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REPORT G23

OF THE

SPECIAL COMMITTEE,

APPOINTED BY THE

COMMON COUNCIL OF THE CITY OF ALBANY,

TO SUBMIT

A PLAN AND ESTIMATE FOR SUPPLYING THE CITY WITH

WATER.

Presented and Ordered Printed March 23, 1846.

ALBANY.

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REPORT.

THE special committee appointed by the Common Council, on the seventh day of August last, to inquire into the feasibility and expense of supplying the City of Albany with pure and wholesome water, and to report to the Board, at as early a period as practicable, the result of their investigations, submit the following

REPORT :

In entering upon the duties assigned them, your committee immediately learned that the complaints of an inadequate supply of water were not only general and without any prospect of relief from efforts heretofore relied upon, but well founded.

That there is a lamentable deficiency in this city, both in the *quantity* and *quality* of water for *family use*, and in the quantity for other uses, and for the *extinguishment of fires*, cannot be denied. Nor can it be affirmed that the Common Council have been wanting in efforts to remedy the evil by furnishing the people with an element so essential to health, comfort, and the preservation of property.

Wells and cisterns of large capacity have from time to time been constructed at no inconsiderable expense; notwithstanding which, and the very rigid economy in the use of water which our citizens have been obliged to use, the wants of the city have been but partially supplied.

Now while the rapid growth of the city in population, and the large investments in manufactures annually made, will necessarily increase the demand for water, the grading of the property west of Hawk-street, and south of State-street, has already destroyed, in this vicinity, many of the sources heretofore relied upon.

Aware of these facts, and that the citizens had repeatedly manifested their wishes upon this subject in language not to be misunderstood, and deeply sensible of the important duty devolving upon them,

your committee were prepared for a task of no little labor; nor were they mistaken in their anticipations.

They soon learned that theirs was not the work of a day; that to present the subject in such a light as to enable each member of the board to examine it in all its bearings, would require the unremitting labor of months. Notwithstanding which, they have endeavored to meet the object of their appointment, and the expectations of the citizens, fully persuaded that a project involving consequences so important should not be trifled with by hasty conclusions; and that whatever examination might be required to ascertain the best source and most feasible plan of furnishing the city with an abundant supply of water, it would be time well employed and labor profitably expended.

While a mere provision may be made for the present wants of the city, or even for a population much greater than we now have, at an expenditure considerably less than that contemplated in the report of the Engineer herewith submitted, your committee cannot view that policy as wise which, in furnishing a city like Albany with water, is confined within the limits of a few years, and neglects to guard against contingencies which may, and in all probability will, arise.

Among other reasons which might be urged in favor of the course recommended by the committee, they submit the following:

A liberal supply of water, with reservoirs sufficiently elevated to command the highest buildings in the city, is especially needed in the event of a fire.

It cannot be disguised that there are large sections of our city occupied by frame tenements, and almost wholly destitute of water, even for family use, a great part of the year. The general and deep anxiety manifested by our citizens at such seasons, proves that they are not insensible to the dangers that surround them, and is a powerful appeal to the Common Council to engage in an enterprise so intimately connected with the interests of the whole community.

We have seen millions of property destroyed in a few hours in the city of New-York, and who will question that a large portion of it might have been saved had the present gigantic work, constructed at

Nor is this all. Just in proportion as the facilities for the extinguishment of fires are increased, the rates of insurance will be lessened, and thus all the benefits now conferred by insurance companies upon the few, be placed within the reach of the many. Your committee do not wish to be understood as undervaluing these noble institutions; but, while it is rare indeed that the wealthy are without a policy to cover their losses, the poorer classes are generally precluded through necessity, from availing themselves of the advantages secured by insurance.

The beneficial effects that would be immediately experienced by the property lying between Lydius and Chesnut, Hawk and Lark-streets, and comprising about forty acres, may be adduced as another argument in favor of the policy recommended.

It is well known that a few of our most enterprising citizens have, within the last two years, incurred heavy expenditures in grading the property embraced within the above described limits. Several hundred thousand cubic yards of earth have been removed from the high grounds, and deposited in the ravines, thus forming lots eligible as it respects location, and capable of accommodating with ease a population of five thousand inhabitants. Now, if the greater portion of this large area must rely for water *entirely* upon that shed from the buildings, the time is certainly far distant when it will be occupied with tenements. But if, on the contrary, this section of the city can at all times be furnished with an ample supply, its position is such, lying between Lydius and Washington-streets, the only avenues from the west, as to find a ready sale and be speedily improved.

Aside from the fact that every building erected increases the taxable property of the city, the district referred to, if properly improved and built upon, could not but exert a healthy influence upon other portions of the city. But even were this not so, were there no collateral benefits that could possibly result from supplying any particular section of the city with water, your committee believe it to be the imperative duty of the Common Council to facilitate, by every proper means, well directed individual enterprise, when exerted in improving the city.

