



City Document.— No. 14.

CITY OF BOSTON.



With the compliments of the

CITY ENGINEER.

CITY ENGINEER.

1870.

City Document.— No. 14.

CITY OF BOSTON.



ANNUAL REPORT

OF THE

CITY ENGINEER.

1870.

CITY OF BOSTON.

OFFICE OF CITY ENGINEER, CITY HALL,

BOSTON, January 10, 1870.

To the Honorable City Council :

In compliance with the sixth section of the ordinance relating to the City Engineer's Department, I have the honor to present the following report, viz :

The ordinance above alluded to was passed October 12, 1868, and differs from the previous one mainly by effecting a complete separation of the Departments of Engineering and Surveying, which were partially distinct before, and under the control of two heads or officers. Each department is now distinct and independent, with well defined duties.

The change had become not only mutually desirable to the officers in charge of said departments, but imperatively necessary to the thorough efficiency of each organization, owing to the enormous increase of work called for by the numerous and extensive schemes of public improvements already initiated, and those in contemplation.

Although the ordinance went into effect upon its passage, and the City Engineer and City Surveyor each assumed charge and control of their special business as defined by the ordinance, yet it was found impracticable to immediately reorganize the working force so as to assign to each department the assistants required, and, as the Auditor decided that the appropriations could not well be divided, it was thought best to continue the old system of using the same force of assistants and employés in common until the close of the financial year 1868-9.

New rooms were assigned to this department, which were

furnished and occupied in February, and a division of the plans, note-books, furniture, etc., was then made. The experience of the few months that had intervened since the passage of the ordinance, proved that it would have been impossible to have maintained the old system much longer; that the combined force of the two departments had already become inadequate, and that besides the additional room required, a reorganization and enlargement of the corps of assistants was imperatively necessary. The work of organizing a force for this department, and getting fairly at work under the new system, interfered for a while with the work of the department; but, by the middle of March, the new office was pretty well equipped, and, so far as this department is concerned, I am satisfied the change has worked well.

The following is a statement of the expenses of the City Engineer's Department, as paid from the appropriation for the department:

Amount of appropriation		\$12,000 00
Salary of City Engineer, and amounts paid assistants, draughtsmen, rod- men, etc.	\$6,206 77	
Instruments and repairs of same	485 99	
Drawing paper and materials	366 35	
Stationery, note-books, etc.	390 23	
Travelling expenses	214 82	
Cloth and labor mounting and bind- ing plans	109 69	
Incidental expenses, tools, stakes, postage and revenue stamps, and expenses of committee	617 61	
Books and picture-frames	151 85	
		<u>\$8,543 31</u>
Unexpended balance		<u><u>\$3,456 69</u></u>

The following statement shows the amounts paid since January 1, 1869, for engineering, from *special* appropriations:

WATER WORKS.

Chestnut Hill Reservoir: pay rolls and incidentals	\$4,805 03	
Roxbury extension (Wards 13, 14 and 15): pay rolls and incidentals	1,448 89	
Deer Island water-pipe: pay rolls and incidentals	143 18	
	<hr/>	\$6,397 10

PAVING DEPARTMENT.

Atlantic avenue: pay rolls and inci- dentials	\$434 24	
Broadway extension: pay rolls and incidentals, etc.	1,176 79	
	<hr/>	\$1,611 03

CHURCH STREET DISTRICT.

Pay rolls and travelling expenses	\$565 50	
Total from special appropriations	\$8,573 63	<hr/> <hr/>

The number of persons employed and paid from the department appropriation was, on the 1st of May (including the City Engineer) 10
 The present number is 14
 The Chestnut Hill Reservoir party numbers 5

The following statement exhibits the operations of the department during the past year:

WATER WORKS.

Several designs for a stand-pipe for the Roxbury high service were prepared, and detailed drawings and specifications made

for the plan finally adopted. Plans and specifications have also been made of the pumping engine house, and numerous drawings of special castings for the extension of the works in the Highland District.

Two large plans of Roxbury, comprising also portions of the city proper and South Boston, have been made, upon which are shown the water-pipes, hydrants, and gates as already laid in the said portions of the city proper and South Boston, and the connection between the same and the newly laid pipes, etc., in Roxbury. These plans show the sizes and location of all the mains and distributing pipes laid, and the location of all hydrants and gates established up to January 1, 1870. Two other large plans of the Highland District have also been made: one showing the location of all houses whose door-sills are more than eighty feet above "tide marsh level," with the actual height of said sills; and the other showing the elevations and depressions of all the streets, and the exact height in figures above "tide marsh level" of all points in the streets where a change of grade occurs. These plans were prepared in order to determine the line of separation between the high and low service, the boundaries and extent of the high service districts, the location of blow-offs and air-cocks, and also to show at a glance the exact pressure to which the pipes will be subjected at any given point, whether in the high or low service system of distribution. A description of the high service districts, as determined by the aid of these plans, will be found in my report to the Cochituate Water Board, which is embodied in the last annual report of that Board.

A copy has been made of the map of Dorchester, which was compiled for the commissioners on annexation, by T. W. Davis, Esq., City Surveyor. Upon this map will be shown the location of all buildings, the elevation of all door-sills above a plane of eighty feet above "tide marsh level," the heights of the summits of all hills, the elevations and depressions of the streets,

and a proposed system of water-pipes, hydrants and gates for the distribution of the water. A party is now engaged upon the field work, and rapid progress is being made.

A compiled map has also been prepared on a scale of 500 feet to an inch, showing Boston and its environs south of Charles River, and as far west as Watertown village. Upon this map it is designed to delineate such general topographical features as will be of service in planning the future extensions of our water supply and distribution. It will also be of service as a map of reference in the discussion of the question of public parks, and the further extension of our corporate limits.

Three plans of East Boston have been made, showing the sizes and location of the water-pipes laid, and the position of hydrants and gates established. One of these plans was made for the use of the Mystic Water Board, of Charlestown, one for the Superintendent of the eastern division, B. W. W., and one for office reference, and upon which to delineate future additions.

A copy of the plan of South Boston, made under the direction of the commissioners appointed to define the bounds of the streets, has been prepared for the use of the Water Department, upon which to show the water-pipes, gates, etc.

A plan, on a scale of three hundred feet to the inch, has been made, showing the proposed extension of Swett street, across the South Bay to the junction of Dorchester and Federal streets, and also the route for a new main water-pipe to South Boston, from the junction of Dudley and Hampden streets, *via* Magazine street, the aforesaid extension of Swett street, Dorchester, Telegraph and Thomas streets, to the reservoir on Telegraph Hill. This plan was designed to show the general features of the projects. Surveys have been commenced, and are now in progress, to enable the construction of a plan upon a larger scale and exhibiting more details.

Surveys have been made and a plan and profile prepared of

the route for a pipe from East Boston to Deer Island, including soundings of the Channel or "Gut," between Point Shirley and the island. This survey was made by order of the President of the Water Board, after the appropriation had been passed by the City Council. The low grade of a portion of the highway in the town of Winthrop, necessitating the laying of a portion of the pipe below tide water, unless the town will fill up or alter the location, and the question of the necessity of laying a larger size of pipe than was estimated for, over a portion of the route, has delayed action. These questions will undoubtedly be settled soon, so that the work may be commenced in the early spring.

Surveys have been made, and a plan nearly completed, which will show the proposed limit of the Beacon Hill high service, the number of houses, hotels, etc., within the district, and the elevations of their door-sills and cisterns above "tide marsh level." Observations by means of pressure gauges will determine the line of division between the high and low service. A variety of calculations have also been made, bearing upon the best mode of supplying this elevated district as thoroughly and efficiently as it is proposed to do the Roxbury high districts, and a report now in progress will soon be laid before the Cochituate Water Board.

Plans have been made of various alterations in the brickwork of the effluent gate house at the Chestnut Hill Reservoir, and of the iron railing, stairs and galleries in said gate house, and the gate chamber connected therewith.

