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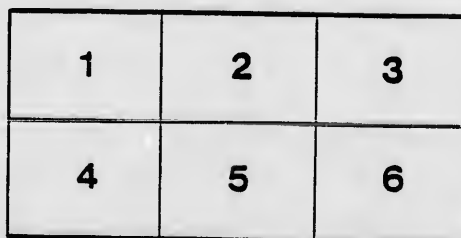
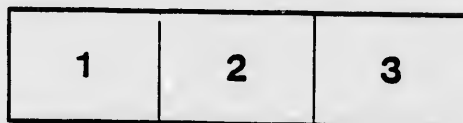
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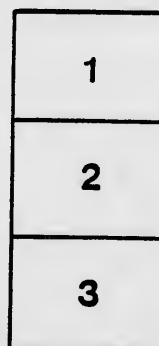
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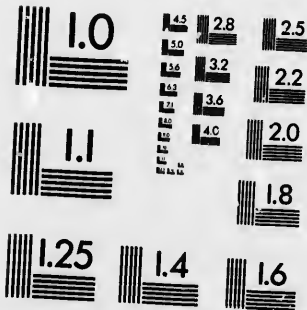
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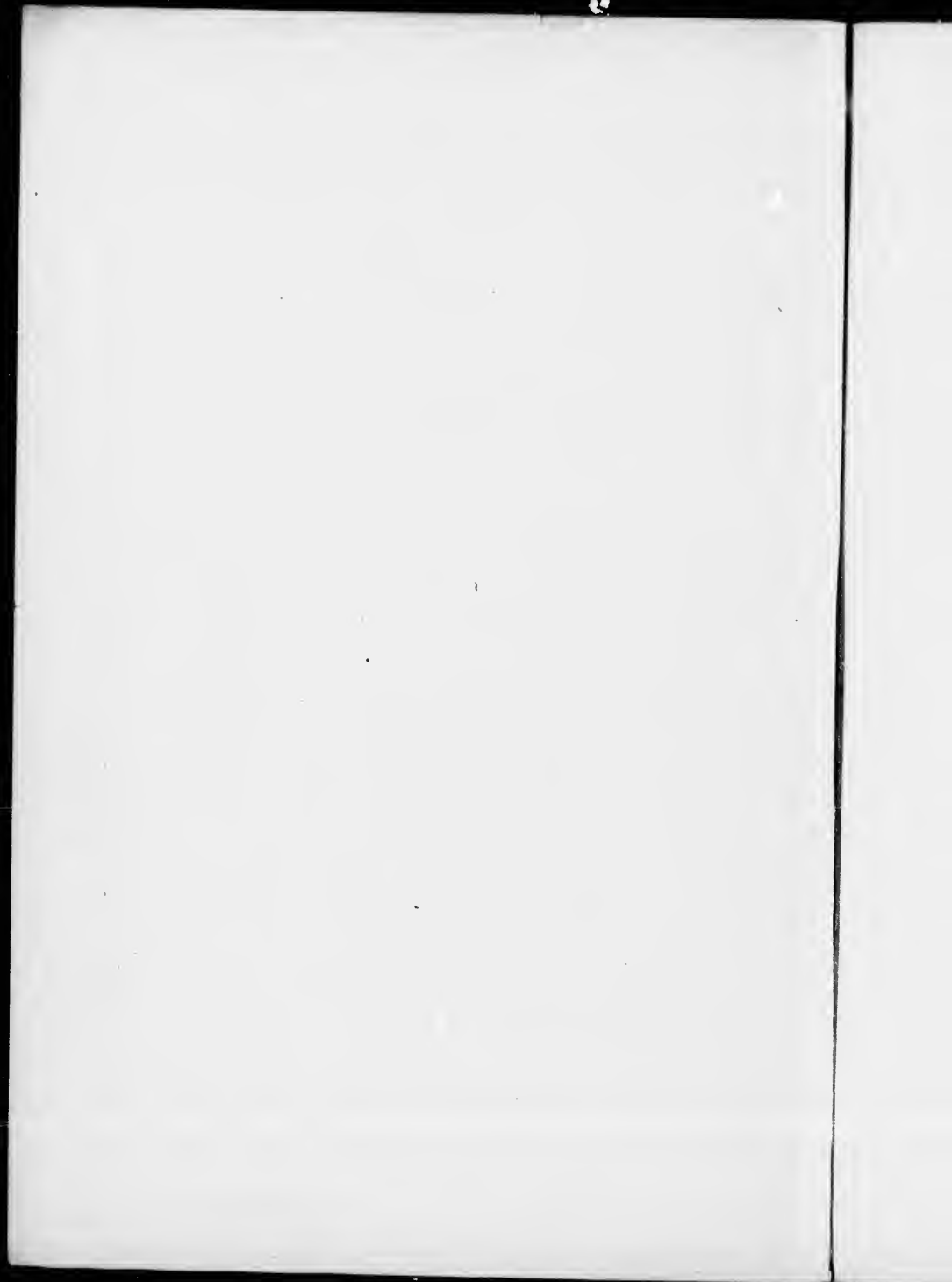
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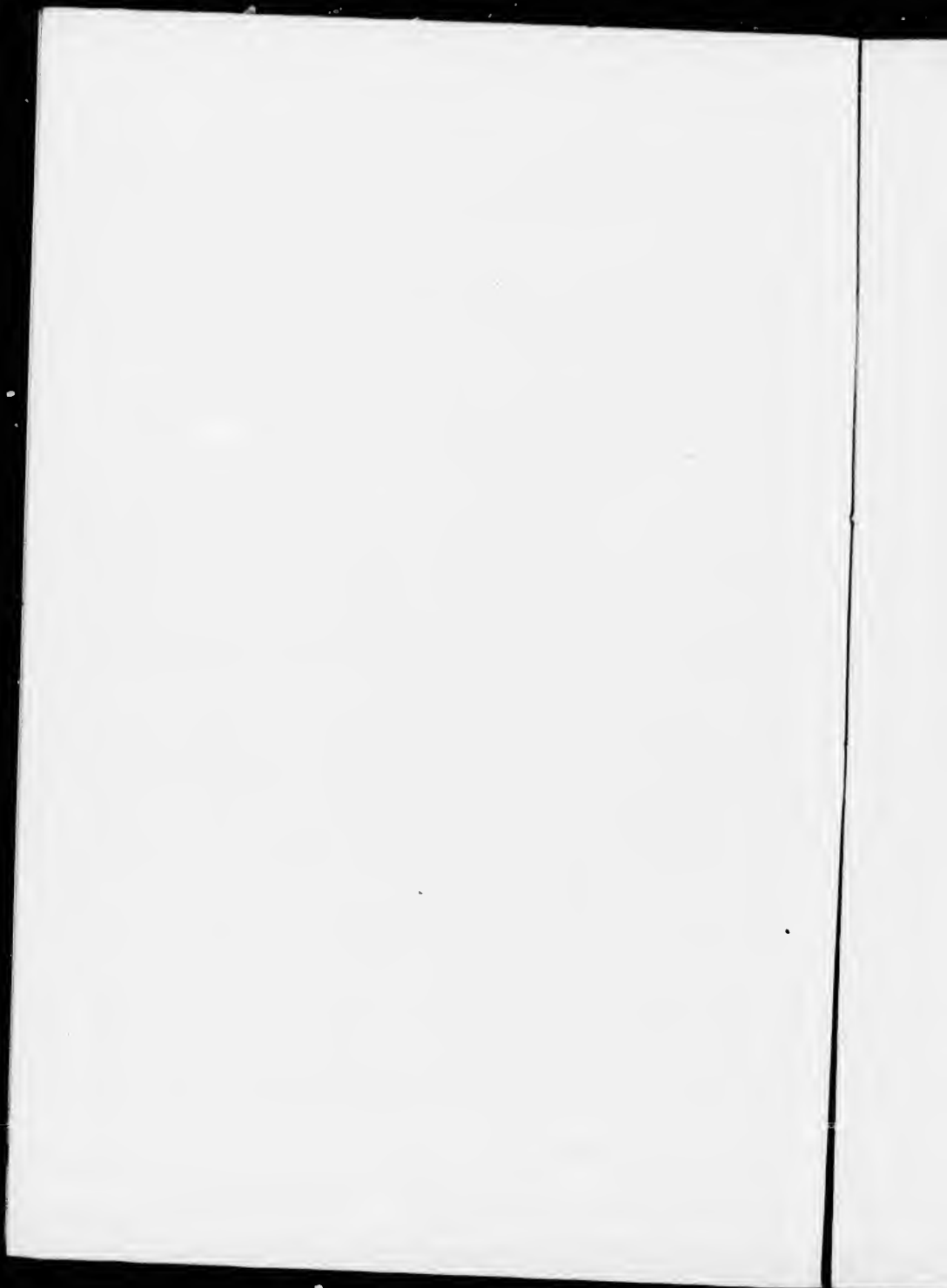
APRIL 1883.

