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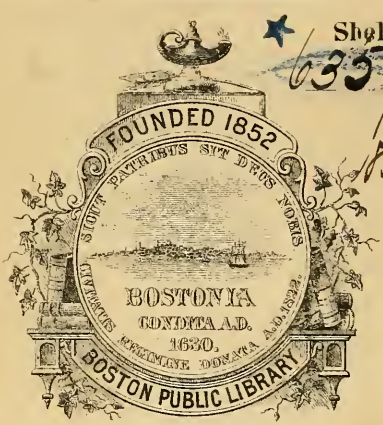

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City Document.—No. 6.

REPORT

OF THE

COCHITUATE WATER BOARD,

TO THE

CITY COUNCIL OF BOSTON.

BOSTON:
1852.
J. H. EASTBURN, CITY PRINTER.

Map.

Office of the Cochituate Water Board.

January 15, 1852.

To the City Council of the City of Boston.

The Cochituate Water Board, in compliance with the provisions of the City Ordinance, respectfully submit their annual

REPORT.

The Board, having been duly organized by the election of a President, from its own members, and a Clerk, proceeded to the appointment of the necessary subordinate officers, and to the adoption of rules and regulations for its own government and in relation to all persons employed. And having in view the great importance of the trust confided to them, it was their endeavor, to establish such a general system for the observance of all, that the great object of the Water Works, the supplying a sufficient quantity of pure water for the great variety of uses to which it might be applied, should be most effectually accomplished, with due regard to the safety and permanence of the works—a proper economy in their management—and the securing an adequate income from them to the City.

In the performance of this duty, however, they met with some embarrassment at the outset, arising out of the want of any authentic description of the works themselves—no official statements of the situation or mode of construction of all the different portions ever having been made. The periodical reports of the *Water Commissioners* contain ample descriptions of many parts, as

they were from time to time completed, and also many statements as to the intended construction of others—there are however entire omissions as to some portions, and the intended mode of construction of others was sometimes altered, without reporting the fact. And the *late Cochituate Water Board* merely reported its own doings. The reports of both these Boards were not always printed, and many of those which were, cannot now be found. It has been therefore, in the first place deemed important, that *a description of all the works, as they have been completed,* should be prepared for the use of the Water Board, and, as such a description may be convenient and useful for the City Council in reference to any action on their part hereafter on the subject of the Water Works, that it should be made a component part of the first Annual Report of the present Water Board. The description will however be as condensed as is practicable, consistently with the great variety of details which it must include. It is intended only to supply a want which is now felt to be serious, and which it may be found more difficult to provide for hereafter.

The attention of the City had, for many years, been attracted to *Lake Cochituate,* or *Long Pond*, as it was formerly called, as the proper source from which a supply of pure water adequate to the prospective wants of the inhabitants might be obtained.* The great cost of the undertaking however, and differences of opinion which existed as to its relative advantages, compared with some other sources, particularly those of Charles River and Spot and Mystic Ponds, prevented any effectual measures being taken for its adoption until the year 1844. In that year, (Aug. 26) *a Board of Commissioners* was appointed by the City Council, "*to Report the*

* See Appendix A.

best mode, and the expense, of bringing the Water of Long Pond into the City of Boston." Their report was made in November following, and the subject submitted to the legal voters at the ensuing Municipal election, for their decision, and they by a large majority voted to instruct the City Council to apply to the Legislature for an act, giving to the City the necessary power to carry the object into effect, An Act was accordingly passed, March 25, 1845, which provided also that the City Council might determine whether the water should be brought *from Long Pond or Charles River.* There were however, several provisions in the Act, which rendered it objectionable, and it was not accepted by the citizens. The Act now in force, was passed the following year, and was duly accepted. By it, the City was authorized, in the mode provided in the Act, *To take, hold and convey into and through the said City, the water of Long Pond so called, and the waters which may flow into and from the same, and any other ponds and streams within the distance of four miles from the said Long Pond, and any water rights connected therewith; and may also take and hold by purchase or otherwise, any lands or real estate necessary for laying and maintaining aqueducts for conducting, discharging, disposing of, and distributing water, and for forming reservoirs; and may also take and hold any land around the margin of said Long Pond, not exceeding five rods in width, measuring from the verge of said Pond, when the same shall be raised to the level of eight feet above the floor of the flume at the outlet thereof, and on and around the said other ponds and streams so far as may be necessary for the preservation and purity of the same, for the purpose of furnishing a supply of pure water for the said City of Boston.*

Lake Cochituate.

Lake Cochituate, thus selected as the source of supply of water for the City, is situate within the limits of the towns of Framingham, Wayland and Natick in the County of Middlesex. It may be considered, a chain of natural, subsiding reservoirs of water, three in number, having a general direction nearly north and south; its extreme length in a direct line being nearly three and one half miles, and its greatest breadth about eighteen hundred feet. The Lake is crossed by the Boston and Worcester and the Saxonville Railroads, and by two County roads, one of which was formerly the Worcester Turnpike, and the other a road leading from Framingham to Newton, and as the two last indicate the natural divisions of the Lake, and separate it into three nearly equal parts, it is, for matter of reference, found convenient to consider the Lake as divided by them, into the Northern, Central and Southern Divisions.

The water of the Lake gradually increases in depth from the shore, in each division; at high water, or when raised eight feet above the flume, mentioned in the Act, its greatest depth is about 70 feet in the Southern, 50 feet in the Centre, and 62 feet in the Northern Divisions. When the water is at this elevation, the superficial area of the Lake is estimated to contain six hundred and eighty-four acres—at 6.5 feet above the flume, the area is six hundred and fifty-nine acres—at 3 feet above the flume, the area is five hundred and fifty-nine acres—at 1.5 feet above the area is five hundred and four acres,—and at low water, or the level of the flume, the area is four hundred and eighty-nine acres.

The shore of the Lake, is generally a bold sand and gravel bank, and the increase of surface which is produced by raising the water, takes place mostly in a great meadow

in the Southern division, South of the Boston and Worcester Railroad; also on another meadow at the southerly end of the same division; on some low grounds near the northerly end of the Central Division, (at the mouth of Snakebrook,) and lastly in some small bays which occur in other places. When the water is raised eight feet above the flume, there are one hundred and twenty-five acres not covered with more than five feet depth of water; at 6.5 feet above, there are one hundred acres covered with a depth of water not exceeding five feet;—at 3 feet above, the peat meadow in the southern division is to a great extent covered, but the other meadow in the same division, and that in the Central, are mostly bare. The whole circuit of the Lake, including the meadows, is about 16 miles; and excluding those, about 12 miles, measured at the verge of the Lake, when the water is eight feet above the flume.

The tract of country which drains into the Lake is bounded by the ranges of hills which divide the streams running into the Merrimack from those which run into the Charles River, and as surveyed covers an area of 12,077 acres, including the Lake; deducting from this amount 677 acres as the area of several ponds included in it, which are estimated to lose by evaporation from their surfaces, a large proportion of the rain which falls upon them, there remain 11,400 acres or 496,584,000 square feet as the water-shed from which the Lake derives its supply. By comparing the quantity of water which was ascertained to have been discharged from the outlet of the Lake, for two years commencing in July and November, 1837, with the quantity of rain which fell during those periods, it was estimated that more than four-tenths of the rain-fall had been received into the Lake; and it being ascertained that the minimum fall of rain at Boston, for a series

of 27 years had been nearly thirty inches, (29.98) it was assumed that four-tenths of that quantity might be realized, as the ratio of the total rain-fall, which would be collected, from the district which drains into the Lake. This would give 496,845,000 cubic feet as the annual supply, or 1,360,504 cubic feet equal to 10,176,570 wine gallons per day. In calculating the future wants of the City the conclusion had been adopted that seven and one quarter million gallons a day would be an ample supply for all the public, domestic and manufacturing uses of the inhabitants when their number should amount to two hundred and fifty thousand. This calculation was based on the supposition that a supply of 28½ gallons a day to each individual, would be sufficient—a supposition which the experience of other cities at the time fully justified, and which our own experience would confirm were the water only applied to the legitimate and useful purposes for which it was intended, without the excessive waste which now takes place. It was concluded therefore that this source might be relied on to afford the necessary supply of water to the City, or at least ten millions of wine gallons per day, throughout the year. In order to effect this however, it was necessary that proper means should be adopted to reserve in store the excess which will collect during the winter and spring, for use during those months, which have been found to be the season of a low state of water in the streams. A dam at the outlet of the Lake to raise the water eight feet above the flume as authorized by the act, was deemed to be all that was necessary for this purpose.

At the time of the passage of the act, the waters of the Lake were in the possession of Mr. William H. Knight, who owned the outlet and had several mill privileges and

manufacturing establishments connected with it, between the Lake and Sudbury River into which it naturally discharges its waters. All Mr. Knight's interest was accordingly purchased and vested in the City and the City thereby acquired the right of exclusive use of the water and of diverting it from its natural channel; subject however to any damages which might be sustained, by proprietors of water rights, situated below Mr. Knight, by reason of the diminution of their supply of water. The *Sudbury river* joins *the Assabet* about 14 miles below Mr. Knight's mill privilege and the two form *the Concord river*, which after flowing through an almost perfectly level country about 10 miles to *Billerica*, thence continues on for about 4½ miles and finally empties into the *Merrimack* at Lowell. All the water of *Concord river*, including that from the Lake, was subject to the use of the *Middlesex Canal* in the first instance to supply the canal, and afterwards the surplus belonged to *the Proprietors of the Mills at Billerica* and to those of three other privileges on Concord river.

Dug or Wonsemog Pond.

In addition to the supply of water contained in the Lake, Mr. Knight also conveyed to the City, that of *Dug or Wonsemog pond*, lying to the south of it. The pond is about eighty rods from the southern shore of the Lake and separated from the peat meadow, on the *Southern* division, by the county road; a culvert is laid beneath the road by which the waters are discharged into the meadow and thence pass into the Lake. It contains about forty-four and one half acres, is elevated about seven feet above the level of the Lake and discharges into it. The shore all around is a steep gravelly

bank eight or ten feet high, and the pond naturally derives its water wholly from springs. The City has also acquired a right to divert the waters of a brook on the east side into it, and thereby to ensure the filling up of the pond every winter. The water is quite deep and remarkably pure and soft, and forms a highly important tributary to the Lake.

Marginal Lands.

In order to enable the City to exercise a proper control over the waters thus acquired, and for the purpose of preventing any acts which might tend to impair their purity, as well as for regulating the right to overflow the adjoining lands, it was authorized to take and hold a strip of land, not exceeding five rods in width on the margin of the Lake. It was soon ascertained however that in cases where land was to be taken for these purposes, or for the construction of the Aqueduct, or Reservoirs, where material injury would be occasioned to the adjoining lands, it would in many instances be the most advantageous mode of adjusting the damages, to purchase the entire lot of land so injured and to make re-sale of such part thereof as might be deemed advisable, after the works should be completed. That system was accordingly adopted. And in consequence, the border, thus purchased, is of very different widths according to the character of the border, and the terms of the contracts which could be made with the proprietors. The whole area which has been purchased around the margin or immediately adjoining is *six hundred and thirty-five and one half acres*, and of this the City has the fee simple. It completes the entire circuit of the Lake with the exception of a piece on the western side of the *Southern division* about

2200 feet in length, five rods in width, and containing about *seven and one half acres,* which the City being unable to purchase, took and now holds possession of under the power given in the act. The precise nature of the tenure which the City has acquired in this and similar cases, is at present not definitely settled, but has been made a question for the adjudication of the Supreme Court, in a case which arose out of the taking of a piece of land for the Aqueduct in Newton. To the above quantity being added the amount purchased of Mr. Knight and others, in connection with the outlet and mill privileges, which was about *thirty-nine* acres, it appears that the whole area purchased and taken in the neighborhood of the Lake and outlet was *six hundred and eighty-two* acres, all of which is still in possession of the City, no sale of any part having been yet effected.

Dudley Pond.

The City also purchased the outlet to *Dudley Pond*, containing *one acre and thirty rods*, and took possession of its waters. This Pond lies in a North Eastern direction from the *northern division* of the lake, and contains about ninety acres, at an elevation of about seventeen feet above it. The water is very pure and soft, and there is no other outlet than that owned by the City, through which it flows into Sudbury river. There is at present no connection between this pond and the lake ; if one should be made hereafter, it could probably be effected most easily, by a tunnel through the hill which occupies part of the intervening land and rises to a height of about sixty feet above the level of the pond. The land lying between the pond and the City's land on the margin of the lake, is not at present owned by the City.

The distance between the lake and pond is about seven hundred feet.

Dam and Gate House.

Having obtained possession of all the waters of the Lake, and of all the land which was required, a new DAM was constructed at the outlet, on the West side of the *Northern division*, in the town of Framingham, and the GATE HOUSE, for the commencement of the aqueduct built on the opposite or Eastern side of the same division in Wayland. The DAM is of solid masonry, of granite, and raised to a height sufficient to retain the water to a point eight feet above the floor of the flume. This corresponds with an elevation of 132.36 feet above tide marsh level, the floor of the flume being 124.36 feet above the same level.

The GATE HOUSE was carried a sufficient distance into the lake to procure the water from the necessary depth, and the bottom of the aqueduct placed in it, at an elevation of 3 feet 4 inches below the floor of the flume, and 3 feet 10 inches below the assumed low water line, so that when the Lake is raised to the high water line, it will stand 11 feet 4 inches above the bottom of the aqueduct. The low water line is therefore six inches above the floor of the flume, and seven feet six inches below the high water line, and 124.86 feet above tide marsh level. There are four gates for regulating the admission of water into the Aqueduct. They are made of cast iron with composition or gun metal facings, and a frame of the same materials, set in hammered stone, and are worked by iron screws in composition nuts. The whole is enclosed in a building of hammered granite, with a metal roof, secured effectually from intrusion.

A CULVERT is also constructed beneath the road, which divides the Northern from the Central divisions, in which provision has been made for placing stop-planks so that the water can be shut off from the Northern, and thereby about two-thirds retained, in case it should be necessary to repair the gate-house or dam.

The Aqueduct.

The aqueduct may be conveniently divided into two parts. *The First Part* extends from the Lake to the Receiving Reservoir in Brookline. It comprises a *conduit of brick masonry* for the greater part of the distance, *a line of iron mains* over the valley of Charles River and *two tunnel excavations* in Newton and Brookline. *The Second Part* comprises *the iron mains* from Brookline to the City, *and the distribution* in the City.

First Part of the Aqueduct. The Brick Conduit.

The Brick Conduit is accommodated to the elevation of the different parts of the line, by winding in a series of irregular curves, care being taken, where it was possible to adopt such a route as would permit its being buried entirely beneath the natural surface of the ground. Its general direction after leaving the Lake, is *South Easterly* for about four and one half miles, to near the village of *West Needham.* It then turns and runs *North Easterly* about two miles. Thence *Easterly*, crossing *Charles River*, about three and one quarter miles. Thence *North Easterly* through the long tunnel, about two and one half miles to the Ventilator. Thence *South Easterly* about two and one quarter miles, through the short tunnel, to the *Receiving Reservoir*, passing through parts of the towns of *Wayland, Natick, Needham, Newton, Brighton, and Brookline.*

It was the original intention to carry the Aqueduct, after passing the road leading from the village of *Newton Centre* to *Newton Corner*, in a *Northerly* direction and North of Nonantum Hill, to the then proposed site for a Reservoir on the North side of Corey's hill, in Brighton; but a further survey of the locality offered sufficient inducements to vary that route, and thereby obviate the necessity of carrying iron mains over Brighton valley, and of being subjected to the heavy damages which would have been incurred in passing through much valuable cultivated land. By adopting the new route, the distance was also materially shortened, and a site obtained which admits of the construction of a much more capacious reservoir than could be built at Corey's hill, except at a very heavy cost. The Aqueduct was therefore laid South of Nonantum Hill, through a more secluded tract of country and lands of inferior value, to the site of the present reservoir in Brookline. In order to effect this however, it became necessary to excavate by tunnelling a passage through two rocky elevations in Newton and Brookline. This work was rendered eventually more tedious and costly than had been anticipated, by reason of the great difficulty of the excavation, and also on account of the irruption of large quantities of water into the works from fissures in the rock through which it was carried.

The Aqueduct, from the Lake to the left bank of Charles river, and from the right bank of the same to Brookline reservoir, is built of brick masonry, eight inches thick, laid in hydraulic cement; it is in section an egg-shaped oval, the largest end down; the greatest width is five feet, and the extreme height six feet four inches, in the interior. It is covered with a plastering of hydraulic cement, on the outside, from the

top down to the chord line of the lower or inverted arch, more effectually to prevent the percolation of surface water into it. It is supported on a puddled embankment, built up above the chord line of the inverted arch; in all cases where the Aqueduct passes over ground whose level falls below the grade line, and also where the ground was found to be marshy, or from any cause not sufficiently solid to support the superstructure. In the latter case the mud and loose soil were previously removed until a firm bearing could be had. The whole is covered with an embankment eight feet wide on the top, with side slopes of two feet horizontal to one foot vertical, and raised four feet above the top of the aqueduct. The Aqueduct through the whole distance thus rests upon, and is covered with, earth to a depth of at least four feet, and it is no where raised, so as to admit a passage beneath it, excepting at the culverts; at the crossing of Charles river, which it passes by two iron pipes; and also over a valley in Needham, near the west bank of the river. In the latter place it is carried over the road-way by a granite bridge of one arch of twenty feet span, and fourteen feet high, and supported over the rest of the valley on a puddled embankment, in some places forty feet high.

In preparing the foundation and laying the reversed arch of the Aqueduct, much delay was occasioned, and additional labor required in the 2d, 5th, 10th, and some other sections, on account of the large quantities of water, and in some cases quicksands which were found near the bottom of the cut.

The first brick of the Aqueduct was laid, October 19, 1846.

The bottom was all united, September 17, 1848.

The top closed up, the interior cleansed, and water let in, Oct. 12. 1848.

The Mains over Charles River, Pipe Chambers and Charles River Bridge.

The remainder of this part of the Aqueduct comprises the Mains over the valley of Charles river, and the tunnels in Brookline and Newton. The former consist of two iron pipes, thirty inches in diameter, which descend fifty-eight feet below the level of the water in the Aqueduct on the west bank of the river, when three feet and ten inches deep, to a stone bridge built over the river, and thence are continued over the interval at a rather lower level and then rise to the Aqueduct on the eastern side. The *Charles River Bridge* is constructed of hammered granite, of three elliptical arches of thirty feet span and seven and one half feet rise, and twenty-one feet long. The mains are each nine hundred and seventy-nine feet in length. The horizontal distance between their termini is nine hundred and fifty-six feet. The *Pipe chambers*, constructed at each end of the mains, are of granite, with iron doors and stone roofs. The admission of water is regulated by stop-planks, provision is made however for placing gates hereafter.

The bottom of the west pipe chamber is 118.97 feet above tide level.

The bottom of the east pipe chamber is 118.52 feet above tide level.

The water in the river at its lowest state is 71 feet below the water in the Aqueduct.

Provision is also made in the pipe chambers for another pipe to be carried across the river when necessary, the wall being pierced and a pipe laid through it.

The Tunnels.

There are two tunnels, excavated through porphyritic rock of extreme hardness, in the towns of Newton and Brookline. The former is *twenty-four hundred and*

ten feet and the latter *eleven hundred and fifty feet* in length. A course of concrete is laid in it of variable thickness to form a bottom of uniform inclination, coinciding with the level of the aqueduct. Those portions which showed signs of perishable rock were lined with brick masonry; and brick arches of extra thickness, were turned over the water course, at all the shafts which had been sunk during the progress of the excavation, for the purpose of supporting the filling of earth which was put into them.

For expediting the work on the tunnels seven shafts were sunk through the rock in the Newton tunnel and four in the Brookline. The rock to be excavated proved much harder than was anticipated, and the work was also much impeded by, as has been stated, the large quantity of water which was encountered, although seven steam engines were kept in constant operation for the purpose of removing it. Three sets of men were employed at each face of the several drifts between the shafts, relieving each other at intervals of eight hours, and thus continuing the work through the day and night.

In the *Newton tunnel* the shafts were commenced at the west end about November 15, 1846.

The first drift was commenced, at the west end, December 30, 1846.

The last drift was completed April 28, 1848.

The brick lining was completed August 27, 1848.

In the Brookline tunnel,

The shafts were commenced December 17, 1846.

The first drift was commenced about January 30, 1847.

The last drift was completed June 20, 1848.

The brick lining was completed August 30, 1848.

The top closed up, the interior cleaned out, and water let in October 12, 1848.

The Waste Weirs.

There are four *waste weirs* constructed for the purpose of letting off the water and also of ventilation; they are built entirely of stone, with iron doors and stone roofs, the walls being carried up to a sufficient height to form an enclosure over the works. The overfall or weir is of stone, through the breast of which two gates are fixed to draw the water off when required. The gates and gate frames are of composition metal set in cut stone, the gates being worked by iron screws in composition nuts.

The first waste weir is in Section No. 3 at Dedman's brook, about three miles distant from the gate house at the Lake. This is the nearest point where, from the level of the ground the water could be discharged. *The second* is at the end of Section No. 5, about one mile west of Charles river in East Needham. *The third* is in Section No. 10 at the outlet of *Baptist pond* in Newton Centre about three miles east of Charles river. *And the fourth* is in Section No. 13, in Brookline about a mile from the reservoir.

By means of the waste weirs, the ventilation has been well regulated, and no inconvenience has been experienced from there having been but one ventilator expressly built for that purpose along the whole line.

Ventilator and Man-holes.

The only *ventilator*, strictly so called, on the aqueduct, is placed near the easterly end of the tunnel in Newton. It is built of hammered granite, square with a coping on the top, and gradually diminishing in size

from the base, and is 14 feet 6¾ inches high, 8 feet wide at the base, and the coping is 7 feet 3 inches. The passage inside is 4 feet 1¼ inches. A great benefit derived from it consists in the means which it affords of an entrance into the Aqueduct, for the purpose of cleansing and examining. *Man-holes* are also placed along the Aqueduct at distances of about a quarter of a mile, for the same purpose. They are covered with stone slabs. A *plug-hole* 12 inches in diameter is also made near the ventilator, to let off the water from the Aqueduct when necessary.

Culverts and Drains.

There are *ten Culverts* and *thirteen Barrel Drains*, for the purpose of draining off, beneath the Aqueduct, the water in its neighborhood.

The Culverts are all of granite, with hammer dressed joints, and laid in hydraulic cement. Their openings are from 2 to 8 feet wide, the smallest being square in form, and the largest having upper and inverted arches. *The Barrel Drains* have stone ends and brick centres, and are laid in hydraulic cement. They are from 1½ to 2 feet in diameter and circular in form of opening.