Finished drawings have also been made, and others are in progress, which will show all the structures connected with the reservoir, just as they had been actually built. The work upon these finished drawings is kept as reserve work, to be done in leisure time, when current work is not pressing. A very considerable amount of time was consumed in preparing the estimates and statements called for by the Water Board last

spring in connection with the request then made for an additional appropriation for completing the reservoir. These estimates and statements may be found in City Document No. 59, 1869.

Very few changes have been made or required in the work at this reservoir during the year, aside from those previously alluded to at the effluent gate house. It was found necessary to strengthen the retaining wall which supports the filling of a portion of the driveway, and a plan prepared by Mr. Wightman, the Resident Engineer, was approved, which accomplishes the object by building a supplementary wall, connected by stone piers with the old one, and forming a terrace along the entire front.

The plans for the gate chambers at Brookline, for inclosing the gates, rendered necessary by the joining of the 48-inch main from the Chestnut Hill Reservoir with the three mains which now supply the city, were also prepared by the Resident Engineer.

With the exception of the slight changes above referred to, the general plans of the work were well matured early in the year, and the work of executing the same and completing the reservoir was in that state of forwardness or maturity that it needed only the well-known executive ability of the Superintendent and Resident Engineer to push the work as rapidly as possible towards its final completion, and the result shows that they have done their duty.

The report from this department to the Water Board in May next, will present in detail the progress of operations on this work as well as of the extension of the works in Roxbury and Dorchester and the general condition of the whole.

ATLANTIC AVENUE.

Soundings were made at the beginning of the year on the easterly line of Atlantic avenue, where it crosses the several

docks, and levels taken of the whole line, from which profiles were made showing the elevations of the existing piers and wharves above mean low water, the depths of water at low tide, and the depth of mud or other material overlaying the hard bottom in the several docks; also, the proposed grade of the avenue as recommended by the Superintendent of Streets, which grade was fixed at an elevation of sixteen feet above mean low water for the whole line from Commercial street to the north-erly side of India wharf; thence rising at the rate of about $\frac{9.5}{100}$ of a foot in one hundred feet to meet the grade of Broad street as previously fixed.

The depth of water below mean low tide and of the mud, was found to vary very materially in the different docks, and the hard bottom appeared to be of the same character as the material of Fort Hill, a mixture of clay and gravel, very hard and compact, and what is commonly called "hardpan."

The first plan proposed for a sea-wall contemplated the excavation of all the mud and objectionable material for a space of about twenty-five feet in width at the bottom of the trench under the whole line of wall, and of building the wall solid from this foundation, without using piles, to the grade of the street. This plan would have called for a wall whose average height would have been thirty feet, fourteen feet of which would have to be laid under water, below the level of low tide, whose width at the base would be seventeen feet, at low water thirteen feet, and at the top three feet, the rear of the wall to be heavily ballasted. This plan, although the most substantial, was also the most costly, and was deemed too expensive.

Another was proposed, the wall resting upon a foundation of piles cut off at a level of one foot below mean low water, and placed three feet apart on centres longitudinally, and two feet transversely of the wall. The principal objection to building a wall designed to support a heavy earth filling, as in this case, upon a pile foundation, where the mud is soft and of considerable

depth, is that the mud being soft and yielding, affords very little lateral support to the piles, and the weight of the filling in the rear presses upon the mud as upon an elastic cushion, which, moving laterally, tends to crowd the piles outward, and overturn the wall. To avoid this objection it was proposed to excavate a trench as in the first instance, removing all the soft and yielding material, and to replace it with good clean gravel in part, and in part with broken stone; thus the piles would be surrounded with a firm, unyielding material that would hold them in place, and the danger to the wall from the spreading of the mud would be avoided. This plan was deemed amply secure, and as its cost per running foot was estimated at about fifty dollars less than the first, it was approved and specifications were drawn.

A practical difficulty, however, made it necessary to slightly modify the plan of the wall, to change its location, placing it twenty feet back from the line of the street, and to build a platform sidewalk resting upon oak piles outside of it. This change was rendered necessary from the fact that the plan of construction of the wall as approved, required that a portion of the trench to be excavated as described above, and afterwards filled with stone ballast, was necessarily in front of the wall, and being outside the limits of the street, upon private ground, the city would be a trespasser unless the consent of the owners could be obtained. Efforts to procure this consent were unsuccessful, and hence the adoption of the modified plan. Proposals, however, were invited and received upon both plans, and the contract, which was awarded to Boynton Brothers, was so drawn that either plan could be executed in part or the whole, as the Committee on Paving should direct. Both of the plans and the specifications were approved by a majority of the Harbor Commissioners, and copies of all plans referred to in the specifications were made and deposited in said commissioners' office.

The contract was awarded to Boynton Brothers, and was

duly executed on the 4th of March, 1869. The contractors were to commence work on or before the 10th of March, and complete the whole on or before the tenth day of October. They were to receive for so much of the wall as should be built according to "*Plan No. 1*" (the second above described), \$92.50 per lineal foot; for so much as should be built according to "*Plan No. 2*" (with platform sidewalk, but not including the same), \$91.82 per lineal foot; for all sluices which might be found necessary, built according to the plan, \$11.17 per lineal foot; and for the platform sidewalk, \$25 per lineal foot; all the work to be done to the approval of the Committee on Paving and the Superintendent of Streets, or some person appointed by them to superintend the work. A superintendent, Mr. Leighton, was appointed by the Committee on Paving, and the work was promptly commenced under his direction and supervision, and would probably have been completed at or near the appointed time, but for changes in the plan of construction which the contractors were ordered to make by the superintendent in charge of the work.

These changes had been discussed by the superintendent and myself, and I had given a conditional verbal assent, subject, however, to the approval of the Committee on Paving.

The superintendent, understanding or claiming that he was authorized by the chairman of the committee to make the change, if I approved of it, and being ignorant of the fact that such change required the approval of the Harbor Commissioners, directed the contractors so to alter the plan of construction of a certain portion of the wall as to omit the dredging, where the mud was only seven or eight feet deep, and substitute small stone chips or ballast for the gravel filling between the piles and in the rear of the wall up to the level of the tops of the piles.

Acting upon the orders of the superintendent, the contractors proceeded to drive the piles for the foundation of the wall in

the dock between T and Commercial wharves, — omitting the preliminary dredging, — and had made considerable progress, when the fact was reported to the Committee on Paving by the Harbor Commissioners, accompanied by a statement that the change which was being made would result in a saving to the contractor of over forty dollars per running foot of wall. The work upon this section was at once stopped by order of the Committee, the Harbor Commissioners positively refusing to sanction the change, and the Committee on Paving disclaiming the authority of the superintendent in ordering it; while the contractors, insisting that they had acted in good faith in complying with the orders of the superintendent, whom they regarded as the authorized agent of the committee, declined to undo the work already done, and proceed according to the specifications, without due compensation.

A modified plan was proposed by the Harbor Commissioners which they deemed an equivalent to the original, and by which the work already done might be saved; but this plan was pronounced impracticable by the superintendent, and the contractors refused to accept it as an equivalent for the original.

Several conferences were held between the committee, the Superintendent of Streets, the City Engineer, the superintendents (Mr. Leighton and T. W. Pratt) and the contractors, and it was finally decided that the City Engineer and Mr. Pratt should confer with the Harbor Commissioners, and, if possible, devise a plan which should meet their approval, and that in devising such plan the engineers need not consider the question of equivalency at all. Plans were accordingly made and submitted to the commissioners, which met their approval and that of their engineers. The plans were then laid before the contractors, who expressed their willingness to execute them, but demanded an additional sum per running foot.

The question of what should be equitably paid the contractors, in addition to the original price, was referred by the com-

mittee to the City Engineer and T. Willis Pratt, who, after several fruitless conferences with the contractors, reported the additional amount that should be paid for the section between T and Commercial wharves at nine dollars and forty-one cents per lineal foot, and for a short piece between T and Long wharves, four dollars and twenty-two cents per lineal foot.

