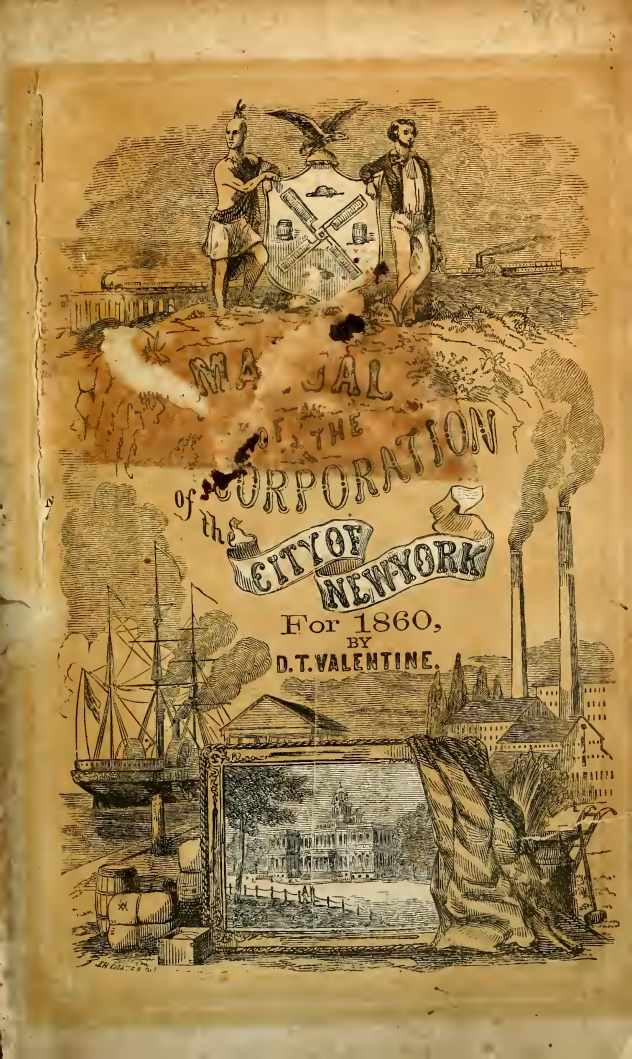
MANUAL
OF THE
CORPORATION
of the
CITY OF
NEW YORK
For 1860,
BY
D. T. VALENTINE.

# ORIGINAL PLAN OF SUPPLYING THE CITY WITH WATER,

## From the River Bronx, in 1798.

*Report of Committee on Supplying the City with Water. Read and approved Dec.* 17, 1778.

The Committee appointed to investigate the subject of supplying the city of New York with water,

REPORT:

That, being impressed with the importance of the subject, they have considered it with all the care and attention in their power, and incline to the opinion that the Bronx river will afford a copious supply of pure and wholesome water. They incline also to think that the plan suggested by Doctor Joseph Brown for conveying the water of that river is, with some few variations, the most eligible that can be adopted. But as any mistakes in the plan or conduct of the business may be attended with incalculable mischief, they would recommend that Mr. Weston, who has been the engineer for the canal companies in this State, and whose abilities are well known, be requested to examine that river, with the situation of the grounds to be employed in the aqueduct, and such other matters incident to the supply of the city with pure and wholesome water from that or any other source, as he may think proper; and that he be requested to report his opinion to the Corporation, with the requisite plans and estimates, as soon as may be practicable.

Your Committee further report that they have considered the several modes which have been suggested for the execution, either by individuals or by the Corporation, of the plan that may be finally adopted. They are sensible that each of these methods is attended with difficulties; but, considering the immense importance of the subject to the comfort and health of their fellow-citizens, that it will not be undertaken by a company unless upon the prospect of considerable gain, and that such gain must be acquired at the expense of the city, your Committee have at length agreed that the undertaking ought to be pursued by, and under the control of the Corporation, as the immediate representatives of the citizens in general.