The first part of the Aqueduct is, for the greater portion of its length, laid entirely beneath the natural surface of the ground; appearing above only for short distances at irregular intervals. The greatest depth of any part is at the tunnels in Newton and Brookline, at the former of which the bottom is about eighty feet, and at the latter about sixty feet. The deepest excavations made for the brick aqueduct, were,—at a short distance from the Gate house, at the Lake;—near the waste weir at Dedman's brook;—near the waste weir in East

Needham;—and near the Cold spring in Section 9, in Newton. It was laid at those places about thirty feet deep. The longest interval that it remains beneath the surface entirely, is from its junction with the Lake, for a distance of about two and a half miles. The bottom of the Aqueduct is not raised above the level of the natural surface, for more than three-fourths of a mile through its whole extent.

The rate of descent in the brick portion, is three and one sixth inches per mile. The fall for the whole distance, including the pipe section over the valley of Charles River, is nearly three and one half inches per mile. The whole descent or fall is 3.81 feet in the brick Aqueduct, which is 14.446 miles long. In the pipe section, 956 feet long, it is 0.45 feet. Making in the whole distance 14.627 miles, a descent of 4.26 feet.

With this descent, and a depth of three feet and ten inches of water, the Aqueduct is found to be sufficient to convey more than ten million gallons in twenty four hours, being considerably more than its originally estimated capacity, with that depth.

The whole quantity of land purchased and taken possession of by the City along the line of the Aqueduct, from the Lake to Brookline Reservoir, is three hundred and five acres and eight rods; it has the fee in two hundred and seventy six acres, and ninety five rods, and holds by possession, taken under the act, twenty eight acres and seventy three rods.

The Receiving Reservoir.

The *Receiving Reservoir* is situate in Brookline, at the Eastern termination of the brick portion of the

Aqueduct. It is formed out of a natural basin enclosed almost entirely by banks rising to considerable height above. On the side which was not protected by the natural embankment, the earth was removed, and a puddled embankment built up to a height of about twenty six feet; the lower part, to the height of eight feet being supported by a retaining wall. For the purpose of relieving the banks from the action of the water, the inner slope of the Reservoir was lined with a slope wall of granite rubble, eighteen inches thick and eleven feet broad, the lining commencing four feet below the top of the bank. The lining has been lately increased to fourteen feet, by adding three feet to the top of the former. *The greatest depth* of water is near the principal gate house, twenty-four feet. *The least depth* is near the *upper gate house*, where it is about 14 feet. The embankment is 20 feet wide at the top, with a gravel walk all around. The surface of the Reservoir contains at a depth of 6 feet below the top of the dam, 22.31 acres, and its capacity is 89,909,730 wine gallons, the contour of the water line being 4696 feet long; at 2 feet below the top of the dam, it contains an area of 22.95 acres, and the capacity is 119,583,960 gallons. The Reservoir in shape is an irregular oval.

The top of the dam is, 126.60, above tide marsh level.
The upper floor of the
principal Gate House, 126.76, " " " "
Low water mark, - - 120.60, " " " "
The bottom of the interior
of the Aqueduct, - - 116.77, " " " "
The bottom of the Reservoir, - - - - - - 100.60, " " " "

A cylindrical brick conduit is laid, at a depth of 8 feet, within the northern embankment, to conduct the water

to the pipe chambers, by means of which the supply of the mains can be kept up, when the water is let off from the reservoir for cleansing it, or for any other purpose.

There are two *Gate Houses* for receiving the termination of the brick portion of the Aqueduct, and the commencement of the conduit leading to the City, with the regulating gates, gauges, &c.

The *Principal or lower Gate House* has its front on the street where it is 26 feet 4 inches wide by 36 feet 8 inches high, including the basement which is 16 feet 4 inches. It is set in the embankment and projects about 4 feet in front of the retaining wall. The height in the rear is 20 feet. The length of the building is 44 feet 4 in. An iron stairway ascends from the basement to the main floor. The building is of hammered granite with an iron roof, and no wood is used in the construction of any part except the doors and sashes. The main floor is on a level with the top of the embankment; and the bottom of the gates which regulate the admission of water into the pipe chambers is 26 feet below the floor. The gates and gate frames are of iron plated with composition metal, set in hammered granite; they are worked by iron screws in composition nuts. There are three pipe chambers, into two of which the mains now laid are introduced, and a thirty-six inch pipe is also laid through the bulkhead into the third chamber, to be connected with another main if necessary hereafter.

The *Upper Gate House* contains the termination of the brick aqueduct, and the stop planks for regulating the flow of water into the reservoir. The building is of granite with a stone roof. The front is 11¼ feet by 11 feet 4 inches high and the length 12 feet.

The Second Part of the Aqueduct.

The second part of the Aqueduct consists of the conduit from Brookline receiving reservoir to the City and the distribution in the City; and comprises *the Iron Mains*, *the Distributing pipes* and *the Service pipes.*

The Mains.

From the Reservoir to the City the conduit consists of two iron mains, one thirty-six inches and the other thirty inches in diameter. They are laid side by side, beneath the public highway which was formerly the Worcester Turnpike, to Brookline village, and thence by the public streets, through Brookline and Roxbury to Tremont street, in Boston, and through that street to Dover street, a distance of about three and two third miles from the Reservoir. At this place the thirty-six inch pipe is reduced to one of thirty inches and the two mains pass together, through Tremont street to Boylston street. From this point the main originally thirty inches is laid across the Common, through Joy and Mt. Vernon streets to Hancock street to supply the Reservoir on Beacon hill, it then passes by the side of the Reservoir through Hancock and Cambridge street to the corner of Chardon street in Bowdoin square. The originally thirty-six inch Main which had been reduced to thirty inches, passes down Boylston street to Washington street—it is there again reduced to one of twenty-four inches, and passes through Washington street, Dock square, Union, Merrimack, Ivers, and Chardon streets to Bowdoin square where it joins the other thirty inch main. The two Mains are laid at a sufficient depth to be secure from frost, and are carried across the Boston and Worcester Railroad in Tremont street in a box of boiler iron of sufficient dimen-

sions and strength to receive and support the mains, from one abutment to the other, under the westerly side-walk of the Railroad bridge, the whole being inclosed in wood.

Distributing Pipes.

By the side of the Mains and connected with them is laid a side pipe, six inches in diameter, the object of which is to prevent the necessity of ever interrupting the flow of water through the mains, when it should be required to supply a new tenant, which otherwise, could only be done by drawing off the water from the main for several hundred feet while the work was doing.

From the mains as they pass by the several streets in their route the distributing pipes of four, six, twelve and sixteen inches in diameter branch off. Those of six inches in diameter, generally, and all under, are connected with the attending side pipe, and those of a greater diameter enter directly into the mains. At Dover street a pipe of twenty inches is connected with the thirty-six inch main and passes through Dover street over South Boston bridge, through Fourth and Atlantic streets, to Telegraph hill, where it enters and supplies the South Boston Reservoir; and branch distributing pipes are connected with it as it passes along the route. And at the junction of Union and Merrimack streets a pipe of twenty inches diameter is connected with the twenty-four inch main (the continuation of the thirty-six inch main) and passes through Union and Beverly streets on the lower side of Warren bridge to Charlestown, and through Charlestown by Chelsea street and on the uper side of Chelsea bridge to Chelsea, thence by the road near the shore to what was formerly Ober's wharf, now belonging to the

City, and thence it passes across the water to East Boston and is laid directly to, and supplies the Reservoir.

The length of the Mains and Distributing pipes laid up to Jan. 1, 1852, is one hundred miles and four hundred and fifty six feet, exclusive of hydrant branches.

Stop cocks are placed on the line wherever required; their present number is eight hundred and ninety seven.

Hydrants for extinguishing fires and other purposes are also placed at intervals of 300 feet, the whole number in the City is eleven hundred and ten, of which there are in Boston proper, - - - - 811

East Boston, - - - -	124
South Boston, - - - -	175

Twenty three hydrants have also been placed along the mains in other towns where the City has made use of the streets and highways, of these there are

In Brookline, - - - - - -	1
" Roxbury, - - - - - -	4
" Charlestown, - - - - - -	11
" Chelsea, - - - - - -	7

The pipe across South Boston Bridge is laid on a foundation of earth supported at the sides by piles and planks, as far as the harbor line. It is thence supported across the public waters, as far as the draw and channel, in a wooden box, resting on piles. It was originally intended that it should be protected from frost, by a filling of non-conducting materials, this was however afterwards abandoned. The pipe is carried in an inverted syphon 20 inches in diameter, with perpendicular ends, under the water, and embedded in the hard bottom of the channel. It is enclosed in a box or frame of timber, and completely enveloped with a covering of hydraulic cement. The distance from the top of the pipe to the bottom of the

syphon, including the box, is 32 feet 6 inches. The space in the clear for passage of vessels is 40 feet. The pipes across Charles and Mystic Rivers, are carried in a similar manner. There are two inverted syphons 30 inches in diameter, in the pipe across Mystic River, placed opposite the draws in Chelsea Bridge. In one the height from the bottom to the top of the box or casing is 42 feet 5 inches, and the space in the clear 50 feet, being considerably more than the present width of the draw. In the other, the height is 29 feet 6½ inches, and the space 39 feet. In the pipe across Charles River the height is about 36 feet, and the space about 39 feet. The pipe across Chelsea creek to East Boston, is laid to the channel, from both sides of the creek, in a box filled with marsh mud or clay, and carried across the channel in a flexible pipe of nearly double the ordinary thickness, with swivel joints. The flexible portion of the pipe is about 461 feet long, laid in a trench dredged out about 6 feet deep, and covered with clay and gravel, to protect it from anchors.

Service Pipes.

The *service pipes* are connected with the distributing pipes, and are carried through the outer walls of the buildings, at the expense of the City, provided the distance from the line of the street is not more than thirty feet. They are almost all of lead, and very generally five eighths of an inch in diameter. There are some however of iron of an inch and a half and two inches in diameter, which were laid only in compliance with the wishes of individuals. The objections to that metal, arising from their filling up with accretions, discoloring the water with rust, and being easily fractured, have been found quite serious. Some objection also was

made to the employment of lead for this purpose, on the supposition that it might communicate a deleterious influence to the water. The subject was submitted to the consideration of the consulting physicians, and investigated with great care by Professor Horsford of Harvard College; and the result at which they arrived, seems to be sufficiently decisive to relieve the anxiety which had been expressed. The whole number of service pipes laid to Jan. 1852, is 16,049, of which 13,549 are lead.

Distributing Reservoirs.

There are *three Distributing Reservoirs*, constructed for the purpose of receiving the water from the mains leading from the Brookline Reservoir, during the latter part of the day and the night, when it was presumed but little would be drawn from the service pipes; and of supplying it to the service pipes in the morning, when the greater portion for domestic purposes is required. By this means a continuous supply could be kept up to a more uniform height.

Beacon Hill Distributing Reservoir.

The most costly distributing Reservoir, belonging to the Water Works, is erected on the site where Beacon Hill formerly stood. The foundation of the Reservoir is more than 70 feet below the former elevation of the hill. It is built with great labor and care, of the most massive description of stone masonry. The whole structure is of granite laid in hydraulic cement, with hammered beds and builds and an undressed external surface, surmounted with a deep cornice. It is situate and bounded 190 feet 3 inches on Derne street, 206 feet 5 inches on the rear of Mt. Vernon street, 191 feet and

7 inches on Hancock street, and 182 feet 11 inches on Temple street. The outer walls are 3 feet thick, and that on Derne street is pierced with five arches, and elevated 58 feet and 9 inches including the coping, above the level of the street; those on the other sides are solid. The walls on Temple and Hancock streets gradually diminish in height with the ascent of the hill; at their junction with the wall on the rear of Mt. Vernon street, they are 40 ft. 8 in. high. The basin containing the water is raised to such a height from the natural surface, that the floor or bottom of the interior of it is 15 ft. 8 inches below the level of the coping. The lateral walls of the basin are built 12 feet within the exterior walls of the reservoir. They are of granite, 5 feet thick at the lower part, and 3 feet at the top. The bottom of the reservoir is covered with concrete to a depth of 3 feet, and afterwards paved with two courses of bricks. The basin is supported on arches of granite. Of these arches, seven extend parallel, from Hancock street towards Temple street, from wall to wall. They are from 11 feet 9 inches, to 15 ft. 6 inches between the piers, and, varying in height with the declivity of the foundation, are from 23 feet to 34 feet high; they give support to about two thirds of the superstructure; extending from the rear of Mt. Vernon street towards Derne street, until they meet the arches running from Derne street at right angles to them. Those arches seven in number, extend back from Derne street, 57 feet and six inches, they are 20 feet 3 inches wide, and vary in height, with the declivity of the land, from 37 to 39 feet, the piers supporting the arches being 3 feet through. Five of them open on the street, their entrance varying in height from 36 feet to 38 feet, and being 14 feet 9 in. wide. The lateral walls of the basin rest on the course of concrete; and there is a space of 4 feet 9 inches between

them and the outer walls. It was estimated that 17,000 cubic yards of hydraulic masonry and concrete were used in the construction. The influent main is introduced in the South Western corner of the structure, and a stair case in the same corner contains a flight of stone steps leading to the top, and is protected on the top by a lantern of cast-iron 9 feet 1 inch high, by 10 feet 6 inches wide in the interior. The effluent main 30 inches in diameter, passes out at the North Western corner.

The contents of the basin are equal to 2,678,961 gallons, its mean horizontal section being 28,014 square feet. The maximum or high water level of the water in Brookline reservoir, which now is 124.60 feet above tide marsh level, is 11 inches above the coping of the inside of the Beacon hill reservoir, or 16 feet 7 inches above the bottom of the basin, the minimum level of the Brookline is 4 feet below this line. The bottom of the Reservoir is

above tide marsh level, - - -	108.03 feet.
The top of the coping outside, - -	124.03 "
The bottom of the waste weir, - -	121.53 "

South Boston Distributing Reservoir.

The South Boston Reservoir is placed on the East side of Telegraph hill, South Boston. The walls are formed of a puddled embankment, lined inside with granite rubble, and the bottom paved with pebble stones. It resembles in shape a segment of an ellipse measuring across the widest part about three hundred and seventy feet, and about two hundred and sixty across the narrowest part. It contains 7,508,246 gallons. The top of the dam is 125.86 feet above tide marsh level and the bottom of the reservoir 105.35 feet. High water mark in the reservoir is 17 feet 9 inches above

the bottom, and 1 foot 9 inches below low water mark at the Lake.

East Boston Distributing Reservoir.

The East Boston Reservoir is placed on Eagle hill East Boston. The walls are formed by a puddled embankment, lined with stone in the interior; the bottom paved and covered with concrete. It is rectangular in shape measuring three hundred and twenty-five feet by one hundred and fifty and contains at a level 3 feet below its top 5,591,816 wine gallons. The top of the dam is 110.60 feet and the bottom of the Reservoir 80.60 above tide marsh level. High water mark is twenty seven feet above the bottom of the Reservoir and seventeen feet three inches below low water mark at the Lake. The outside slope of the embankment on the west side is 93½ feet, on the east 70½ feet on the south 67 feet and on the north 56 feet. The top walk is 7 feet wide.

Public Fountains.

There are at present ten public fountains supplied with the Cochituate Water, and situate in the following public squares and places. *The principal* is in the pond or fountain basin on the Common, the coping of which is 24.60 feet above tide level and 96 feet below the minimum level of Brookline reservoir.

One is placed in the public garden and receives the waste water from that on the Common.

Two are in front of the State house.

Two in Franklin and Blackstone squares.

One in Chester square.

One in the square in front of the West church.

One in Haymarket square.

One in Maverick square, East Boston.

All the fixtures connected with the several fountains belong to the City, excepting those of the fountains in front of the State house, which were erected at the expense of the State. As it is important, in reference to a proper economy in the use of the water, that the quantity consumed in the several fountains should be known, an estimate of the *hourly consumption* has been prepared. It is however to be considered as giving the theoretical discharge only, as calculated from the area of the orifice and the height to which the water is thrown, but the resistance, from the air and from the water being thrown back upon itself, not being taken into the account. It is nevertheless believed to be a sufficient approximation, for all practical purposes, and the error, if there be any, consists in *underrating* the quantity used. The fountain on the Common consists of twelve different jets, by which the water is thrown into a variety of forms, as it rises from a pipe on a level with the basin, without any ornamental fixtures connected with it. *Five* of these jets are *solid cylinders* of water, one of which is 3 inches, two are 4, and two 6 inches in diameter, rising to a height of from 75 to 98 feet. The quantity of water used by them severally, is from 103,380 to 392,280 gallons, the 3 inch jet using the former, and one of the 6 inch jets using the latter quantity. *Four* of the jets are *hollow cylinders*, rising from 3 feet to 88 feet, and consuming from 25,620 to 118,020 gallons. In the *three* remaining jets another variety of figure is produced, by the shape of the aperture. They rise from 30 feet to 80 feet, and use respectively 214,560—220,380, and 314,040 gallons. The least consumption of water from any of these jets is therefore that from a hollow cylindrical jet, which rises from 15 feet to 20 feet, and is 25,620 gallons. The greatest consumption is from

the solid jet, from a tube 3 feet long and 6 inches in diameter, which is 392,280 gallons an hour.

The fixtures of the fountains at the *State house*, and in *Franklin* and *Blackstone squares* are of cast iron, in shape of an ornamental vase supported on a fluted column. Those at the *State house* are about 12 feet high, above the receiving basins, and those in the *squares* 7 feet nine inches. The water rises above the respective vases from 3 feet to 7 feet. The quantity discharged from two jets at the *State house*, is 9,420 and 12,360 gallons, and that from three jets in the *squares* is 12,840, 18,300 and 32,700 gallons. At the *Public garden*, the water rises from 6 feet to 8 feet, and there is used 91,800 gallons. At the fountain in Cambridge street, it rises 4 feet and there are two jets using 8,100 and 9,240 gallons. At *Chester square*, there are two jets, one rising from 25 to 30 feet and using 24,900 gallons, the other rising from 8 to 10 feet and using 31,320 gallons.

The Compensating Reservoirs.

It has been stated that the right which the City acquired, by purchase of Mr. Knight, to use the waters of the Lake, is subject to the claims of the proprietors of the mill privileges below, and also of the Middlesex Canal, for any diminution of their supply of water. In reference to these claims therefore, and for the purpose of affording to those proprietors, during the dry season (when alone they feel any inconvenience) a quantity of water equal to that which they had formerly received from the Lake,—the City has purchased and holds two compensating reservoirs in the towns of Hopkinton and Marlborough.

The Hopkinton Reservoir.

The Hopkinton or Whitehall Reservoir is situate in the town of Hopkinton in the County of Middlesex. Following the very circuitous course of Sudbury river into which it discharges, it is about eighteen miles distant from the outlet of the Lake. The reservoir extends over an area of five hundred and seventy-six acres, the height of the dam is ten feet ten and one-half inches, and when full the water is nine feet ten and two-thirds inches deep. Its capacity is estimated at 125,403,290 cubic feet or 940,524,675 wine gallons.

The Marlborough Reservoir.

The Marlborough, or Fort Meadow, Reservoir is situate in the town of Marlborough in the County of Middlesex; about twelve miles distant from the Lake. The Reservoir has a water shed of twenty-two hundred and fifty-seven acres; and covers an area of two hundred and ninety-nine acres. The height of the dam is thirty feet; and, when full, the water is twenty-five feet deep; it discharges into the Assabet river, and following its course, is about fourteen miles distant from its union with Sudbury river, by which the Concord river is formed. The capacity of the Reservoir is estimated at 185,932,787 cubic feet or 1,394,495,902 gallons.

Ramshorn and Boon Ponds, lying about two miles distant, were included in the purchase of the Reservoir.

Assuming five cubic feet a second, to be the natural discharge from the Lake, during one hundred and twenty days of the dry season, which was the quantity calculated from the observations made in 1844–5, the estimated capacity of the two compensating reservoirs is far more than sufficient to supply the loss of water, by

its diversion from the Lake into the Aqueduct. In fact it is believed, that, after making a large deduction for evaporation and absorption, which must take place in the passage of the water, from Hopkinton reservoir to the outlet of the Lake, and from Marlboro reservoir to Concord river, enough is received from each of them at the particular season when it is required, to make good the loss of water formerly flowing from the Lake, at this season of the year.

Newton Aqueduct.

Among the claims which were made on the City for damages arising out of the construction of the Aqueduct, were several for large amounts, occasioned by draining of the springs in the neighborhood of the Newton Tunnel. For the purpose of meeting these demands, and of obtaining the means of compensation for them, an aqueduct was constructed in Newton, by means of the formation of a company under the provisions of the law of the Commonwealth, called the *Newton Aqueduct Company*, the stock of which is all held in trust for the City. And the water can be appropriated in such manner as the interests of the City may require. A large well was dug; and a reservoir formed beneath the surface on a sufficient elevation, and a large quantity of water was obtained, adequate for the supply of a number of families. Pipes were also laid through the streets conformably to law, and by their means together with permanent cisterns laid in cement masonry, a substitute has been obtained for five wells in the vicinity of the tunnel which had failed; and there is apparently a sufficiency for many more.

Jamaica Pond.

During the past year, the City has also become possessed of the waters of Jamaica Pond, the Water Board having purchased in its behalf, the franchise and properties of the "*Aqueduct Corporation.*" The pond is situate in the town of Roxbury in the county of Norfolk. The surface of the water at its minimum level, or when one foot above the lower side of the effluent pipe, is, according to a survey of the pond made by Col. Loammi Baldwin, in 1833,—45.27 feet above the coping of the dry dock at the Navy Yard in Charlestown, or 50.36 feet above tide level. At the time of the survey, the water was 4.43 feet above the minimum level, and covered an area of 67.22 acres, or 2,928,103 sq. ft.

At 1.43 feet above that level, the area as estimated, is 62,688 acres, or 2,730,684 square feet:

At 7.43 feet above that level, 71,445, or 3,112,144 sq. ft.

" 10.43	"	" -	73,668,	" 3,208,978.	"
" 13.43	"	" -	76,443,	" 3,329,857.	"
" 1.57	below,	" -	58,90,	" 2,565,684.	"
" 4.57	"	" -	54,915,	" 2,392,097.	"
" 7.57	"	" -	50.316,	" 2,191,764.	"

From observations of the height of water for 11 years ending Dec. 1833, it appeared that the highest year was 1831. The greatest height being 9 feet, 4¾ inches, and the least, 6 feet, 2½ inches, and the mean for twelve months being 7.795 feet.