These prices were finally accepted by the contractors, and a new contract made in October, under which the work is now progressing and by the terms of which the whole work is to be completed on or before May 1, 1870.

It should be explained in this connection that the statement, above referred to in the communication of the Harbor Commissioners, that the change ordered by the superintendent would result in a saving to the contractors of over forty dollars per running foot, was undoubtedly made under a misapprehension of facts both as to quantities of material and the prices; for I found, by careful estimates, that the actual difference in cost to the contractors would be inside of *fifty cents* in their favor, while the contractors claimed that the balance would be on the other side. In fact, such a misapprehension is evident when it is shown that the entire cost of dredging and gravel filling in this particular dock would not have exceeded five dollars per running foot, and if all the broken stone required had been omitted, the cost of that would have been only nine dollars per running foot.

In my judgment, the modified plan of construction as ordered by the superintendent would, in that particular dock, have been equally as secure as the original, and would have expedited the work very materially. But as the Harbor Commissioners thought differently, and had absolute legal power in the premises, the work was necessarily delayed in this locality for several months, and was finally resumed at an additional cost of over nine dollars per running foot.

The work is now progressing favorably, and is in that state of

forwardness that there is every prospect of its completion at the appointed time.

FORT HILL.

The final grading and paving of Oliver street was completed in August, and in the fall the work of excavating the main body of the hill was commenced on the easterly side at the level of Purchase street, under a contract for filling Atlantic avenue, made with B. N. Farren, Esq., on the 27th of October, 1869. All material removed is measured in the bank, and monthly estimates of the amount so taken are made by this department and certified to by the City Engineer.

CHURCH STREET DISTRICT.

In the early part of the year the final estimates were made of the amount of gravel removed from the bank at Readville, and deposited in this district. Since then the necessary surveys, levels and estimates have been made to determine the amount of gravel removed from the banks at Monterey and Mt. Hope, and used for filling on this territory. The amount of filling from other sources has also been determined and certified to.

BROADWAY EXTENSION.

A general plan for the bridges and necessary structures required for the extension of Broadway at "the high grade" was prepared under my direction in 1867. This was designed more especially to illustrate the main features of the "high grade" project, and, at the same time, afford the necessary basis for the preliminary estimates of cost.

The necessary orders for the extension at the "high grade" were passed by the City Council in the latter part of April, by which the Committee on Paving were authorized to make all contracts for the execution of the work.

The work of preparing detailed plans and specifications of

the bridges and piers was commenced on the following week by Mr. Clemens Herschell, C. E., well known as the designer of the Columbus avenue bridge over the Boston and Albany Railroad, the Albany street bridge over the same railroad, and of the Public Garden bridge. He had been engaged by the Committee on Paving to do the work under the direction of this department, the expense to be charged to the appropriation for the extension.

Before much progress had been made by Mr. Herschell, plans and specifications were presented to the committee by the Moseley Iron Bridge Works Co., with which the committee were so well pleased, that the same were referred to me for my opinion as to style and strength. Although confined at home by ill health, I examined the plans and specifications as requested, calculated the strains of the various parts, and noted my objections. Subsequently, the plans were returned to me with additional details, and the specifications in a new draft for re-examination. I suggested some further slight changes that would be necessary before I could give my approval; these were promptly made by the Bridge Co., and my approval was given to the committee on the 24th of May. Mr. Herschell's designs and specifications not being ready at this time, and the committee not feeling satisfied with the progress made, accepted the Bridge Co.'s plans, and at once advertised for proposals, to be received until June 7th, for building the bridges, etc., according thereto. The contract was awarded to the Moseley Iron Bridge Co., and the necessary agreements were prepared, dated June 12, 1869.

The plans and specifications, though approved and adopted by the committee, had yet to receive the sanction and approval of the Harbor Commissioners before the work could begin; for, by the terms of the act of the Legislature, authorizing the extension of Broadway and the building of a bridge over Fort Point Channel, the work must be done under their supervision and

direction. The plans were retained for a considerable time, and were thoroughly and critically examined by their engineers, and several changes were prescribed, some of which, in my judgment, were judicious, and some not; but nearly all were of a nature to increase the cost of the work quite materially. By the terms of the contract, the entire work embraced in the specification is to be done to the satisfaction of the City Engineer, the Committee on Paving, the Superintendent of Streets, and the superintendent in charge of the work on the part of the city, for the sum of \$331,708.76.

As this is one of the most important structures of the bridge kind ever erected in the city, a description of it may be of interest, and not out of place in this report.

The structures embraced in the contract with the Moseley Iron Bridge Co. include everything except paving, between the easterly side of Foundry street in South Boston and the north-westerly side of Lehigh street in Boston proper, a distance of 1,117 feet.

Beginning at the easterly side of Foundry street, the first structure is an iron bridge over said street of a clear span of fifty-six feet, and at an elevation of twelve feet in the clear above the same. This structure is to rest upon a substantial stone abutment built by the city on the easterly side of the street, and upon wrought-iron columns built by the contractor on the westerly side.

The bridge is a modification of the style known as the "Bow-string Girder," and consists of two main wrought-iron arches springing from shoes or sockets at the ends, which rest upon the abutment or pier, the ends being tied together by a horizontal tie, or what is usually called the lower chord. This lower chord and the floor beams or cross-girders of the roadway and sidewalk are suspended from the arches by vertical suspension bars. Besides the arches, a supplementary horizontal boom or upper chord of wrought-iron is provided and attached to the

arches at the crown, adding greatly to its strength, and, by means of the vertical and diagonal bars connecting said chord with the arches, forming a spandril-bracing, the stability of the arch, under a travelling load, is greatly increased. The height of the arches in this span is five and one-half feet from the lower chord to the upper chord at the centre.

Each arch and the attached upper chord combined is to have a sectional area of twenty-six square inches, and each lower chord at its centre a sectional area of twenty-six square inches, exclusive of rivet holes. The vertical suspension bars to be of bar-iron, three inches by $\frac{3}{8}$ -inch, and to be placed two feet apart, and the diagonal or lattice bars to be two inches by $\frac{1}{8}$ -inch, the intersections of these bars to be covered with ornamental castings. Stays or bracings, of 3-inch T iron, are to be placed eight feet apart to give lateral stiffness to the arches. The floor-beams or cross-girders are to consist of double 9-inch wrought-iron I beams, brought into compressive strain by tension rods of two inches diameter, attached to the I beams beneath the main arches, and strained over struts of cast-iron. These beams project beyond the arches to form a support for the sidewalks and are placed four feet apart. Upon these iron floor-beams or cross-girders are to be laid, for the roadway, cast-iron plates four feet square and $\frac{3}{4}$ -inch thick, ribbed twice across the surface by ribs three inches by $\frac{3}{4}$ -inch at the middle, and tapering toward the edges. This completes the roadway ready to receive the wooden pavement, which is to be furnished by the city.

The sidewalks of this bridge and throughout all the structures hereinafter described, are to be floored with yellow pine three inches thick. The railing for the sidewalks is to be uniform throughout the whole length of the several structures, and is to consist of an upper rail of double $2\frac{1}{4}$ -inch I iron, middle and lower rails of double 2-inch I iron, with vertical rods $\frac{3}{4}$ -inch diameter, placed six inches apart on centres and diagonal rods

$\frac{1}{2}$ -inch diameter, — the intersections to be covered with ornamental castings. Stays or bracings of 3-inch T iron will be introduced wherever required to give lateral stiffness.

The next structure extends from the last described, to a point on the easterly side of the Old Colony and Newport railroad tracks, a distance of about four hundred and forty feet. In this structure the street is supported upon wrought-iron columns set in rows of three, crosswise the street, twenty feet apart; the rows being eleven feet apart, lengthwise the street. The roadway being forty feet wide, and the middle column of each row being placed in the centre, the two outer ones come directly under the sidewalk curb, and the sidewalks — each ten feet wide — are supported upon wrought-iron brackets attached to the outer columns. These columns are twelve inches in diameter and $\frac{1}{4}$ -inch thick, of the Phoenix Company's make, and are each supported by three piles cut off two and one half feet below mean high water, and capped with stone to a point four feet below the surface of the ground. That portion of the column which comes below the surface of the ground (four feet deep) is enclosed in boxing two feet square, and the space between the boxing and the column is filled with concrete composed of broken stone or gravel, and hydraulic cement.

