 109.1	121.5 121.5	110.8 110.8	110.3 110.3	108.9 108.9	109.2 109.2	110.6 110.6	113.9 113.9	114.2 114.2
July	114.1 114.1	116.4 116.4	115.6 115.6	116.8 116.8	109.1 109.1	121.5 121.5	110.8 110.8	110.3 110.3	108.9 108.9	109.2 109.2	110.6 110.6	113.9 113.9	114.2 114.2
August	114.1 114.1	116.4 116.4	115.6 115.6	116.8 116.8	109.1 109.1	121.5 121.5	110.8 110.8	110.3 110.3	108.9 108.9	109.2 109.2	110.6 110.6	113.9 113.9	114.2 114.2
September	114.1 114.1	116.4 116.4	115.6 115.6	116.8 116.8	109.1 109.1	121.5 121.5	110.8 110.8	110.3 110.3	108.9 108.9	109.2 109.2	110.6 110.6	113.9 113.9	114.2 114.2
October	114.1 114.1	116.4 116.4	115.6 115.6	116.8 116.8	109.1 109.1	121.5 121.5	110.8 110.8	110.3 110.3	108.9 108.9	109.2 109.2	110.6 110.6	113.9 113.9	114.2 114.2
November	114.1 114.1	116.4 116.4	115.6 115.6	116.8 116.8	109.1 109.1	121.5 121.5	110.8 110.8	110.3 110.3	108.9 108.9	109.2 109.2	110.6 110.6	113.9 113.9	114.2 114.2
December	114.1 114.1	116.4 116.4	115.6 115.6	116.8 116.8	109.1 109.1	121.5 121.5	110.8 110.8	110.3 110.3	108.9 108.9	109.2 109.2	110.6 110.6	113.9 113.9	114.2 114.2
Year	114.1 114.1	116.4 116.4	115.6 115.6	116.8 116.8	109.1 109.1	121.5 121.5	110.8 110.8	110.3 110.3	108.9 108.9	109.2 109.2	110.6 110.6	113.9 113.9	114.2 114.2

that its use should be restricted. Under the provisions of chapter 524 of the Acts of 1907 the city is required to meter annually 5 per cent of the unmetered services as well as all new ones. Assuming that eventually meters on every service will bring about a normal consumption, still other methods are necessary if the desired result is to be had in a reasonable length of time; in fact, other methods must be employed in any event if the large waste in the main pipes and services is to be checked.

The Deacon waste water meter is an instrument that records the rate of flow into any particular section of the pipe system and, when operated in connection with an efficient inspection service, it forms a most efficient means of detecting waste. The city now is equipped with eighty-five of these meters, or enough to cover the entire city; they should be operated in connection with a thoroughly efficient force of inspectors, and a rigid system of fines should be imposed in case of failure to repair leaks after reasonable notice. In addition, the water used in public buildings, schoolhouses, etc., should be at once metered and a charge made at least for all water wasted. Further, all city and state departments should be required to make daily or weekly returns to the Water Commissioner, giving data by which the water used from hydrants and standpipes may be (approximately) estimated. There seems to be no reason why the consumption should not be reduced at least to 100 gallons per capita.

Monthly Rainfall in Inches During 1908 in Various Places in Eastern Massachusetts.