The lowest year was 1823, when the greatest height was 4 feet 10 inches, and the least 0.4 inches, the mean being 2.759 feet.

In 1822, October, the water fell below the minimum level, and continued very low, until Feb. 1823, when it was 4 inches above.

At 1.43 feet above the minimum level, the
estimated capacity of the pond is, 28,844,183 galls.
" 4.43 feet above, - - - 92,505,525 "
" 7.43 " " - - - 160,458,315 "
" 10.43 " " - - - 231,570,938 "
" 13.43 " " - - - 305,132,820 "

An iron main 10 inches in diameter was laid in 1840. It passed from the pond to the street, by Mr. Ward's farm house, and thence partly beneath the street and partly through land of Ebenezer Francis and others, to Tremont street, and by that street to Bowdoin square, in Boston.

The foregoing statement is believed to contain a description of all the property belonging to the City in the Water Works. It has been compiled, as far as was possible, from the reports of former Boards, under whose direction the several portions were completed, and the language of those reports has been followed in describing, both the principles on which those portions were planned, and their modes of construction And the Water Board would congratulate the City Council, that after a lapse of time sufficient to afford some test of the adaptation of the works to the great purposes for which they were designed, as well as of the durability of their construction, there is so little cause for fear or anxiety on either of these subjects hereafter: and that notwithstanding the inherent difficulties of the undertaking, the variety and number of persons employed, and the great rapidity with which the whole was completed, the water works continue to bear the most unquestionable testimony to the science, skill and faithfulness with which they were planned and executed.

The following are the dates of the principal events which occurred in the construction of the water works.

1846, *March* 30*th.* The act was passed, authorizing the City to supply the *City proper and South Boston* with water from *Long Pond.*

1846, *April* 13*th.* It was accepted by the legal voters of the City.

1846, *August* 20*th.* Ground was broken at the lake and the excavation for the Aqueduct commenced, and the name of *Long Pond* changed to LAKE COCHITUATE.

1846, *October* 19*th.* The first brick of the Aqueduct was laid on the 1st division.

1846, *November* 15*th.* The shafts commenced on Newton Tunnel, and

1846, *December* 17*th.* On Brookline Tunnel.

1846, *December* 30*th.* The first drift began on Newton Tunnel, at the west end, and

1847, *January* 30*th.* On Brookline Tunnel.

1847, *November* 20*th.* Corner Stone of Beacon Hill Reservoir, laid with appropriate ceremonies.

1848, *April* 28*th.* Last drift completed at Newton Tunnel, and

1848, *June* 26*th.* On Brookline Tunnel.

1848, *August* 27*th.* Brick lining completed on Newton Tunnel, and

1848, *August* 30*th.* On Brookline Tunnel.

1848, *September* 17*th.* Bottom of the brick work in the Aqueduct all united.

1848, *October* 12*th.* Top of the Aqueduct closed up and the water let in at about 10 o'clock, and it arrived at the reservoir in about 11 hours.

1848, *October* 14*th.* Water let into the 30 inch main, laid from Brookline Reservoir to Beacon Hill Reservoir; by means of the conduit in the embankment of the Reservoir from the Aqueduct to the pipe chambers, and reached the Common in about three hours.

1848, *October 25th.* The great celebration took place in Boston, on the introduction of the water, and the fountains on the Common played for the first time, in presence of the City Authorities and an immense concourse of persons.

1848, *November 16th.* The Brookline Reservoir was finished and water let in for the first time.

1849, *May 1st.* The additional act was passed by which the City was authorized to supply East Boston.

1849, *November 23d.* Water let into Beacon Hill Reservoir, and

1849, *November 28th.* Into South Boston Reservoir.

1849, *December.* The works for supplying East Boston commenced, by excavating for the Reservoir at Eagle Hill, East Boston.

1851, *January* 1. Water let into East Boston Reservoir.

The Water Board, on entering upon the duties of their office, were fully aware how much the usefulness of the water-works must depend on the system to be adopted for their care and management; they have endeavored, therefore, to carry out such an arrangement of the different agencies employed, that the great interests of the City might be best subserved. For the purpose of showing their course of action on this subject, they beg leave to annex to their report, the rules and regulations which they have adopted.*

It seemed to them in the first place important, that the general superintendence, and all the practical details connected with the preservation of any of the existing portions, or construction of any new ones; and also all those relating to the maintaining, and distributing a due supply of water; should be confided to the exclu-

* See Appendix, B.

sive care of some one individual, subject only to the control of the Water Board, and the supervision of its President, as provided for in the ordinance. They accordingly, by virtue of the authority especially given them, "to define the powers and prescribe the duties of the City Engineer relating to the subject," vested this charge in that officer. His intimate acquaintance with the different parts of the works, from their commencement; and his peculiar qualifications in other respects, in the opinion of the Board, eminently entitled him to the trust.

He was therefore appointed the General Superintendent of the water-works.

It it his duty to exercise a general control over all subordinate officers, and other persons employed:

To attend to the construction of new works, and to all repairs which may be requisite at any time:

To inspect the Aqueduct personally:

To direct the discharge of water from Lake Cochituate and the Reservoirs:

To prepare all plans of construction:

To certify all bills for materials or labor:

And to receive returns from the several Superintendents and to communicate them to the Board.

Superintendents were also appointed on the various portions of the works; and their powers and duties defined. They receive their orders directly from the City Engineer, and are answerable to him, and made responsible for the faithful performance of their several duties. The Superintendents of the Lake,—of the several reservoirs,—and of the pipe chambers at Charles river, are required to keep accurate records of the water levels at these places; and to transmit them regularly to the City Engineer. And as it is important, in reference to

claims made on the City by the proprietors of the mills at Billerica and other persons, that the amount of rain-fall each year should be determined, as accurately as is possible, the Superintendents of the Lake and the compensating reservoirs at Hopkinton and Marlborough are required to keep proper rain gauges for that purpose; and with the same view, the Superintendent of Concord river keeps a record of the height of the water, at the mills in Billerica. The mains and distributing pipes are also placed in charge of a Superintendent, whose duty it is to attend to the laying and repairing of them; —to keep a record of all the labor performed, and materials used; and return the same weekly to the City Engineer; and also to report the quantity of materials on hand at the pipe yard. And an officer was also appointed to give immediate attention to shutting off water, in case of leakage and to letting it on after due repairs are made; and to receive and pay over, to the City Treasurer, the fees provided in the ordinances to be paid therefor.

By means of the regulations thus adopted, due information has been received of the general condition of the works, and of every occurrence relating to them which required special attention. And the several returns of the Superintendents of the Lake and of the reservoirs at Brookline and in the City have shown the quantity of water at those places, three times a day during the year; of the Compensating reservoirs, at Marlborough daily; and at Hopkinton once a week; and also the height of the water in relation to the crest of the dam at Billerica mills daily, together with the waste of water weekly at the Lake.

The Board are required by the ordinance to state, in their Annual Report, the condition of all the water

works, and of the lands and other property connected therewith, an account of all receipts and expenditures, together with any information and suggestions which they may deem important, and to transmit at the same time the reports of the City Engineer and Water Registrar.

With regard to the present condition of the works; the Board beg leave to refer the City Council to the report of the City Engineer, who is also directed by the ordinance to give to the Council the necessary information on that subject. His report is herewith transmitted and it contains a full and detailed statement in relation to the several portions of the works. The Water Board have also personally, from time to time, visited all the different parts (including the interior of the brick aqueduct, which has been carefully examined by a committee) and the result of their observation fully confirms the statements of the City Engineer on the subject.

The brick aqueduct continues firm and no apprehension is felt of its settling. The puddled embankments, particularly those of sand and gravel, are believed to afford a sufficient, and perhaps in many cases the best, foundation for the superstructure. That in Needham over Ware valley, which might have occasioned some anxiety on account of the height, of upwards of forty feet, to which it was necessary to raise it, has not yielded in any part, and the aqueduct rests upon it as immovably as if it were supported on any foundation of masonry. The leaks in the aqueduct, which existed from the beginning, do not appear to have increased any where; and in some places, when they were examined, appeared to be stopped or much diminished. One new crack has been discovered, about a hundred and fifty feet in length; it is

not however at present considered a matter of much importance.

The state of the Mains and Distributing pipes is equally satisfactory. The pipes and inverted syphons for conducting the water to South and East Boston, which were considered the most vulnerable parts of the distribution, have not been affected by frost, as it was feared they might be; indeed experience seems to show, that by keeping a constant current passing through them, that danger will in all probability be entirely obviated; and the Board are not at present aware of any other which is likely to threaten them. A trifling settling of one of them on Chelsea bridge was attended with no serious consequences. The long extent of the mains, and other pipes, renders them liable to leakage from the expansion or contraction of their material, by the variation of temperature; this can never be prevented; as it generally consists however in only slightly opening the joints it is easily remedied.

The alterations which have been made in the Brookline Reservoir, as before mentioned, will it is believed, add considerably to its usefulness. By raising the slope wall two feet perpendicularly, its capacity has been increased nearly twelve millions of gallons.

For the purpose of ascertaining the exact quantity of water which passes from the Reservoir into the mains, and thereby determining the amount used in the City, it has long been deemed very desirable to obtain a meter, which could measure that quantity with precision, to be placed in the pipe chambers. But little confidence however could be placed in any of the inventions previous to one recently made by Mr. Samuel Huse. And the Board having witnessed the accuracy of those made on a smaller scale, have agreed with him for the construction

of two sufficiently large for the Reservoir, similar in principle to those already made by him of smaller dimensions, for the City. The Board feel assured that if the larger ones perform their work with the accuracy and steadiness, which those now in use have exhibited, they will leave nothing further to desire. And it is presumed that hereafter, the very important knowledge of the actual consumption of water in the City, will be attainable at any time, without involving the necessity of shutting off the water from the Aqueduct, which it is now necessary to do.

It has been found also necessary to replace two of the largest stop cocks on the thirty-six inch main, the past year, they having got so much out of repair as to be useless. The new ones have been constructed on an improved principle, as it is believed, in having the movement of the valve made horizontal instead of vertical. By it a more complete control can be had over the valve, and the danger of a sudden shutting down of the valve, by the breaking of the screw, or any other part, is obviated.

The report of the City Engineer also shows the number of feet, size and location of the *distributing* pipes, the number and length of the *service pipes*, and the number of *fire hydrants*, which have been added the past year; also the *number of repairs* and the reasons for which they were made. It likewise contains a schedule of the quantity of hydrants, pipes, and other *stock on hand;* an estimate of the *consumption* of water for the three past years; and tables of the *rain-fall* at Boston and several other places for a series of years, and, which is of most importance, of the rain-fall during the dry seasons from 1818 to 1851.

During the year sixty-nine new *hydrants* have been established in the city, making the number in the city

1110, and the whole number 1133. Every endeavor has been made to prevent the hydrants freezing, by due attention to their mode of construction, and by carefully packing around them during the cold season; and generally the efforts have been successful. Some instances, however, have occurred which it was impossible to prevent. They have been kept under strict observation, and have been at once thawed out when discovered to be frozen.

There have been 11,692 feet of *distributing pipe* laid down, of 12, 6, and 4 inches diameter—making the whole length of pipe now laid, including the hydrant branches, a small fraction over 103½ miles.

The number of *service pipes* laid during the year was nine hundred and nine, and their length 31,203 feet. The whole number of these pipes now laid amounts to 16,049.

There have been sixty-four cases of *repairs* made on the distributing pipes, and one hundred and seventy-three cases of repairs on the service pipes. The repairs on the distributing pipes have averaged nearly one case to every mile and a half of the whole length, and those on the service pipes to nearly one case to every ninety-five pipes. The necessity for the repairs on the pipes has been owing in a great measure to their expansion or contraction from change of temperature—by which the lead run into the joints has been caused gradually to work out and leakage occasioned. The amount of these repairs has been increasing from year to year, so as to threaten to be hereafter a cause of very serious expense, in all the pipes which have been laid until very recently. An improvement has, however, been lately adopted, (suggested by similar ones used in Scotland,) in the mode of casting, by which a groove is sunk in the

interior of the hubs, into which the lead runs, and thereby is formed into a bead, by which it is prevented working backwards and forwards with the expansion or contraction of the pipes, and it is presumed will, to a great extent obviate the difficulty in all those which shall hereafter be laid.

The average *daily consumption* of water for the last three years is estimated to have been as follows:

For 1849,	- - - -	3,680,000 gallons.
" 1850,	- - - -	5,837,883 "
" 1851,	- - - -	6,883,782 "

Being for the last year over forty-nine gallons daily to every individual in a population of 140,000. The greatest monthly consumption took place in June, and amounted to 7,924,971 gallons daily average, or more than fifty-six gallons to every individual. The least consumption was in April, and amounted to 4,950,000 gallons daily, or over thirty-five gallons to each individual. The number of water-takers at the beginning of the year 1849 was 5,200; at the end of the same year, 12,108; in 1850 it was 13,463, and in 1851, 16,076. Supposing each to represent a family of seven individuals, and taking the mean number between those who took it at the beginning and those at the termination of the several years, the quantity to each individual, daily,

In 1849 was	- - - - -	60.91 gallons.
In 1850 "	- - - - -	63.23 "
In 1851 "	- - - - -	66.58 "

The consumption on some days also far exceeded the averages before stated. July 4th it was estimated to be 10,537,000. And for several days in September it was more than 11,000,000.*

* Since this report has been in the press, the daily average of one week, in January, was 10,850,563 gallons, and on one day it was 12,044,062 gallons.

The average for the year is more than double the quantity what was originally estimated to be a sufficient supply, for all the wants of the present number of inhabitants in the city. Indeed, it is nearly equal to the quantity which it was supposed would be required for a population of two hundred and fifty thousand, and on some days it has far exceeded even that amount.

Were this large quantity, wanted or used for any necessary or useful purpose, it would not be essential, perhaps, to call the particular attention of the City Council to it, but the Water Board are convinced that much of the consumption is to be attributed to wastefulness, which might be easily prevented by a little caution on the part of those who are chargeable with it. It was stated in a Report made to the City Council, in 1838, as a reason for considering twenty-eight and one half gallons as sufficient; that it apeared to be "the largest quantity furnished to any city which is subject, for any portion of the year, to the influence of a cold climate, or where the habits of life are of 'British origin.'" How far the peculiar habits of life have affected the result, it is impossible to say; it has become very obvious, however, that the influence of climate has been vastly underrated, if indeed it has not been entirely mistaken; for it is somewhat uncertain whether it was meant to be intimated that the consumption would be increased or diminished by the cold weather. In fact one great, and perhaps the principal, cause of waste, which has come to the knowledge of the Board, arises from the custom which is presumed to prevail very generally, of letting the water run at night, and sometimes during the day likewise, to prevent its freezing in the pipes. Now, the waste from this source may be more or less, without reference at all to the object to be

attained, the frost can be as effectually prevented by the continuous circulation of a small quantity of water in the pipe, as by a large one; the loss, however, may be a matter of small importance in one case, but becomes in the other a very serious evil, calling upon the City Council to adopt some measures for its prevention. At the request of the Water Registrar, the Police were directed by the late Mayor, to report the places where they should discover that the taps had been left running at night, and they have accordingly reported upwards of four hundred cases as coming within their knowledge, in the course of two or three nights. They were all cases where the gush of water was heard in the street. The pipes had therefore probably been left open to the full extent of their orifice, with reckless disregard of the entirely unnecessary waste occasioned by it.

There are other sources of waste arising from an improvident use of the water for necessary purposes. Many who pay a certain sum a year for the use of the hand hose, for a certain portion of the day, appear to be quite regardless of the extent to which they go, in the exercise of their privilege. Livery stables, water closets, and urinals, are also known sources of waste; the stream in the latter being in many cases permitted to run continually. It is easier indeed to detect these cases, than to provide a remedy for them. With regard, however, to cases where the taps are left running at night, we think that the fact of their being heard in the street, is sufficient evidence that the evil is of sufficient magnitude to justify the shutting off the water from the premises. And, in regard to livery stables and other places, where large quantities of water are habitually used, it may be be necessary to attach meters, at the expense of the occupants; or so to alter the water rate

now paid, as to compensate for the whole quantity of water wasted.

The whole subject is one which the Board would submit to the serious attention of the City Council. They fully believe that the quantity which was originally calculated to be sufficient, is most ample for all the necessary wants of the inhabitants; and that about two thirds of all that is now used, is absolutely wasted. If, however, this waste continues to increase as it has heretofore done, it is apparent that our present means of supply will be insufficient, and it may be necessary to add still more to the water debt, by laying an additional main to the Receiving Reservoir in Brookline.

The *Supply* of water in the Lake, the past year, has much exceeded the quantity anticipated at the commencement of the works. This has been partly owing to the greater fall of rain, than that which formed the basis of the calculation originally, and partly to the Lake having received a greater proportion of the rain-fall, than the ratio which had been assumed. The annual rain-fall was estimated at thirty inches, and four tenths of that quantity assumed as the ratio which would be realized, which (the area of drainage being 496,584,000 square feet) would give 496,584,000 cubic feet. The largest estimate of the rain-fall this year, is that returned by the Superintendent of Hopkinton Reservoir, viz., very nearly forty-four inches, (43.97) four tenths of which would be nearly 728,323,200 cubic feet, or 5,462,424,000 gallons.

But the quantity absolutely wasted at the Lake and which never entered the Aqueduct, was (as estimated by measurements taken on the 14 feet gauge below the outlet dam) 4,891,312,480 gallons, which, added to 2,512,580,-

430, the quantity used in the city, during the year, will make 7,403,892,910 gallons. The proportion this year collected, must, therefore, have been equal to fifty-four per cent. of the whole rain-fall on the water shed. The probability however is, that any assumed ratio of the rain-fall, to the quantity collected, must be, in all cases, extremely arbitrary and uncertain, and that the proportion may depend, not only on the soil and sub-soil of the area of drainage, by which a greater or less quantity is saved from evaporation and percolation, but also on the quantity falling, the state of the atmosphere, with regard to moisture or dryness, the prevalent winds, or currents of air, and, perhaps, other circumstances with which we are unacquainted.

The lowest point to which the water fell in the Lake, the present year, was 4 feet 1 inch above the flume, or 3 feet 11 inches below high water mark, which was on the 18th October. The quantity of water then left in the Lake, above low water mark, was estimated at 632,164,500 gallons. From that time it has continued rising, and on the 31st December, it was within 7½ inches of high water mark. The quantity wasted from the Lake, during the year, was 4,892,472,480, or nearly twice the quantity estimated to have been used in the city.

By the returns from the Hopkinton and Marlboro Reservoirs, it appears that the water at the former was at its lowest point, on the 6th October; when there were left 4 feet 2½ inches. The quantity previously stored up, which was discharged from that Reservoir, from the 17th of June to 24th October, was 1,023,904,600 gallons. The Marlboro Reservoir was exhausted about the 2d October. The discharge from it from

June 1st to October 1st, was 1,100,554,650 gallons. Making a total from the two, of 2,124,459,250 gallons contributed to the supply of Concord river, during the same period that it is estimated 975,028,771 gallons were consumed in the city.

The natural flow from the Lake, during the dry season, the past year, is estimated by the City Engineer, at 555,763,771 gallons, obtained by deducting from the quantity consumed in the city during that period, the depression at the Lake, viz., 28 inches, which is equal to 419,265,000 gallons. It is obvious that this estimate is quite large enough, and that perhaps something might be deducted from it, from the fact that the water used in the city, did not, all of it, come from the Lake, a part, although the quantity is entirely uncertain, having leaked into the aqueduct. According to this estimate, however, it appears that the natural supply from the Lake, during the past year, is only a little more than one fourth the quantity discharged from the Compensating Reservoirs, and a little more than one half of what was discharged from the Marlboro.

To this time, therefore, we think there can be no pretence that the Middlesex Canal, or Mill privileges on Concord river, have been injured by diverting the water of the Lake; we believe, on the contrary, they have been thus far greatly benefited; and that the supply which they have received during the past dry season from the Marlboro Reservoir alone, is an ample compensation for all they have lost from the Lake.

The water on Concord river, was below the crest of the Dam, at Billerica Mills, from the 1st of July, to the 24th of October.

It has been stated previously, that the whole *quantity of land*, purchased and held by the city, round the margin of the lake, and adjoining the same, was

643 acres, 2 qrs. 2.61 rods.

Near Saxonville, connected with the Mill privileges of Mr. Knight, - -	38	"	3	"	29	"
Along the line of aqueduct,	305	"		"	08	"
Near Brookline Reservoir,	34	"	3	"	17	"
Making a total of	1022		1		16.61	

In 1850, (Oct. 15) the late Water Board reported to the City Council a schedule of lands, which might be disposed of by the city around the Lake,—in and near Saxonville,—and along the line of the Aqueduct, beginning at Lake Cochituate, and ending at the Brookline Reservoir. They did not, however, recommend a public sale of these lands, but thought it would be much better to keep them a few years longer; unless they could be disposed of at private sale to the abutters, who could afford to give, in most cases, much higher prices for them than could be obtained, if they were forced into the market. The late Water Board also reported an estimate of the value of these lands, they stated, however, that if sold at auction, they might not bring $30,000. The aggregates of the schedules is as follows, viz :—

1. Around the Lake,	36	parcels,	containing	$208\frac{3}{4}$	acres,	Value,	8,660
2. In and near Saxonville,	5	"	"	35	"	"	5,000
3. Along the Aqueduct,	48	"	"	$133\frac{7}{8}$	"	"	24,350
Whole amount,	89	"	"	$377\frac{5}{8}$	"	"	$38,010

In the above estimate of land along the Aqueduct,

is included a small quantity near the Reservoir, viz., 5 parcels, containing about 2 acres, valued at $1,800.

The Board consider the foregoing schedule, as far as it describes the particular parcels of land which may be disposed of without injury to the works, as judicious, and a sufficient guide for their action. They are afraid, however, that the valuation attached to them is more than there is any immediate prospect of having realized. They have received but very few applications for any of them, and the prices offered have invariably been much less than the value stated in the schedule. It has been, and will continue to be, however, the wish and intention of the Board, to dispose of all the lands and other property of the city, connected with the water works, which their prudential management does not require them to retain. A portion of these estates are rented, generally for small amounts, to tenants at will. The income which the city derives from this source, is therefore but small. The whole amount of rent receivable from all this property, including that in Hopkinton and Marlboro, is twelve hundred and ninety-two dollars $\frac{91}{100}$.

The Board also transmit to the City Council, the report of the Water Registrar, prepared according to the provisions of the ordinance.*

The whole number of water takers during the year, has been sixteen thousand and seventy-six. The number of cases where the water has been cut off, is eighteen hundred and thirteen. There have been no abatements. And the expenditures in his department have been eighteen hundred and eighty dollars and twelve cents.