From its very position Albany is destined to become a great manufacturing city, if facilities for the free development of its resources be afforded. Favorably located upon the great line of railroad communication, uniting the western lakes with the Atlantic ocean—upon the noble Hudson, near the head of navigation, and at the terminus of the Erie and Champlain canals, Albany, if she would compete with other cities, and manifest, in future, the same rapid growth and improvement that have distinguished her past advancement, must engage in her service those elements of enterprise that constitute so distinguishing a feature of the present age, and especially manufactures.

Favorable as the site of Albany is for trade and commerce, your committee believe that it is no less so for manufactures, and that she will hereafter engage in them extensively, and with success, if the same facilities so liberally afforded in other sections of the country, be extended to her, and her municipal authorities manifest that fostering care over her interests so essential to permanent prosperity.

The absolute dependance of most manufactories upon an abundant supply of water, requires no proof; it will at once be perceived, therefore, that by affording such a supply we add a new element of prosperity, or rather fully develop one, that has within the last few years been exhibited in different sections of the city.

As some diversity of opinion may exist among our citizens respecting the propriety of any measure being taken by the Common Council in a work of such great magnitude, and one that must necessarily involve a very heavy expenditure, and increased taxation, it is thought by the committee to be due to the subject, that they should give at least some of the reasons why they submit such a proposition to the consideration of the board. Your committee verily believe, that if the city does not engage in the enterprise and carry it forward to completion, the complaints which have heretofore existed will not be diminished, but will rather increase with the population. Besides, from the *experience of the past*, your committee are decidedly of the opinion, that a project of such vast importance, and so intimately connected with our future welfare, should not be left to individual enterprise, or to any chartered company, but should be under the perfect control of the city.

It is generally true, that individual enterprise and incorporated companies, in the absence of competition, are so managed and directed as to return the largest possible profit on the capital invested; indeed, your committee are not aware of any instances in which such individuals

or companies have proved so patriotic and disinterested, as to serve the public without a calculation of private gain; and where these sources have been depended upon for supplying cities with water, the *uniform* result has been a *minimum quantity* at a *maximum rate*.

By contrasting the quantity of water and its cost to the consumer, in the cities of our own country that are supplied by municipal authority, with those of cities that depend upon incorporated companies, it will appear that the quantity is not only incomparably more *abundant* in the former, but the price *far lower*.

It is for these, among other reasons, that your committee would urge upon the Common Council the propriety, nay, even the *necessity*, of engaging in this enterprise, believing that this indispensable prerequisite to comfort, health, and the general prosperity of the city, should not be under the control of those whose interest it is to regulate its price by the necessities of the consumer.

In conclusion your committee would state, that their attention was called at an early day to various streams in and near the city, as sources of supply, and to their examination devoted not a little time.

Satisfied that nothing short of actual demonstration would convince many of our citizens of the impracticability of their favorite sources your committee directed levels and measurements of the different streams to be taken. While this course was most assuredly due to those who had devoted not a little time to the subject, and were deeply interested in the result, your committee deemed it of paramount importance to determine positively the different localities from which an adequate supply of water could be obtained.

Thompson's Lake, situate on the Helderburgh, some eight hundred feet above the level of the river, and distant about fifteen miles from the city; and also Warners's Lake, lying about one mile farther to the southwest; Batterman's creek, near Hamilton village, in the town of Guilderland; the upper branch of the Patroon's creek, near the western termination of the new branch of the Mohawk and Hudson railroad, and other streams, were severally examined, and ascertained to be too limited in capacity, or too distant to warrant the necessary expenditures in directing their waters to the use of the city.

Your committee therefore were compelled to rely either upon the main body of the Patroon's creek, the Hudson river, or the Mohawk river; and as the surveys and estimates necessary to determine the most feasible and economical of these sources would involve an expenditure which your committee, acting in behalf of the Common

Council, did not feel authorised to incur ; they stated the result of their labors thus far, to the board, on the sixth day of October last, and were then empowered to engage the services of an engineer. Under this authority they employed Major D. B. Douglass, well and favorably known, not only in this community but in different sections of the country, as an accomplished scholar and an experienced engineer.

He has given to the whole subject that careful attention which its great importance most certainly demands, and the result of his surveys is herewith submitted ; from which it will appear that the whole work necessary to bring a supply of water from the Patroon's creek, above Tivoli falls, to a point convenient for distribution to all parts of the city—a supply ample for present use, and for a long time to come—including damages for the conversion of the entire stream, when the increased wants of the city shall require the same, will cost three hundred and seventeen thousand five hundred and twelve dollars ; and that the cost of Mains and Pipes through all the streets of the city built upon, embracing almost all the streets opened, will be two hundred and sixteen thousand nine hundred and four dollars, making the total for the work complete, \$534,416.

It must be borne in mind, however, that a large proportion of the pipes will not be required for years, and that the estimates for this part of the work will be proportionate to the quantity laid down for use.

The above sum compared with the estimates for procuring the like amount of water from the Hudson river or the Mohawk river, shows a balance in favor of the Patroon's creek over the former, of \$191,599, and over the latter of \$437,768 ; and as the analysis of the waters shows that of the Patroon's creek above the falls, to be purer than either of the others, your committee find it the most easy part of their duty in giving the preference to this creek.

The above amount your committee are aware, will be considered by some too large, and that the citizens should even *submit* to the inconvenience now experienced, rather than to *oppress* the city with such an enormous debt.