MONTREAL:
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DEC. 1883.







*To his Worship the Mayor and to the Aldermen and Council-
lers of the City of Quebec.*

GENTLEMEN,

In conformity with a letter from His Worship the Mayor, dated October 14th ult., entrusting me with the study of such improvements as were possible to the Quebec Water Works ;

Having taken communication of the reports submitted to the Council by the Engineers who have already studied the question, namely :

Messrs. G. R. BALDWIN in 1848.

T. C. KEEFER in 1860.

G. R. BALDWIN in 1865.

CHARLES BAILLARGÉ in 1881 ;

Having examined the plan of the distribution pipes I had, on the 30th December last, prepared, as a preliminary study, a profile of the supply pipe from Lorette to Pointe au Lièvre on one side, and to the Foulon on the other, but, His Worship having given me to understand, on the 27th Jannary last, that there was a difference between the work as executed and the Baldwin scheme, on which I had based my calculation, I had to request him to let me have a section of the pipe as it was actually laid, which section was forwarded to me at the end of February last, and has slightly modified the conclusion of my study ;

Having in several instances visited the place, and having been present at a fire in Montcalm's ward, where I have been able to ascertain personally what improvements were needed in that branch of the civic service ;

I have the honor to submit you the present report :

I could not find out by what cause nor why the execution of the works had not been made in accordance with the Baldwin scheme.

An important element of it has been suppressed: the reservoir he had proposed on the Côte à Perreault was dispensed with and thereby the success of the whole scheme was compromised. Instead of connecting the main supply pipe with the reservoir, it has been allowed to run without interruption along Grande Allée, into the city and thence, down to Saint Roch and Lowertown, causing all the high points of the city to remain above the hydraulic gradient and, consequently the pressure due to the difference of level has been completely annulled on Grande Allée as well as on Mount Pleasant.

It is therefore absolutely necessary to bring back under the hydraulic grade line all points that are above it, as I have done to the Saint Liguori Water Works, the efficiency of which I restored by the simple application of this hydraulic principle.

According to this principle, no supply pipe should, at any point of its line, rise above the imaginary straight line drawn from one end of the conduit to the other, and which is called hydraulic gradient; should it happen that, at any point whatever, the pipe would rise above that straight line, the water would no longer flow down with the pressure due to the difference of level, but simply run as in an open trough unless, the case having been foreseen, the upper end of the pipe is calculated of a size sufficient to meet the emergency.

At a first sight I thought I had found a cheap way of re-establishing the hydraulic grade; it consisted simply in joining the 18 inch main pipe, now actually in use, with the net-work of distribution of the lower part of the town by laying a 10 or 12 inch pipe all along Arago street, and at the same time, I would have kept up the pression in the upper part of the town by a pipe of smaller bore laid along or in the neighborhood of the stairs leading from Champlain street to Cove field, at the foot of Cape Diamant.

The cost of this would not have exceeded a few hundred dollars, but on the one side, the pression in the lower part of the town would have been excessive, and on the other side, the quantity of water supplied by this 18 inch pipe would not have been sufficient for the actual wants of the city, so that the upper part would have been deprived of water during part of the day, while in the lower part, the water would not only have run to waste, but it would even have become a source of danger.

Consequently I had to abandon that idea in order to adopt another one which considerably modifies the actual system.

I should like to save the whole of the supply and prevent the loss of water either by leakages of pipes or wasting by individuals.