Under this impression, and to avoid any further delays which may arise, unless measures are taken to prevent pecuniary embarrassments and other difficulties in the course of the business, your Committee would recommend—

That an act be prepared and presented to the Legislature, investing the Corporation with the powers necessary to effect the great end they have in view, and granting them the moneys arising from the tax upon sales at auction in the said city, with such further aid as the Legislature may think proper to enable them by the reception thereof, or by loans founded thereon, to defray the expenses incident to the undertaking.

New York, 17th Dec., 1798.

JNO. B. COLES,
GABRIEL FURMAN,
JOHN BOGERT,
JACOB DE LA MONTAGNIE.

Read and approved in Common Council.

MR. WESTON'S REPORT ON SUPPLYING THE CITY WITH WATER. READ AND FILED MARCH, 1799.

*City of New York*, ss:

At a Common Council held on Saturday, the 16th day of March, 1799, the following Report of William Weston, Esq., on the practicability of introducing the water of the *River Bronx* into this city, made at the request of this Board, was read, and ordered to be printed, viz:

SIR: In compliance with the request contained in your letter of the 18th of December last, I have taken the earliest opportunity which my engagements and the state of the weather would permit, to ascertain the practicability of introducing the water of the Bronx into the city of New York; the result of which investigation I have now the honor of transmitting to you, requesting that you will lay the same before the Common Council, who, as the immediate guardians of the city, must feel peculiarly anxious to possess such information on the subject as may enable them to determine upon the propriety of the measures necessary to be taken to accomplish that important object.

I am sensible that *estimates* of the expense attendant on the execution, would have been a desirable piece of information; but a wish to render them as accurate as the uncertainty of the business will admit, induces me to request a further indulgence of time to procure information on several material points, essential to be known, previous to the completion of the necessary calculations, but with which I am at present unacquainted.

Though the *amount* of the expense ought, and doubtless will, have a proper degree of influence on the final decision, yet perhaps it is not a disadvantage, in the first instance, that the question should be determined on its abstract merits alone.

In an object of this nature, the first point to be fixed, is the *quantity* of water necessary to be delivered in a given time: was nothing more required than a sufficiency for culinary and other domestic uses, the matter might be easily ascertained. But as the principal object of this undertaking is the introduction of a copious and constant supply for cleansing and cooling the streets, it becomes a question of importance to determine, as near as may be, the amount of the required demand. Several specific quantities have been mentioned, but in my opinion they are all inadequate to the contemplated purpose. In this, as in all other undertakings, I conceive it to be an object of the first consequence to have the *effect* dependent on the *will*, and where, from the nature of the thing, no certain conclusions can be obtained, it is wisest to err on the safe side.

Whatever doubts may be entertained of this deduction as a general principle, I believe there can be none, respecting the propriety of it in the present instance; for, however great the amount of the surplus water may be, there are a variety of useful and productive purposes to which it may be advantageously applied. Proceeding on this ground, I have endeavored to calculate, as near as the want of sufficient data would enable me, the *minimum* quantity necessary to be introduced in twenty-four hours.

Though conclusions deduced from hydraulic principles of the *expense* of water

issuing from pipes of given diameters, placed on the summits of the several streets, would have been much preferable to vague guesses; yet the infinite variety of cases, arising from different degrees of *depression* below, and *distance* from, the principal reservoir, would have rendered the operation a very laborious one, and, from a variety of causes, the result very uncertain. Indeed, every mode with which I am acquainted, may be objected to on the latter principle; but though it is perhaps impossible to ascertain the *exact truth*, we must endeavor to approximate as near thereto as possible. Conceiving it to be the intentions of the gentlemen who have recommended the measure of washing the streets, as essential to the health of the citizens, to have a regular and plentiful current of water running at least *twelve hours* every day, through all the streets, by means of pipes placed at their respective summits, producing an effect similar to what we may observe to be done by a moderate *shower of rain* of the same duration; calculating, therefore, the area of the city, the quantity of water usually descending in the time above mentioned, and making due allowance for such parts of the general surface as are pervious to water, we shall obtain a result that perhaps on the whole will be as near the truth as can be done by any other mode, and sufficient to answer every purpose required. I find that the area of the city, bounded by the East and North rivers, and the intersection of them by Grand street, is upwards of 750 acres, and, making an allowance of 350 for public squares, gardens, and other unpaved surfaces, we have a remainder of 400 acres, which, being unpenetrable to the *rain*, all that falls on that surface must be discharged by means of the *channels* of the different streets into the adjacent rivers. I have made various inquiries, but have not as yet received any correct information of the quantity of water produced by a moderate shower of twelve hours' continuance; I am, therefore, under the necessity of assuming as a fact, what may hereafter be proved to be erroneous, though I have reason to believe that my calculations will not be found to be *overrated*.