The columns themselves are also filled solid with concrete, and are then capped with a cast-iron cap, so formed on its upper side as to receive and hold in position the transverse girders, which are 12-inch wrought iron I beams. These I beams project beyond the outer columns, and rest upon the brackets before described, forming the support for the sidewalk. Upon these 12-inch I beams, longitudinal beams of heavy 6-inch I iron are placed under the roadway, and are four feet apart from centre to centre. Upon these rest the cast-iron plates four feet square, similar to those above described.

The last or westerly row of columns, near the Old Colony and Newport Railroad, supporting the structure just described,

differs from the others inasmuch as it forms a pier upon which is to rest the southerly end of the long span bridge hereinafter described. The number of columns in this pier is the same (three); but the two outer ones are to be twenty-four inches in diameter, and $\frac{5}{16}$ -inch thick, and the middle one twelve inches by one-quarter, like the others. These columns are to be connected at the tops by a pedestal constructed of 15-inch wrought-iron I beams, securely fastened. This pedestal forms the southerly bridge seat for the next structure, which is a bridge of one hundred feet span, extending from the last described pier, over the tracks of the Old Colony and Newport Railroad, at an elevation of fourteen feet in the clear above said tracks, to a pier in Fort Point Channel situated about eighty feet southeastwardly from the centre of said channel.

This pier is to consist of five cast-iron screw-piles, of twenty-four inches internal diameter and one and a quarter inches thick, so placed that two of them come directly under the ends of the adjoining arches on each side of the roadway, and one under the centre of the roadway.

These screw-piles are coated with a coal-pitch varnish, which has been in successful use for several years in protecting water-pipes from corrosion. The sections are joined by bolting the projecting flanches firmly together. They are to be screwed into the clay bottom until a firm and substantial bearing is obtained, and then the soft material is to be removed from the interior, and the pile filled with hydraulic concrete and capped.

Upon these piles, and connecting them at the tops, is to be a pedestal of wrought-iron I beams, fifteen inches high and $\frac{5}{8}$ -inch thick at stem, securely fastened to the piles, and widened, if necessary to receive the ends of the bridges properly, by brackets. Diagonal tie-bars four inches by $\frac{3}{4}$ -inch will connect the outer piles with the middle one.

The bridge of one hundred feet span, which rests upon the piers above described, is of the same style as the one above

described over Foundry street, differing only in dimensions and proportions, and in the style of flooring.

The main girders or arches in this bridge are to be ten feet high from lower to upper chord, and are each to have a sectional area of fifty-six square inches for the arch and upper chord combined, and fifty-four square inches for the lower chord. The suspension-bars, lattice-bars, and ornamental castings, and also the floor-beams or cross-girders are to be precisely the same as in the Foundry street bridge; but, instead of cast-iron plates, the flooring will be of wood, consisting of 8-inch by 4-inch Burnettized spruce timbers fitted between the iron floor beams, flush with their tops, and placed three feet apart on centres, to which is spiked an under flooring of 3-inch Burnettized spruce plank, upon which an upper flooring of 3-inch white oak plank is laid at right angles therewith, and spiked thereto.

The pivot drawbridge and pier are the next structures in order, and are located nearly in the centre of the channel. The openings for the passage of vessels are about forty-four feet each, and the whole length of the bridge is one hundred and sixty feet, and rests upon a central and two end-piers. The southerly end-pier has just been described; the northerly pier is of precisely the same description. The central pier upon which the bridge turns is composed of cast-iron screw-piles of the same dimensions as those already described. Sixteen of these piles are placed in the circumference of a circle of about forty feet diameter, being about eight feet apart, and three are to be set at the centre in a line with the current of the stream. Each of the outer piles is to be connected with the central ones at the top, and also at a level of eight feet below the tops of the piles by radial 6-inch wrought-iron I beams, firmly bolted to clasp-rings encircling each pile.

Similar I beams will also connect the outer piles with each other at the same levels, and diagonal rods crossing each

other will connect the top of each outer pile with the lower clasp-rings of the adjoining piles. Upon the caps of the outer piles is to be a pedestal of 15-inch wrought-iron I beams, curved to form a true circle and securely fastened to the piles; and, to the top flanch of this beam, a steel-headed track-rail, weighing not less than fifty-seven pounds per yard, is to be bolted. Upon this track-rail rest the wheels which support the turntable. These wheels are to be of cast-iron, chilled, sixteen inches in diameter, with a face or bearing surface six inches broad and truly coned to the radius of the circle. They will be placed about four feet apart. Radial rods, two inches in diameter, pass through the centre of each wheel, connecting it with a central hub eighteen inches in diameter. The outer ends of these radial rods project and pass through a curved wrought-iron band, four inches by $\frac{1}{2}$ -inch, which extends entirely around the circle just outside the wheels and keeps them always at equal distances apart and insures a uniform motion. A 6-inch wrought-iron pivot passes through the aforesaid hub at the centre, and extends downward through the cap of the centre pile, and three feet into the concrete filling; it also extends upwards and passes through a heavy cast-iron disc-plate five feet square, and one and one-half inches thick. Fastened to this central disc are to be radial 7-inch wrought-iron I beams, connecting it with a ring composed of 15-inch wrought-iron I beams, to the under side of which is bolted a steel-headed rail similar to the one above described. This ring is an exact counterpart of the circular pedestal before described, only it is inverted and the track-rail rests upon the tops of the wheels. Circumscribing this upper ring is to be a square frame of 7-inch wrought-iron I beams, firmly secured thereto at the points of contact, and also by means of the same sized beams at the angles. This square frame, with the upper ring, radial beams and central disc, all securely fastened together as described, form the turntable upon which rests the bridge. The towers, to the tops of

which are attached the cables or suspension rods that sustain a portion of the weight of the bridge when swung open, are placed directly over the ring which forms part of the turntable, and exactly midway of the bridge longitudinally. These towers are to be thirty-seven feet high, five feet by one and a quarter feet at the base, and twelve inches square at the top. The corner posts are to be 5-inch angle iron, connected either by plate iron or by lattice bars. The towers are tied together and braced, across the roadway, by three wrought-iron tubes or beams, of triangular section, five-sixteenths inch thick and of nine-inch faces attached at different levels, and connected together by vertical struts of 6-inch I beams. In the bays thus formed are to be diagonal rods, meeting in a ring at the centre, formed of bar iron three inches by three-fourths inch. The cables or suspension rods, which transmit a portion of the weight of the bridge to the towers, are three in number for each tower; the longest one being two inches in diameter, the middle one, one and three-fourths inches, and the shortest one, one and a half inches.

The construction of the bridge itself is the same as already described in the case of the one hundred feet span, except that the spans being only about eighty feet, the cross-section of the arches and chords is correspondingly reduced. The arches are to be of the same height (ten feet).

Within the space formed by the circle of screw-piles, and resting upon the lower set of radial beams, is to be a floor of 3-inch yellow pine, — the space to be enclosed and partitioned off to form apartments for an engine-room and a dwelling for the draw tender; or in lieu thereof, a suitable building is to be erected on the fender pier.

Two caloric engines, of not less than three-horse power and all necessary gearing for moving the bridge, to be furnished. Also, a wrought-iron stairway, with steps of yellow pine, will be built from the level of the roadway to the fender pier.