Places.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Total.
Framingham	3.24	4.22	3.67	1.75	5.41	0.71	3.43	4.36	0.96	2.52	0.89	2.95	34.14
Dam 4, Ashland	3.43	4.60	3.84	1.81	5.94	0.90	3.48	4.30	0.89	2.53	0.90	3.07	35.69
Cordaville	4.21	5.28	4.26	2.14	5.56	1.02	4.18	5.39	1.12	2.63	1.12	3.53	40.44
Lake Cochituate	3.33	4.30	3.62	1.80	4.58	0.82	3.91	3.98	0.77	2.37	0.85	2.70	33.03
Chestnut Hill Reservoir	4.50	6.22	4.18	2.64	4.56	1.28	4.18	5.56	1.22	4.34	1.17	3.46	43.31
Spot pond	3.48	4.27	3.26	2.41	3.81	0.78	3.40	3.97	0.62	3.66	1.04	2.65	33.55
Cambridge Observatory	3.55	3.60	2.81	1.31	4.00	1.25	3.34	4.01	0.83	3.45	0.81	2.70	31.66
Waltham, Boston Manufacturing Company	9.14	4.05	4.03	1.87	3.59	2.00	3.80	4.06	0.83	3.29	0.83	2.60	40.09
Lowell, Locks and Canals Company	3.20	4.96	2.71	1.96	4.19	0.93	3.04	4.29	0.34	2.57	1.14	3.03	32.36
Main drainage yard, 795 Massachusetts avenue	2.82	3.91	3.47	1.62	4.13	2.06	3.64	4.24	0.60	3.70	1.37	2.57	34.13
Average of above ten places	4.09	4.54	3.59	1.93	4.58	1.18	3.64	4.42	0.82	3.11	1.01	2.93	35 84

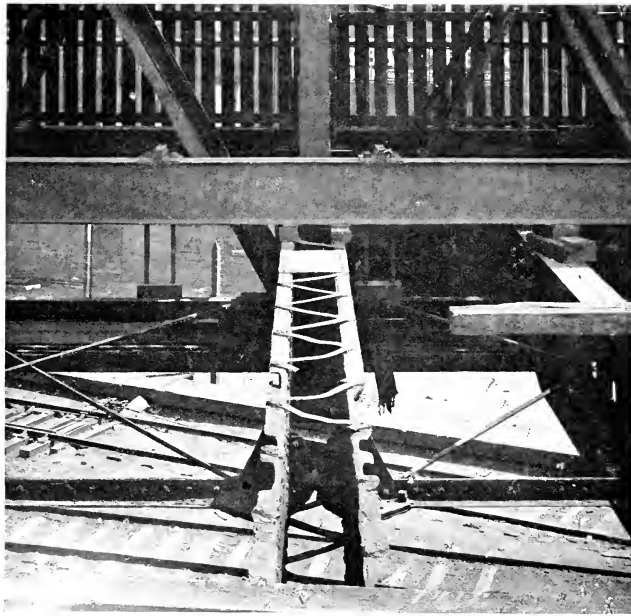


FIG. 1.—BOYLSTON STREET BRIDGE. FLOOR BEAM OF ORIGINAL BRIDGE, CORRODED AND BROKEN.

GENERAL STATISTICS.

Daily average amount used during year 1908 (gallons)	98,379,300
Daily average amount used through meters during year 1908 (gallons)	22,557,600
Number of services February 1, 1909	95,045
Number of meters in service February 1, 1909	5,380
Number of meters under supervision February 1, 1909	118
Number of elevators under supervision February 1, 1909	584
Length of supply and distributing mains, in miles, February 1, 1909	753.17
Number of public hydrants in use February 1, 1909	7,919
Yearly revenue from annual rates (assessed)	$1,382,789.78
Yearly revenue from metered water (assessed)	$1,260,363.18
Percentage of total revenue from metered water	47.7
Yearly expense of maintenance	$551,773.02

MISCELLANEOUS.

Estimates have been made for extending the bridge on Dorchester avenue at Ashmont and for public convenience stations near the corner of Broadway and Dorchester avenue and at Roxbury Crossing.

Plans have been prepared and estimates made for the abolishment of the grade crossing of Saratoga street and the Boston, Revere Beach & Lynn Railroad, for a fence on Paine street at Mount Hope Cemetery, for a wall and fence at North Dorchester burial ground, for the abolishment of the grade crossing of Welles avenue and the Shawmut branch of the New York, New Haven & Hartford Railroad and for a bulkhead on Northampton street, adjoining the land of A. W. Cole.

Reports have been made on the settlement of Charlesgate Bridge over the Boston & Albany Railroad and Ipswich street, on the level of the ground water in the Back Bay district, on the grades of streets occupied by street railway tracks and on repairing a portion of the yard of the Wayfarers' Lodge.

Grades were given for a driveway at the Parental School.