Fixing, therefore, the depth, as shown by the rain-gage at one-fourth of an inch, we shall find the total amount to be 363,000 cubic feet, or 2,221,560 ale gallons, and adding to this, 778,440 gallons as an adequate supply for domestic consumption, we shall have *three millions* of gallons to be introduced into the reservoir every twenty-four hours.

I beg leave to observe, that an increase or diminution of the above quantity may be effected by *one* of the plans submitted to your consideration, without materially altering the design or enhancing the estimate, while by the other, the *expense* will be nearly proportioned to the quantity required. I offer the preceding calculations merely as an essay to determine a point, which as yet has remained undiscussed, though of such importance that I deem it the basis of the whole work. I shall readily yield to any valid reasons that may be produced in support of variations from the above conclusions.

The *quantity requisite* being determined, the next point to be ascertained, is from what *sources* it can be most conveniently derived. I am acquainted with but two modes that deserve any consideration. The first is the introduction of a *part* or the *whole* of the waters of the Bronx; the second is a supply

obtained from the springs of the Collect. As this question has much agitated the public mind, and each plan in its turn been extolled or decried by their respective advocates and opponents, it has produced (what is too frequently the effect of a collision of sentiments) a more obstinate attachment to preconceived opinions. I do not, therefore, expect that any arguments which I shall produce, will reconcile the jarring interests; yet I trust that the statement I shall offer, (and it is the result of some experience and reflection,) will enable those whose province it is to judge of the merits and disadvantages of the different *plans*, to select *that* which, on the whole, shall he most conducive to the public welfare.

In order to form a correct opinion on the subject, it is necessary to take into consideration the *efficiency* of supply—the *quality* of the water, as it respects the different uses to which it is to be applied, and the *expense* of execution.

On the first of these heads, I am aware that it has generally been believed, and pretty confidently maintained, that at those seasons when the demand will be greatest and most essential, that the waters of the Bronx are wholly inadequate; these assertions have been made with a degree of positiveness that would induce one to believe they were founded on the most careful and accurate *experiments*, which I have every reason to imagine have as yet never been made, instead of which, I have do doubt they are the random guesses of superficial observation. The question is of such importance, that we ought to be very careful that we proceed upon the most certain ground. In a matter of this consequence, I may be allowed to be a little diffuse.

It is evident that at the period when the greatest supply of water is wanted, there will, from natural causes, be the least quantity furnished; this is a common principle, applicable to all rivers and springs; the very few examples to the contrary, are mere exceptions to the general rule. This circumstance has created doubts in the minds of many persons of the efficiency of the Bronx. Previous to my examination of that stream, I had regretted that proper experiments had not been made at the season above alluded to, as then the fact would have been ascertained beyond all dispute. It is universally allowed that, for the greatest part of the year, there is a superabundant quantity; what the diminution may be, is not now easily ascertained; we must rely altogether upon the information of those persons whom a long residence has afforded the best opportunities of judging of its usual decrease; but, as not materially interested on the subject, we cannot expect any considerable degree of accuracy in their observations. Allowing for this circumstance, I have been careful to take the lowest average of the results of three distinct cases, founded on the best data I could procure, and applying to them well-known hydraulic laws. I am persuaded that the natural stream of the Bronx alone, if conveyed without waste, would be fully adequate to the supply before mentioned; but, fortunately, a minute accuracy is not required, as will appear by the following account of the