The fender-pier is to be two hundred and sixty feet long and

sixty feet wide, and is to entirely enclose the draw-pier without being connected with it, thus preventing any shock caused by passing vessels from being communicated to the draw-pier. In construction, this fender-pier is quite a novelty, and rather expensive as an experiment. It consists of three parallel rows of tongued and grooved sheet-piling of 6-inch spruce or pine, placed twenty-nine feet six inches apart from centre to centre of each row — the rows being in the direction of the thread of the current. Each row to be capped longitudinally with a cap twelve inches square tenoned to the piles every five feet, or oftener, if necessary. Cross timbers twelve inches square and thirty-two feet long, lapping each other at the centre, are to be bolted to the longitudinal caps and to each other at the lap joint. These cross timbers are to be placed six feet apart from centre to centre, and covered with a flooring of 3-inch spruce or pine plank. Suitable belaying-posts are to be bolted to the longitudinal caps, floor-timbers and sheet-piling, and longitudinal oak ribbons three inches thick are to be fastened to the channel side of the sheet-piling between low water and the top of the pier. Fender-guards of oak piles or sheet-piling are also to be built to protect the end piers of the drawbridge, and to extend out from said piers to meet the fender-guards which extend from the shore parallel with, and eighteen feet outside of, the bridge.

From the pier at the northerly end of the drawbridge is to be another bridge of one hundred feet span, precisely similar to the one of the same span already described. But the pier upon which its northerly end rests is composed of five screw-piles arranged like those already described.

From this last mentioned pier to Lehigh street, a distance of about two hundred feet, the structure rests upon wrought-iron columns, and is identical in every respect with that on the South Boston side already described.

The bridge over Lehigh street completes the list. It is of a

clear span of fifty feet, of the same style of construction as the one over Foundry street, is to be twelve feet in the clear above Lehigh street, and its northerly end is to rest upon stone abutments, built by the city.

Before work was commenced by the contractor, borings were made at various points on the entire line of the extension. Eight borings were made on the South Boston side, which showed that the surface of the clay bed underlying the mud was about level with mean low water at Federal street, and thence sloped downwards to the lowest point, which was on the easterly side of Fort Point Channel, near the tracks of the O. C. & N. R. R. At this point the surface of the clay was twenty-four feet below mean low water, in the centre of the channel it was eighteen feet below mean low water, on the westerly side eight feet, and thence to Lehigh street, it varied from eight to ten feet. Two of the borings were sunk into the clay with a view of determining its thickness and consistency at various depths. One of these borings was made at the point where the clay bed was most depressed. The total depth of this boring was ninety-five feet from the surface of the ground, and the clay was penetrated to a depth of fifty-five feet and was found to be of the very finest quality, entirely free from stones, gravel or sand, and, in point of consistency, appeared to be firmer and tougher near the surface, than at a greater depth. The other deep boring was made in the channel near the centre, and was carried down to the rock, a depth of one hundred and eight feet below mean low water, and through ninety feet of clay. The character of the clay was much the same as in the last boring, and, so far as the stability of the structures which are to rest on it are concerned, it was evident that nothing would be gained by penetrating the clay more than eight or ten feet. In view of the clay being softer than was anticipated, I suggested the addition of a broad exterior flanch to the screw piles at a point eight or ten feet above the screw-blade to form a bearing shoulder on the

surface of the clay when the piles were screwed into place. The suggestion was approved and is being carried out.

PROGRESS OF THE WORK.

The construction of the fender-pier in the centre of the channel has been a very slow and difficult job, as might have been expected. It is, however, nearly completed. The screw-piles for the draw-pier are all in position and ready to be sunk. The iron columns on the South Boston side are nearly all set, and some of the 12-inch iron floor-beams are in position. On the Boston side, the pile foundations for the iron columns are all driven. Most of the iron-work and lumber is on hand and ready to set up as soon as the sub-structures are ready. The amount paid to date is \$174,388.

The Resident Superintendent of this work, on the part of the City, is T. Willis Pratt, Esq.

ABUTMENTS AND RETAINING WALLS FOR BROADWAY EXTENSION.

These comprise two abutments — one on the easterly side of Foundry street, and one on the northwesterly side of Lehigh street — and retaining walls on each side of the street from said abutments, to Federal street on the South Boston side, and to Albany street on the Boston side.

The abutments and retaining walls to rest on piles, cut off at a level of seven and one-half feet above mean low water. The abutments to be of such height as to permit the bridges above described to rest thereon, at an elevation of twelve feet in the clear above the roadways, and to be built of Quincy or Rockport granite, cut to dimensions, with rough-hammered beds, builds and vertical joints. The retaining walls to be coursed rubble masonry, laid in cement mortar, and suitably bonded, the top surface to be built on an incline corresponding with the grade of the street.

Proposals were duly invited, and the contract was made with Messrs. Clapp & Ballou, in August, to furnish all materials and do all the work on or before October 1st, at the following rates for the various kinds of work, viz :

For excavation, per cubic yard	\$0.85
For filling " "	1.00
For furnishing and putting in ballast, per cubic yard, .	1.50
For furnishing and driving all piles, per pile . . .	3.90
For furnishing and laying in cement all rubble masonry, per cubic yard	8.81
For furnishing and laying in cement all dimensioned stone, per cubic yard	21.35

The work on the South Boston side has been completed. On the Boston side the retaining walls are finished and a portion of the abutment. The whole work will be finished, probably in February.

The amount paid contractors to date, as per my estimates, is \$45,512.42.

BRIDGES.

The duties of the City Engineer in respect to this class of structures remain the same under the present ordinance as under the preceding one.

The following is a list of the bridges which the city has to maintain in whole or in part: —

1st. BRIDGES OVER TIDE-WATERS, RIVERS AND CREEKS.

- * Albany street bridge, — over the Roxbury Canal.
- * Dover street bridge, — across entrance to South Bay.
- * Broadway bridge, — over Fort Point Channel (now building).
- * Federal street bridge, — over Fort Point Channel.
- * Mt. Washington avenue bridge, — over Fort Point Channel.
- * Meridian street bridge, — over Chelsea Creek.

- * Chelsea street bridge, — over Chelsea Creek.
- Winthrop bridge, — from Breed's Island to Winthrop.
- * Neponset bridge, — over Neponset River.
- * Granite bridge, — over Neponset River.
- Milton bridge, — over Neponset River, at Lower Mills.
- Mattapan bridge, — over Neponset River, at Upper Mills.
- * Commercial street bridge, — over Creek at Commercial Point, Dorchester.
- Mill Dam bridge, — over sluices connecting the "Fall Basin" with Charles River.
- Longwood avenue bridge, — over Longwood Creek and Brookline Branch Railroad.

2D. BRIDGES OVER RAILROADS AND HIGHWAYS.

- Albany street bridge, — over Boston and Albany Railroad.
- Tremont street bridge, — (water pipes) Boston and Albany Railroad.
- Ferdinand street bridge, — over Boston and Albany Railroad.
- Berkeley street bridge, — over Boston and Albany Railroad.
- Columbus avenue bridge, — over Boston and Albany Railroad.
- Dartmouth street bridge, — over Boston and Albany and Boston and Providence Railroads, at junction.
- Berkeley street bridge, — over Boston and Providence Railroad.
- Dorchester street bridge, — over Old Colony and Newport Railroad.
- Broadway bridge, — one over Lehigh street; one over Foundry street (now building).

All the bridges marked with an asterisk in the first list, and the Chelsea Point or Winthrop bridge are, or will be, when completed, in the charge of superintendents under the direction of the Committee on Bridges.

All the others, except the Tremont street water-pipe bridge,

* Bridges provided with draws or openings for the passage of vessels.

which is in the charge of the Water Board, are in the charge of the Superintendent of Streets, under the direction of the Committee on Paving.

ALBANY STREET BRIDGE (OVER ROXBURY CANAL).

This bridge is a new one, and was completed and opened to travel early in the year.

Plans and specifications were made last year by this department, and a contract made with Joseph Ross, Esq., of Ipswich, to build the structure for the sum of \$7,450. It is provided with a draw, of the kind known as a Counter-balanced Turn-Table Draw. It has a roadway of thirty feet, a single sidewalk of six feet on the westerly side; and the opening for vessels is thirty-four feet. Changes in construction, authorized by the committee, increased the cost to \$7,965.58. The estimated cost was \$8,000.