To your committee, however, this great *mountain of debt*, compared with the vast benefits resulting to all classes from a bountiful supply of pure and wholesome water, appears a mere *mole-hill*. They believe that when the indispensable means of general health and comfort to the citizens and of protection to their property are to be secured only by the expenditure of money, it is more *wise* calmly to deli-

liberate upon the best means of meeting the expenditure than to sit down despondingly to count the cost.

Large as the cost of the work may appear, your committee are of the opinion that the payment of the amount can be provided for by the city, without prejudice to its credit or general interest, and without oppressive taxation upon its citizens ; and therefore recommend to the Common Council that the necessary measures be taken to enable the board to undertake and prosecute the work without delay ; and in furtherance of the object, your committee have caused a law to be prepared, (by them deemed necessary for the purpose,) to be presented to the Legislature for enactment.

In recommending the project of supplying the city with water, your committee feel that a very important duty remains to be performed by them, though not strictly enjoined upon by their appointment, to wit, to report the best method of raising and paying the cost incident thereto.

In entering upon this part of their duty, your committee do not expect to present the best method, but hope to make suggestions that other minds may improve upon, and mature into a perfect system.

In view of all the advantages arising from the proposed work, that every species of property, real and personal, will be benefitted thereby, and therefore should pay its due proportion of the cost, and as posterity and the property to accumulate in the future, will also share in its usefulness, your committee can see no reason why the present generation and property of the city should pay the whole expense of the work.

Your committee, after much labor and reflection upon this subject, would suggest the following plan for paying the amount necessary to complete the work, viz : that the cost of bringing the water into the reservoirs for distribution, amounting to \$317,512, be borrowed on the bonds of the city, payable in fifty years, and that such an amount be raised annually by a general tax, as when added to the water rates collected, will equal the payment of interest on the loan, the current contingent expenses, and a sufficient sum towards a sinking fund, to pay said bonds at maturity ; and that said sinking fund be invested upon unincumbered real estate in this city, of double the value of the amount loaned, exclusive of buildings. That such portion of the amount as may be required for Mains and lateral Pipes, be also borrowed by the city, temporarily, and the same be apportioned and assessed upon all the lots of ground fronting upon the streets in

which they shall be laid, in proportion to the size of their respective fronts ; such apportionment, however, shall not extend beyond the line of the pipes so laid. The amounts so apportioned and assessed shall be paid to the chamberlain of the city, and may be paid at once, or by equal annual instalments, with seven per cent interest on the same, in two, or three years, at the option of the owner ; the collection thereof to be enforced in like manner as other assessments made by the city ; and whenever the line of pipes shall be extended in any street, by the authority of the city, payment of the like amount, and in like manner, shall be made by the owners of the lots fronting upon the street as far as the pipes shall have been extended. This mode of payment, your committee presume, will not prove onerous upon the owners of lots, as the expense will not probably exceed sixty cents per foot front, as will appear by the estimate of the engineer. The service pipe for drawing water from the Mains, should be put in under the direction of the superintendent appointed for the purpose, at the expense of the person desiring the water.

The amount estimated by your committee to be raised annually, to meet the payment of interest on the loan of \$317,512, contingent expenses, and the sinking fund, is as follows :

For interest on loan at six per cent,.....	\$19,050 72
“ sinking fund to be invested at seven per cent,.....	728 26
“ probable loss through failure to invest,.....	25 00
“ contingent expenses,.....	8,000 00
Total,.....	\$27,803 98

Your committee have thus reported the estimated cost of the work, and the required annual amount to meet the current expenses incident thereto ; the much more difficult task remains to say what proportion of this sum shall be raised by a tariff of rates, and what proportion from the taxable property of the citizens, so that, while the poorer classes are not rated too high for an indispensable article of consumption, the taxable inhabitants, after paying rates for the same article, shall not be over burdened to make up the deficit ; your committee, however, deem it advisable that the price of water should be as low as possible for all use, graduating the rates according to the quantity consumed, and thereby putting it within the means of all, and inducing the greater number of our citizens to become customers ; in fine, to fix the rates so low that none would refuse to take it on account of the price.

From the Marshals' returns of the census taken the past year, it

appears that there were residing within the city at that time, 7,495 families, and from the best information your committee can obtain, 85 of the number reside west of Perry street, leaving 7410 families east of said street ; that there were also 172 wholesale stores, 542 retail stores, 389 groceries, 76 taverns, 6 breweries, 8 iron works, 19 manufactories, besides various other establishments, all requiring more or less water.

Your committee believe that the following sum can be realized from customers per year, at the rates put down for each class, as follows :

1,000 families at.....	\$1,.....	\$1,000 00
1,000 do	2,.....	2,000 00
1,000 do	3,.....	3,000 00
1,000 do	4,.....	4,000 00
1,000 do	5,.....	5,000 00
1,000 do	6,.....	6,000 00
100 wholesale stores at	3,.....	300 00
250 retail do	3,.....	750 00
150 groceries at.....	3,.....	450 00
30 taverns at.....	6,.....	180 00
6 breweries at.....	50,.....	300 00
8 iron works at....	12,.....	96 00
10 manufactories at..	10,.....	100 00
Total per year,.....		\$23,276 00

Those not included in the above who will probably take water when the rates are so moderate, are thought ample to make up any deficiency in this sum.