A topographical survey of Mount Hope Cemetery is in progress.

A survey of the Neponset Bridge and a plan of the present structure have been made.

Respectfully submitted,

WILLIAM JACKSON,
City Engineer.

CITY ENGINEERS,
1850–1909.

E. H. CHESBROUGH, M. Am. Soc. C. E.,
November 18, 1850, to October, 1855.
(Died August 18, 1886.)

JAMES SLADE,
October 1, 1855, to April 1, 1863.
(Died August 25, 1882.)

N. HENRY CRAFTS,
April 1, 1863, to November 25, 1872.
(Died June 14, 1908.)

JOSEPH P. DAVIS, M. Am. Soc. C. E.,
November 25, 1872, to March 20, 1880.
(Resigned March 20, 1880.)

HENRY M. WIGHTMAN, M. Am. Soc. C. E.,
April 5, 1880, to April 3, 1885.
(Died April 3, 1885.)

WILLIAM JACKSON, M. Am. Soc. C. E.,
April 21, 1885, to the present time.

APPENDICES.

APPENDIX A.— Table Showing the Widths of Openings for Vessels in all Bridges Provided with Draws in the City of Boston, January, 1909.

APPENDIX B.— Engineering Department Property Schedule.

APPENDIX C.— Elevations and Datum Planes Referred to Boston City Base.

APPENDIX D.— Engineering Department Annual Reports, 1867–1907.

APPENDIX E.— Engineering Department, Revised Ordinances.

APPENDIX F.— Meridian Line.

APPENDIX A.

Widths of Openings for Vessels in all Bridges Provided with Draws in the City of Boston, January, 1909.

Name of Bridge.	Location.	Number of Openings.	Width.	
			Feet.	Inches.
Atlantic Avenue	Over Fort Point channel	1	42	6
Boston & Maine R. R., Eastern Division	Boston to East Cambridge	1	39	8
" " " " "	Over Miller's river	1	35	10
" " " Fitchburg Division	Boston to Charlestown	1	36	7
" " " " " (teaming freight)	" "	1	36	7
" " " Southern Division (freight)	Boston to East Cambridge	1	39	10
" " " " " (passenger)	" " "	1	39	8
" " " Western Division	" " "	1	39	8
" " " " "	Over Miller's river	1	36	0
Broadway	Over Fort Point channel	1	42	7
* Brookline Street	Brighton to Cambridge	1	40	0
* Cambridge	Boston to Cambridge	1	50	0
Cambridge Street	Brighton to Cambridge	1	36	4
Canal	Boston to East Cambridge	1	36	0
Charlestown (main channel)	Boston to Charlestown	2	50	0
" (north channel)	" "		49	9
Chelsea (south channel)	Charlestown to Chelsea	1	38	9
" (north channel)	" "	1	60	0
Chelsea Street	East Boston to Chelsea	1	36	0
Commercial Point	Dorchester	1	24	2

Congress Street	Over Fort Point channel	1	50	0
Dorchester Avenue	" " "	1	41	4
Dover Street	" " "	1	40	0
Grand Junction R. R	Brighton to Cambridge	1	39	0
" " "	East Boston to Chelsea	1	60	0
Granite	Dorchester to Milton	1	36	0
Harvard (Boston side)	Boston to Cambridge	2	36	6
" (Cambridge side)	" "		36	10
L Street	Over Reserved channel, South Boston	1	39	8
Lock, Charles River Dam	Boston to East Cambridge	1	45	0
Malden	Charlestown to Everett	1	50	0
Meridian Street (East Boston side)	East Boston to Chelsea	2	59	2
" " (Chelsea side)	" " "		59	0
Mt. Washington Avenue (Boston side)	Over Fort Point channel	2	42	2
" " " (South Boston side)	" " "		50	0
Neponset	Dorchester to Quincy	1	36	0
N. Y., N. H. & H. R. R	Over Fort Point channel	1	41	9
" " " Y-connection	" " "	1	42	0
" " " Old Colony Division	Dorchester to Quincy	1	51	0
North Beacon Street	Brighton to Watertown	1	30	0
North Harvard Street	Brighton to Cambridge	1	36	0
Northern Avenue (Boston side)	Over Fort Point channel	2	75	0
" " (South Boston side)	" " "		75	0
Prison Point	Charlestown to Cambridge	1	37	6
Summer Street	Over Fort Point channel	1	50	0
Warren	Boston to Charlestown	1	36	0
Western Avenue	Brighton to Cambridge	1	36	0
" "	Brighton to Watertown	1	35	10

* Drawless opening; clear headroom of 26 feet at mean high water.