There has been expended in repairs on the bridge, replanking, etc., \$594.80.

The amount of travel over this bridge is very great, and constantly increasing, and it seems highly improbable that the insignificant requirements of navigation in this canal will much longer make this bridge a necessity, and it will give way to solid filling, and the full width of the street made available.

DOVER STREET BRIDGE.

A thorough examination of the draw of this bridge was made last summer, and a report of its condition, accompanied with a plan and specifications of changes and repairs, which I deemed necessary, was submitted to the Committee on Bridges, with the recommendation that this bridge and the Mount Washington avenue bridge should be put in thorough repair at once, so that, upon the completion of Broadway, three good avenues would be available while the necessary work contemplated on the Federal street bridge should be in progress. That report is, I presume,

on the files of the Committee on Bridges, and its recommendations should be carried out without delay.

An examination of other parts of this structure will be made at an early day.

The repairs on this bridge during the year cost \$834.14.

FEDERAL STREET BRIDGE.

The city of Boston was authorized to widen this bridge to a width of seventy feet, by an act of the Legislature, approved April 24, 1869.

Estimates were made of the cost of this widening, exclusive of the drawbridge, which amounted to \$19,000.00.

It was, however, subsequently deemed that such a widening, leaving the drawbridge in its present narrow and contracted condition, would be poor economy and of little public advantage. The opinions of the Committees on Streets, Paving and Bridges, favored the making of the drawbridge of the full width of seventy feet, with the roadway clear and unobstructed by any middle truss, and this department was called upon to devise a plan for the draw, which would fulfil these conditions, without materially altering the present bridge beyond what would be necessary to provide room for the enlarged draw. Accordingly levels were taken, and measurements made to determine the amount of available room beneath the roadway for depth of girders, wheels, etc., without raising the grade of the street; and also to locate the present piling to see how much would be available for the new structure, and the additional amount that would be required. Progress upon this work was necessarily interrupted by the current demands upon the department from work already in progress, and was suspended entirely for a season, while the surveys, plans and specifications for the Dartmouth street bridge were being prepared.

The problem presented by the requirements of the committees was more difficult of solution than at first appeared. It was

not simply to decide upon the best style of draw, but upon the best style that could be fitted to the place, and at the same time satisfy the requirements of the committee and the demands of a judicious economy. If an entirely new structure were to be built and no restrictions as to grade, it need not require a very long time to perfect designs and specifications; although, in that case, there would be room for considerable debate as to which of the various styles of drawbridges now in use would be best adapted to the unusual width of roadway demanded in this case, and the oblique angle which the opening for the passage of vessels makes with the axis of the bridge. If the bridge could be placed at a proper elevation, there would be no question but that permanent foundations and a substantial iron structure would be the most suitable, and, in the end, most economical. But, with all our present bridges, the grade is so low that the tracks and running gear have to be placed below extreme high water mark, and no little trouble and inconvenience ensues. The superintendents have complained of the low grade of the draw-piers, and the necessarily contracted space beneath the bridges into which the machinery is crowded. Of course, the greatly enlarged dimensions of the drawbridge in the present case called for additional depth or space between the surface of the roadway and the top of the draw-pier, which could only be obtained by raising the grade of the roadway or still further depressing the draw-pier.

Under these circumstances, I felt that the expense of permanent foundations and an iron superstructure, as an adjunct of the present patched-up bridge and at its present grade, would be quite unwarrantable.

Accordingly, designs were prepared of several styles of draws, to be built of wood, which, it was thought, would outlast the present wooden structure. At this stage the policy of the Harbor Commissioners, as announced in the case of the Broadway bridge, rendered it certain that additional requirements

would be made in this case, and that, besides the widening of the roadway of the bridge, the span would also have to be increased so as to make the opening for the passage of vessels forty-four feet in the clear. It therefore became necessary to make a new series of calculations of strains to determine the new proportions and dimensions of parts, and to reconstruct the designs. The designs, which have been made, include several styles of draw, or modifications of styles already in use, such as the "Counter-balanced Turn-table"; a "Centre Pivot," without turn-table, — the draw travelling upon attached wheels — a "Side Pivot," with wheels attached, and a "Slide" or "Rolling Draw," like the present. The "Centre Pivot" design would require a middle truss, and would probably be the least expensive, although no definite estimates have been made.

After the Broadway bridge contract was made, and it became certain that within a year this additional avenue to South Boston would be opened, the necessity for pressing this work became less urgent, and a majority of the Bridge Committee favored its postponement until the completion of Broadway. For this reason, and on account of the demands of other work, very little has since been done on the work by this department, except preparing a plan exhibiting the present pile foundations, with the proposed additions, to present to the Harbor Commissioners for their opinions and views; for it would be useless to spend further time upon the details of any plan unless the commissioners will approve of the necessary foundations. Some additional drawings have, however, been recently made to illustrate the application of a plan proposed by a Mr. Rich, of South Boston, to this particular locality. The general features of this plan were exhibited in a model, and, as applied to this locality, may be thus described: — The present draw is to remain just as it is, and a turnout bridge, wide enough for two lines of vehicles to pass each other, is to be built in an easterly direction alongside the present pathway of the vessels approaching the draw, for a dis-

tance of about two hundred feet, or far enough to permit a vessel to lay between the present draw and the easterly end of the "turnout," where another draw is to be built, connecting with a similar turnout on the opposite side of the shipway. At the entrance to the turnouts, gates are so arranged that when the present draw is open for the passage of vessels, its guard gate is closed and the turnout gate is open. By this plan it is claimed there will be no detention of travel, as only one draw will be open at a time. The idea is not a new one by any means, although the particular mode of its application is novel. In this instance, it involves the building of about five hundred feet of bridge, including an extra draw. It could be applied to this bridge in connection with the proposed widening, without any interruption to the travel; and it is claimed that the combined cost of widening the present bridge to seventy feet, *exclusive* of the draw, and building the "Turnout bridge" and draw, will be from ten to twelve thousand dollars cheaper than the proposed plan of widening the present bridge, *including* the draw; and that the "Turnout" plan will better accommodate public travel.

The various plans will soon be laid before the Committee on Bridges.

The cost of repairs on this bridge during the past year was \$1,512.10.

MOUNT WASHINGTON AVENUE BRIDGE.

This bridge was examined early in the season, and found in a most wretched condition throughout.

The wooden trusses of the drawbridge were in an unsafe condition, the chords being badly decayed, and in one place the lower chord was rotted entirely through. The stringers and timbers which form the sidewalk bulkhead were very rotten, and the flooring of the bridge in bad condition. In short, the whole bridge is in such condition as to require almost an entire

renewal above the caps of the piles, or at least, above the stringers. At that time it was thought that the widening of the Federal street bridge must be taken hold of, and, as both could not go on together, this was repaired as well as possible, and the trusses strengthened so as to make it last until another year. When it became apparent that the work on Federal street bridge would be postponed until the completion of Broadway, I again called the attention of the committee to this bridge, in the report above alluded to, in connection with the Dover street bridge. No action, however, appears to have been taken. I consider this bridge in a very bad condition, and should be attended to at once.

The amount expended for repairs on this bridge during the year was \$2,486.52.

MERIDIAN STREET BRIDGE.

This bridge, exclusive of the draw, is in very good condition. The draw itself, as to soundness and stability, is in good condition; but it does not work as easily as it should. The track was levelled up, new white oak bearing-plank put in, and wrought-iron plates interposed between the track-rail and the oak bearing-plank, in 1868; but owing to the work not having been properly done, or for some other reason, it did not entirely remedy the evil. The draw is a cumbrous, unwieldy affair, and its foundations not the best, and it would undoubtedly have been better policy to have built it anew, upon more substantial foundations, at the time the bridge was rebuilt, in 1866. A smaller and lighter draw would answer every purpose in this locality.