* See Appendix D.

There has been an increase in the number of water takers over last year, of 2,613.

The total amount received for water rates has been.

For water used during 1850, -	$353,33	
" " " " 1851, -	160,946,39	
		$161,299.72
Received for letting on water, - - -		1,019.00
		162,317.72
The whole amount received to Jan., 1851, -		$97,943.14
Being a gain in the rates for the year, - -		63,003.25
		$160,946.39

The report of the Water Registrar likewise contains a list of the different water tenants, and the amount of water rate paid by each respectively, from which a condensed statement has been prepared, and it appears that the amount received from the different classes of water tenants, has been as follows:—

12,343	Dwelling houses, including boarding houses, - - - - -	106,067.35
2,345	Stores, shops, offices, cellars, - -	12,187.17
263	Hotels, restorators, saloons, - -	6,528.29
298	Stables, - - - - - -	5,905.09
8	Railroads, - - - - -	4,903.11
13	Steam boats, - - - - -	1,690.02
	Manufacturing purposes, - - -	11,068.83
53	Sugar refineries, breweries, distilleries, and bakeries, - - - -	3,458.35
	Public buildings, charitable institutions, &c., - - - - -	1,261.33
1	Motive power, - - - -	546.79

	Shipping contract with watermen, -	1,844.37
1036	Hose, - - - - - -	3,121.00
	Other purposes, - - - -	2,364.74
		$160,946.39

The Board annex to this report an account of all *the receipts and expenditures* of the past year.*

The whole amount expended was - -		$144,814.87
From which, deducting payments for unfinished work of 1850, unsettled claims for land and other damages, by statement annexed, - - - -	37,587.01	
Amount paid for Jamaica pond,	45,217.50	82,804.51
Balance charged to current expenses, - -		$62,010.36
The whole amount of receipts was,		
For rents, - - - - -	980.86	
For old materials, &c., - -	6,318.78	7,299.64
		$54,710.72

By the 14th sec. of the Act of 1846, the City Council were authorised to issue scrip, or certificates of debt, to meet all payments *of interest*, which may accrue upon any scrip by them issued; *provided, however*, that no scrip or certificates should be thus issued *after the expiration of two years* from the completion of the aqueducts and other works. It seemed to be the duty of the Water Board, therefore, to ascertain the time of the completion of the works, and to give due information to the City Council, for its guidance in reference to any action on the subject. An examination was accordingly

* See Appendix, E.

had of the progress which had been made, and the Board being convinced that the whole would be completed by the 30th of April following, an order was passed (March 26th,) that the construction account of the water works be closed on the 30th of April, (then next ensuing,) and the works be then considered as finished, and all expenditures, made after that time, be charged to the current expenses of the year. In accordance with the foregoing order therefore, the account before stated includes, among the current expenses, all that has been paid during the year, for the extension of the works; and also for the alterations made in the Brookline and East Boston Reservoirs, and which may be in fact considered as the completion of those works; and deducting those payments, the amount would be as follows: —

Amount charged to current expenses, - -		$62,010.36
Paid on account of extension of works, during the year, viz :		
Distributing pipes, - - -	9,450.01	
Service pipes, - - - -	9,227.75	
Hydrants, - - - -	2,406.30	
Stop-cocks, - - - -	1,833.84	
Meters, - - - - -	405.56	
Air-cocks, - - - -	81.00	
Labor on the above, in the blacksmith and plumbing shop, and proving yard, - - - -	2,613.63	
Brookline Reservoir, - -	5,760.87	
East Boston Reservoir, - -	1,459.99	33,237.95
Leaving a balance of - -		$28,772.41

As the current expenses of the works for the past year, including repairs.

The valuation of the pipes and other *Stock on hand*, in and connected with the pipe yard,

January 1, 1851, was, - - - - -	$29,703.79
January 1, 1852, - - - - - -	22,249.76
Making a difference of - - - -	$7,454.03

Which is to be charged, partly to extension and repairs of the works, during the year and partly to old materials sold and accounted for, in the previous statement, and to depreciation in value.

A description has already been given of *Jamaica Pond*, and the property connected with it.

By the 20th sec. of the Water Act of 1846, the city was authorised to purchase and hold all the property of the Aqueduct Corporation, and to connect the same with their other works. And by the ordinance establishing this Board, this power was expressly and unconditionally vested in it. It became its duty, therefore, to judge of the necessity of exercising the power; and it was made responsible for not making the purchase, if, upon a careful examination of the subject, it thought that the public interest required it. Nor was there any thing in the ordinance, which required that the Board should refer its action to the sanction of the City Council. With a view to what the Board believed to be the interest of the city, and after due consideration, and every effort to obtain a just estimate of the value of the property, it was decided to purchase, and to offer the sum of forty-five thousand dollars for it. The offer was accepted by the corporation, and the property conveyed to the city.

The reasons which influenced the Board, were fully stated in a communication made to the City Council at

the time. They consisted,—in the actual gain which would be made, of a large number of takers of Cochituate water in this city and in Roxbury,—in relieving the city from all claims for which it was held liable by the Aqueduct Corporation—in the annulling the privilege which they possessed, of breaking up and injuring the streets, whenever and wherever they saw fit,—in the securing to the city the entire control of the supply of water to the inhabitants, relieved from the mischief which might arise from competition with a rival corporation,—and in the intrinsic value of the property.

The present number of water takers in Roxbury is 35, paying, by virtue of agreements made with the late Aqueduct Corporation, $1,111.60 a year. The number of takers of Cochituate water, who formerly took that from Jamaica pond, and who would have continued to take it, if the city had not purchased it, is, as returned by the Water Registrar, 500, paying an average water rate of at least eight dollars each. Since the purchase by the city, the water has been shut off in Tremont street, near the city line. There have been many applications for the water in Roxbury, which at present it does not seem expedient to grant. Under their act of incorporation, the late corporation were authorised to sell the water to parties in Roxbury; but were not authorised to take up the streets, except for the purpose of bringing fresh water *into Boston.* No new line of mains can therefore now be laid, for applicants off the present route. The Board have caused some inquiries to be made of owners and tenants, in the low portion of Roxbury, in relation to their desire to take the water, and it is believed an income of $4000 a year might be derived from that source. The cost of supplying the inhabitants of that part of Roxbury,

cannot be accurately stated, without a survey and careful estimates, which have not yet been made. The Board would, however, suggest respectfully to the City Council, that it will be necessary to apply to the Legislature for power to undertake the measure, if the Council should hereafter consider it proper and advisable.

The Board are happy to state, in concluding their report, that the large amount of claims for land taken for purposes of the Aqueduct, and for damage to land and water rights, which were left unsettled by the former Board, are nearly all adjusted. By reference to the statement of expenditures, it will be seen, that the amount paid during the year past has been $24,960.57. The demands made, in many of these cases, appeared so extravagant to those who were authorized to settle them, that no amicable arrangement could be effected; and in some, it was deemed advisable to appeal from the award of the Court's Commissioners, for the purpose of having the questions decided by the verdict of juries. We fear however that but little has been gained to the City by this course. The damages awarded by those tribunals having been, in all the cases, still more excessive. The case of Charlotte Harbach and others, in which the Water Commissioners reported that "they had ordered an appeal from the award of the Court's Commissioners, on the ground that, the amount awarded of $7,700, is far greater than the actual damage sustained," has, during the past year been determined, and the jury have increased those damages to $10,479.94 and costs, and even their being still further increased $3291.00 depends on the Supreme Court's decision of a question of law which has been reserved. The damage in this case and others, in the vicinity of the New-

ton Tunnel, some of which have been settled by the Board, as also the expenditure involved in the establishment of the Newton Aqueduct, have been the remote consequences of the construction of the Tunnel, not anticipated at the time. It was not calculated that the City would be held liable in damages, exceeding twenty thousand dollars, as has been the case, for injuries done to four or five estates, by being exhausted of their springs of water, even to a great distance from the tunnel, which was sunk more than seventy feet beneath the surface of the ground. The demands now unsettled are comparatively of much less consequence, and it is hoped that the whole will be closed during the year. The claim of the Proprietors of Mill privileges on Concord River, arising out of the diminution of their supply of water from the Lake, now in course of litigation, is of the most importance. All the latter claims have hitherto been, as we think, amply provided for, by the supply which the City has afforded from other sources; and we trust that an arrangement, mutually acceptable to all parties, may soon be made, by which that supply may be made permanent, and all the questions now at issue be finally disposed of.

The Water Board annex to their report a map of the whole line of the aqueduct; and a general map showing the relative positions of the compensating reservoirs, and the course of the Concord River to the Merrimac. Also, plans of the high service in the city, and of the elevation of the door sills, cisterns and points of delivery of the several dwellings in it. The latter have been taken, from a survey which has recently been made, with reference to alterations which have been proposed in the Beacon Hill Reservoir; for the purpose of remedying, if possible, the deficiency which has been

experienced in the supply of water to the most elevated portions of the city—none of which alterations, however, have hitherto been adopted.

The foregoing report is respectfully submitted.

THOMAS WETMORE, *President.*
HENRY B. ROGERS,
JAMES W. SEVER,
SAMUEL A. ELIOT,
JOHN H. WILKINS,
JONATHAN PRESTON,
JOHN T. HEARD,

Cochituate Water Board.

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GENERAL MAP
of the
BOSTON WATER WORKS,
designed to show the bearing of the
COMPENSATING RESERVOIRS.
For the Cochituate Water Works
by
E.S. CHESBROUGH,
City Engineer
1868.
DRACUT
LOWELL
TEWKESBURY
CHELMSFORD
BILLERICA
WILMINGTON
CARLISLE
ACTON
BEDFORD
BURLINGTON
WOBURN
STOW
CONCORD
LEXINGTON
WINCHESTER
STONEHAM
MEDFORD
LINCOLN
WEST CAMBRIDGE
SUDBURY
WALTHAM
CHELSEA
COMPENSATING RESERVOIR
MARLBOROUGH
NATICK
WESTON
NEWTON
BRIGHTON
BOSTON
HARBOR
EAST BOSTON
SOUTH BOSTON
ROXBURY
BROOKLINE
WEST ROXBURY
DORCHESTER
FRAMINGHAM
SOUTHBOROUGH
LAKE COCHITUATE
NEEDHAM
CHARLES RIVER
HOPKINTON
COMPENSATING RESERVOIR
Explanation
Scale of Miles

APPENDIX.

A.

It has been thought that a record of the past proceedings of the City government on the subject of the introduction of water for the use of the citizens, might be interesting and useful; it has therefore been prepared and is here annexed to the Report of the Water Board.

The first act of the Municipal government of Boston, in relation to the subject, took place in 1825. *Professor Daniel Treadwell*, was then commissioned by the Mayor to ascertain the practicability of supplying the City with water for domestic uses, extinguishing fires and general purposes. Professor Treadwell estimated the population of the City to be 50,000, collected into 8,000 families, and that 1,180,000 gallons would be the maximum for daily consumption; but making the necessary allowance for the increase of the City, within a few years, that the supply ought not to be less than 1,600,000 gallons. He did not take into this account, however, the supply required for extinguishing fires; but recommended "that in such an emergency, the use of the water for most other purposes should be forbidden." With regard to the source, in the neighborhood, from which 1,600,000 gallons or more, daily, could be obtained, he recommended Charles River, above the falls at Watertown, and Spot Pond in Stoneham, as possessing advantages over all others. And he estimated the cost of bringing the water from Charles River, at $252,777, and from Spot Pond, at from $296,288 to $353,404, according to which of two routes, which he designates, should be taken. The cost of reservoirs and distribution, he estimated at $262,065, supposing that the pipes should be carried through all the streets mentioned in Hale's map; which would be 116,190 feet, or nearly 22 miles.

In March, 1833, the Mayor was directed by the City Council, to apply to the Legislature for a grant of the necessary power to

bring in water. The application was made however so late in the session, that nothing could then be done, and it was therefore referred to the next General Court.

In 1834, a new commission was appointed by the City government, and *Col. Loammi Baldwin* was selected to make a further survey and examination of all the sources, from which water could be obtained. Col. Baldwin made a minute examination of the subject, and presented his report in October, 1834. After describing the ancient and modern aqueducts, pumps and artesian wells in Europe, and the aqueducts in this country, and the number of wells and character of the water taken from them in the City, he described the Ponds in the neighborhood, and finally recommended, as most eligible, *Farm and Shakum Ponds* in Framingham, together with incidental sources dependent upon them, and *Long Pond* in Natick. He considered the capacity of the former as equal to 555,794 gallons daily, and the latter to be equal to 16,156,800 gallons daily, at the time of the measurements; and estimated that the cost of the former would not exceed $750,000, by which a copious supply of 5,000,000 gallons might be brought in, but did not include in it the cost of distribution. He thought also, the supply from Long Pond to be quite practicable, but more expensive than the other, and that it would cost 20 or 30,000 dollars more. And he described the line of an aqueduct from Farm Pond, which he considered to be the best upon the whole, that he had been able to discover. Col. Baldwin also annexed to his report, a statement of the capacity of Jamaica Pond, which has been referred to in this report, and gave it as his opinion, that more than ten times the quantity of water might be distributed in the town of Boston from this source, than had hitherto been used.

In 1836, *Mr. R. H. Eddy*, Civil Engineer, at the request of the Mayor, examined the subject and recommended Spot and Mystic ponds as sources of supply. He estimated the capacity of the former at from $2\frac{1}{2}$ to 3 million gallons daily, and that of the latter at 12,960,000 gallons daily; and that the cost of the former would be $388,747.76, and of the latter, including a conduit of masonry and steam engines, at $218,130.00. To which latter sum was to be added from $58,400 to $175,200, as the expense of supplying from 1 million to 3 million gallons a day by pumping, which would be necessary, as the pond is about on the level of high water mark.

August 16, 1836, *a general meeting* was held at Faneuil Hall, and a vote was passed to introduce water at the expense of the City, to appoint a permanent board of Commissioners for the purpose, and to apply to the Legislature for the necessary power.

In 1837, a new Commission was appointed, consisting of *Daniel Treadwell, James F. Baldwin, and Nathan Hale*, to examine the

sources, and the best means of introducing and distributing a supply of water. The subject was carefully attended to, and they made their report in November following. In estimating the quantity which would be necessary, they referred to the consumption of other places as a guide. They state that in 1833, in London, the quantity supplied was 187 imperial gallons to each tenant daily; and in Philadelphia, 160 beer gallons to each tenant, including water used for fires, watering streets, and all other purposes. In 1831, the actual supply to an inhabitant in London, was $27\frac{3}{4}$ wine gallons; and in Philadelphia, in 1836, it was $28\frac{1}{2}$ wine gallons. They considered $28\frac{1}{2}$ gallons, therefore, as sufficient for each inhabitant—That in five years there would be a population of 87,000, requiring therefore $2\frac{1}{2}$ millions daily. And that there would be at the end of ten years 105,000, requiring 3 million gallons daily. They thought it expedient therefore, to provide accordingly in their designs for the works. A majority of the Commission recommended that the supply should be drawn from Spot and Mystic Ponds, which in their opinion would be ample not only for the present, but "for an extended period in the future." Mr. Baldwin, however, dissented and recommended Long Pond, which the Commissioners had carefully measured, and thought might be made to supply 8,743,680 gallons daily through the year. The cost of delivering the supply upon Beacon Hill, without distribution, was estimated,

From Mystic Pond, - - - - -	$869,860
Spot and Mystic Ponds, - - - -	850,006
Long Pond, - - - - - -	1,118,294

And the cost of distribution including reservoirs on Beacon Hill and Fort Hill, and the pipes laid for distribution in the streets, nearly $67\frac{1}{4}$ miles, $657,554.

The same year, *Messrs. Treadwell and Hale*, at the request of the City Council, revised their report, and again reported an adherence to their former opinion, and *Mr. Baldwin* also adhered to his.

The same year, a public meeting of the citizens was held and a vote was passed, that it was expedient for the City to provide a supply of water at the public expense, Yeas, 2541, Nays, 1621, and that it was expedient to begin the work "next year," if leave be granted, Yeas, 2507, Nays, 1652.

April 6, 1838, the City Council ordered an application to be made to the Legislature for leave to bring the supply either from *Long Pond* or *Mystic and Spot Ponds*. This application was accordingly made, but it was so late in the session, that nothing could be done and it was referred to the next year.

In 1839, (*January* 10,) the Mayor presented the petition again, and a bill conformable thereto was reported; but sundry inhabitants of Boston, together with the proprietors of the Middlesex canal and several towns, having remonstrated against it, the

bill was recommitted, and underwent a long hearing before a joint special Committee, who finally reported, in April, a resolve authorizing the Governor to appoint three Commissioners to report all the facts and information relating to the subject.

In August, 1844, the City Council appointed another Board of Commissioners, " to report the best mode and the expense of bringing the water of *Long Pond* into the City." The Board consisted of *Patrick T. Jackson, Nathan Hale, and James F. Baldwin.* They made their report November 9th, following. They assumed that the quantity to be brought in, should be a sufficient supply for a population of 250,000, which they expected would be double the population which would be in the City, when the works would be completed. They also agreed with the former Commissioners, that $28\frac{1}{2}$ wine gallons for each inhabitant would be sufficient, and therefore that a population of 250,000 would require 7,125,000 gallons a day, which would be equal, very nearly, to a regular flow of eleven cubic feet a second. A measurement was accordingly made at the Pond; and combining their own observations with those of the Board of 1837, they stated it to be their opinion, that it might be relied on, by means of a dam and gates, for retaining such a quantity of water as would ensure the requisite supply during the year. For the purpose of conducting the water, they recommended the construction of a brick aqueduct, similar in every respect to the one since built, and a reservoir at Corey's Hill in Brighton; and they calculated that the aqueduct with an inclination of 3 inches in a mile, and filled to a depth of 3 feet 10 inches, would be sufficient for a flow of eleven cubic feet a second, or a little more than 7 millions gallons every 24 hours. It has since been proved by experience that the aqueduct is sufficient to admit the flow of more than 10 million gallons. They also recommended the construction of three or four reservoirs of moderate dimensions, on *Beacon Hill, Fort Hill, Copp's Hill and Dorchester Heights;* and they estimated that the cost of the whole would be $2,118,535.83.

In the same year, Sept. 3d, a general meeting was held at Faneuil Hall, and continued by adjournment to the evenings of Sept. 4th, Oct. 1st, Nov. 14th—26th, and Dec. 3d; and after the whole subject had been fully discussed, a resolution was adopted, instructing the Mayor and Aldermen to submit the propositions, for introducing water from *Long Pond* at the expense of the City, and for an application to the Legislature,—to the legal voters at the ensuing municipal election. This was accordingly done, and a vote was passed at that election in favor of the project—Yeas, 6260, Nays, 2204, and in favor of applying to the Legislature for the requisite powers; Yeas, 1252; Nays, 2207. An application was accordingly made in behalf of the City Council at the ensuing session, and in 1845, the act was passed (Mar. 25.) It likewise

authorized the City Council to adopt *Charles River* as the source if it saw fit. It contained some provisions, particularly those relating to the powers to be given to the Board of Commissioners, which caused it to be rejected by the people, when submitted to them for their assent, on the 19th of May, by a vote of 3670 yeas, to 3999 nays.

In the same year, an application was made by the proprietors of Spot Pond, to sell that pond to the City. It was thereupon deemed expedient by the City Council, that a Board of Commissioners should be appointed, whose opinions should be entirely unbiassed by any of the preceding transactions, who should be able to take up the whole subject apart, and examine it by themselves. *Messrs. John B. Jervis*, of New York, and *Walter R. Johnson*, of Philadelphia, were accordingly appointed Commissioners, to examine the sources from which a supply of pure water could be obtained. Their report was dated Nov. 25th. They made a careful survey anew of *Spot Pond*, *Charles River*, *and Long Pond*, and reported the result very much in detail, giving the preference to the latter. They estimated the cost, including land and water rights, 1,846,599 dollars, exclusive of distribution.

The plan of the aqueduct proposed by them, did not vary essentially from that of the former Board of Commissioners.

In 1846, *March* 30, the Act now in force, was passed, and accepted by the legal voters, *April* 13, by a vote of 4637 yeas, to 348 nays.

1846, *May* 4. *Nathan Hale, James F. Baldwin*, and *Thomas B. Curtis*, were elected by the City Council, *Water Commissioners*, under the provisions of the Act. These Commissioners held their first meeting, May 5th, and appointed *John B. Jervis*, of New York, consulting engineer. They afterwards divided the works into the Western and Eastern Departments, and appointed *E. Sylvester Chesbrough*, Chief Engineer of the former, and *William S. Whitwell*, of the latter. The works were immediately commenced and finished under the same direction; excepting the part connected with East Boston, which was not finished until 1851.

August 20, 1846. The ground was first broken for the Aqueduct at the Lake, in presence of the City Council and others. The first shovel-full of earth was thrown by *Josiah Quincy, Jr.*, the Mayor of the City, and the second by *John Quincy Adams*, late President of the United States; and on the same day, the name of the *Long Pond* was changed to Lake Cochituate.

The term of office of the Water Commissioners being limited to three years, by the Act, it accordingly expired May 4, 1849. And the City Council, by virtue of powers contained in the Act,

extended the time eight months longer. They made their final report, *Jan.* 4, 1850.

In 1850, all the "rights, power and authority," given to the City by the Act, were vested in the *Cochituate Water Board*, consisting of a Commissioner, an Engineer, and a Water Registrar; subject to the direction of a Joint Standing Committee of the City Council, by an ordinance passed Dec. 31, 1849, which was limited to continue in force one year.

The same year, the supply of water to East Boston was completed.

In 1851, the present *Cochituate Water Board* was established, and all the powers which the City Council derived from the Acts of the Legislature on the subject, as far as the same could be delegated, were vested in it, by ordinance, Oct. 30, 1850; subject to the ordinances of the Council.

B.

Rules and Regulations of the Cochituate Water Board.

There shall be a stated meeting of the Board every Wednesday at 11 o'clock, A. M., for the transaction of such business as may come before it.

A majority of the Board shall constitute a quorum.

All meetings shall be notified by the Clerk, by leaving a written or printed notification at the place of abode of the several members.

There shall be a meeting on a day subsequent to the 20th of every month, for the examination of such bills and accounts, as it may be necessary to report to the City Auditor.

All bills and accounts against the City, authorized by this Board, shall be entered by the Clerk in a monthly draft, which shall be presented to the Board at the said monthly meetings, and which after being signed by the President, shall be delivered to the Auditor;—and no bill or account, shall be approved by the Board unless it is so entered.