The tariff of rates should be such that the amount to be raised yearly by tax, might vary from \$5,000 to \$10,000.

Your committee have thus merely presented the materials and outlines of a system, by which the whole cost of the work may be liquidated, and its current expenses provided for, to be matured at the proper time, and not for immediate action by the board ; feeling confident, however, that though for the first few years the amount to be realized from rates may fall short of the above sum, still, without any material increase of rates for family consumption, will, by the increase of population alone, soon far exceed such sum ; and should the rates even be doubled, the price, it is believed, would not exceed

the amount charged in cities watered by chartered companies. Should it even be necessary to raise by direct tax \$15,000, to meet the yearly deficit from rates, the great saving in the present expenses of the city, owing to the want of a full supply of water, in the construction and repairs of public cisterns, hydrants and wells, and the amount that will be saved in the expenses of the fire department, would, it is thought, more than compensate for the increase.

Permit your committee in closing, to say, that the subject they have had under consideration, is one of deep concern, of vital importance to the interests of this city, and that they feel confident the board will give to it that calm investigation, and profound deliberation which its great, and paramount importance demands.

All of which is respectfully submitted.

H. B. HASWELL,
JNO. McKNIGHT,
SAMUEL WESCOTT,
PHILANDER COLEY,
ROBT. McCOLLOM,
Committee.

Albany, March 23, 1846.

REPORT

Of Maj. D. B. Douglass, with Plans and Estimates for supplying the City of Albany with Water.

TO ALDERMAN HASWELL,

Chairman, &c.

SIR:—I respectfully communicate the following Report of calculations and examinations made by me, in obedience to your request, on the supply of the city of Albany with water; and,

First. As to the *quantity* to be supplied.

This quantity is, of course, to be estimated from the number of inhabitants; but evidently not from that number as it now stands. The city is in a state of progressive increase, at a rate, which would double its population, ordinarily, in some twenty years, and unless due regard be paid to this circumstance, in any project for supplying the inhabitants with water, it might become necessary after a few years to make essential *changes* in the system, and so to incur new and heavy expenditures to meet an increased demand. A momentary attention to the progress of the city in time past, will enable us to realize the value of this consideration.

From the census returns from the year 1790 to 1845, it appears that the ratio of increase, in successive periods, has been as follows, viz:

From 1790 to 1800	a little more than	4½	per cent,	per annum.
From 1800 to 1810	nearly.....	5½	do	do
From 1810 to 1820	a little more than	3	do	do
From 1820 to 1830	about.....	6¾	do	do
From 1830 to 1840	about.....	3½	do	do
From 1840 to 1845	a little more than	4	do	do
And the average of the whole (55 years)		4½	do	do

The most rapid of these rates, that which occurred between 1820 and 1830, would double the population in the short term of *eleven*

years; but as this is much higher than the ratio for any other period, it is probable that it may have arisen from some peculiar circumstance incident to that particular time, and that it is not to be relied on therefore as the basis of a general calculation.

The average ratio, four and one-half per cent per annum, is of course not liable to this objection—and from this we get *sixteen* years as the cycle in which the population would be regularly doubled.

The ratio of four per cent, which is the average of the last five years, doubles in about *eighteen* years; that of three and one-half per cent, the average of the preceeding ten years, doubles in *twenty-one* years; and that of three per cent, which is the lowest average rate of any previous period, still doubles in only *twenty-four* years.

According to the census of 1845, the population of that year was 41,138; from which, with the ratios just quoted, we find the dates at which the City may be expected to attain the round numbers of (say) *one, two, three* and *four* hundred thousand inhabitants, as follows:

There will be, for instance,	By the ratio of $4\frac{1}{2}$ per ct.	By the ratio of 4 per ct.	By the ratio of $3\frac{1}{2}$ per ct.	By the ratio of 3 per ct.
A population of 100,000,.....	In A. D. 1866	In A. D. 1868	In A. D. 1871	In A. D. 1876
do do 200,000,.....	do 1882	do 1886	do 1892	do 1900
do do 300,000,.....	do 1891	do 1896	do 1903	do 1913
do do 400,000,.....	do 1898	do 1904	do 1912	do 1924

Such are the conclusions to which we are led on this subject by the experience of former years. Nor does there appear any good ground of inference, from circumstances likely to operate upon the prosperity of the City, that its increase will be less rapid in time to come, than it has been in time past. On the contrary, there is reason to believe that it will be, for some years at least, much more rapid. The growth and extension of settlements, in the west and northwest; the general increase of industrious and enterprising population in wide districts with whose interests, the interest of Albany and its vicinity, are more or less essentially connected; the obvious capabilities of the city itself as a manufacturing and trading emporium, in the same relation, with all the productive resources of a vast and thriving interior country to sustain it, and the means of transport, by land and by water, rapidly developing on all sides, as if for its accommodation; these, and other like considerations, induce a belief that the growth of Albany is rather to be accelerated than retarded, for a generation to come at least. At all events, in a very moderate period, even without any

acceleration, it is sure to become a large and populous city; and this consideration should certainly be embraced in determining the scale of a great work of permanent and practical utility, like that now contemplated.