APPENDIX B.

ENGINEERING DEPARTMENT PROPERTY SCHEDULE, MAIN OFFICE.

1 horse.
2 carriages.
1 automobile.
1 sleigh.
2 harnesses.
3 robes.
Instruments for drawing.
Instruments for surveying, as follows:
2 Temple transits.
7 Buff & Berger transits.
1 Berger & Sons transit.
1 P. & R. Wittstock transit.
8 Gurley transits.
1 Keuffel & Esser level.
2 Temple levels.
4 Buff & Berger levels.
7 Gurley levels.
13 Boston rods.
4 New York rods.
10 Troy rods.
4 Philadelphia rods.
Apparatus for blueprinting.
Cases for plans and books.
Reference library, 1,492 volumes.
15,071 plans engineering works, loose.
14 volumes plans engineering works, bound.
Photographs of engineering works.
1 microscope.
1 mercurial barometer.
1 aneroid barometer.
1 holsteric barometer.
1 set hydrometers.
1 hygrometer.
1 pair field glasses.
3 typewriters.
2 dynamometers.
1 pantagraph.
3 calculating machines.
1 volt meter.
1 comptometer.
2 thermophones.
2 cameras.
3 planimeters.
1 Bourdon pressure gauge.
1 Burroughs arithmometer.
1 Steiger calculating machine.
1 Egli calculating machine.

SURVEYING DIVISION.

2 Temple transits.
2 Moody transits.
2 Buff & Berger transits.
4 Berger & Sons transits.
1 Buff & Buff transit.
1 Stackpole transit.
1 Troughton & Sims transit.
1 P. & R. Wittstock transit.
7 Buff & Berger levels.
1 Moody level.
18 Boston rods.
1 Troy rod.
8 iron rods.
32,669 plans.
3,747 lithographed maps.
1 pantagraph.
3 planimeters.
1 Federal blueprinting machine, No. 10.

APPENDIX C.

ELEVATIONS AND DATUM PLANES REFERRED TO BOSTON CITY BASE.

Feet.	
*0.00	Boston city base. This base is used by the towns of Brookline and Watertown and the cities of Chelsea, Everett, Malden, Newton and Waltham.
—4.98	Cambridge city base.
+0.64	Somerville city base.
0.00	Metropolitan Park Commission base.
+0.60	Harbor and Land Commission base.
10.00	Metropolitan Water Board base.
—100.00	Metropolitan Sewerage Board base.
—100.00	Boston Transit Commission base.
—100.00	Charles River Commission base.
15.62	Highest recorded tide, April 16, 1851. Charles Harris, Level Book 22 (15.10 above mean low water, United States Coast Survey Chart of Boston Harbor, 1857).
15.45	Old bench mark on coping of old dry dock at Charlestown Navy Yard.
15.11	New bench mark on coping of old dry dock at Charlestown Navy Yard, northwest end over crowfoot.
5.00	Piles to be cut off for buildings.
12.00	Minimum cellar bottom grade.
9.82	South Boston base. Formerly in use, now abandoned.
99.40	Charles river flood elevation, at the Brookline pumping station, February 13, 1886.
97.50	Charles river flood elevation, March, 1902.
95.66	Charles river average flood elevation, 1886 to 1902, both inclusive.
0.00	Mean low water about 1830.†
+0.34	Mean low water, 1867.†
+0.79	Mean low water, 1902.†
+0.58	Navy yard base, 1902.†
10.63	Mean high water, 1902.†
5.71	Mean sea level, 1902.†
9.84	Mean rise and fall of tide, 1902.†

* Definition of Boston city base: "Boston city base is a datum plane 15 feet above the average height of the sill of the Charlestown dry dock." (Page 552, report of Committee on Charles River Dam, 1903.)