If however the Clerk shall doubt as to the correctness of any bill or account, he shall not enter the same in the said draft, until he shall have exhibited the same to the Board, with his objections, at their next monthly meeting, for their final decision.

And no bill or account shall be entered in the monthly draft unless it be delivered to the Clerk before the 20th day of that month.

Clerk.

The Clerk of the Board shall be chosen by ballot, and hold his office during the pleasure of the Board. He shall give his whole time to the service of the Board, attend all its meetings, and keep fair records of all its proceedings. He shall be entrusted with all the books, plans, papers, and documents, and be responsible for their safety.

It shall be his duty to keep in a neat and methodical style, a complete set of books, wherein shall be entered a full and accurate statement of all the receipts and expenditures of the Board; to receive all bills and accounts against the City, for work or labor done, or materials furnished pursuant to orders of the Board, examine them in detail and cast them up, and enter the same in the books.

He shall prepare a monthly draft and enter in the same a cor-

rect schedule of all bills and accounts to be presented at the monthly meetings of the Board. And shall be duly sworn to the faithful performance of the duties of his office.

He shall notify the meetings of the Board, and perform such further services as may be required by the Board, or the President of the same.

City Engineer.

The City Engineer shall, under this Board, be the General Superintendent of the Water Works. He shall take charge of Lake Cochituate, of the Reservoirs, Aqueducts and Pipes, of all the lands, and of all the machinery, structures and property connected with the Water Works, subject always however to the supervision of the President, and to such regulations, directions and restrictions as this Board may from time to time prescribe.

He shall exercise a general control and oversight over all the superintendents, agents and other subordinate officers.

He shall diligently attend to the execution of all works to be hereafter constructed; and take immediate measures for the repair of any damage which may happen to the aqueduct, pipes, reservoirs, dams, gate-houses, and all other structures or property belonging to the Water Works. He shall attend to the sufficiency of supply in the pipe yard, to meet every casualty.

He shall carefully inspect the aqueduct and other works, from time to time, in person, with a view to such repairs as may be necessary.

He shall direct the discharge of water from all the Reservoirs and from the Lake; and shall keep in his office the returns of the several superintendents in relation to the water levels at the Lake, and all the Reservoirs, and of Concord River, and of the pipe chambers in Charles River; and make a report to this Board of all the said returns, as often as he shall receive the same.

He shall use due diligence in the preservation and protection of Lake Cochituate, and of the water in the Lake; of the reservoirs, aqueducts and other property of every description belonging to the Water Works, from injuries and nuisances.

He shall prepare all plans of construction, make all necessary estimates connected with the works, whether for construction or repairs, certify all accounts, bills and contracts for materials purchased or labor performed, under his direction; shall notify the Board of all the breaches of contract; shall personally, under the direction of this Board, supervise and arrange all contracts for labor to be performed or materials to be purchased; and be intrusted with the construction of such new works; and the purchase and laying down of such mains and pipes, as the Water Board may from time to time direct.

He shall forthwith report to this Board, all cases of unexpected casualties or damages to the lake, aqueduct or other property; and all matters and things which may in any way affect injuriously, the supply of water in the lake, aqueduct or pipes, which may come to his knowledge.

Subordinate Officers.

The following subordinate officers shall be appointed by the Water Board; who shall hold their offices during the pleasure of the Board, and receive such compensation as the Board may from time to time deem expedient.

A Superintendent of Lake Cochituate.
" " Brookline Reservoir.
" " Marlboro' Reservoir.
" " Hopkinton Reservoir.
" " Pipe Chambers at Charles River.
" " Concord River.
" " City Reservoirs and Fountains.
" " Iron Aqueducts and Pipe Yard.
A Draughtsman.
A Service Clerk. And such other Clerks as may from time to time be necessary.

And it shall be the duty of the several subordinate officers, strictly to observe and to use their best endeavors to enforce all the rules and regulations of the Water Board, and the orders of the President of the Board, and of the City Engineer, relating to the several subjects confided to them respectively.

Lake Cochituate.

The Superintendent of Lake Cochituate, shall have the special charge of the said Lake, and of the lands and property of the City on the margin of the same, and of the exterior of the aqueduct, from the lake to the waste-weir at Dedman's Brook in Needham, including the said waste-weir. It shall be his duty diligently to attend to the protection of the said aqueduct, waste-weir, and other property; to the prevention of all nuisances and trespasses upon the said lands or the water of the lake, and forthwith to report to the City Engineer, all cases of damage or unexpected casualties which may happen to the lake, aqueduct, or other property.

And it shall be his further duty to keep an accurate record of the water levels at the lake daily, in the morning, at noon, and in the afternoon; specifying therein the depth of the water in the aqueduct, the height of the surface of the lake above Knight's

flume, in the north and south divisions; the temperature of the water in the gate house, and of the air in the shade; the height of the water on the 14 feet guage below the outlet dam; and to make a correct return of the said records to the City Engineer weekly, and as much oftener as the said Engineer may direct.

And he shall shut down the gate at the lake, upon receiving notice from the Superintendent of the Brookline Reservoir.

Brookline Reservoir.

The Superintendent of the Brookline Reservoir, shall have the special charge of the same, and of all the structures and other property of the City connected therewith,—of the interior of the aqueduct from the reservoir to the lake; and of the exterior from the reservoir to the waste-weir at Dedman's Brook,—of the waste-weir at Webber's Barn in Brookline, and also of those at Newton Centre and East Needham.

And it shall be his duty diligently to attend to the protection of the reservoir, aqueduct, waste-weirs and other structures and property confided to his charge; and to the prevention of all nuisances and trespasses upon the same; to keep the grounds and walks around the reservoir in good order, and forthwith report to the City Engineer all cases of damage or unexpected casualties upon the said aqueduct, reservoir, or other property.

And it shall be his further duty to keep a correct record of the water levels at the reservoir daily, in the morning, at noon and afternoon, specifying therein the depth of the surface of the water below the top of the dam in the reservoir, also the depth in the upper gate-house, and the temperature of the water in the gate-house at eight feet below the surface, and of the air in the shade. And to return to the City Engineer weekly, and as much oftener as he may require, a correct copy of the said record.

Marlboro' Reservoir.

The Superintendent of the Marlboro' Reservoir, shall have the special charge of the Compensating Reservoir in Marlboro' and of all the lands, structures and other property of the City immediately connected therewith; and it shall be his duty diligently to attend to the preservation of the same, and to the prevention of all trespasses upon the lands and other property, or upon the waters of the reservoir; and forthwith to report to the Engineer all cases of damage or unexpected casualties, which may happen to the same.

And also, to attend to the Cunningham roads, to examine them personally, as often as once in each week, and to make such repairs upon the same as may, from time to time be necessary.

And he shall keep daily, a true record of the height of water in the reservoir, and return a correct statement of the same to the City Engineer weekly, and as much oftener as he may require.

He shall also, whenever required, take the guage of the water below the dam, and report the height of the same to the Engineer.

Hopkinton Reservoir.

The superintendent of the Compensation Reservoir in Hopkinton, shall have the special charge of the said reservoir, and of all the lands, structures and other property of the City connected therewith; and it shall be his duty diligently to attend to the care and preservation of the same, and to the prevention of all trespasses.

He shall keep a correct record of the height of water in the reservoir; taking the measurement of the same every day at noon, and shall transmit a true copy of the same to the Engineer weekly, and as often as he may require.

And he shall forthwith report to the Engineer, all cases of damages and unexpected casualties.

Pipe Chambers, Charles River.

The Superintendent of the Charles River Pipe Chambers, at Newton Lower Falls, shall have the special charge of the same and of the waste-cocks, and of all the fixtures and property of the City connected therewith; it shall be his duty diligently to attend to the same, to remove all obstructions therefrom, and to ascertain the quantity of water by measuring the depth of water above the bottom of the aqueduct in the said chambers daily, and he shall report the same to the City Engineer weekly, and as often as he may require.

Concord River.

It shall be the duty of the Superintendent of Concord River, to make and keep a true record of the height of water in Concord River, by taking daily an accurate measurement of the same at Billerica Mills, above the crest of the dam; and he shall transmit the same to the City Engineer weekly, and as often as he may require, together with a statement as to whether the Mills are in operation or not.

City Reservoirs and Fountains.

The Superintendent of the City Reservoirs, and Fountains, shall have the special charge of the Beacon Hill, South Boston and

East Boston Reservoirs, and of all the Public Fountains in the City; and it shall be his duty diligently to attend to the same, and to protect the same from all trespasses and nuisances. And he shall measure the quantity of water in the said reservoirs daily, in the morning, and in the afternoon, and as much oftener as the City Engineer shall require; and make a record of the same, and return the same to the City Engineer daily.

Iron Aqueducts

The Superintendent of the Iron Aqueducts, shall have the charge of all the mains and pipes from Brookline Reservoir to the City; and in the streets of the City, including South and East Boston; and of the pipe yard. And he shall diligently attend to the same, and to all the fixtures and machinery, and other matters and things belonging to the Water Works in the pipe yard; and he shall forthwith in case of accident to the said mains or other pipes, proceed to repair the same. And it shall be his duty to put in such service pipes, and lay down such mains and other pipes as may from time to time be directed; and to repair all injuries to the streets and sewers caused by the water works.

He shall keep a true account of the pipes, machinery and other matters and things in the pipe yard, and give immediate notice to the City Engineer, of all accidents which may happen to the mains or pipes, or to any thing connected therewith.

And it shall be the further duty of said Superintendent, whenever any part of the streets or highways in the City, or in any other town or place where any of the pipes or other parts of the said water works under his care are laid, are in any way obstructed thereby or rendered dangerous to the public travel, by reason of any repairs thereon, or for any other cause, to cause a sufficient fence to be placed where the said obstruction exists, and to keep the same sufficiently lighted; and to station a person to guard the same during the night; and to take care that all the provisions of the 9th section of the "Ordinance of the City in relation to streets" are duly observed.

He shall make a full report, weekly, to the City Engineer, of the work and labor performed, and materials used in his department; and he shall duly return to the said Engineer once in each quarter, and as much oftener as he may require, a correct statement of the quantity of pipes and other materials in the pipe yard.

Service Pipes

It shall be the duty of the Service Clerk to receive all applications for water to be admitted into, or shut off from, the service pipes,—and he shall observe all the directions of the President, the

City Engineer or of the Water Registrar, in relation to the said applications; and forthwith cause the water to be let on, or shut off from, any of the service pipes, when so directed by either of them. He shall keep a true record of all places where the water shall be shut off or let on, specifying the time and the reasons therefor, and shall return a true copy of the said record every week to the office of the Water Board.

He shall forthwith pay over to the City Treasurer, all moneys which he shall receive for letting on or shutting off the water.

C.

THOMAS WETMORE, ESQ., *President Cochituate Water Board;*

SIR :—The following report, relating to the general condition of the Water Works, and other matters of interest connected therewith, has been prepared in compliance with the 13th Sec. of the Water Ordinance of Oct. 31st, 1850.

Lake Cochituate.

The roads, culverts, walls, and grounds around the Lake are all in good order, except the culvert at the outlet of Dug Pond, which has proved defective and needs renewal in part.

The examination of the interior of the aqueduct between Lake Cochituate and Charles River, which was made in company with the President and another member of the board, (Mr. Wilkins,) showed that it was all in good order. No defects different from those known to exist before, were discovered, except a fine longitudinal crack, along the top of the arch, under the road in East Needham or Grantville, about 150 feet long.

Between Charles River and the Brookline Reservoir, no new defects have been discovered during the year. (This part of the aqueduct was also examined in company with the President of the Board.) The same difficulties with regard to the clay puddled embankments, mentioned in the annual report of last year, still exist. An attempt has been made to repair the aqueduct on the most troublesome one, at Webber's Barn, by putting in concrete foundation and backing, for 43 feet, on the east side of the Waste Weir, and 30 feet on the west side. A very great improvement has been effected, but as a good deal of water has been allowed to waste at this point, it is not yet decided whether the aqueduct has been made perfectly tight or not.

The other defects alluded to, consist of cracks that were discovered before and about the time the aqueduct was completed, and numerous leaks into the aqueduct. These cracks have been watched carefully ever since, and are the chief points to which attention is directed, when the usual semi-annual examinations of the works are made. Most, if not all of them, have ceased to enlarge, and are generally so fine that a person seeking for them,

but unacquainted with their localities might easily fail to discover them. The only troublesome ones are those already described as existing on the clayey embankments.

The leaks into the aqueduct, through the brick-work, were not near so strong as they were at the examinations in 1850, especially on the part near Lake Cochituate, where by far the greatest number exists. This difference was probably owing to the dryness of the season, which influences very much the amount of leakage into the aqueduct, especially into the tunnels. As no evil has yet resulted from these leaks, farther than the large sums the City has had to pay in the form of damages, for draining neighboring wells, and as the water they bring into the aqueduct is pure and cool, and *paid for*, they may be looked upon as a benefit; for other cities have built and are proposing to build aqueducts to collect water in the same way, in order to get it purer than they could in any other manner. The high puddled embankment at Ware's Valley just west of Charles River, stands remarkably well, and in common with all others made of gravel and sand, will probably never give any trouble from settling.

The Cochituate Dam, *the Gate House at the Lake*, and all the structures along the line, are in good order. They were built in a very permanent manner, and promise to answer the purpose for which they were intended.

The Brookline Reservoir.

This reservoir has received considerable attention, as being of great importance in the particular management of the Water Works, and of considerable attraction to the public generally. The grounds around the reservoir, are believed to be in better order than they ever were before. The inside slope wall has been raised about two feet higher, perpendicularly, by a single course of granite flagging, which has added not only very much to its appearance, but allows the reservoir to be filled with safety about two feet deeper.

Originally the top-water line of this reservoir was considered as six feet below the top of the dam, but the inside slope wall was built so as to admit of the water being raised two and one-half feet higher. Now it may be raised 4½ feet higher; but it is not thought advisable, on account of high winds, to raise it more than 4 feet; that is, to 2 feet below the top of the dam. The importance of raising the wall, is not confined to the appearance or preservation of the banks of the reservoir; but, besides supplying water at a higher level in the City, it will be felt in case of a sudden and serious accident to any part of the brick aqueduct; as the City would then have two days more supply on hand.

Beacon Hill Reservoir.

The pointing of this reservoir last year, seems to have put an effectual stop to all external signs of leakage. Beneath the interior arches, under the basin, an occasional drop falls, producing on pebbles, fragments of stone and chips, the effect observed by all who have noticed the droppings from the roofs of limestone caverns. The former dampness of these interior arches, has very much diminished.

In consequence of the very large consumption of water during very cold as well as in warm weather, it has been found impossible to keep up the level of the Beacon Hill reservoir, unless a portion of the service around it was shut off from the rest of the City. To a limited extent, this has been done, and most of the time the high service has been well supplied, and no inconvenience has resulted to other parts of the City. It is impossible to prevent at all times however, a loss of water from the highest cisterns that are generally supplied, on Beacon Hill; for whenever it is necessary to examine or repair the brick aqueduct or the large iron pipes, the surface of the water in this reservoir must fall below its usual level.

South Boston Reservoir.

The water in this reservoir has not stood so high, by from 1 to 4 feet usually, as it has in the Beacon Hill Reservoir. As no practical evil results from this difference of level, which is owing to the heavy draft upon the 36 inch main, no means have been used to prevent it, nor could they be without producing positive evils elsewhere; unless a separate line of pipes were laid down from the Brookline to this reservoir. A small leak from this reservoir has existed ever since it was completed. In consequence of grading the street around Telegraph Hill last autumn, this leak has appeared to increase, but in amount, it is of no importance; in looks however, it is quite objectionable, and may easily be remedied next spring.

East Boston Reservoir.

Water was let into this reservoir for the first time on the first day of Jan. 1851; and after it was filled to a depth of more than 14 feet, it began to leak. At first it was feared that the bank might give way and the water was drained off; but after several cautious trials of refilling and emptying again, it was found that the rate of leakage continued about the same, and appeared to be owing, in a great measure, to the undisturbed natural soil, in the

bottom and sides of the reservoir, not being as impervious as was supposed.

Late in the autumn, the inside slope walls of this reservoir were pointed, and the bottom plastered with cement; but it was too late in the season to make a perfect job of it. As soon as the frost leaves the ground in the spring, we expect to make it tight. In the meantime it answers fully the purpose for which it was intended, and no apprehension of difficulty from it is felt.

Iron Pipes.

The iron pipes leading from the Brookline Reservoir to the reservoirs in the City proper, South Boston, and East Boston, together with the distributing pipes through every part of the City are, it is believed, in good condition.

The boxing and pile work across Charles and Mystic rivers, have received no injury, except in two instances from the shocks of vessels which have broken two or three of the guard timbers. The inverted syphon nearest Chelsea, has settled a little, and caused two leaks in a joint near by, but the cost of repairing it was only a few dollars.

The 20 *inch flexible pipe* across the channel of Chelsea creek after a trial of one year, during which it has been exposed to settling, and the changes of temperature in the water, appears to be perfect. This pipe is different in the construction of its joints, and larger in size, it is believed, than any other flexible pipe in the world.

The whole amount of pipes laid up to the present time will be found in the following statement,

Statement of the length of different sizes of pipes laid, and stop cocks put in, to Jan. 1st, 1852.

	DIAMETERS IN INCHES.								
	36	30	24	20	16	12	6	4	Agg's.
Feet of pipes laid in Brookline, Roxbury and Boston proper.	19,355	30,332	5,773		5,714	46,666	194,578	65,887	
No. of stop cocks in the same.	4	7	10		12	95	405	163	
Feet of pipes laid in and for S. Boston				8,155		10,875	46,508	16,512	
No. of stop cocks in do,				3		25	64	20	
Feet of pipes laid in and for East Boston.				15,972	1,523	8,593	48,356	1,699	
No. of stop cocks in do.				4	3	13	63	6	
Feet of pipe in Newton and Needham.		1,958							
Totals. Length of pipe.	19,355	32,290	5,773	24,127	7,237	66,134	289,442	84,098	528,456 ft. or 100 miles and 456 ft.
Number of stop cocks.	4	7	10	7	15	133	532	189	897

To the above aggregate length of pipes, should be added the hydrant branches and bends. As there are 1133 of these, and they average 16 feet in length, their total length would be 18,128 feet, or 3 miles 2288 feet, making the whole length of pipes 4 in. and upwards in diameter, laid down in and for all parts of the City of Boston, a small fraction over 103½ miles.

Statement of the number of feet, size, and location of distributing pipes laid in Boston proper, South Boston and East Boston, in the year 1851.

Boston proper.

Names of Streets.	Between what Streets.	Dia. of pipes in inches.	Feet.	
Tremont,	Rutland and Concord,	12	252	Whole distance.
"	Northampton across Chester,	12	261	" "
Harrison avenue,	Crossing Railroad Bridge,	12	81	
" "	At Dover street,—side pipe,	12	36	
Mount Vernon,	End of pipe to enter Common Sewer, River street,	12	18	
	Total 12 in. in Boston Proper,		648	
Albany,	From Rochester, across Troy,	6	180	Whole distance.
Concord,	Tremont and Suffolk,	6	630	Beginning at Tremont street.
Chester square,	" " "	6	621	" " " "
South,	Harvard and Lehigh,	6	360	" " Harvard "
East Springfield,	Washington and Harrison avenue,	6	270	" " Washington street.
Union Park Fountain,	From Fountain to Sewer—waste pipe,	6	32	" " " "
Chester square "	" Square to Fountain,	6	112	
Indiana,	Washington and Tremont,	6	162	Beginning at hyd't. 575 ft. from Washington street.
	Total, 6 in. in Boston proper,		2,367	
Knox Street and Lincoln Court,	Bay and Fayette,	4	324	Whole distance.
Hamburg,	Mystic and Harrison avenue,	4	405	" "
Bumstead court,	Haymarket place and Boylston street,	4	36	Beginning at Haymarket place.
Briggs place,	From Suffolk,	4	162	" " Suffolk street.
Fabin,	Newland towards Tremont,	4	252	" " hyd't 200 feet from Newland street.
India wharf,	Branch to Hydrant, at North East end of Wharf,	4	180	
New Jail yard,		4	81	Ending at wall of building.
Myrtle,	Centre and Grove,	4	90	Beg'g at hyd't. 150 ft. fr. Centre st.
Trumbull,	Newland towards Tremont,	4	54	" 400 ft. from Newland.
Pipe yard,	From Pleasant,	4	72	
	Total, 4 in. in Boston proper,		1,656	

Names of Streets.	Between what Streets.	Dia. of pipes in inches.	Feet.	
Dorchester,	Fifth and Mercer,	12	450	Beginning 60 feet from Fifth st.
K.,	First and Second,	6	315	" at First street.
P.,	Fifth and Sixth,	6	189	" at Fifth street.
F.,	Sixth and Seventh,	6	225	" at S. side of Sixth st.
Mercer,	From Dorchester to Eighth,	6	873	" at Dorchester street.
C.,	Fifth and Sixth,	6	158	Ending at Sixth street.
Sixth,	C. and B.,	6	157	Beginning at C street.
	Total, 6 in. in South Boston,		1917	
Old Road,	Fourth and L.	4	450	Beginning at Fourth street.
Dove,	Dorchester and F,	4	153	" at Dorchester street.
Athens,	A. and B,	4	90	" at 20 ft. from A st.
Gold,	E. and Dorchester,	4	675	Ending at Dorchester street.
Silver,	Dorchester and G.,	4	540	Beginning at Dorchester street.
Quiney	Dorchester and F.,	4	198	" at " "
Gates,	Telegraph and Eighth,	4	311	" at Telegraph "
Telegraph,	Gates and Dorchester,	4	670	" at Gates "
	Total, 4 in. in South Boston,		3087	
	East Boston.			
East Boston Reservoir,		12	153	Waste weir pipe
Eutaw,	Brooks and White,	6	558	Beginning at Brooks street.
Sumner,	At Junction of New,	6	81	" Blow off " or waste pipe.
Orleans,	Maverick and Decatur,	6	441	Beginning at Maverick street.
	Total, 6 in. in East Boston,		1080	
Cross,	Border and New,	4	190	Beginning at Border street.
Lexington Place,		4	144	From Lexington street.
	Total, 4 in. in East Boston		334	

Recapitulation.

		12 in.	6 in.	4 in
Boston Proper,	Total number of feet of distributing pipes laid in 1851.	648	2367	1656
South Boston,	" " " " " " " " " "	450	1917	3087
East Boston,	" " " " " " " " " "	153	1080	334
		1251	5364	5077

Service Pipes.