Besides that, I would try to avoid the loss of pressure caused by the friction in pipes of small bore which are by far too long.

Therefore, this is what I have the honour to suggest:

CHAPTER I.

WATER SUPPLY.

The laying of a second supply pipe running all along the old one, at a distance of about 4 or 5 feet, and with which it will connect at particular points. This pipe laid double under the St. Charles River would reach the foot of the rock, at the corner of Aqueduet and St. Michel streets where it would divide in two branches described below.

I would also suggest the double branch passage under the River for the present pipe, so as to provide for its repairs in case of accidents to one of the conduits without interrupting the supply.

A 26 inch pipe coming from Lorette could give, at the point of which I have spoken, about 15,000,000 gallons in 24 hours, or an average of about 300 gallons per individual, but as no such pipe is on the market, and as it would be necessary to get them cast to order, which would increase their price and delay the delivery, as besides, the super-abundance of water cannot but be advantageous for the city, without entailing a much greater outlay, I should recommend that this second pipe be 30 inches in diameter, and it would bring to the aforesaid point about 23,000,000 gallons in 24 hours.

From this point, the pipe would divide into two branches, one of which would go directly to Mount Plaisant, from where it would supply all the upper part of the town, while the other laid along Arago street, Abraham hill, St. Georges and St. Eustache streets would supply a reservoir in the neighborhood of the Westerly end of Mont-calm market.

ARTICLE 1ST.

FIRST BRANCH.

If the first of these branches was 12 inches in diameter, it would bring to Mount Plaisant about 6,000,000 gallons of water in 24 hours, or an average of over 350 gallons per head or more than twice the required average; but, as the pipe that already exists along St. John street is a 14 inch bore for a distance of about 2 miles, up to the Basilica, and as it is expedient to keep the same diameter all along the line, it would be cheaper to accept this 14 inch bore for the 1700 feet of the projected pipe; this would give to Mount Plaisant about 11,000,000 gallons in 24 hours, or 647 per head.

To reach Mount Plaisant, the pipes having to pass through private properties should be laid in a tunnel connecting with the sewer, which would allow an easy access in case of repairs and, at the same time, would be safer for the buildings built above it and would prevent damages arising from slips of earth.

In distributing water to the upper part of the town, it is essential not to forget the hydraulic gradient, and, for that purpose, the water will have to reach Côte à Perreault by particularly chosen streets.

With this precaution water will be over abundant, and will give to the upper part of the city a constant and nearly unlimited supply with a continuous pressure of 70 lbs. to the square inch at the highest point (Côte à Perreault); of 107 lbs. at Mount Plaisant (instead of 8 or 9 lbs. as found in 1860 when the valves were wide open); and of 160 lbs. on St. John street, opposite Palais street.

I beg to state here that, even in Montreal, the average pressure is but 75 lbs., and that in St. Cuneoade and St. Gabriel, where the pressure was to depend on the construction of the engine, the Town Councils did not ask me for more than 30 lbs. for domestic use, although it can be brought up to 75 lbs. in case of fire.

ARTICLE 2ND.

SECOND BRANCH.

This second branch will be a 14 inch pipe, and follow, as first stated, Arago street, Abraham hill and St. Georges and St. Eustache streets, where it would furnish a reservoir with 5,000,000 gallons of

water in 24 hours, if that quantity was necessary for distribution in the lower part of the town.

This reservoir will be placed in the neighborhood of the westerly end of Montcalm market on account of the proper elevation of this spot (175 feet), and so as to connect, at distances very nearly equal, with the distribution of St. Rochs on one side and Champlain ward on the other.

The object of this reservoir is to reduce the too high pressure given by a direct connection with Lorette, a pressure which would be 200 lbs. in the lower part and would necessitate pipes of too great a thickness for the distribution as well as for the service, entailing thus, in case of leakage, considerable damages, exposing the city to frequent accidents and to innumerable law suits.

Section 1st.

RESERVOIR.

The reservoir should be in two separate and distinct sections 100 feet square and 20 feet deep, each holding about 1,250,000 gallons.

This separation would allow the cleansing or repair of one section or the other without interrupting the service.

Both sections to be automatic, that is to say, provided with floats which would open or close the supply pipe according to the demand of the consumption.