The experience of cities, under circumstances similar to those of Albany, assigns from 25 to 30 gallons per diem as the average supply for each inhabitant. The smaller number may be sufficient when there is need of economy, but the larger will be beneficially used when the supply is abundant. It is not supposed, of course, that each individual actually consumes this quantity; but that the aggregate, embracing all the different objects of consumption, such as putting out fires, washing down streets, supplying baths, and manufactories of different kinds, with all the multifarious domestic uses to which an abundant supply of pure soft water is sure to be appropriated; all these collectively, are about in the ratio mentioned.

We are now prepared to estimate, from the number of inhabitants, and the rate of supply to each, the capacity for which the works of supply ought to be calculated. It appears that for the present population, embracing the probability of increase for the next eight or ten years only, a net supply of one and a half millions of gallons daily, would suffice. But it is frequently desirable, for repairs or other purposes, to shut off the head water of the supply for a few days; and that this may be done, without the necessity of suspending the distribution, the capacity of the works of supply should be graduated so as to yield when needed, at least two millions of gallons daily. Nor is this all. To meet the increasing demand of future years, there should be a corresponding capacity of increase in the means of supply, so that, without any material substitution or renewal of the works, they could be made competent to yield, say a little more than twenty years from this time, *double* the quantity now proposed, and a little more than forty years, *treble*.

Secondly. As to the *level* at which the water shall be delivered.

The great diversity of elevations in the city of Albany, viz., from 12 to 220 feet above ordinary tide water, suggests the necessity of having at least *two* distributing Reservoirs or Tanks, at different elevations. If there were indeed an abundant natural supply for the whole city, available at the highest point, such a double arrangement would not be necessary. There would be no objection in that case; but on the contrary, some advantage in having the whole delivery from one point, under the command of the more elevated head, but in the case before us this is not practicable. It will be necessary to raise

the water by some artificial power for the higher delivery, and it will be better economy therefore, to supply the bulk of the city from a lower point, and only to raise so much as may be absolutely necessary, for the higher service.

In examining the topography of the City, with some care, in reference to this arrangement, I have been led to adopt a dividing line between the upper and lower deliveries, at the height of 120 feet above tide. A horizontal plane at this height is found to intersect some of the principal streets, as follows, viz :

Lumber street,	about 135 feet, west of Ten Broeck street.
Third street,	36 feet west of the same.
Second street,	115 feet west of the same.
First street,	340 feet west of the same.
Patroon street,	240 feet east of Swan street.
Orange street,	131 feet east of Dove street.
Canal street,	175 feet west of Dove street.
Elk street,	opposite west part of the Academy.
Washington street,	125 feet west of the City Hall.
State street,	50 feet east of Capitol street.
Capitol street,	140 feet south of State street.
Lancaster street,	150 feet west of Capitol street.
High street,	20 feet south of Lancaster street.
Hawk street,	19 feet north of Jay street.
Jay street,	120 feet west of Hawk street.
Hudson street,	232 feet west of Hawk street.
Hawk street, (again)	145 feet south of Hudson street.
Hamilton street,	west of High street.

By the Marshals' returns of the census in the different wards, it appears, as nearly as can be now estimated, that about 30,500, say three-fourths of the whole population, reside *below* the line here designated, and the remaining one-fourth *above*. With regard to manufactories and other establishments, in which water is much used, the proportion of *these*, situated above the dividing line, appears to be much smaller; probably not more than one-eighth. Nevertheless, as a safe estimate, I assume the water, to be raised by steam or other power, for the upper supply, at one-fourth the whole; and this I apprehend will be a safe estimate in any state of future increase.

For the effective delivery of the water in all parts of each district, in the upper stories of the more elevated houses for example, and with sufficient command of head, every where, for the extinguish-

ment of fires. I propose to give to each distributing Reservoir, an extra head of fifty feet above the maximum of its district. Thus the maximum of the lower district, being taken at 120 feet above tide, I graduate its distributing reservoir at 170 feet; and the maximum of the upper district, at the highest point of Washington street, being about 220 feet, I make the surface of its reservoir 270 feet above tide. These grades give a command in the latter case considerably above the top of the building called the Point Store, near Townsend's park; and in the former, about 75 feet above the roof of the Delavan House. But it would be easy, if occasion should require, to throw the whole head of the upper system upon the lower, giving a command in that case of 175 feet above the roof of the Delavan House.

Thirdly. With these preliminaries, we proceed next, to consider the *sources* from which water may be obtained. These are :

- 1st. The Patroon's creek.
- 2d. The Hudson river, and
- 3d. The Mohawk river, above the Cohoes.

Each of which I shall discuss in the order in which I have named them.