† John R. Freeman, civil engineer, in report to Committee on Charles River Dam, 1903, pp. 562, 569, 570.

The following tidal records may be of interest:

High Tides.

[Plane of Reference, Boston City Base.]

Feet.	Date.	Where taken.	By Whom.
15.62	April 16, 1861	Average of 7 observations	Charles Harris.
14.94	Nov. 27, 1898	Average of 15 observations.	
13.72	Nov. 8, 1900	Malden Bridge	F. P. Spalding.
14.19	Nov. 25, 1901	Average of 10 observations.	
13.60	Dec. 14, 1902	North Ferry, Boston	J. H. Edmonds.
13.00	Feb. 17, 1903	North Ferry, Boston	J. H. Edmonds.
13.40	Jan. 14, 1904	North Ferry, Boston	J. H. Edmonds.
14.83	Jan. 25, 1905	Average of 34 observations.	
14.70	Jan. 25, 1905	Inner harbor, 10 observations.	
13.50	Nov. 15, 1906	Neponset Bridge	M. F. Toomey.
13.00	April 19, 1907	North Ferry	J. H. Edmonds.
13.00	Dec. 5, 1907	Mt. Washington avenue	BostonTerminal Co.

Low Tides.

5.60	Nov. 27, 1898	Deer Island, Met. sewer station	Self-recording gauge.
—3.50	Feb. 1, 1900	Deer Island, Met. sewer station	Self-recording gauge
—2.94	Feb. 3, 1900	South Boston station, Edison Electric,	D. A. Harrington.
—3.00	Feb. 4, 1904	Deer Island, Met. sewer station	Self-recording gauge
—2.70	Mar. 23, 1905	Deer Island, Met. sewer station	Self-recording gauge.

APPENDIX D.

ENGINEERING DEPARTMENT ANNUAL REPORTS, 1867–1907.

Number of Report.	For the Year.	Year Published and City Document Number.	Number of Report.	For the Year.	Year Published and City Document Number.
First	*1867	1868—22	Twenty-fourth	*1890	Executive Department Report, Document 1, Part I. 1891.
Second and Third	1868–69	1870—14			
Fourth	1870	1871—15			
Fifth and Sixth	*1871–72	1873—23	Twenty-fifth	1891	1892—11
Seventh	*1873	1874—20	Twenty-sixth	1892	1893—10
Eighth	1874	1875—19	Twenty-seventh	1893	1894—10
Ninth	1875	1876—24	Twenty-eighth	1894	1895—10
Tenth	*1876	1877—15	Twenty-ninth	1895	1896—10
Eleventh	*1877	1878—20	Thirtieth	1896	1897—10
Twelfth	*1878	1879—22	Thirty-first	1897	1898—12
Thirteenth	*1879	1880—33	Thirty-second	1898	1899—12
Fourteenth	*1880	1881—25	Thirty-third	1899	1900—14
Fifteenth	1881	1882—52	Thirty-fourth	1900	1901—14
Sixteenth	1882	1883—53	Thirty-fifth	1901	1902—15
Seventeenth	*1883	1884—55	Thirty-sixth	1902	1903—15
Eighteenth	*1884	1885—54	Thirty-seventh	1903	1904—15
Nineteenth	*1885	1886—41	Thirty-eighth	1904	1905—15
Twentieth	*1886	1887—38	Thirty-ninth	1905	1906—15
Twenty-first	*1887	1888—39	Fortieth	1906	1907—17
Special report	1888	1888—117	Forty-first	1907	1908—17
Twenty-second	1888	1889—38	Forty-second	1908	1909—16
Twenty-third	1889	1890—39			

* Out of print.

APPENDIX E.

(REVISED ORDINANCES, 1898, CHAPTER 16.) ENGINEERING DEPARTMENT.