They would be both provided with filters at the outlets so as to purify the water from the dust it would be exposed to by being in the neighborhood of St. John, St. Joachim and Nouvelle streets, as well as that from the market itself.

Section 2nd.

DISTRIBUTION IN ST. ROCHS AND JACQUES-CARTIER WARDS.

A 14 inch pipe laid from the reservoir alongside the rising main, would run through St. Eustache, St. Georges streets and Abraham hill to supply Saint Rochs and Jacques-Cartier wards with 3,000,000 gallons of water in 24 hours or more than 200 gallons per head.

*Section 3rd.*DISTRIBUTION IN THE PALAIS AND ST. PIERRE AND CHAMPLAIN
WARDS.

A 10 inch pipe should follow St. John, Conillard and Hébert streets, going down the cape in a straight line to Sault au Matelot street where it will give 1,500,000 gallons in 24 hours, for the Palais and St. Pierre and Champlain wards, or about 200 gallons of water per head.

As you may judge, the quantity allowed to each ward is very liberal, and the supply will be constant in the upper as well as in the lower part and the pressure continuous everywhere with a minimum of about 70 lbs. per square inch.

Should this new mode of supply necessitate any changes in the distribution pipes, I could, under short notice, furnish you a plan of such changes.

CHAPTER II.

MEANS TO PREVENT THE LOSS OF WATER.

The loss of water in the city sewers is probably the most difficult question to solve, as one must take into account the rock on which Quebec is built.

ARTICLE 1st.

LAYING OF PIPES.

In order to overcome this difficulty, I see no other means but those I suggested to the Corporation of St. Jean-Baptiste Village, near Montreal, while preparing for its Council a project of Water Works and sewerage, it consists in forming the invert of the sewer with a coat of cement at the bottom of the trench and to cover it with an arch of brick-work, leaving a conduit or tunnel 4 or 5 feet high, on the sides of which the water and gas pipes could be laid, as they are in the large tunnels of London and Paris, resting either on iron brackets or on a projection of the stones of the wall itself.

This method of building sewers is the cheapest and most durable of all, allowing an easy superintendence of all conduits under the City's control, doing away with the digging up of the streets, and the

incumbering of the roadway, reducing the danger of leakage of the pipes through the break or the vibration of the ground under the wheels of vehicles; besides the facilities it gives to find immediately any leak and attend to it.

While at present, the distribution pipes are laid immediately above the sewers, and the water that escapes finds its way directly into the sewer without it being possible to locate the leak except with great expense of time and money.

I have then the honour to suggest the construction of these tunnels to the Council whenever it will be necessary to renew the pipes or lay out new ones.

ARTICLE 2nd.

WASTE BY THE OCCUPANTS.

As regard the wasting of water by occupants it can only be lessened by ordering that service pipes be not laid except under control of the engineer in charge of the Water-Works, and also by enacting the general use of hydrometers which would keep track of all that occupants consumed. The average cost of these meters is twenty dollars each. The reimbursement of this sum could be effected in the same way as the Gas Companies perceive the rent of their meters, that is to say, 10 or 12 per cent of the original value, so that in seven or eight years the meters would be completely paid for, leaving to the Corporation an annual income of 10 or 12,000 dollars on the hydrometers alone.

But this wasting can also be prevented by having a number of inspectors who would systematically visit each house so as to ascertain the state of the taps, and would inform against all delinquents, so as to have them punished.

I would suggest here a few details of less importance, but which, however, are a continual source of loss of water, and which the Corporation ought to control by imposing the use of cisterns in houses, and the adoption by proprietors, of W.C. of approved pattern, and binding them to protect the service pipes against frost. This protection can be had by efficient and cheap precautions.

CHAPTER III.

HYDRANTS.

I have now to speak of hydrants. With the pressure and quantity obtained by the improvements just mentioned, the efficiency of the hydrants actually in use will be considerably increased, they, nevertheless, will always be of a hard and slow working. Under the present system it matters but little if the firemen lose ten minutes in adjusting the hose to the hydrant, as they are obliged to wait for the arrival of the water to the hydrant.