1. *The Patroon's Creek.* This is, doubtless, the most natural source of supply, since it can be brought to a convenient point for distribution at the height of 170 feet, without the use of any extraneous power or machinery whatever. The works required for this purpose would be a dam of moderate elevation, at some few hundred yards above Tivoli Falls, and a line of aqueduct by the most convenient route from that point to a point in the city plat, near the head of the north branch of the Patroon-street Hollow; probably not far from the intersection of Second and Knox-streets.

The ground on this line is extremely uneven, intersected by numerous deep ravines and gullies, running into the Patroon's creek below the falls; but the difficulties thus presented, are by no means insuperable; nor even very serious, when we come to consider them in particular. The construction of an aqueduct, I may observe, is, in some respects, as compared with a rail-road or canal, *peculiar*; consisting only of a water main or culvert of moderate dimensions, it occupies but little space in the ground when completed, and admits all the same irregularities of surface, after its construction, as before. It follows then, that in cases where deep cutting is to be encountered, such as would present a serious obstacle to works of a different character, an easy and often economical alternative is found, for the construction of an aqueduct, *in tunnelling*. And especially when the length of cutting is not very considerable, this mode is preferable to an open cutting even of very moderate depth.

The line in question is particularly well calculated for the profitable use of this expedient. It is not long, not more than 1,600 yards altogether, and this length is subdivided into several sections by the ravines of which I have spoken. In some instances these ravines though appearing very deep and difficult, are capable of being connected together by drift-ways (tunnels,) less than 100 feet in length, through clay banks, easy of excavation, and at no very great expense. Some of the ridges are wider, and require of course, longer drifts, but not in any case so as to be very objectionable on that account. In fact, I am inclined to think that it will be found the best policy in the final location, to carry the line as far south as possible, though it should increase the length of these tunnels, since it would, at the same time, diminish, or perhaps avoid altogether certain embankments across the ravines, which, in a construction of this sort, are far more to be dreaded.

The expense of preparing the line, according to these views, is estimated as follows :

400 yards of open cutting and back filling, average \$9.50,	\$3,800
Embankments and culverts, extra,.....	15,000
1,200 yards drift way, (section 16 yards,) back filling included at \$20,.....	24,000
1,600 yards, 3½ feet, barrel culvert of brick, at \$40 per yard,	64,000
Dam, depurating Reservoir, and distributing Tank, &c....	20,000
Total.....	\$126,800

This is intended to be a liberal estimate of the cost of all the works necessary for bringing the water of the creek to the lower front for distribution. I proceed now to consider the probable amount of indemnity to be paid for the water thus taken ; it being understood, of course, that any judgement on this subject at present is given provisionally, and without any intention to prejudice the proper adjustment of the question upon its merits, whenever the time for so doing shall come.

According to a gauge of the creek, made by Mr. Carpenter, in a low state of the water, the daily discharge, *in that state*, appears to be 832,882 cubic feet, or 5,205,562 gallons.* By a little management it might be augmented to an *average* discharge, say one-fourth greater ; and in that case—having an available fall of 150 feet—the aggregate working power of the stream would be estimated, which, according to the usual mode of estimating steam engines, would be rated at 150 or 160 horses.

The existence of such a natural power in the immediate vicinity of

* The English standard gallon, by which estimates of this kind are generally made, differs but little from the common beer gallon ; the former running about 6¼ to the cubic foot, and the latter 6½.

Albany, is undoubtedly a matter of great value and interest, not only to the Proprietor but to the City. Nor should its diversion be contemplated by any one, without good and sufficient reason. Yet, whenever that reason shall occur, both the value and interest are computable and may be countervailed. The *specific value* may be fairly estimated and reimbursed : the *power* may be made up in other power, if necessary ; and with regard to the more *general interest*, such facilities, I apprehend, will be afforded to manufactories by the improvement now contemplated, as cannot fail greatly to enhance the value of all manufacturing capital in and about the city, for the benefit of all concerned.

The actual rents now received for the waters of the Patroon's creek, are understood to amount to a little less than \$7,000 per annum. In addition to which, other powers are in course of preparation, for which the rents are estimated at \$2,500 ; making in all \$9,500. The capital answering to this, at 6 per cent, would be \$158,335.33, which we may assume, in the way of estimate, as the present value of the creek. But as the waters will only be required progressively, not more than one third now, and probably not much more than one half at twenty years from this time, I have calculated a present value on the principle, that half the amount (\$79,166.66,) is payable now, and the remainder at the term of twenty years, giving the surplus water always to the present proprietor.

The result is as follows, viz :

Present payment,	\$79,166
Present investment, at 6 per cent, simple interest, to meet a like payment in 20 years hence,	35,986
Total value of the creek on this principle,	\$115,152
To be added to the previous estimate,	126,800
Making the entire cost of the water delivered as above, ..	\$241,952

II. Let us now compare with this the project of raising the water from the Hudson river.

The point which appears to me the most convenient for taking the water in this way, is opposite the foot of Colonie-street. A proper chamber of permanent masonry being erected outside the pier, for the first reception of the water ; a conspicuous culvert of brick is proposed to be laid from it, crossing the basin (below bottom,) and so running up Colonie-street to the position of a pump chamber, which I have assumed of near the intersection of Jackson-street. This will of course be the position for the steam engine and its appurtenances, and from the forcing pumps at this point a couple of jointed mains will

lead the water up the steep slope of the hill to the distributing tank, say between Ten Broeck and Swan-streets. Finally, to complete the arrangement, as neither the character of the ground nor the economy of the work admits a *very large* distributing reservoir at the point mentioned, I propose to carry a leader from the distributing tank along the extension of Colonie-street, westward, till it strikes the Van Woert-street ravine; at the head of which, by means of a dam, a convenient store reservoir may be formed, of three or four acres.