SECTION 1. The Engineering Department shall be under the charge of the City Engineer, who shall be consulted on all matters relating to public improvements of every kind in respect to which the advice of a civil engineer or architect would be of service; shall, unless otherwise specifically provided, take charge of the construction of all public works of the city which properly come under the direction of a civil engineer; shall make such surveys, plans, estimates, statements and descriptions, and take such levels and prepare such specifications and contracts as the mayor, the board of aldermen, the common council, any committee of the city council or of either branch thereof, the board of street commissioners, or any officer in charge of a department, may need in the discharge of its duties; shall, upon being notified by the superintendent of streets, supervise all repairs on the bridges of the city used as highways which affect the safety of the structures, and shall, when required by the mayor or any officer in charge of a department, measure the work done by contract for the city, and certify to the results of such measurement. Said engineer shall have the custody of all surveys and plans relating to the laying out, locating anew, altering, widening and grading of streets; and his office shall be deemed to be the office of the surveyor of highways.

SECT. 2. Said engineer shall, in his annual report, include a report upon the safety and completeness of all ponds, basins and reservoirs under the charge of the water department, and of all bridges within the city limits used as highways.

(Stat. 1870, chap. 337; Stat. 1895, chap. 449, par. 21.)

APPENDIX F.

MERIDIAN LINE.

In 1870 an act was passed by the Massachusetts Legislature requiring each land surveyor in the state at least once in every year to adjust and verify his compass by the meridian line established in the county wherein his surveys were to be made.

A meridian was marked by stone monuments and a book of record kept by a custodian designated by the County Commissioners.

The law compelling surveyors to test their compasses annually was modified in 1875, so that surveyors who did not use the compass in turning angles were relieved from the penalty attaching to the violation of the original act.

The meridian posts for the County of Suffolk were placed on the southerly portion of the "Parade Ground" on Boston Common. They are granite posts, three in number, placed 200 feet apart, are 18 inches square at the base, 1 foot square at the top, and 8 feet long, being firmly set in a bed of concrete with their tops originally just below the surface of the ground.

A stone curb was placed even with the surface of the ground over the top of each post, with a metallic composition cover.

The surface of that part of the Common where the posts are set was raised several feet in 1897, the posts being protected by building a brick manhole around each stone, the posts being accessible by the removal of the manhole cover.

As the cover and cap of the manholes are made of iron it is now necessary to set up the compass in the production of the line marked by the monument to avoid local attraction. The point selected has been 290 feet north of the northerly stone.

The following table gives the number of tests for each year, with the average readings:

YEAR.	Number of Readings.	Average of Readings West of North.	YEAR.	Number of Readings.	Average of Readings West of North.
1871.....	9	10–53–46	1890.....	7	11–39–56
1872.....	8	11–09–47	1891.....	4	11–49–30
1873.....	3	11–07–53	1892.....	–	
1874.....	3	11–11–40	1893.....	1	12–32–20
1875.....	3	10–58–33	1894.....	–	
1876.....	2	11–13–00	1895.....	–	
1877.....	8	11–12–35	1896.....	–	
1878.....	13	11–28–56	1897.....	8	12–04–37
1879.....	4	11–35–15	1898.....	6	12–34–34
1880.....	7	11–34–53	1899.....	–	
1881.....	3	11–28–23	1900.....	8	12–33–45
1882.....	5	11–36–18	1901.....	–	
1883.....	5	11–42–04	1902.....	13	12–44–44
1884.....	6	11–46–13	1903.....	8	12–43–42
1885.....	8	11–43–12	1904.....	4	12–48–45
1886.....	4	11–39–58	1905.....	12	12–56–42
1887.....	14	11–51–54	1906.....	6	13–19–20
1888.....	3	11–40–57	1907.....	8	13–16–35
1889.....	–		1908.....	12	13–27–05

CONTENTS.

REPORT ENGINEERING DEPARTMENT FOR 1908.

General Index to Contents Engineering Department Reports, 1867–1892, will be found in Report of February 1, 1892.

APPENDICES.

ILLUSTRATIONS.