The whole number of Service Pipes is 16,049, and they are mostly of lead $\frac{5}{8}$ inch in diameter, a few of the same metal are $\frac{3}{4}$ inch, and fewer still 1 inch: these are introduced only when large quantities of water are used. About 2500 of the service pipes are of cast iron, $1\frac{1}{2}$ and 2 inches diameter; but it is a source of regret that any have ever been laid, as they are much more troublesome to keep in repair, and discolor the water more than lead pipes.

Statement of Service Pipes laid in 1851.

Diameter in inches.	Boston.		South Boston.		East Boston.		Total.	
	Number.	Length in feet.	Number.	Length in feet.	Number.	Length in feet.	Number.	Length in feet.
2	2	146	-	-	1	60	3	* 206
$1\frac{1}{2}$	1	36	-	-	-	-	1	36
1	7	574	5	931	5	821	17	2,326
$\frac{3}{4}$	18	1,372	2	369	4	472	24	2,213
$\frac{5}{8}$	545	16,622	114	3,843	205	5,957	864	26,422
					Aggregate, - - -		909	31,203

Each service pipe, laid in 1851, is furnished with a stop-cock, of corresponding size, at the junction with the distributing pipe.

Stop Cocks.

These are all in good order, as far as can be ascertained. They require much attention to keep them in good working condition, and are of great importance in allowing repairs to be made in small districts, without interfering with general supply of the whole city. The large stop-cocks, the 36 and 30 inch ones in particular, are sources of peculiar anxiety, as they are so heavy, and subjected to such enormous strains, that they are very liable to get out of repair, unless managed with great care. The two 36 inch stop-cocks on Tremont street, at the head of Dover street, have been taken out to be repaired, and new ones put in their places. This work was dreaded for a long time, and put off for more than a year, in consequence of a supposed necessity of keeping the 36 inch main closed for two and perhaps three days. In order to shorten this time as much as possible, the 20 inch main through Dover street, was connected with the 12 inch pipe in Harrison avenue, and this again was laid across the Worcester railroad bridge, to connect with the 12 inch pipe on the north side, thus allowing, by means of two additional stop-cocks and a short

* Fountains.

extra 12 inch side pipe at the intersection of Dover street and Harrison avenue, the City proper, to be connected at pleasure with the South Boston Reservoir, even if the connection with the 36 inch main in Tremont street should be cut off. After taking this precaution, and filling up the Beacon Hill and South Boston Reservoirs as much as possible, the work was commenced. By taking out one stop-cock at a time, and by the repairers working four days with only twelve hours rest in the whole time, the old stop-cocks were both taken out, and the new ones put in. After the first one was put in, the water was let on and the reservoirs filled before the second was commenced, so that scarcely any inconvenience was felt by the tenants on the high service, though they were notified before the first stop-cock was commenced, to expect a temporary loss of water.

When these stop-cocks were renewed, they were put in horizontally and fitted with bevel-geer to adapt them to this purpose. The horizontal position is found to be the only safe one in New York, and experience here teaches that whenever the old large stop-cocks have to be taken out for repairs, they had better be altered so as to fit them for the horizontal position.

The taking out of the stop-cocks at Dover street, led to the discovery of an unusual amount of accretion on the inside of the large pipes, much more than has been discovered as yet in any of the smaller distributing pipes. Prof. Horsford of Cambridge, was requested to examine the interior of the pipes and stop-cocks at the time, and was so much interested, as to make very minute investigations of the substance collected in them, the results of which will no doubt be communicated to you.

Fire Hydrants.

During the year, 11 new hydrants were established in the City proper, 11 in South Boston, and 47 in East Boston. Altogether there have been established up to the present time—

In Boston proper,	811
" South Boston,	175
" East Boston,	124
" Brookline,	1
" Roxbury,	4
" Charlestown,	11
" Chelsea,	7
Total,	1,133

Ten of these are at the public institutions at South Boston.

By comparing this statement, with the one made in the Annual Report of the Cochituate Water Board for 1850, it will be seen

that the number of hydrants was then stated at 1,005, too small by 59. The discrepancy is owing partly to those at the public institutions at South Boston not being included then, and partly to the assistant who took off the number from the plans, not knowing all the alterations and omissions that had been made. The present enumeration has been made with a great deal of care by two persons, one of whom has a particular knowledge of about every hydrant in the City. A similar observation should be made relative to the length of pipes laid.

The great importance of these hydrants in cases of fire, now that so much dependence is placed upon them, renders it absolutely necessary to spare no pains to keep them constantly in order. Though some of them, which have been established more than three years, have never been used in extinguishing fires, they are all examined at least twice a year. After every fire, all the hydrants used are examined and put in order, if at all injured. Before very cold weather sets in, they are packed around with salt meadow hay, which is removed in the spring. This precaution, together with that of providing wastes to prevent any water from standing in the hydrants above the valves, when they are not in use, has proved sufficient to prevent freezing in almost every case.

In a few instances, where hydrants are peculiarly exposed, they have been known to freeze, and as far as practicable, such changes have been made as to remedy this difficulty, but where this could not be done, they are frequently examined during very cold weather and ice kept from forming in them. Notwithstanding every precaution hitherto taken, however, a hydrant will occasionally be found out of order, when most needed. In most cases this has been owing to the street watermen, putting them out of order, and failing to report having done so. As the hydrants are generally but from 250 to 300 feet apart all over the city, it is seldom a serious matter, if one should be out of order when a fire occurs.

Repairs of Pipes.

During the year 1851, the following leaks occurred, and were repaired.

Where.	Diameter of Pipes in inches.												
	36	30	24	20	16	12	6	4	2	$1\frac{1}{2}$	1	$\frac{3}{4}$	$\frac{5}{8}$
Boston proper,	6	7	1		1	11	11	15	2	40	4	3	110
South Boston,						2		1					9
East Boston,				3		1	5					1	4
Total,	6	7	1	3	1	14	16	16	2	40	4	4	123

Of the leaks that occurred in pipes 4 inches and upwards in diameter, 2 were caused by flaws in the castings; 2, (one 30 inch, and one 20 inch,) were cracked, probably by carelessness in unloading, after they had been proved; 4 by freezing; 8 by settling of earth, and 48 by expansion and contraction, produced by change of temperature, which caused the lead in the joints to work out. Total, 64, or 1 in every $1\frac{1}{2}$ miles nearly.

Of the leaks that occurred in service pipes, 79 were caused by flaws or defects, (43 in the pipes, 14 in the stop-cocks, and 22 in the connections,) 3 by rats gnawing the lead, 10 by injuries produced by the tenants, 4 by freezing, and 77 by the settling of earth producing fractures, in most cases where the service pipes enter the walls of houses. *Total*, 173, or 1 to every 95 service pipes nearly.

Complaints have sometimes been made, that sufficient notice of intention to shut off the water to make repairs, was not given. It should be remembered, that it is not always practicable to give notice, especially in the case of sudden and serious accidents, which require the water to be shut off immediately. Whenever the nature of the case admits of a little delay, if it should be in the day time, printed notices are left at all the houses to be shut off, so that the occupants may have time to draw as much as they may wish to use, till the water is let on again, and for no other purpose. For this reason, whenever it is necessary to draw off the water for two or three hours at night, from any portion of the city, no notice is given, as it is presumed that no serious inconvenience will result from the omission. In some instances, boilers in private houses have been known to collapse, in consequence of the water being shut off, and suddenly let on. This could easily be prevented, either by having a cistern in the house, or a safety valve in the boiler, and as everything inside of the houses, in the arrangement and construction of the water apparatus, is done without any reference whatever to the City, the owners or tenants alone, should be responsible for any defects in their own work.

Stock on hand and Tools.

An account of stock on hand Jan. 1, 1852, will be found in the statement below. The rule is, not to have less on hand than one spare pipe, branch or stop-cock, of every size and pattern; and as far as practicable to keep two. Some patterns are very rarely needed, and it is not necessary to keep more than one to spare; of others that are used quite often, a much larger number is kept on hand.

The accommodations and conveniences of the Pipe Yard, are sufficient for the storage of as many pipes, branches, stop-cocks

and hydrants as are likely to be needed ordinarily, and to do all the mechanical work indispensable to the immediate laying down and repairing of the pipes, &c.; but the manufacture of all articles used, is done elsewhere. In consequence of the limited size of the yard, most of the large pipes and branches are kept under the Beacon Hill Reservoir and in South Boston.

If some alterations were made at the pipe yard, and a turning lathe purchased, at an expense for the whole not exceeding $1000, the repairing and fitting up of many articles which have now to be sent to machine shops in South Boston, or other parts of the City, might be done at the pipe yard for less money, and the expense of sending back and forth, saved.

Statement of Pipes and other stock on hand, exclusive of Hydrants and Tools, January 1st, 1852.

	Diameters in inches.												
	36	30	24	20	16	12	6	4	2	1½	1	¾	⅝
No. of pipes,	8½	66	2	40	22	58	51	115	506	96			
Y Branches,	-	1	-	-	1	1							
3 Way Branches,	2	3	-	1	4	7	9	6	50				
4 Way Branches,	-	2	1	2	1	4	2						
Flange pipes,	8	7	2	2	-	-							
Sleeves,	10	8	8	6	8	4	11	9	20				
Caps,	-	-	-	-	-	11	6	12					
Reducers,	-	1	1	-	1	2	5	4					
Bevel pipes,	-	-	-	3	-	-	4	4					
Curved pipes,	4	9	1	-	2	4							
Quarter turns,	-	-	-	-	-	3	4	4					
Double hubs,	-	-	-	7	9	-	1						
Stop cocks,	4	1	2	2	3	2	10	10	-	-	124	86	418

Lead pipe—84 feet, of 2 inch; 228 feet, of 1 inch; 33 feet, of 1¼ inch; 50 feet, of ¾ inch; 86 feet, of ⅝ inch.

Block tin pipe—74 feet, of ⅝ inch.

For service pipes—561 square boxes; 26 T boxes; 51 long boxes; 65 tubes; 3 flanges, with tubes; 144 1 inch couplings; 42 ¾ inch couplings; 224 ⅝ inch flange cocks; 23 ¾ inch flange cocks; 25 1 inch flange couplings; 175 ⅝ inch flange couplings.

Pig lead, 29,640 lbs.—Gasket, 350 lbs.

Hydrants.

10	Wilmarth pattern,	in order.
4	Ballard Vale pattern,	
19	Lowell pattern,	
1	Hooper pattern,	
34		

16 Kingston pattern, to be altered.

For Hydrants, 10 *bends*—20 pieces for lengthening, rendered necessary by raising grades of streets; 16 nipples, 3 frames and covers; 30 self-acting wastes; 15 spare screws, for Lowell patterns; 23 of 1¼ inch cocks, for wharf hydrants.

Besides the foregoing stock, there is at the pipe yard a seven horse steam engine used at the Newton tunnel. Also two proving presses, and as large a number of tools, of various sorts, valued at about $500, as are sufficient to carry on the operations essential to extending and repairing pipes.

Consumption of Water by the City.

As there is no division in the Brookline Reservoir, and no water-metre there yet, it is impossible to tell with a great degree of accuracy, what the daily consumption of water by the City has been. Quite frequently however, opportunities have been afforded of measuring the consumption with sufficient accuracy; that is, when no water was let into the reservoir from the aqueduct, and the City was supplied from the Brookline Reservoir. The results obtained in this way, have been used as checks upon the estimates in the following table:

Daily average number of wine gallons, drawn from the Brookline Reservoir.

	1849.	1850.	1851.
January,	1,700,000	5,181,716	7,233,729
February,	-	5,214,010	7,221,119
March,	1,550,000	4,841,185	6,137,913
April,	-	4,960,993	5,365,202
May,	3,600,000	5,346,066	6,238,364
June,	4,300,000	6,906,454	7,924,971
July,	4,800,000	8,514,194	7,180,169
August,	4,100,000	8,004,558	7,235,020
September,	4,800,000	6,585,496	7,230,610
October,	4,550,000	4,504,309	6,716,619
November,	3,800,000	4,960,518	6,473,514
December,	3,600,000	5,037,015	7,663,363
Average for the year,	3,680,000	5,837,883	6,883,782

Note. The observations for February and April, 1849, were too imperfect to base an estimate upon. The month of August was very wet. In the summers of 1849 and 1850, a great deal of water was used in flushing out the common sewers, and for the public fountains. In June, 1851, unusual waste was made in the city to keep the Brookline Reservoir down. In December, the same year, the excessive cold caused a great deal of water to be wasted to prevent pipes in houses from freezing.

The standard of measure adopted on the Boston Water Works, is not precisely the wine gallon, but is exactly *two fifteenths of a cubic foot*, so that in order to reduce the gallons in the foregoing statement to cubic feet, it is only necessary to divide by $7\frac{1}{2}$. It is to be regretted that there is not some common unit of measure on all the Water Works throughout our country; as it is, New York has adopted the Imperial gallon, Philadelphia, the Ale gallon, and Boston, the Wine gallon.

The foregoing table has been prepared with a great deal of labor, and although not to be considered as perfectly accurate, is believed to approximate very closely to the truth. If it were not for the irregularity in the aqueduct, caused by the Newton and Brookline tunnels, and the varying quantity of water which pours into the tunnels, from their tops and sides, it would be possible to make a very close estimate of the amount consumed, a record of the daily observed depths of water in the aqueduct, at the east end of the pipes across the Charles River, and at the Brookline Reservoir having been kept.

The rapid increase in the rate of consumption suggests that it will not be many years in reaching the extent of the estimated reliable capacity of the Lake; and the experience of the past year, is a warning not to expect more from Lake Cochituate, with the present means of storage, than an average of 10,000,000 gallons daily throughout the year. If the enormous waste which now takes place could be prevented, all thoughts of adding to the present capacity of the Lake, might be suffered to rest for many years to come. As it is, however, such a question is likely to be forced upon your consideration in a short time.

Compensating Reservoirs.

The Hopkinton and the Marlboro' reservoirs are both in good order, so far as regards the dams and fixtures for regulating the discharge of water from them. The buildings that were purchased with the former, especially the Mills, are fast going to decay in consequence of being unoccupied.

The Cunningham roads, which cross the Marlboro' Reservoir, have been complained of by the town as not being wide enough, and not built of suitable materials. They have been kept in a safe condition however, and are to be made conformable to the understanding with the town in other respects, in the spring, in accordance with the instructions of the Board.

The estimated quantity discharged from the Hopkinton Reservoir between the 17th of June, and the 31st of October, 1851, is 1,023,904,600 wine gallons, and the discharge from the Marlboro'

Reservoir from the 30th of June to the 31st of October, 1851, was 1,100,554,650 gallons; making a total of 2,124,459,250 gallons.

During the longest period mentioned, the estimated consumption by the City, was 975,028,771; but this consumption lowered the surface of Lake Cochituate 28 inches, which for an area of 550 acres, would equal 419,265,000 gallons; leaving as the natural supply of the Lake during this period only 555,763,771 gallons, in addition to what was actually allowed to flow through the natural outlet; or but little more than one fourth of what was discharged from the Compensating reservoirs for the benefit of the Middlesex Canal, and Mill owners on the Concord River.

Rain Gauges.

Observations with rain gauges have been made at three different points for the Board, viz.: for one year at the Hopkinton Reservoir, and a few months at the Marlboro' Reservoir, and at Lake Cochituate.

As the quantity of rain that may be expected to fall, is so important an element in all calculations of future probable supply, it has been thought advisable to take considerable trouble to collect and preserve for future reference the following statistics. They are the result of many years observations, and have been kindly furnished, mostly by the gentlemen who have made them, and whose names are mentioned over the heads of each set of observations. in Inches

The annual quantities for 34 years in Boston, 27 years in Waltham and Lowell, 20 years in Providence, and 10 years in Cambridge are given; and the monthly quantities are given for 10 years in Boston, Cambridge, Waltham and Lowell, and 1 year in Hopkinton. The importance of the monthly gaugings will appear, when it is considered that the quantity of water which Lake Cochituate may supply to the City, with the present means of storage, will depend, not so much upon the annual depth of rain, as upon the quantity falling during the months of June, July, August, September and October. For this reason a table has been prepared, showing the amount of rain during those months for a number of years, and at several points in this vicinity. The gaugings for the warm season are much more reliable than those made in the winter, as will be evident from a careful inspection of the tables of the monthly quantities.

Annual Fall of Rain at several places, in Boston and Vicinity.
in inches

Year.	Boston, Enoch Hale.	Boston, J. P. Hall.	Cambridge, Prof. Bond.	Waltham, B. M. Co. Dr. Hobbs.	Lowell, Merrimack Man. Co.	Providence, Prof. Caswell.
1818	42.99	-	-	-	-	-
1819	35.48	-	-	-	-	-
1820	44.18	-	-	-	-	-
1821	36.89	-	-	-	-	-
1822	27.20	-	-	-	-	-
1823	46.43	47.30	-	-	-	-
1824	35.98	36.02	-	-	-	-
1825	32.41	35.34	-	34.59	28.46	-
1826	41.68	41.14	-	37.44	32.49	-
1827	44.39	48.91	-	50.65	51.86	-
1828	34.98	32.41	-	41.71	37.67	-
1829	47.99	46.85	-	42.09	36.94	-
1830	44.62	42.95	-	47.00	42.59	-
1831	50.86	51.61	-	45.77	51.73	-
1832	46.68	46.69	-	47.21	52.90	38.83
1833	39.71	37.86	-	39.11	43.87	34.51
1834	38.03	39.60	-	38.91	31.78	41.84
1835	35.48	37.86	-	39.30	32.42	30.06
1836	35.71	40.86	-	35.10	35.53	37.77
1837	29.98	33.52	-	37.98	30.86	31.62
1838	37.57	42.52	-	40.75	37.52	36 38
1839	34.82	41.10	-	38.80	38.21	36.63
1840	42.87	49.16	-	42.00	38.70	41.59
1841	38.28	47.05	-	41.70	40.38	47.86
1842	35.68	39.11	40.13	38.24	38.61	37.71
1843	43.79	46.69	50.81	40.46	39.47	42.40
1844	36.15	37.54	35.98	34.09	35.71	35.00
1845	-	46.32	47.56	43.04	39.00	43.56
1846	-	29.95	30.37	26.90	28.03	29.51
1847	-	46.93	48.22	43.90	46.26	47.60
1848	-	40.98	43.04	36.23	42.29	40.48
1849	-	40.30	40.97	40.74	41.90	34.69
1850	-	53.98	54.07	62.13	51.09	51.48
1851	-	44.31	41.97	41.00	45.68	43.30

Amount of Rain during the months of June, July, August, September and October, from 1818 *to* 1851 *inclusive, in inches*

Year.	Boston, by E. Hale.	Boston, by J. P. Hall.	Waltham, by Dr. Hobbs	Lowell, by Merrimack Manufacturing Co.	Year.	Boston, by E. Hale.	Boston, by J. P. Hall.	Waltham, by Dr. Hobbs	Lowell, by Merrimack Manufacturing Co.	Cambridge, by Prof. W. C. Bond.
1818	17.93	-	-	-	1835	16.69	17.88	20.41	14.31	-
1819	16.65	-	-	-	1836	10.44	12.56	11.71	17.56	-
1820	20.58	-	-	-	1837	8.79	8.59	10.84	11.49	-
1821	13.74	-	-	-	1838	19.07	22.90	23.17	20.53	-
1822	13.74	-	-	-	1839	12.55	15.77	15.49	17.53	-
1823	13.32	14.55	-	-	1840	14.33	16.31	16.26	16.81	-
1824	13.36	13.60	-	-	1841	12.26	14.91	16.42	16.94	16.82
1825	14.82	17.50	17.65	18.61	1842	14.54	15.61	16.62	17.32	17.46
1826	24.22	25.68	21.645	18.21	1843	19.19	19.44	21.66	20.08	23.92
1827	17.34	20.03	23.87	24.12	1844	15.29	15.52	16.61	21.00	15.79
1828	13.23	13.15	18.44	15.14	1845	-	13.38	16.12	15.07	16.61
1829	17.56	17.84	16.67	9.04	1846	-	9.21	8.91	11.03	11.89
1830	20.05	19.03	21.67	19.84	1847	-	20.88	21.08	21.43	21.21
1831	21.39	23.67	22.47	21.67	1848	-	14.83	15.22	18.38	20.38
1832	13.41	14.58	14.51	21.78	1849	-	17.90	19.46	19.28	18.74
1833	14.66	14.94	19.36	22.16	1850	-	20.02	29.40	21.48	25.56
1834	18.18	21.60	19.74	15.94	1851	-	14.09	14.35	18.92	14.68

Monthly Fall of Rain at Cambridge.

BY PROF. W. C. BOND.

Year.	Jan.	Feb.	Mar.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Total.
1842	0.78	3.18	2.24	3.36	2.33	5.84	1.42	5.60	3.34	1.26	4.14	6.64	40.13
1843	1.60	5.64	5.77	4.17	2.17	5.38	2.47	8.74	1.52	5.81	4.20	3.34	50.81
1844	4.29	2.03	5.84	0.34	1.96	1.77	2.90	3.35	4.50	3.27	1.50	4.23	35.98
1845	1.97	2.73	3.67	1.48	2.63	3.15	4.07	2.53	2.58	4.28	10.43	8.04	47.56
1846	2.60	1.50	1.56	1.50	3.59	2.68	3.19	2.37	2.01	1.63	2.55	5.19	30.37
1847	3.67	3.34	5.91	2.83	1.94	5.49	2.53	5.22	6.54	1.44	4.94	4.37	48.22
1848	2.89	4.00	2.50	1.20	7.68	2.81	2.58	3.50	5.18	6.31	1.16	3.23	43.04
1849	0.72	1.46	6.90	1.18	2.75	1.37	1.17	6.52	2.13	7.56	5.43	3.78	40.97
1850	3.86	2.51	3.27	4.79	7.22	2.97	2.62	7.64	9.82	2.51	3.52	3.34	54.07
1851	1.03	4.22	2.01	9.16	3.92	1.62	3.21	1.20	3.98	4.67	4.96	1.99	41.97
Average,	2.34	3.06	3.97	2.99	3.62	3.31	2.62	4.67	4.16	3.87	4.28	4.41	43.30

Monthly Fall of Rain at Waltham, in inches.

BY DR. EBENEZER HOBBS.