The power of the steam engine, for this plan of supply, should be at least 100 horses. Such an engine, working twenty hours per diem, for six days in the week, would raise an average of 2,000,000 gallons per diem, to the height of 170 feet, or 1,500,000 gallons working in like manner, 15 hours per diem. Taking the former as the basis of a comparative estimate, the attendance, oil, fuel, and wear and tear of engine and pumps, are estimated at \$11,000 per annum; equivalent, at 6 per cent, to a capital of \$183,333

To this, add first cost of engine and pumps,	12,500
Pump chamber, engine house, stand pipe, &c.	9,820
1,450 feet leading main, from the river [excavation, puddling and back filling included,].....	24,850
Water chamber, including coffer, &c.....	6,540
Two 24 inch flanced mains from the pumps to the distributing tank, 1,515 feet,	27,785
Distributing chamber,	6,500
2,200 feet brick culvert leading to the store reservoir, ...	28,600
Dam and fixtures for store reservoir,	4,500
Total present investment,	\$304,428

This estimate, you will see, provides for the maintenance of the *power* forever. It is limited, however, in capacity to 2,000,000 gallons per diem, and would require an additional outlay for additional power, whenever the demand should exceed that limit, and this consideration must be embraced, to make a just comparison between *this* and the preceding project.

I suppose that an additional engine of equal capacity to that estimated, would be required in 20 years. The first cost of such an engine, with perpetual capital to cover wear and tear, attendance, fuel, &c., amounts to \$196,000. Its present value, therefore, at 6 per cent simple interest, is, \$88,853

Which added to the previous estimate of	304,428
Gives a total of	\$393,271

Even *this*, however, does not place the capacity of this supply on the same footing as that of the Patroon's creek, since that furnishes 6,000,000 gallons, this yields only 4,000,000, and would require a further addition of power whenever the consumption should exceed 4,000,000.

Estimating this, therefore, for a term of 40 years, at ...	\$40,280
We obtain a total, (comparable with the preceding,) of	\$433,551

III. *Finally*, the Cohoes project.

Any line for bringing the waters of the Mohawk from the head of the Cohoes to the city, is understood to be about ten miles in length. It would be unsafe to assume the grading of such a line, for such a purpose, and on ground such as it must needs occupy, (along the hill-side of the Hudson valley, and with numerous drainages crossing it,) at less than \$10,000 per mile, or for the whole line, \$100,000

A barrel culvert of 3½ feet diameter, bedded in concrete, would cost complete, \$65,472 per mile, and for 10 miles,	654,720
To which add for reservoirs, tanks &c.,.....	25,000
And we have a total of	779,720

This expenditure, it should be observed, is only calculated for a *natural flow* of the water from the head of the Cohoes, the height of which would not be sufficient to deliver it in the city, at an elevation greater than 125 feet; making a difference of about 40 feet in this respect, against the project.

Permit me now, before offering the few remarks that remain, to recapitulate the results thus far obtained, as follows:

1. The Patroon's creek, taking 2,000,000 gallons *now*, with power to increase to 6,000,000, delivered in the city at 170 feet above tide, \$241,952
2. The Hudson river, contemplating the same quantities raised by steam power, to the same height, with capital invested sufficient to maintain the steam power forever, \$433,551
3. The Mohawk, to be taken from the head of the Cohoes and delivered in the city at the height of 125 feet, \$779,721

It still remains to speak of the means and cost of raising one-fourth the proposed supply into the Reservoir of the upper delivery. The position of this Reservoir, in the case of taking the water from the Patroon's creek, occurs, fortunately, on the precise line of the aqueduct, where it passes under the high ground near the extreme head of Lumber-street. This ground is the most elevated that oc-

curs any where near the immediate city bounds, and being in so convenient a relation to the proposed line, it needs but a vertical shaft and stand pipe, with a proper steam power to raise the water from a side tank connected with the aqueduct, directly into the Reservoir.

The power necessary for this purpose, supposing only ten hours work per diem, is but 25 horses. And an engine of this calibre, with investment for attendance, wear and tear, &c., as above, is equivalent to a capital of only, \$41,000
 Added to which, the cost of the reservoir, tank, main, &c. 34,560
 Gives the total cost, \$75,560
 Making with the prior estimate, 241,952

A total of \$317,512

About the same addition of expense would have to be incurred for this purpose, in the case of the Hudson river project, making the aggregate in that case, \$509,111.

In connexion with the Cohoes project the additional expense would be considerably augmented, as both the *quantity* to be raised and the *height*, would in this case be much *greater*; but it is perhaps unnecessary to go further into detail in a plan which is not very likely to be preferred.