But when the water is constantly under pressure at the hydrant, the question of losing a few minutes becomes of serious moment. In the United States, a loss of 3 seconds is a sufficient reason for the authorities to invite improvements.

There are several patterns of hydrants, all of which are more or less advantageous. I would particularly recommend the "Matthews'" hydrant as improved by Mr. Lesage, engineer of the Montreal Water Works, and specially adapted to our climate by myself, by means of improvements to the jacket as well as to the working part, when I built the St. Henri Water Works.

This hydrant stands about 3 feet above the ground, so as to be easily found in the snow during winter, it is covered with a frost jacket made of non-conducting substance which protects it from freezing, and the conical form of which prevents the frost from lifting it out of its seat.

It also has the advantage of connecting with the sewer so as to allow the water left in after the closing of the valves to escape thus removing its liability to freeze.

CHAPTER IV.

PROBABLE COST.

I can give you but an approximative estimate of the costs, as I could not ascertain the nature of the soil along the line. However, I believe I have foreseen every thing except rock excavation which I did not take into account and which would probably slightly increase the cost of the undertaking.

These works include 1st a second well at Lorette with some changes to the *Chuteau d'eau*;

2nd. A reservoir in two sections, each 100 square feet by 20 feet in depth, with automatic valves and filters;

3rd. A tunnel through private properties.

Length of pipe in feet.	Diameter of pipe in inches.	Thicknes in inches.	Pressure in lbs. per sq. inch.	Head in feet.
5,800	30	0.75	50	116
3,700	30	0.97	100	230
9,500	30	1.00	150	350
21,500	30	1.12	200	460
700	14	0.74	200	460
1,000	14	0.71	150	350
5,700	14	0.74	200	460
2,250	14	0.52	75	175
3,000	10	0.38	50	116
500	10	0.50	75	175
2 forks	30	1.12	200	460
2 "	18	1.12	200	460
6 valves	30	1.12	200	460
6 "	18	1.12	200	460

All these works I value at the sum of \$495,000.00.

However high this estimate may seem to you, I take the liberty to remark that, besides the changes to be made at the very source and to the main pipe up to the corner of St. Michel and Aqueduct streets, I have added: 1,700 feet of 14 inch pipe to reach Mount Plaisant, 5,700 feet, also 14 inch, to reach the reservoir; the two sections of the reservoir; 2,250 feet of another 14 inch pipe, to go to the foot of Abraham hill; 3,500 feet of 10 inch pipe for the Palais, St. Rochs and Champlain wards.

CHAPTER V.

REMARKS.

The quantity of water supplied by these works will, for a long time, be much in excess of the quality required by the population of Quebec, inasmuch as in England they have succeeded in reducing the average daily consumption to 24 gallons per head; in the United States, to 20 gallons; in Spain to 16 and in France even down to 11 gallons.

From this to a good many years to come, the consumption will not reach the allowance made, but, should the reverse ever happen, the Corporation should bear in mind that the actual capacity of St. Charles River is but about 29,500,000 gallons in the summer months, when about 2 inches deep of water pass over the lip of the dam. Should the city consume 20,000,000 gallons, there will only be $\frac{9}{8}$ of an inch of water passing over the dam leaving only nine or ten million gallons for the use of proprietors on either side of the river, and they may perhaps, then, raise a question which does not, to day call for consideration.

CHAPTER VI.

CONCLUSIONS.

Before concluding this work which has unfortunately been delayed by uncontrollable circumstances, I have the honour to call your attention to the fact that all pipes which I suggested, must necessarily be coated with the varnish that has been adopted by engineers ever since 1858, so should be all the pipes that may come to replace those now in use, otherwise you will sooner or later, come to the result already manifested elsewhere, namely the contraction of the diameter of the pipes by the incrustation of their internal surface.

Engineers have ascertained that without this precaution, some pipes in England have gradually contracted from a 4 inch diameter to a passage of $1\frac{1}{2}$ inch, and it is to be feared that the Corporation of the city of Quebec will soon be obliged to renew every one of its distribution pipes which, were not thus protected when first being laid.

The whole, nevertheless, respectfully submitted.

J. ALPHONSE U. BEAUDRY.

Montreal, April 5th, 1883.

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