The repairs on this bridge during the year have cost \$842.58.

CHELSEA STREET BRIDGE.

This bridge was partially renewed in 1868. At that time plans and specifications were prepared by this department for

rebuilding the entire structure, which I deemed the wisest course. The committee, however, thought differently, so the specifications were redrawn to cover the building of a new draw and certain prescribed repairs, and a contract made with Joseph Ross for doing the work for the sum of \$6,150. It was found, however, upon removing the earth covering of the bridge, that the entire flooring was so much decayed as to be unsafe. A new flooring was accordingly ordered by the committee, which was put in by Mr. Ross. The total cost was \$9,146.35.

The bridge is now in very good condition. The repairs during the year amounted to \$42.

WINTHROP BRIDGE (BREED'S ISLAND TO WINTHROP).

This bridge has no draw, and the travel over it is very light. The bulkhead stringers need renewal in some places, and an examination of the flooring, which will be made in the spring, will undoubtedly discover many defects now concealed by the earth covering.

NEPONSET BRIDGE (OVER NEPONSET RIVER).

This Bridge was formerly a toll-bridge belonging to the Turnpike Corporation, and since it was made free has been maintained jointly by the towns of Dorchester and Quincy. Its condition is reported good by the authorities of Dorchester; but an examination will soon be made and its condition reported to the Committee on Bridges.

GRANITE BRIDGE (OVER NEPONSET RIVER).

This bridge is "*Granite*" only in name, which is derived from the street of which it forms a part. It is a pile structure, provided with a drawbridge of the old style known as the "Leaf-Draw." It is in very fair condition; but will require some repairs on the planking of the roadway. The city maintains the bridge to the centre of the draw.

MILTON BRIDGE (OVER NEPONSET RIVER AT LOWER MILLS).

This is a substantial stone bridge, in good condition, with new railings; but is rather too narrow, and a widening to correspond with the width of roadway on the Milton side would be a great improvement. It is maintained jointly by the city and the town of Milton.

MATTAPAN BRIDGE (OVER NEPONSET RIVER).

This bridge is a light iron structure, recently erected and in good condition. The web of the main girders is very thin, and lower chord too light for the standard of burden usually required in our city bridges. It is maintained jointly by the city and the town of Milton.

COMMERCIAL STREET BRIDGE (OVER CREEK AT COMMERCIAL POINT).

This is a pile structure, provided with a "Leaf-Draw." The draw, draw-pier, and northerly end of the bridge are in good order. The southerly end of the bridge is quite "shaky,"—the bulkhead stringers are rotten, and the piling needs renewal. The flooring is covered with earth, and is probably more or less decayed, and should be examined soon.

MILL-DAM BRIDGE (OVER SLUICES).

These sluices or water-ways through the Mill-dam were originally provided with tide-gates, which permitted the water to flow into the "full basin," so-called, during flood-tide, but closed at the ebb and shut the water in. After the abandonment of the tide-mills, caused by the filling of the "empty basin," these gates were removed and the tide now ebbs and flows through the sluices. They are openings or water-ways, six in number, about twenty feet wide, and separated from each other by stone piers about five feet thick, built up to within four feet of the roadway. The sluices are then covered with round logs laid close together,

the ends resting on these piers, and upon the logs is the earth covering of the roadway. These logs are more or less rotten and insecure, and the question has arisen — “ With what shall they be replaced ? ”

These sluices will have to remain open for many years, certainly as long as this basin remains unfilled ; for into this basin flows all the drainage of “ Stony ” and “ Muddy ” brooks, and until the basin is filled and very large covered canals provided for conveying this drainage to tide water in Charles River, the maintenance of these sluices will be a necessity.

Plans have been prepared, by request of the Paving Department, for covering these sluices in a safer and more substantial manner, with either a wooden or iron structure, whichever shall be decided most suitable under all the circumstances. Specifications will be drawn as soon as the committee determine which plan to adopt.

LONGWOOD AVENUE BRIDGE.

This bridge crosses “ Muddy Brook ” (the centre of which forms the boundary line between Boston and Brookline), the adjacent marsh flats and the Brookline Branch Railroad. It is a trestle-work structure, resting on oak piles, has a plank roadway, and a sidewalk, on the southerly side only, and is not a suitable structure for the locality. The abutments are poorly built, and in bad condition. The care and maintenance of the structure belongs to Boston and Brookline jointly. By orders from the Paving Department, — to prepare plans and specifications for a suitable structure, with proper abutments, — considerable work has been done in making surveys, levels and soundings, and preparing the necessary plans. The plans in detail will soon be ready to submit to the Committee on Paving, and the Selectmen of Brookline.

ALBANY STREET BRIDGE (OVER BOSTON & ALBANY R. R.)

This bridge was built in 1867-8, by McKay and Aldus, from designs by Clemens Herschell, C. E. The entire cost of the

bridge, abutments, and retaining walls, was \$65,973.22. The structure is in good order.

HARRISON AVENUE AND WASHINGTON STREET BRIDGES.

These bridges are maintained by the Boston and Albany Railroad Co.; but by an agreement with the city, by which the corporation was permitted to raise these bridges, the plans of reconstruction were to be approved by the City Engineer. Accordingly plans for new iron bridges, designed by E. S. Philbrick, C. E., were submitted to me, and carefully examined in all respects as to their strength and stability, and approved. The Harrison avenue bridge has since been built, and is a first-class specimen of iron work. The Washington street bridge will probably be built this season, in connection with the raising of the Suffolk Street District.

FERDINAND STREET BRIDGE (OVER BOSTON & ALBANY R. R.)

This bridge has been lowered during the year, by permission of the Boston and Albany Railroad Corporation, improving very materially the grades of the adjacent streets. It is in good condition.

BERKELEY STREET BRIDGE (OVER BOSTON & ALBANY R. R.).

This bridge was built for the Boston Water Power Company by the "Moseley Iron Bridge Works." It is probably as good a bridge as could have been built for the money it cost; but it is a lighter and cheaper structure than I should have recommended. It has, however, been quite well tested during the past year while Tremont street was closed, and a recent examination disclosed no perceptible deflection or permanent set to the girders as compared with an examination made last spring.

The present mode of planking the roadway on a dead level, is objectionable, as there is no provision for shedding the rainfall. A substantial Burnettized bottom flooring should be laid

and covered with asphaltum concrete so as to give a longitudinal crown to the roadway, and upon this a pavement of wooden blocks should be laid. The iron work should be thoroughly painted.

BERKELEY STREET BRIDGE (OVER BOSTON & PROVIDENCE R. R.).

This structure was built by the Boston & Providence Railroad Company, and was accepted as a part of Berkeley street last year. The roadway and sidewalks are supported upon very heavy cast-iron columns, placed in rows crosswise the street, the rows being about twenty feet apart. The columns rest upon a pile foundation, capped with granite blocks. Upon these columns heavy wrought-iron Phoenix I beams or girders are laid crosswise the roadway, and upon these, similar longitudinal floor-beams are placed about four feet apart. The flooring, as originally built, consisted of spruce plank laid flatwise and fitted between the floor-beams, resting on the lower flanch. The space above the plank was filled with gravel to the level of the tops of the floor-beams, and directly upon the gravel was placed the wooden block pavement. As might have been expected, the gravel covering rotted the plank; a portion of the wooden blocks also rotted at the bottom and settled unevenly, causing the surface of the roadway to present a very rough appearance. Under these circumstances it is not surprising that the heavy travel of last summer broke through the planking and revealed its rotten condition.

This department was immediately called upon to prepare plans for re-covering the bridge, and the following general plan was proposed. To strip the bridge to the iron work, then to fit between the longitudinal iron girders 4-inch spruce plank floor-beams, set edgewise, and resting upon the lower flanch of the girders; these planks to be placed three feet apart from centre to centre and to be of graduated widths, — from twelve

to eight inches, — the widest being placed in the centre of the roadway and thence diminishing in width to the gutters, forming a lateral crown to the roadway. Upon these plank floor-beams a flooring of 4-inch spruce plank, planed to an even thickness, to be laid diagonally of the roadway and thoroughly spiked. The Nicholson block pavement to be laid on this flooring. The curb or wheel-guard to be of cast-iron. The sidewalk to be replanked with 3-inch plank laid close and covered with asphaltum concrete.