Fourthly. The system of pipes for distributing the water. A very minute detail on this part of my report would require more minuteness of survey than it has been in my power to attain. With regard to the expense, however, I have endeavored to proceed on safe grounds, with such a knowledge of the length and relation of the streets as could be procured, and with the light of much valuable information drawn from the experience of other cities.

In New-York, the average cost of 883,125 feet of pipe has been \$1.42 per foot, but of course a greater average weight of pipe would be needful for that city than for this.

According to the returns furnished me by the city surveyor, it appears that there are in the city of Albany, 196,625 feet of streets now built upon. These have been distributed with great care, into six classes, varying in size of pipe from 3 to 15 inches, and the expense of each class separately estimated, with due allowance for every possible item, and the aggregate of the whole is \$216,904, making the grand aggregate in the case of the Patroon's creek, \$534,416
 To which should be added for land rights say, \$2,000
 And for agencies, engineering and other contingencies, to complete the work..... \$20,000

A brief remark only remains in conclusion, on the Quality of the different waters.

To ascertain this in the most satisfactory manner, specimens of each were taken up and placed in the hands of Dr. Emmons, to be analysed in comparison with other waters of the city, and it the substance of his report which I now give: "The water in each bottle, the Doctor observes, was transparent, limpid and without odour or unpleasant taste; indeed, each, so far as it could be tested in this way, appeared of an excellent character for drinking, and so nearly alike that it was difficult to distinguish them from each other. But though so nearly similar in their sensible properties, chemical tests demonstrated some differences." The test of *hardness*, for example, (tincture of soap,) showed number 2, (Hudson river water,) and number 3 (Patroon's creek above the falls,) softer than number 1, (Mohawk water,) and number 4, (Patroon's creek below the falls.) A specimen of each being treated with a given portion of the tincture; the turbidness of 1 and 4 was so great that print could not be distinguished through them, while it could be distinctly seen through 2 and 3.

By the analysis the water of Patroon's creek above Tivoli, (number 3,) showed of soluble matters per gallon, 3.12 grains; and of vegetable and organic matter, 1.60. Total 4.72.

The same water below the mills, near the turnpike number 4, showed of soluble matter, 4.48 grains, and of vegetable and organic matter, 1.60, as before.

The soluble matters are generally chlorides of lime, magnesia, &c., a little sulphate of lime, some carbonate of lime, and a trace of silicic acid and alumine.

The chief difference in the two specimens just given, appears to be in the proportion of carbonate of lime, the former having only a fraction of a grain in a gallon, while the latter has more than 2 grains; and this would seem to account for its greater hardness.

Of the other waters, that from the Hudson river, (number 2), contains of soluble matter per gallon, 4.48 grains, and of vegetable and organic matter, 1.84, total 6.32. Another specimen, however, taken by Dr. Emmons, showed of soluble matters per gallon, 4.34 grains, and of vegetable and organic matters, 3.00, total 7.24. The waters of the Mohawk, (number 1,) in the Doctor's list, showed of soluble matter per gallon, 5.36 grains, and of vegetable and organic matters, 2.52, total, 7.88

It results, generally, that the water of the Patroon's creek above the falls, as might be expected from its origin in a clean sandy region,

is decidedly the softest and purest of all. That of the creek below the mills, and of the Hudson river, somewhat inferior in both respects; and the Mohawk decidedly inferior.

Some other analyses of city waters were also furnished by Dr. Emmons, and are given for comparison.

1. The Penstock water contains of soluble matters per gallon,.....	4.64 grains.	
And of vegetable, &c.....	8.00 do	—total 12.64
2. A well in Lydius-street contains soluble matters per gallon,	13.12 grains.	
Vegetable and organic,	6.12 do	—total 19.24
3. Well at the Old State House contains soluble matters per gallon,.....	24.00 grains.	
Vegetable and organic,	12.00 do	—total 36.00
4. Well at the Exchange contains soluble matters per gallon,	47.20 grains.	
Vegetable and organic,.....	17.48 do	—total 64.68
5. Well at the Capitol park contains soluble matter per gallon,.....	47.24 grains.	
Vegetable and organic,.....	18.28 do	—total 65.52

With regard to the action of water upon lead pipes, it appears that the hard waters are less active than those less hard. The hardest well waters above noticed, for example, scarcely produced any sensible effect upon strips of bright lead immersed in them for several weeks, while in pure rain water the surface was covered with white powder in less than twenty-four hours. The Doctor is of opinion, however, that the small degree of hardness in the waters furnished, is sufficient to render their actions upon lead inappreciable.

In the remarks which I have thus presented, you will see that I have confined myself wholly to an original inquiry, as to the quantity of water required, and the best mode of obtaining it, without reference to any measure which may have been pursued hitherte for obtaining a partial supply. I take it for granted that all which belongs to that branch of the subject will receive due attention in those quarters to which it more properly belongs.

Expressing my thanks to Mr. Carpenter and Dr. Emmons for their valuable aid, and my acknowledgements to yourself for the kindness and politeness with which you have rendered all the assistance in your power,

I have the honor to be,

With great respect,

Your obedient servant,

Albany, March 19, 1846.

D. B. DOUGLASS.