RIVER BRONX,

whose principal source is from a lake, about four miles to the northward of the White Plains, known by the name of Rye Pond. This is a beautiful sheet of

water, upwards of a mile in length, containing, as appears from an old survey, upwards of 500 acres of water, which, flowing from the outlet, is received into another pond, a short distance below, whose area exceeds fifty acres. From this pond it descends, with a rapid current, upwards of a mile to Mr. Robins's mill; a few rods below which, it unites with the other branch of the Bronx. This last, which has its origin in a swamp a few miles to the northward, retains the name of the Bronx to its source; yet it is the least considerable stream, particularly in the summer, when it is reduced to a small current; while the other branch is sufficiently large to turn an overshot wheel twelve hours out of twenty-four, in the driest times. Rye Pond is bounded by high and bold shores, which, tending towards each other at the outlet, are admirably calculated for the formation of an immense reservoir. This being filled during the winter and spring, may be retained until the month of July, when the natural supplies begin to diminish; it may then be discharged periodically, so as to afford any given quantity of water that may be requisite for the use of the city. This lake is supplied wholly by springs, many of which are internal, and few of the others originate more than a mile from the head. These are so constant and copious, that no doubt can arise of their capacity to fill the reservoir to the contemplated height of *six feet*, which may easily be effected by throwing a dam across the outlet of the lower pond. This would form a sheet of water of more than 600 acres in extent, containing 959,713,920 gallons of water; affording (independent of the natural stream of the Bronx,) a diurnal supply of nearly *eight millions* of gallons for 120 days, three-eighths of which quantity is sufficient for our purpose. The surplus, *five millions*, may be given to the mills below the point of partition; so that, instead of injuring (and consequently recompensing them for the damages) the mills on the Bronx, as has been generally apprehended, they will derive essential benefits from the measure. Having, I flatter myself, removed the doubts of the most incredulous, respecting the efficiency of the supply to be derived from the Bronx; it remains to examine the competency of the waters of the Collect. The general bias of opinion seems to lean in favor of this scheme; and if it can be made satisfactorily to appear that the required supply can be obtained from this source, I am ready to allow that it is a work that would be soonest accomplished, and attended with the least expense. But we ought to be extremely cautious in hazarding an experiment where the *cost* would be so great, and the *event* so doubtful. The question is of infinite importance, and, unfortunately, one that cannot be determined by abstract reasoning. The *capacity* of the Collect has been attempted to be proved by its present extent; but that, in my mind, is a most fallacious mode of reasoning; for, however great that may be, a powerful steam engine would soon exhaust it, unless replenished with numerous and copious springs. On these alone, therefore, it is evident we must depend, and I know of no other mode of estimating their combined effect than by calculating the quantity of water issuing from the outlet of the Collect, which, even at this time, is so inconsiderable as scarce to deserve attention, and, if my information is correct, it ceases to flow altogether in the summer. I am sensible that we should not too hastily conclude that the above is the total amount of the supply that may be derived from this source.

I think it very probable that, from the nature of the surrounding ground, which is a coarse and porous gravel, a considerable portion thereof may percolate through, into the adjacent rivers. Much, and perhaps the greatest quantity, is also daily drawn off by the Tea-water Pump, which, from its vicinity, I have no doubt, is supplied from the same source. It is true, that by sinking deeper into the earth, an augmentation of *quantity* would be procured; yet, if we went lower than the surface of the tide-water, I apprehend that the *quality* would be materially injured. Leaving the question, as I fear it will remain, undetermined, we next proceed to examine the *quality* of the respective waters. To appreciate their merits fairly, we should judge of their utility by the extent of their application. Proceeding on this ground, I believe it may be safely affirmed that the water of the Bronx is at least equal to that of the Collect, though this is contrary to the general opinion; the only reason that I can perceive for the preference usually given to the last mentioned, arises solely from its superior coolness: however grateful this may be to our feelings, it does not follow that it is equally conducive to our health; for whatever degree of purity it may now possess, the period is not very remote when, from the natural increase of the city, these springs must be subject to those contaminations which have already rendered so many wells unfit for use; an evil that is daily increasing, and to which no effectual remedy can be applied. This, to me, has ever appeared an insurmountable objection. The idea of supplying a large city with *pure* water from a reservoir in its *centre*, has always been a very strange one to me. From the representations made respecting the water of the Bronx, I believe many persons have hastily concluded that it was unfit for use. When it is considered that the principal cities in Europe are necessarily supplied from *rivers*, and with water generally taken from those parts which, from a variety of causes, are most impure, and yet that the experience of ages has not evinced any known ill effects arising from the practice, I conceive that little fears will be entertained of the salubrity of the water of the Bronx, which is a collection of innumerable springs, issuing from a rocky and gravelly country, and running, with a rapid current, over a bed of the same materials. It will be conveyed into the city without any additional impurity, and, ere it is distributed from the reservoir, will, by a mode of purification hereafter described, be rendered as clear as spring water.