Year.	Jan.	Feb.	Mar.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Total.
1842	1.04	3.38	2.51	3.16	2.54	5.90	2.20	4.70	2.86	0.96	3.67	5.32	38.24
1843	2.76	1.64	5.78	4.30	0.82	3.73	2.77	8.60	1.02	5.54	3.50	.	40.46
1844	4.14	.	4.20	0.24	3.30	1.26	2.44	2.85	4.20	5.86	3.14	2.46	34.09
1845	3.44	1.70	2.84	1.76	2.62	2.63	3.84	3.30	2.55	3.80	10.28	4.28	43.04
1846	2.58	.	4.38	1.57	3.66	2.44	2.38	2.18	0.82	1.09	2.04	3.76	26.90
1847	3.08	3.84	3.26	3.10	2 36	5.94	2.36	4.18	6.88	1.72	4.16	3.02	43.90
1848	3.24	1.56	4.08	1.56	5.96	3.10	1.92	2.28	3.32	4.60	1.68	2.93	36.23
1849	1.36	0.40	6.66	1.32	3.62	2.00	2.16	5.36	1.94	8.00	4.60	3.32	40.74
1850	4.96	2.96	4.12	5.45	7.56	3.72	3.48	9.64	9.92	2.64	3.36	4.32	62.13
1851	1.36	3.92	1.20	8.98	3.60	1.64	3.23	0.99	3.64	4.85	5.34	2.25	41.00
Average,	2.80	1.92	3.90	3.14	3.60	3.24	2.68	4.41	3.71	3.91	4.18	3.17	40.66

Boston.

BY JONATHAN P. HALL.

1842	0.80	3.20	3.35	3.50	2.90	5.30	1.82	4.44	3.25	0.80	4.45	5.30	39.11
1843	2.20	6.08	6.17	3.88	1.60	4.61	2.15	6.88	0.98	4.82	3.40	3.92	46.69
1844	3.68	2.42	6.00	0.20	2.72	1.40	2.17	2.62	3.53	5.80	3.15	3.85	37.54
1845	4.58	4.25	3.83	1.23	2.82	2.05	3.28	1.82	2.23	4.00	10.25	5.98	46.32
1846	3.12	2.95	2.73	1.23	2.02	2.25	2.51	1.80	1.30	1.35	4.17	4.52	29.95
1847	3.28	4.70	4.77	2.20	2.03	4.09	2.65	6.45	6.64	1.05	5.12	3.95	46.93
1848	2 30	3.90	4.05	1.40	6.30	1.73	1.35	3.10	3.55	5.10	2.25	5.95	40.98
1849	0.35	1.15	7.35	0.90	3.10	1.45	0.85	6.25	1.25	8.10	5.50	4.05	40.30
1850	4.59	2.52	5.32	4.82	6.63	2.77	2.70	5.30	7.15	2.10	3.32	6.76	53.98
1851	1.30	4.20	3.88	9.37	3.31	1.80	3.09	1.27	3.50	4.43	5.51	2.65	44.31
Average,	2.62	3.54	4.74	2.87	3.34	2.75	2.26	3.99	3.34	3.75	4.71	4.69	42.60

Hopkinton.

BY ALBERT WOOD.

1851	1.86	3.85	2.08	7.60	4.18	2.46	2.47	1.61	2.55	7.02	5.65	2.64	43.97

Lowell.

1842	.97	3.99	2.89	2.87	2.38	5.19	1.03	5.43	4.31	1.36	4.95	3.24	38.61
1843	2.14	2.04	5.44	3.14	2.10	4.49	2.39	8.16	1.36	3.68	3.28	1.25	39.47
1844	.93	1.07	3.45	.29	3.64	1.87	3.50	6.90	3.55	5.18	2 25	3.08	35.71
1845	1.20	1.80	3.64	1.68	2.75	2.68	3.40	2.58	3.05	3.36	7.97	4.89	39.00
1846	2.44	1.82	3.27	1.31	4.21	2.40	3.59	2.79	.64	1.61	2.70	1.25	28.03
1847	5.42	3.14	3.46	2.26	2.15	6.75	3.01	3.81	4.85	3.01	3.70	4.70	46.26
1848	2.83	2.10	3.54	1.60	7.41	4.01	2.16	3.15	4.06	5.00	2.68	3.75	42.29
1849	1.13	.83	5.07	2.06	4.04	1.70	2.20	5.53	2.51	7.34	5.70	3 80	41.91
1850	3.32	4.38	2 75	4 22	7.12	2.23	2.78	7.65	6.21	2.61	2.92	4.90	51.09
1851	2.07	4.43	1.76	7.88	3.29	2.00	4.26	3.29	2.86	6.51	5.30	2.03	45.68
Average,	2.24	2.56	3.53	2.73	3.91	3.33	2.83	4.93	3.34	3.97	4.14	3.29	40.80

Complaints of Bad Water.

Last Spring, principally in the months of April and May, there was a very general complaint of the water tasting badly; and in many instances, though not so generally, the smell was considered bad. This subject received immediate attention, and every thing was done that was thought judicious, to discover and remedy the evil. The principal measure that was resorted to, was a thorough flushing of the pipes all over the city, by passing through them as rapid a current as it was possible to produce by opening hydrants and waste cocks. In some particular cases, after every thing had been done that could be thought of with the main and distributing pipes, the evil complained of was not removed. In almost every instance of this kind, the trouble was at last traced to filters that had become filled with decayed animal matter.

The probability is that one great cause of complaint in the spring is owing to the change of temperature in the water, causing it to have a flatter taste. During the winter the temperature of the water in the pipes is seldom more than 4 or 5 degrees above the freezing point, and the change which takes place in this respect in the spring is very great. Lest, however, the difficulty should be owing to collections of offensive matter in the pipes during the winter, it is intended to commence the general flushing, or "blowing off," a month earlier this year than the last, that is, the last of March instead of the last of April.

At the ends of courts and of some streets, where the pipes terminate without being connected in both directions with the general circulation and form "dead ends," the "blowing off" system has to be practised frequently, about once in ten days throughout the year, otherwise complaints of bad water are made. Small fish have sometimes got into the service pipes and died there, giving to the water of the houses to which the pipes belonged, a bad taste and smell. This was more frequently the case in the spring, just after the strainers in the Brookline Gate House had got out of order. Great pains are taken to prevent this, and only two instances of fish getting into service pipes are known to have taken place since last spring.

Surveys.

During the year 1851, the following surveys were made by order of the Board, viz:

1st. Of that portion of the City, included in the "High Service" on Beacon Hill. The object of this survey was to aid in determining upon some permanent plan by which, if possible, to prevent the level of the water in the Beacon Hill Reservoir from

being drawn down so much as it frequently is, when a large quantity is consumed by the City, and at the same time, not to confine the use of the 30 inch main to the high service alone.

2d. Of the line of the proposed pipe for supplying the public institutions on Deer Island.

3d. Of the property of the City, connected with the Hopkinton Reservoir. The results of this survey are not quite ready to be reported yet.

The surveys ordered by the Board for the purpose of ascertaining the probable cost of supplying a portion of Roxbury, and the houses on the Mill Dam, with Jamaica Pond water, have not been commenced yet; but are to be shortly.

Visit to other Water Works.

A visit was made in company with the President and another member of the Board to the Water Works of New York, Philadelphia and Baltimore, with the hope of obtaining information that might lead to greater economy in the extension and repairs of the Boston Water Works. The result of this visit was very satisfactory, as showing that no very important improvements in those cities had been overlooked here. In the matter of stop-cocks and stop-cock and hydrant boxes, some hints were obtained which may prove valuable.

Lands belonging to the Water Works.

These with a few buildings upon them, are in as good condition as could be expected, considering that there are in almost every town mischievous persons who take pleasure in destroying the property of a city or large corporation. But few depredations have been committed; and in one case, the offenders have been traced out already.

Expenditures.

As all the expenditures connected with the Water Works, for which the City Engineer, who is not a disbursing agent, is in any way responsible, have been minutely kept account of by the Clerk of the Board, any statement of these expenditures, from the former, could not add to the information already in your possession.

Which is respectfully submitted,

E. S. CHESBROUGH, *City Engineer.*

Boston, Jan. 1852.

D.

WATER REGISTRAR'S OFFICE, BOSTON, JANUARY 1ST, 1852.

THOMAS WETMORE, ESQ.,

President of the Cochituate Water Board.

SIR:—

In accordance with the 16th Section of the Ordinance providing for the care and management of the Boston Water Works, passed October 31st, 1850, the following Report is made.

The number of Cochituate Water takers at the present time, is 16,076, being an increase since December 5th, 1850, of 2,613.

The total number of cases where the water has been shut off during the year 1851, is 1813. Of these, 1029 were for repairs; 784 were for non-payment of water rates.

The whole number of cases where the water has been let on during the year, is 3,540. Of these, 922 were cases which had been previously shut off for repairs; 558 were those which had been shut off for non-payment of water rates, and 2,060 were let on for the first time.

Repairs have been made upon the service-pipes, streets, sidewalks, &c., in 396 instances.

There have been *no abatements* made during the year.

The total amount received from December 31st, 1850, to January 1st, 1852, for water rates, is - - - - - - - -		$161,299.72
Of the above, there was received for water used during the year 1850, the sum of	$353.33	
Leaving the receipts for water used during the year 1851, - -	160,946.39	
Total amount, - - - -		161,299.72

In addition to the above, there has been received, for letting on water, in cases where it had been shut off for non-payment of water rates, - - - - - - - - - - 1,018.00

A detailed statement of the receipts for the year 1851, *is included in this report.*

The amount of assessments already made, for the year 1852, is - - - - - - $156,479.30
This amount during the year, will probably be increased to at least - - - - 175,000.00

The expenditures in my department during the year 1851, have been, - - - - 1,880.12
The items of this expenditure are as follows, viz:

Paid	Wm. F. Davis, for services as clerk, -	631.75
"	Chas. L. Bancroft, " " " - -	557.75
"	John H. Eastburn, for printing - -	209.34
"	Samuel Huse, for work on meters, &c., -	185.13
"	Eayrs & Fairbanks, books and stationery,	100.62
"	George W. Hunkins, distributing bills, -	36.00
"	Francis A. Bacon, " " -	36.00
"	John H. Colby, " " -	24.00
"	Edwin Fish, " " -	16.25
"	Wm. B. Rowland, for services, - -	28.00
"	J. A. Richards, for travelling expenses, -	21.00
"	Healey & Spaulding, for horse hire, -	20.00
"	Stephen Smith, for desks for office, -	10.00
"	Stephen Maddox, for washing towels, -	3.28
"	Tyler & Blanchard, for advertising in East Boston Ledger, - - - - -	1.00
	Amount, - - - -	$1,880.12

By the purchase of the Jamaica Pond Aqueduct in April last, the City secured 35 water takers in Roxbury, exclusive of those given in the foregoing statements. About this time the main pipe of this Aqueduct burst near the Roxbury line, and has not since been repaired. This circumstance, has increased the number of Cochituate Water takers in the City, about 500. These are included in the 2613, above enumerated.

Statement showing the number of Houses, Stores, Steam Engines, &c., in the City of Boston, supplied with Cochituate Water to the first of January, 1852, *with the amount of Water Rates paid for* 1851.

990	Dwelling Houses,	$5.00	$4,950.00	
1448	" "	6.00	8,688.00	
1476	" "	7.00	10,332.00	
1455	" "	8.00	11,640.00	
1528	" "	9.00	13,752.00	
1231	" "	10.00	12,310.00	
784	" "	11.00	8,624.00	
507	" "	12.00	6,084.00	
302	" "	13.00	3,926.00	
243	" "	14.00	3,402.00	
91	" "	15.00	1,365.00	
100	" "	16.00	1,600.00	
77	" "	17.00	1,309.00	
64	" "	18.00	1,152.00	
54	" "	19.00	1,026.00	
38	" "	20.00	760.00	
31	" "	21.00	651.00	
39	" "	22.00	858.00	
1	" "	22.50	22.50	
19	" "	23.00	437.00	
34	" "	24.00	816.00	
170	" "	25.00	4,250.00	
1	" "	25.50	25.50	
1	" "	30.00	30.00	
1	" "	75.00	75.00	
1658	" "		7,982.30	
12,343				106,067.30
1430	Stores,	5.00	7,150.00	
4	"	6.00	24.00	
165	"	8.00	1,320.00	
2	"	9.00	18.00	
5	"	10.00	50.00	
1	"	12.00	12.00	
1	"	13.00	13.00	
1608	Amounts carried forward,		8,587.00	106,067.30

1608	Amounts brought forward,		$8,587.00	106,067.30
4	Stores,	15.00	60.00	
177	"		671.45	
1,789				9,318.45
294	Shops,	5.00	1,470.00	
2	"	6.00	12.00	
2	"	700	14.00	
34	"	800	272.00	
8	"	10.00	80.00	
5	"	15.00	75.00	
1	"	11.00	11.00	
80	"		230.98	
426				2,164.98
61	Offices,	5.00	305.00	
3	"	6,00	18.00	
8	"	8.00	64.00	
4	"	10.00	40.00	
2	"	13.00	26.00	
9	"		22.50	
87				475.50
1	Building,	20.00	20.00	
4	"	25.00	100.00	
2	"	30.00	60.00	
4	"	40.00	160.00	
1	"	50.00	50.00	
12				390.00
1	Bank,	1.33	1.33	
6	"	5.00	30.00	
3	"	8.00	24.00	
1	"	15.00	15.00	
2	"	25.00	50.00	
13				120.33
58	Market Stalls,	5.00	290.00	
1	" "	8.00	8.00	
59	Amounts carried forward,		298.00	118,536.56

59	Amounts brought forward,		$298.00	118,536.56
5	Market,	10.00	50.00	
1	"	75.00	75.00	
1	Packing House,	8.00	8.00	
66				431.00
31	Cellars,	5.00	155.00	
1	"	6.00	6.00	
6	"	8.00	48.00	
5	"		19.24	
43				228.24
1	Hotel,	338.50	338.50	
1	"	330.46	330.46	
1	"	351.00	351.00	
1	"	192.00	192.00	
1	"	187.50	187.50	
1	"	163.50	163.50	
1	"	162.00	162.00	
1	"	151.50	151.50	
1	"	139.50	139.50	
1	"	138.00	138.00	
1	"	135.00	135.00	
1	"	127.50	127,50	
1	"	123.00	123.00	
1	"	120.00	120.00	
1	"	97.50	97.50	
1	"	90.00	90.00	
1	"	85.50	85.50	
1	"	79.50	79.50	
1	"	78.00	78.00	
2	"	73.50	147.00	
2	"	72.00	144.00	
1	"	69.00	69.00	
1	"	67.50	67.50	
2	"	66.00	132.00	
1	"	64.50	64.50	
1	"	61.50	61.50	
4	"	60.00	240.00	
1	"	58.50	58.50	
1	"	52.00	52.00	
1	"	42.00	42.00	
36	Amounts carried forward,		4,167.96	119,195.80

36	Amounts brought forward,	$4,167.96	119,195.80	
1	Hotel,	39.00	39.00	
1	"	37.50	37.50	
2	"	33,00	66.00	
1	"	31.50	31.50	
2	"	30.00	60.00	
1	"	27.00	27.00	
1	"	25.50	25.50	
4	"	25.00	100.00	
1	"	24.00	24.00	
3	"	21.00	63.00	
3	"	18.00	54.00	
3	"	15.00	45.00	
1	"	13.00	13.00	
4	"	12.00	48.00	
64				4,801.46
1	Restorator,	40.00	40,00	
1	"	24.00	24.00	
12	"	15.00	180.00	
1	"	13.00	13.00	
5	"	12.00	60.00	
8	"	10.00	80.00	
58	"	8.00	464.00	
1	"	6.00	6.00	
2	"	5.00	10.00	
9	"		43.83	
98				920.83
1	Saloon,	30.00	30.00	
1	"	20.00	20.00	
1	"	18.00	18.00	
3	"	15.00	45.00	
1	"	12.00	12.00	
10	"	10.00	100.00	
66	"	8.00	528.00	
2	"	6.00	12.00	
3	"	5.00	15.00	
13	"		26.00	
101				806.00
	Amount carried forward,			125,724.09

	Amount brought forward,			$125,724.09
1	Custom House,	150.00	150.00	
1	Mass. Gen. Hospital,	125.00	125.00	
2				275.00
1	Institution for Blind,	35.00	35.00	
1	Medical College,	30.00	30.00	
1	State House,	20.00	20.00	
1	Asylum,	30.00	30.00	
1	"	25.00	25.00	
1	"	15.00	15.00	
1	Eye and Ear Infirmary,	20.00	20.00	
1	Nat. Hist. Soc. Rooms,	10.00	10.00	
8				185.00
13	Churches,	5.00	65.00	
2	"	20.00	40.00	
4	Halls,	5.00	20.00	
2	"	15.00	30.00	
3	Schools,	5.00	15.00	
24				170.00
1	Theatre,	10.00	10.00	
1	"	18.00	18.00	
1	Gymnasium,	15.00	15.00	
1	Museum,	12.00	12.00	
1	Tremont Temple,	20.00	20.00	
1	Masonic Temple	5.00	5.00	
6				80.00
1	Stable,	160.00	160.00	
1	"	144.00	144,00	
1	"	118.00	118.00	
1	"	114.00	114.00	
1	"	110.00	110.00	
3	"	100.00	300.00	
1	"	96.00	96.00	
9	Amounts carried forward,		1,042.00	126,434.09

9	Amounts brought forward,		$1,042.00	126,434.09
1	Stable,	90.00	90.00	
1	"	86.00	86.00	
1	"	84.00	84.00	
2	"	72.00	144.00	
4	"	70.00	280.00	
1	"	68.00	68.00	
1	"	61.67	61,67	
3	"	60.00	180.00	
2	"	56.00	112.00	
3	"	50.00	150.00	
4	"	48.00	192.00	
1	"	46.67	46.67	
1	"	46.00	46.00	
1	"	45.00	45.00	
2	"	44.00	88.00	
1	"	41.00	41.00	
6	"	40.00	240.00	
5	"	36.00	180.00	
1	"	35.50	35.50	
1	"	33.00	33.00	
1	"	32.00	32.00	
4	"	30.00	120.00	
1	"	29.00	29.00	
2	"	28.00	56.00	
1	"	27.50	27.50	
1	"	26.00	26.00	
1	"	25.00	25.00	
1	"	24.25	24.25	
1	"	24.00	24.00	
1	"	23.34	23.34	
2	"	22.50	45.00	
1	"	21.25	21.25	
6	"	20.00	120.00	
1	"	19.79	19.79	
1	"	18.75	18.75	
6	"	18.00	108.00	
2	"	17.50	35.00	
1	"	16.75	16.75	
1	"	16.25	16.25	
1	"	16.04	16.04	
87	Amounts carried forward,		4,048.76	126,434.09

87	Amounts brought forward,		$4,048.76	126,434.09
1	Stable,	16.00	16.00	
6	"	15.00	90.00	
1	"	14.06	14.06	
2	"	14.00	28.00	
9	"	13.75	123.75	
8	"	12.50	100.00	
2	"	12.00	24.00	
1	"	11.72	11.72	
1	"	11.33	11.33	
8	"	11.25	90.00	
1	"	11.12	11.12	
1	"	11.00	11.00	
1	"	10.50	10.50	
21	"	10.00	210.00	
1	"	9.82	9.82	
1	"	9.00	9.00	
10	"	8.75	87.50	
1	"	8.12	8.12	
9	"	8.00	72.00	
18	"	7.50	135.00	
1	"	6.88	6.88	
1	"	6.57	6.57	
26	"	6.25	162.50	
8	"	6.00	48.00	
1	"	5.75	5.75	
1	"	5.62	5.62	
3	"	5.50	16.50	
34	"	5.00	170.00	
133	"		361.59	
398				5,905.09
1	Shop and Engine,	339.72	339.72	
1	" "	209.04	209.04	
1	" "	195.78	195.78	
1	" "	183.60	183.60	
1	" "	153.30	153.30	
1	" "	140.70	140.70	
1	" "	129.48	129.48	
1	" "	121.88	121.88	
8	Amounts carried forward,		1,473.50	132,339.18

8	Amounts brought forward,		$1,473.50	132,339.18
1	Shop and Engine,	120·00	120.00	
1	" "	114.00	114.00	
1	" "	113.52	113.52	
1	" "	111,29	111.29	
1	" "	109.00	109.00	
1	" "	108.00	108.00	
1	" "	107.76	107.76	
1	" "	99.60	99.60	
1	" "	97.40	97.40	
1	" "	96.48	96.48	
1	" "	89.10	89.10	
1	" "	86·40	86.40	
1	" "	83.24	83.24	
1	" "	80.00	80.00	
1	" "	78.00	78.00	
1	" "	75.00	75.00	
1	" "	73.62	73.62	
1	" "	73.00	73.00	
1	" "	68.22	68.22	
1	" "	64.76	64.76	
1	" "	61.50	61.50	
1	" "	61.08	61.08	
1	" "	60.00	60.00	
1	" "	55.00	55.00	
1	" "	54.54	54.54	
1	" "	54.24	54.24	
1	" "	52.62	52.62	
1	" "	51.90	51.90	
1	" "	49.80	49.80	
2	" "	48.00	96.00	
1	" "	46.62	46.62	
1	" "	45.00	45.00	
1	" "	41.92	41.92	
1	" "	40.50	40.50	
1	" "	40.00	40.00	
1	" "	38.00	38.00	
1	" "	37.65	37.65	
1	" "	36.00	36.00	
1	" "	32.64	32.64	
1	" "	31.80	31.80	
49	Amounts carried forward		4,308.70	132,339.18

49	Amounts brought forward,	$4,308.70	132,339.18	
1	Shop and Engine,	30.74	30.74	
2	" "	30.00	60.00	
1	" "	26.20	26.20	
1	" "	25.95	25.95	
1	" "	25.71	25.71	
1	" "	25.00	25.00	
3	" "	24.00	72.00	
1	" "	22.84	22.84	
1	" "	22.68	22.68	
1	" "	22.26	22.26	
1	" "	21.00	21.00	
1	" "	18.86	18.86	
1	" "	20.00	20.00	
1	" "	18.28	18.28	
1	" "	18.00	18.00	
1	" "	17.70	17.70	
1	" "	15.00	15.00	
1	" "	14.67	14.67	
1	" "	14.24	14.24	
1	" "	13.32	13.32	
1	" "	13.16	13.16	
1	" "	13.15	13.15	
1	" "	10.56	10.56	
1	" "	10.53	10.53	
1	" "	9.75	9.75	
1	" "	9.15	9.15	
1	" "	7.76	7.76	
1	" "	7.65	7.65	
1	" "	7.08	7.08	
81				4,901.94
1	Fac'y and Engine,	1,587.60	1,587.60	
1	" "	1,145,85	1,145.85	
1	" "	512.55	512.55	
1	" "	174.66	174.66	
1	" "	126.00	126.00	
1	" "	78.00	78.00	
1	" "	69.84	69.84	
1	" "	51.42	51.42	
8	Amounts carried forward,		3,745.92	137,241.12