The lumber was to be one-half Burnettized and one-half creosoted, to test its relative merits. The proposed plan as above described was carried out.

Upon uncovering the bridge it was discovered that some of the iron columns had either settled or were not properly levelled when set, and that it would be necessary to level up the whole structure. The Providence Railroad Company desired that the whole bridge should be raised a foot, and offered to bear the expense of raising, and as this operation would enable us to re-adjust the columns at their proper relative height it was decided to raise the whole bridge an average height of twelve inches. The execution of the entire work was intrusted to Joseph Ross, Esq., and it was promptly and successfully accomplished.

The bridge, with all its travel, was lifted bodily by screws attached to each column. Every column had marked upon it the exact height it was to be raised, and a granite leveller was provided for each column, whose thickness corresponded with the mark upon the column. The work was all done without any interruption to the public travel.

The cost of the work was \$16,124.18.

COLUMBUS AVENUE BRIDGE (OVER BOSTON & ALBANY R. R.).

This bridge was built in 1865 from designs by Clemens Herschell, Civil Engineer for the Boston Water Power Company. It is a wrought-iron lattice bridge of very good design

as to strength and stiffness; but not a remarkably good specimen of workmanship. By the laying out of Columbus avenue, June 24, 1869, the care and maintenance of this bridge and abutments was assumed by the city. Its condition is fair, but similar measures to those proposed for the Berkeley street bridge should be taken here to crown the surface of the roadway so as to shed the rainfall.

DARTMOUTH STREET BRIDGE (OVER B. & A. AND B. & P. R. R.).

This department was called upon to furnish plans and estimates for a bridge over the Boston and Albany and the Boston and Providence Railroads, at their junction. Approximate estimates were furnished of the cost of a substantial iron bridge, with suitable abutments and piers, and some progress made in the preparation of drawings in detail; but it was decided that there was not ample time to prepare, decide upon and execute plans for such a structure in season for the "Peace Jubilee"; and it was also thought that a well-built wooden structure would answer all the public requirements for ten or fifteen years, and could be built for less than half the money. Accordingly, plans and specifications were at once prepared for a wooden trussed bridge.

The abutments and intermediate piers consist of oak piling and heavy trestle-work. The two main trusses, which are built continuous over the piers, are respectively two hundred and twenty and one hundred and ninety-eight feet long, and of the style known as the "Pratt Truss." The lower chord is formed of four pieces each six by twenty-four inches; the upper chord has four pieces, each six by ten inches; the posts or struts are each six by twenty-four inches, except over bearings, where they are twelve by twenty-four inches. All counter-rods are single and one and one quarter inches in diameter, and the others are in sets of two and three, and vary from one and three-fourths

inches diameter at the bearings to one inch at the centre of the spans.

The sidewalk trusses rest on the same piers as the main trusses; but as the piers are necessarily at an angle oblique to the axis of the bridge, the lengths of the spans vary. They are continuous over piers.

The lower chords consist of three pieces: the centre one, six by twelve inches; the two outer ones, four by twelve inches. The upper chord has three pieces: the middle one, six by eight inches, and the outside ones, three by eight inches; the struts over bearings are eight by twelve inches, and the intermediates, four by twelve inches.

The counter rods are single and one inch in diameter; all the others are double and one inch diameter at the centre of spans, and increase one-eighth of an inch for each bay to the bearings.

The trusses are eight feet in height from outside to outside.

The floor-timbers are four by fourteen inches, placed two in each bay or panel; every other one is double and trussed with a truss-rod one and one-fourth inch diameter, the struts being continuous twelve by twelve inch timbers running the whole length of the bridge.

The roadway floor is double, the lower one being of 4-inch spruce, and the upper one 2-inch white oak, laid crosswise the bridge.

The sidewalk floor is of two thicknesses of 2-inch spruce plank.

The trusses are covered with a wooden coping, and all the woodwork and ironwork exposed, was painted three coats and sanded.

All the woodwork was creosoted or Burnettized.

Proposals were invited, and the contract awarded to Joseph oss, of Ipswich.

Although not entirely completed by Jubilee week, yet the roadway was finished and the bridge pretty severely tested by the moving crowds.

The bridge is a first-class piece of work, and as substantial as could be made of wood. The cost was \$26,780.

DORCHESTER STREET BRIDGE (OVER OLD COLONY AND NEWPORT R. R.).

The bridge over the Old Colony and Newport Railroad at this place was originally built, and has since been maintained, by the Railroad Company. In order to complete the widening of the street it was necessary to enlarge this bridge, extend the abutments, and build new retaining walls. So far as the alteration of the bridge and abutments were concerned, the city was powerless to act without the consent of the Railroad Company. Therefore an agreement was concluded between said company and the city, by which the city was to do all the work required, and assume the care and maintenance of the bridge and abutments ever after, the Railroad Company paying four-fifths of the cost.

Plans and specifications were prepared, for all the work required, last March. Proposals were invited, and contracts awarded, to the Atlantic Works for building the bridge; and to Messrs. Clapp and Ballou for the masonry, grading and filling.

The old bridge was a wooden one, and could not be economically widened, and a structure, mainly of iron, was recommended. The width of the street, as widened, is fifty feet, and the clear span of the bridge twenty-seven feet. The bridge consists of seven parallel wrought-iron plate-girders, thirty feet in length, twenty-two inches high in the centre, and seventeen inches high at the ends, placed eight feet six inches apart from centre to centre, under the roadway, and eight feet under the sidewalks, — all tied together at the bottoms with two-inch angle iron. Oak stringers of 4-inch plank are placed edge-

wise on the lower flanches of the girders, and bolted to the webs. Upon these stringers floor-timbers of four by twelve inch creosoted spruce are placed at right angles with the girders, and three feet apart from centre to centre. An under flooring of 4-inch creosoted spruce plank is laid upon these floor-timbers, the top surface being just flush with the tops of the girders, and over this an upper floor of 3-inch white oak plank is laid at right angles, or crosswise the roadway. The outer roadway girders support a cast-iron wheel-guard or curb, provided with flanches and sockets on its sidewalk face for receiving one end of each of the sidewalk floor-timbers,—the other end resting upon an angle-iron flanch, riveted to the web of the sidewalk girder. The sidewalk floor is of 2-inch spruce plank.

The railing is composed of cast-iron posts riveted to the sidewalk girders, and horizontal rails of wrought-iron pipe fitted to posts by a right and left screw.

Beneath the sidewalk, and not connected with the bridge, are a pair of wrought-iron plate girders, sixteen inches deep and twenty inches apart, with cast-iron cradles fitted between and bolted to the web-plates, to support a 12-inch water pipe. All the work under both contracts has been done, and the cost of the bridge work was \$3,000, and of the mason work, grading and filling, \$8,250.

D STREET EXTENSION BRIDGE—ABUTMENTS AND WALLS.

Estimates for the Committee on Laying out and Widening Streets have been made of the probable cost of an iron bridge, the necessary abutments and retaining walls, that would be required if the extension of D street, from its present terminus to Federal street, were made at the high grade, crossing the Old Colony and Newport Railroad fourteen feet in the clear above the tracks.

SHAWMUT AVENUE EXTENSION AND INDIANA PLACE
WALLS, &c.

Surveys, levels and soundings have been made, and plans partly finished for the structures that would be required by the extension of Shawmut avenue over the Boston and Albany Railroad, the raising of the grade of Indiana place and of Castle street. Preliminary estimates have been made for the Committee on the Suffolk Street District, of the cost of these structures.

Respectfully submitted.

N. HENRY CRAFTS,

City Engineer.

BOSTON PUBLIC LIBRARY



3 9999 06315 932 9