The next object to be ascertained is the *practicability* and *probable expense* of accomplishing the respective plans. And here it may not be amiss to observe, that in a matter of such immense consequence to the present and future convenience and welfare of the city, every local view, every subordinate consideration, should yield to the general good—that a regard to the primary object alone should decide the question, regardless of a paltry difference of expense, or the immediate emolument to be derived from the undertaking. On the first of the above-mentioned heads there have been a diversity of opinions, which, previous to an actual survey, was not to be wondered at. These doubts must now be removed, as it appears from the examination that has been recently made, that the Bronx is sufficiently elevated above the highest parts of the city to introduce its waters therein without the aid of machinery; and the intermediate ground, though very irregular, presents no obstacles which art and industry may not

surmount. A general view of the subject is all that I am now able to present, and all that is necessary to be known, in this stage of the business. An outline of the plan I would recommend for adoption, as best adapted to the varying face of the country, will be sufficient to enable you to form a tolerably correct idea of the eligibility of the measure. The best situation I have yet seen to draw the water from the Bronx, is a short distance above Mr. Lorillard's snuff-mill. A break in the western bank enables us to divert the stream, by means of a dam thrown across it, without any difficulty. The water being raised six feet above its natural level, will flow over a small swamp, from which originates the little rivulet called Mill brook; following the direction of this stream, a canal may be drawn along its northern bank at a small expense, for the distance of three miles, when the ground falling off rapidly, renders it necessary to cross the valley in which Mill brook runs, by means of an aqueduct, to the opposite rising ground, along which the level may be preserved to the heights above Harlem river. An open, walled canal, will be the cheapest mode of conveying the water so far; a little loss is not material, as a small increase in the section will remedy such waste. A declivity of six inches in a mile, with a section of 1152, and linear border of 89 6-10ths inches, will occasion a velocity in the current sufficient to introduce into the small reservoir at the extremity of the canal 6 cubic feet of water per second, which is more than the quantity required, supposing the daily supply to be *three millions* of gallons. The most difficult and expensive part of the route will be the conveyance of the water across Harlem river. The most eligible mode of effecting this, appears to me to be by means of cast iron cylinders, of two feet diameter, with a difference of 8 feet between the extremities. This descent will produce a velocity of 22¾ inches per second, yielding, in that time, 5 95-100ths cubic feet, while the required quantity is only 5 65-100ths. From the cylinder to the reservoir it is a matter of consequence to preserve as much of the water as possible; to effect this object, the bottom and sides should be rendered impervious to that element. An absolute necessity to preserve a regular and uniform descent, leaves us little room in the choice of our route, which will be chiefly along the shore of the North river. The *quality* and *make* of the ground vary much. The greatest impediments are occasioned by the numerous ravines which intersect the line of the canal. Over all these, aqueducts must be constructed. The level may thus be preserved upwards of six miles, or within two miles of the city; there it descends so much, that unless higher ground can be found, it will again be necessary to have recourse to iron cylinders to convey the water into the Grand Reservoir, which may either be placed in the Park, or a vacant piece of ground to the northward of the Hospital, either of which are sufficiently elevated to distribute the water through all parts of the city. The total distance from the Bronx to the Park is 14 miles, 7 furlongs, and the descent twenty-three feet. It is to be observed that the principal object of this survey being to ascertain the practicability of the plan, and neither my time nor the season permitting that minute investigation which is necessary to be made, previous to the commencement of any operations, there is a probability that advantageous deviations may be made from the route pursued.