8	Amounts brought forward,		$3,745.92	137,241.12
1	Fac'y and Engine,	37.50	37.50	
9				3,783.42
1	Foun'y and Engine,	461.74	461.74	
1	" "	107.40	107.40	
1	" "	94.32	94.32	
1	" "	65.28	65.28	
4				728.74
1	Factory,	172.33	172.33	
2	"	30.00	60.00	
2	"	22.50	45.00	
1	"	18.00	18.00	
6	"	15.00	90.00	
1	"	12.50	12.50	
2	"	12.00	24.00	
3	"	10.00	30.00	
5	"	8.00	40.00	
1	"	7.50	7.50	
1	"	6.70	6.70	
1	"	5.00	5.00	
1	"	4.00	4.00	
27				515.03
1	Sugar Refinery,	1,542.36	1,542.36	
1	" "	824.88	824.88	
2				2,367.24
1	Bathing House,	135.00	135.00	
1	" "	55.00	55.00	
2	" "	50.00	100.00	
1	" "	40.00	40.00	
1	" "	35.00	35.00	
2	" "	15.00	30.00	
8				395.00
	Amount carried forward,			145,030.55

	Amount brought forward,			$145,030.55
1	Printing Office,	24.00	24.00	
4	" "	12.00	48.00	
2	" "	10.00	20.00	
1	" "	9.00	9.00	
6	" "	8.00	48.00	
1	" "	7.50	7.50	
13	" "	6.00	78.00	
1	" "	3.75	3.75	
29				238.25
1	Distillery,	250.00	250.00	
1	"	191.36	191.36	
1	"	110.00	110.00	
1	"	90.00	90.00	
1	"	60.00	60.00	
1	Brewery,	45.00	45.00	
1	"	25.00	25.00	
7	"	15.00	105.00	
1	"	6.25	6.25	
15				882.61
2	Bleacheries,	10.00	20.00	
4	"	8.00	32.00	
1	"	5.00	5.00	
1	Dye House,	60.00	60.00	
1	Laboratory,	7.50	7.50	
9				124.50
1	Laundry,	30.00	30.00	
1	"	15.00	15.00	
2				45.00
1	Cooperage,	25.80		25.80
1	Bakery,	15.00	15.00	
2	"	10.00	20.00	
2	"	8.00	16.00	
1	"	7.50	7.50	
6	Amounts carried forward,		58.50	146,346,71

6	Amounts brought forward,		$ 58.50	146,346.71
30	Bakery,	5.00	150.00	
36				208.50
1	Ship Yard,	15.00	15.00	
1	" "	13.75	13.75	
1	" "	12.50	12.50	
1	" "	11.25	11.25	
1	" "	7.50	7.50	
5				60.00
1034	Hose,	3.00	3,102.00	
1	"	9.00	9.00	
1	"	10.00	10.00	
1036				3,121.00
1	Fountain,	25.00	25.00	
2	"	15.00	30.00	
1	"	12.45	12.45	
3	"	12.00	36.00	
2	"	9.00	18.00	
1	"	8.00	8.00	
8	"	6.00	48.00	
1	"	3.00	3.00	
19				180.45
1	Rail Road Co.	1,286.42	1,286.42	
1	" " "	1,005.00	1,005.00	
1	" " "	864.42	864.42	
1	" " "	585.00	585.00	
1	" " "	583.80	583.80	
1	" " "	408.25	408.25	
1	" " "	155.22	155.22	
1	Freight House,	15.00	15.00	
8				4,903.11
1	E. Boston Ferry Co.	509.04	509.04	
	Amounts carried forward,		509.04	154,819.77

1	Amounts brought forward,		$509.04	154,819.77
1	Chelsea Ferry,	347.64	347.64	
1	Steamboat,	160.00	160.00	
1	"	110.00	110.00	
1	"	92.00	92.00	
1	"	90.00	90.00	
1	"	80.00	80.00	
1	"	76.00	76.00	
1	"	72.00	72.00	
1	"	68.00	68.00	
1	"	33.34	33.34	
1	"	32.00	32.00	
1	"	20.00	20.00	
13				1,690.02
	Contractors for supplying shipping,	1,844.37		1,844.37
1	Rolling Mill,	1,015.20		1,015.20
	Prop's Bost. Trav.	546.79		546.79
	Street Waterers,	380.00		380.00
	Bost. Gas Light Co.	300.00		300.00
	Watering Ships, &c.	192.25		192.25
	Build'g Purposes,	157.99		157.99
	Amount of Water Rates,			$160,946.39

Which is respectfully submitted,

J. AVERY RICHARDS,

Water Registrar.

E.

Statement of all Expenditures made by the Cochituate Water Board, from January 1st, 1851, to January 1st, 1852.

Blacksmith Shop, for Stock, &c., -	$191.85
Plumbing " " " " -	77.36
Proving Yard, " " " -	303.68
Carting, Boston, - - - - -	566.46
" S. Boston, - - -	135.36
" E. " - - -	128.80
Wagon hire, for Superintendent, -	690.75
Travelling Expenses, - - -	620.12
Salaries and Wages, - - -	8,844.61
Office Expenses, for rent, furniture, &c.,	1,869.93
Postages, - - - - -	24.19
Expresses, - - - - -	23.07
Stationery, - - - - -	143.91
Printing, - - - - -	470.47
Advertising, - - - - -	78.70
Recording Deeds, &c., - - -	23.12
Miscellaneous Expenses, - -	517.69
Taxes, - - - - - -	1,737.62
Fuel, - - - - - -	17.37
Lanterns, - - - - -	25.72
Oil and Wicking, - - - -	82.01
Tools, - - - - - -	229.89
Fountains, - - - - -	528.35
Beacon Hill Reservoir, - - -	2,055.77
South Boston " - - -	289.80
East " " - - -	2,045.23
Brookline " - - -	5,995.37
Brick Aqueduct Repairs, - -	1,045.91
Lake Cochituate, - - - -	294.08
Tolls and Ferriages, - - -	140.80
Service Pipe, - - - -	31.16
" " Boston, - - -	3,341.48
Amount carried forward,	$32,570.63

Amount brought forward,		$32,570.63
Service Pipe, S. Boston, - -	1,179.75	
" " E. " - - -	1,183.34	
Water Pipes, - - - -	2,499.94	
" " Boston, - - -	1,925.25	
" " S. " - - -	2,121.28	
" " E. " - - -	732.15	
Hydrants, - - - - -	2,117.88	
Hydrant Boxes, - - - -	30.32	
" " Boston, - -	17.81	
" " S. " - -	16.35	
" " E. " - -	24.07	
Stop Cocks, - - - -	1,668.14	
" " Boston, - -	242.22	
" E. " - -	7.00	
" Cock Boxes, - - -	136.33	
" " " Boston, - -	11.72	
" " South " - -	3.98	
Laying Water Pipes, Boston, -	275.47	
" " " S. " -	6.25	
" Service " " - -	3.50	
Packing, - - - - -	36.14	
Water Meters - - - -	404.56	
Union Stop Cocks, - - -	85 00	
Air Cocks, - - - -	81.00	
Engine Hose, - - - -	158.40	
Repairing Streets, Boston, - -	139.36	
" " S. " - -	5.33	
" " E. " - -	14.00	
" Water Pipes, - -	107.34	
" Stop Cocks, - -	100.37	
" " Cock Boxes, -	116.19	
" Hydrants, - -	142.13	
" Hydrant Boxes, - -	122.12	
Engine, Boilers, &c., - - -	98.81	
Marlboro' Reservoir, - - -	388.06	
Whitehall " - - -	137.39	
Rents, - - - - - -	246.45	
Mason Work, - - - -	16.00	
Covering Water Pipes, E. Boston, -	4,015.49	
Land Damages, - - - -	7,876.04	
Land and Water Rights, - -	17,442.75	45,935.68
Amounts carried forward,		$78,506.31

Amount brought forward,		$78,506.31
Water Works, W. Division, - -	945.00	
Water Works, E. Boston, - -	3,421.88	
" " Boston, - -	761.10	
Damages, Boston, - - -	1,339.33	
" E. " - - - -	810.00	
Jamaica Pond Aqueduct, - -	45,237.50	
Sam'l Holbrook, (to pay small bills,)	300.00	
Cash paid to City Treasurer, -	172.30	52,987.11
		131,493.42

Amount paid for Labor, viz :—

Letting on and shut'g off Water, Boston,	1,769.06	
" " " " " " E. "	214.98	
Blowing off Hydrants, Boston, -	733.00	
" " " E. " -	20.87	
Laying Water Pipes, " -	617.00	
" " " S. " -	814.43	
" " " E. " -	322.10	
" Service " " -	2,074.91	
" " " S. " -	546.74	
" " " E. " -	866.87	
Blacksmith Shop, - - -	723.14	
Plumbing, " - - - -	508.74	
Proving Yard, - - - -	1,546.14	
Repairing Streets, Boston, - -	184.94	
" " E. " - -	59.12	
" Water Pipes, - -	348.43	
" Service " - - -	711,73	
" Hydrants, - - -	429.09	
" Hydrant Boxes, - -	1.75	
" Stop Cocks, - -	240.87	
" Stop Cock Boxes, - -	15.75	
Miscellaneous, - - - -	123.00	
Watchmen, - - - - -	76.00	
Hydrants, Boston, - - - -	149.75	
" E. " - - - -	108.67	
Blowing off Water Pipes, - -	85.00	
Stop Cocks, - - - - -	29.37	13,321.45
		$144,814.87

Amount brought forward,		$144,814.87
Cr.		
Marlboro' Reservoir, Rent of Mill, -	150.00	
Whitehall, " " " Buildings,	151.79	
Rents of house, pasture, &c., in Wayland,	249.33	
" " houses, land, &c., in Saxonville,	147.94	
Land and Water Rights, for stone & bricks,	30.00	
Old Materials sold, - - -	2,776.58	3,505.64
Amount drawn for on City Treasurer,		$141,309.23

Cash paid City Treasurer, viz:

For an old shed and lead pipe, -	50.00	
" 6 Carts and 12 bodies, - -	400.00	
" Iron Service pipes, - -	2,000.00	
" Rent of house, land, &c., -	181.80	
" Iron Service pipes, and old rope,	714.04	
" An old building at Saxonville, and Water tank at E. Boston, -	230.00	
" Water Cistern, an old building and rent of a water privilege at Saxonville, and for sundry other articles, - - -	218.16	3,794.00
		$137,515.23

Statement of Payments made by the Cochituate Water Board, for completing work left unfinished in 1850*; for unsettled claims for land and other damages, and for Jamaica Pond Aqueduct.*

Taxes, for 1850, - - -	303.86	
Covering Water Pipes, at E. Boston,	4,015.49	
		4,319.35
Land Damages, viz:		
John Jennings, Execution, -	3,779.42	
John W. Harbach, - - -	1,039.67	
Aaron D. Weld, - - -	2,578.05	
T. W. Slack, - - - -	125.00	
Samuel Chandler, Sheriff, costs,	16.00	
James Brown, - - -	100.00	
		$7,638.14
Amount carried forward,		$11,957.49

Amount brought forward,			$11,957.49
Land and Water Rights, viz:			
Charlotte Harbach and others, -		9,520.81	
Doct. E. Morse, - - -		455.47	
Edward Bradbury, - - -		749.00	
Francis Skinner, - . -		6,500.00	
Samuel Chandler, Sheriff, costs,		35.45	
Henry Richardson, for costs, -		61.70	
			$17,322.43
Water Works, W. Division,			
Two Executions, for bricks, &c.,		905.00	
Water Works, Boston,			
John Dorr and others, damages,		200.00	
Jamaica Pond Aqueduct, -		45,217.50	
Damages, Water Works, E. Boston,			
Paid J. D. Turner, for damages,		800.00	
Water Works, East Boston,			
T. M. Cutter's bill of nails, cordage, &c., - - - - -		118.78	
C. Wooley's bill, for filling over pipes, - - - - -		543.46	
B. Bixby & Co.'s bill, for finishing work over Chelsea creek,		2,186.79	
S. Borden, the State Commissioner,		250.00	
Damages, Boston,			
B. Bradley, for damages, - -		271.80	
" Costs, - -		21.86	
Stephen M. Allen, for damages,		500.00	
Sundry persons in Brookline, for damages in 1848, - -		457.34	
Beacon Hill Reservoir,			
For Lantern,	1,463.00		
" Painting, &c.,	47.62		
" Iron Door,	40.40		
" Stone Work,	170.98	1,722.00	
Marlboro' Reservoir,			
Land of A. Maynard,	180.06		
" " W. Cox,	150.00	330.06	
			53,524.59
			$82,804.51

Statement of the whole Expenditures of the Water Commissioners and the Water Boards of 1850 *and* 1851, *to Jan.* 1, 1852.

Lake Cochituate,	100,000.00
Factories, &c., on the outlet,	50,000.00
Lake roads, bridges, swamps, &c.	38,332.48
Cochituate Dam, at the outlet,	8,458.20
" Gate House,	29,907.12
Bridges, Culverts and Waste Weirs on the line of Aqueduct,	74,499.54
Newton Tunnel, (2,410½ feet long,)	102,297.36
Brookline " (1,150 " ")	47,378.26
Construction of Brick Aqueduct,	817,717.73
Land and land damages,	212,679.79
Brookline Gate House,	33,356.36
" Reservoir, (including land,)	164,120.85
B. Hill " "	509,610.21
S. Boston, " "	90,908.10
E. " " "	65,368.14
Hopkinton " (Compensating,)	29,534.36
Marlboro' " "	39,169.05
Boon and Ram's Horn Pond Reservoir, (compensating,)	4,001.54
Engineering expenses on Western Division,	67,570.56
" " " Eastern "	30,303.02
Water Commissioners' salaries,	38,500.00
Office expenses, including Clerk hire, to Jan. 5, 1850,	10,480.22
Distribution, repairs, &c.,	1,884,512.92
Miscellaneous expenses,	11,492.73
Travelling expenses, since Jan. 4, 1850,	1,796.10
Salaries, " " "	27,007.10
Office expenses, rent, furniture, &c. since Jan. 4, 1850,	2,443.86
Stationery,	236.88
Printing,	822.63
Taxes,	3,613.11
Brick Aqueduct, repairs,	3,854.42
Damages, other than land,	6,081.19
Jamaica Pond Aqueduct,	45,237.50
	$4,551,191.33

Statement of the Expenditures and Receipts on account of the Water Works, to Jan'y 1st, 1852.

The whole amount drawn for by the Commissioners, - - - -		4,043,718.21
The whole amount drawn for by the Water Board of 1850, - -		366,163.89
The whole amount drawn for by the Water Board of 1851, - -		141,309.23
		$4,551,191.33
Amount paid into City Treasury, by the Commissioners, - -	47,648.38	
Amount paid into City Treasury, by the Water Board of 1850, -	8,153.52	
Amount paid into City Treasury, by the Water Board of 1851, (*including* $1,438.38, *received by the service clerk, for sundries, and paid into the City Treasury*), - - - - -	5,232.38	61,034.28
		$4,490,157.05
Sundry payments made by the City, - - - - -	28,813.64	
Discount and interest on loans, -	999,805.64	1,028,619.28
		5,518,776.33
Sundry credits by the City, -	549.11	
Amount received for Water rents &c., - - - - -	332,516.09	333,065.20
Making the whole cost of the Water Works to Jan. 1, 1852,		$5,185,711.13

SAMUEL HOLBROOK,
Clerk Cochituate Water Board.

TABLE OF DISTANCES AND LEVELS.

Distances.

From the Gate House at the Lake to the Waste Weir at Dedman's Brook—Sec. 3, -	15,870	feet,
Thence to the Waste Weir, in Sec. 6, -	19,011	"
Thence, to the Pipe Chamber, West side of Charles River, - - - - - -	6,306	"
Thence, across Charles River, to East Pipe-Chamber, - - - - - -	956	"
Thence, to the Waste Weir, in Sec. 10, -	15,025	"
Thence, through Newton Tunnel, 2410 feet, to the Ventilator, - - - - -	7,308	"
Thence, to the Waste Weir, in Sec. 13, -	8,650	"
Thence, through Brookline Tunnel, 1150 feet, to Brookline Reservoir, - - -	4,103	"
Thence, to the Gate House, at the East end of the Reservoir, - - - - -	2,000	"
Thence, to Dover Street, - - -	19,625	"
Thence, to the Fountain on the Common,	4,073	"
Thence, to Beacon Hill Reservoir, -	1,200	"
Thence, to East Boston Reservoir, -	20,129	"
From Dover Street to South Boston Reservoir,	8,570	"

From the Lake to E. end of Brookline Reservoir,	15.005	miles.
From Brookline Reservoir, to Fountain on the Common, - - - - - -	4.488	"
From Brookline Reservoir, to Beacon Hill Reservoir, - - - - - - -	5.094	"
From Brookline Reservoir to East Boston Reservoir, - - - - - - -	8.528	"
From Brookline Reservoir, to South Boston Reservoir, - - - - - -	5.350	"
From Hopkinton Reservoir, along *Sudbury River*, to the outlet of the Lake, about	18	"
Thence, to the junction of *Sudbury River* with the *Assabet*, about - - - -	14	"
From Marlboro' Reservoir, along the *Assabet*, to its junction with the *Sudbury*, about	14	"
Thence, along *Concord River*, to the Mills, at Billerica, - - - - - -	10	"
Thence to the *Merrimack at Lowell*, -	4½	mls.

Heights of important points above Tide Marsh Level.

Floor of Knight's Flume, - - -	124.36	feet.
Low Water Mark, Lake Cochituate, - -	124.86	"
High " " " " - -	132.36	"
Bottom of interior of Aqueduct, at Lake Cochituate, - - - - - - -	121.03	"
Bottom of interior of Aqueduct at West Pipe Chamber, - - - - - - -	118.97	"
Bottom of interior of Aqueduct at East Pipe Chamber, - - - - - - -	118.52	"
Bottom of interior of Aqueduct at Brookline Reservoir, - - - - - -	116.77	"
Bottom Brookline Reservoir, - - -	100.60	"
Upper floor of Brookline Gate House, -	126.76	"
Low Water Mark, Brookline Reservoir, -	120.60	"
Top of Dam of " " - -	126.60	"
Bottom of Beacon Hill Reservoir, - -	108.03	"
Top " " " Coping (outside)	124.03	"
Bottom " " " Waste Weir, -	121.53	"
" South Boston " - - -	105.35	"
Top " " " Dam, - -	125.86	"
Bottom of East Boston " - - -	80.60	"
Top " " " Dam, - -	110.60	"
State House Floor - - - - -	106.94	"
Coping of Charlestown Dry Dock, - -	5.09	"

ERRATA.

Page 8, *line* 5, "496,845," *should be* "496,584."
" 57, " 2, *dele* "*Cochituate.*"
" 64, " 3, *from the bottom*, "1252," *should be* "6,252."

BOSTON WATER WORKS.

PROPOSED

Plan of Distribution

for the

HIGH SERVICE.

Surveyed by order of the

Secretary Thos. Girard

1851.

E.S. CHESBROUGH
City Engineer

SCALE

CHARLES RIVER

WEST BOSTON BRIDGE

EXPLANATION

20 inch pipes are marked thus
16 inch
12 inch
8 inch
6 inch
Stop-cocks are shewn thus
Hydrants

RESERVOIR

MILL DAM

PUBLIC GARDEN

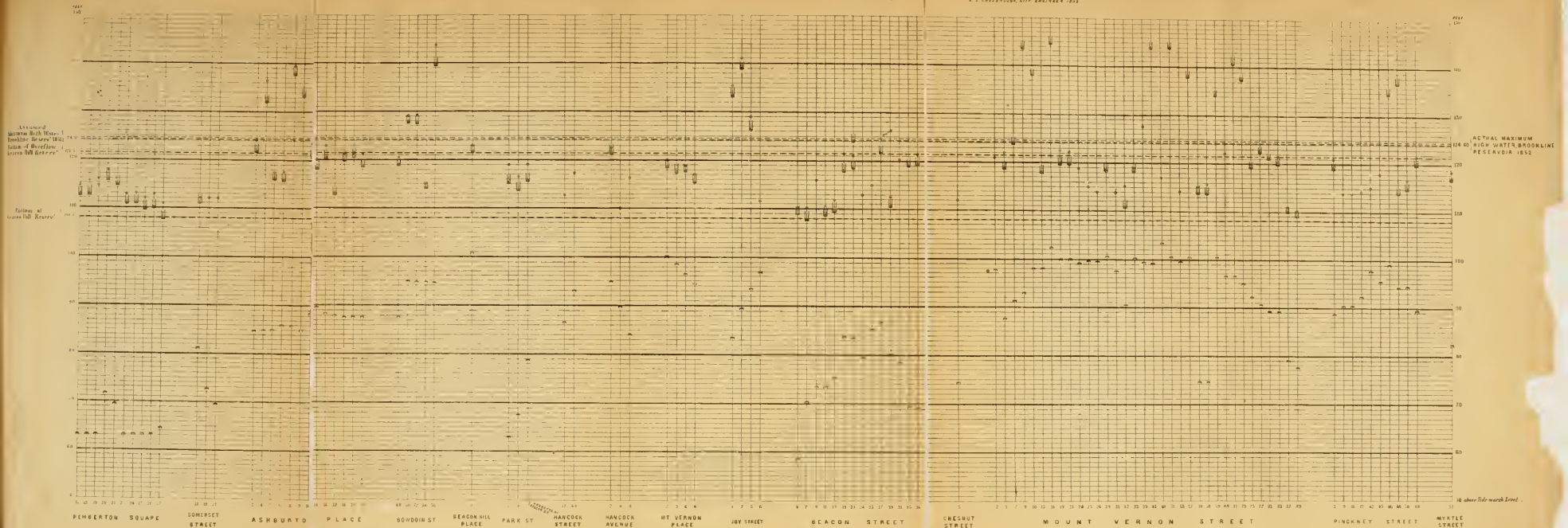
The dotted lines in the Reservoir are intended to illustrate the plan proposed by Jonathan Preston Esq

Elevations of Door Sills,

and Cisterns where Points of Delivery are over 110 feet above Tide Marsh Level.

Door Sills shown thus ⌐, *Cisterns thus* ⊔, *Points of delivery thus* ○.

C. L. Chesbrough, City Engineer, 1852.



Note { *Each perpendicular line represents a house, the number of which and the Street where situated, will be found at the bottom of the Sheet*

Thos. Ritt Charles Perkins

Tappan & Bradford's Lith.

FRAGILE

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