Although the *form* and *dimensions* of the reservoir are objects of importance, it is now premature to point out the particular mode of construction I would recommend to be adopted. Yet it may not be improper to give a general outline thereof, as perhaps it may tend to remove many of the prejudices which have been entertained against the supposed impurities of the waters of the Bronx. It is proposed to divide the reservoir into *three parts*, two of which will again be subdivided, each of these minor divisions capable of containing a daily supply of water. The first division, or reservoir of *reception*, will contain the water as immediately delivered by the cylinder of discharge. While one of its subdivisions is filling, the other, in a quiescent state, will be depositing the adventitious matter, with which the water may be intermixed. After so remaining twenty-four hours, it will be drawn off by an aperture near the bottom, (so as to prevent any buoyant particles from entering,) into the reservoir of *filtration*, where it will still further purify itself, by gradually depositing the remaining sediment, until it is finally received into the reservoir of *distribution*, after percolating through a bank of washed sand and gravel, in imitation of that natural process to which all water owes its purification. This last reservoir it is proposed to arch over, so as to preserve the water pure and cool; from hence it will be distributed, in separate and distinct pipes, through every part of the city.

The water destined to cleanse and cool the streets may be taken immediately from the reservoir of reception, as I conceive it is not necessary that it should be very pure.

The surplus water, which for a considerable part of the year will not be wanted for washing the streets, may be applied to a variety of purposes, but perhaps to none more useful or advantageous than the supplying of dry-docks, which may be constructed to receive the largest ships.

If the water in the Collect is deemed adequate to all the purposes of domestic consumption, it must be raised, by means of a steam engine, into a reservoir. The situation before mentioned will, in this case, be very convenient. Although one engine might be constructed so as to raise both the water for washing the city and for family use, yet, as from the quantity necessary to be raised, it would be unwieldy in its parts, and more liable to accident, and, also, as two-thirds of its power would be useless the greatest part of the year, I believe it will be most advisable to erect two. The first, destined to raise the water for cleansing the streets, placed at the foot of the hill to the northward of the Hospital, which would be supplied with water from a reservoir made in the adjacent low ground. This would be replenished twice in twenty-four hours by the tide, by means of an open canal, or culvert, communicating with the reservoir. The small engine might be placed near the other, the pump well being supplied with water from the Collect, conveyed in a culvert or pipes. The following calculations of the dimensions of the largest engine will be found sufficiently correct to enable you to form a tolerable idea of the annual expense attendant on it. Admitting the quantity (as before calculated) to be sufficient, we find that 2,200,000 gallons, or 359,640 cubic feet, must be daily raised. Supposing the engine to work sixteen hours out of twenty-four, we have 22,477 feet to be raised every hour, or nearly 375 every minute; estimating ten strokes

to be made in a minute, each stroke must yield 37½ feet; but as pumps generally fail in producing the calculated quantity, say 40 feet per stroke; and if the lengths of the strokes are 8 feet, it will require a pump of 30 27-100ths inches diameter. But a pump of that dimension would not answer in practice; it will be necessary, therefore, to diminish the diameter, and increase the number of pumps; six of 12 3-10ths inches will be equal in area to that before mentioned. As the water would be raised about 50 feet, the weight of the column would be 15,613 lbs., which would require a cylinder of 44 2-10ths inches diameter (allowing the active power of Mess. Bolton & Watts's engines to be 8 lbs. on every circular inch). Such an engine would consume about 330 lbs. of coal per hour.

Having thus given you every information necessary to be known for your guidance, I shall conclude by remarking that my objections to the Collect—being founded on the doubts I entertain of its efficiency to supply the annually increasing demand of this improving city, and to the contamination its waters will be subject to—will be done away altogether, when it shall be made to appear that they are groundless. In such a case, there can be no question which plan is most eligible, as it respects the *time* and *expense* of execution.

I am, sir,

With respect,

Your ob't serv't,

WM. WESTON.

The Hon'ble RICHARD VARICK.

New York, March 14th, 1799.

Printed by order of the Common Council.

ROBT. BENSON,

*Clerk.*