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1843

A MEMOIR

OF THE

CONSTRUCTION, COST, AND CAPACITY

OF THE

CROTON AQUEDUCT,

COMPILED FROM OFFICIAL DOCUMENTS:

TOGETHER WITH AN ACCOUNT OF THE

CIVIC CELEBRATION

OF THE FOURTEENTH OCTOBER, 1842,

ON OCCASION OF THE COMPLETION OF THE GREAT WORK:

PRECEDED BY A

PRELIMINARY ESSAY

ON

ANCIENT AND MODERN AQUEDUCTS.

BY CHARLES KING.

NEW-YORK:
PRINTED BY CHARLES KING.
1843.

TO

THE PEOPLE OF THE CITY OF NEW-YORK,

WHO BY THEIR DELIBERATE VOTE,

INVITED AND CONSENTED TO THE TAXATION BY WHICH THE

VAST EXPENSE OF CONSTRUCTING THE

CROTON AQUEDUCT

WAS DEFRAYED;

AND TO

THE SUCCESSIVE COMMON COUNCILS,

WHO HAVE DILIGENTLY, INTELLIGENTLY, AND PERSEVERINGLY

CARRIED OUT THIS VOTE

TO A SUCCESSFUL AND MAGNIFICENT ISSUE,

THIS VOLUME,

RECORDING THE PROGRESS AND ACCOMPLISHMENT

OF AN ENTERPRISE, ALIKE GRAND IN DESIGN

AND BENEFICENT IN RESULTS,

IS INSCRIBED BY THEIR FELLOW CITIZEN,

CHARLES KING.

PREFACE.

In laying this volume before the Common Council and the public, it may be proper to state the circumstances under which it was undertaken.

In October last, after the Celebration which commemorated the completion of the Croton Aqueduct, the joint Committee of the Common Council, constituting the Celebration Committee, determined that a *Memoir* of this great and successful enterprise should be prepared, and by a unanimous vote confided the duty to the author of the following pages.

It was accepted with satisfaction, enabling him as it would, in recording the progress and completion of this noble and useful work, exceeding in grandeur and costliness any ever executed by a comparatively small community, to claim for the city of his birth and his affections, credit for that far-seeing and disinterested public spirit which, looking beyond the present, is content to endure and labor for remotest generations.

In effect, water might have been obtained adequate to the actual wants of the city at very much less cost, leaving to posterity the care of providing for its own need; but the more generous view prevailed, and, in deciding as the people of New York by their votes did, to construct an Aqueduct like those which, in attesting the grandeur of ancient Rome, still pour rivers into the streets of the fallen city,—

"Lone Mother of dead Empires!"

they furnished an admirable illustration of the public spirit and wise forecast of freemen.

In prosecuting the investigations necessary for this work—which, after all, is much in the nature of a compilation—such time only could be devoted to it, as might be snatched from the engrossing and Sysiphean labors of a daily newspaper.

Nevertheless, it is hoped that in the Preliminary Essay, in which a cursory examination and description is attempted of the chief ancient and modern aqueducts, as well as of the devices for supplying themselves with water in use among the earliest peoples—nothing material to the information of the general reader is omitted.

The Memoir of the Croton Aqueduct is compiled from official reports and documents, as for the most part is the sketch of the numerous attempts which, from an early day, were made by the citizens of New York, to insure a supply of pure and wholesome water.

In preparing the Preliminary Essay, it was necessary to look into many books, and their pages, when suited to the design in hand, have been freely availed of.

Frontinus is the great authority as to the Roman Aqueducts, and his treatise is nearly embodied entire in these pages.

Professor Charles Anthon's *Dictionary of Antiquities*, Stuart's *Dictionary of Architecture*, *Hydraulia*, a work published in London, by *C. Matthews*, in 1834, descriptive of water works in Great Britain, and the exceedingly clever book on Hydraulics and Mechanics, published in our city last year, by Thomas Ewbank, have furnished or indicated much of the material used in the Essay. To Ewbank's book particular obligation is acknowledged, alike for what is to be found in its pages, and for references they afford to other sources of information.

Many other miscellaneous works have been consulted — which are occasionally indicated in the marginal notes.

To *Mr. David T. Valentine*, the Assistant Clerk of the Board of Aldermen, the writer is greatly indebted for the means of compiling the *Memoir*. His long and faithful service in the office he holds—his remarkable familiarity with all that has been done by the corporation in relation to the water works, and indeed with all the other business, multifarious as it is, of that body—the methodical arrangements of his office, which enabled him at once to put his hand on any paper or document inquired for—combined with the most courteous and obliging disposition, have aided unspeakably in this compilation, and saved many a weary hour of fruitless research.

A few words as to the style in which the volume is published:

It was the earnest wish and desire of the Author, that a book, commemorating so magnificent an enterprise should be sent forth with some luxury of typography, and especially with the illustration of numerous engravings, and he earnestly pressed this view on the Committee. But considerations of economy seemed to them to forbid any unavoidable expense, and he was therefore reluctantly compelled to publish an unadorned volume.

Such as it is, it is submitted to those at whose bidding, and through whose gratifying confidence, it was undertaken, Messrs. HENRY E. DAVIES, EDWARD D. WEST, CLARKSON CROLIUS, JR., FREDERICK R. LEE, and CHARLES W. SMITH, of the Board of Aldermen, and GEORGE F. NESBITT, WILLIAM DODGE, RICHARD H. ATWELL, DANIEL WARD, and CHARLES J. DODGE, of the Board of Assistant Aldermen, and through them to the Common Council and the city, with the regards of their obliged friend and servant,

THE AUTHOR.

ROBERT H. MORRIS,

MAYOR.

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PRELIMINARY ESSAY.

WATER, as one of the elements alike of animal and vegetable life, has always been an object of man's attention. In the early ages, indeed, it was reverenced as the substance of which all things were supposed to be made, and the vivifying principle that animated the whole; hence rivers, fountains, and wells were worshipped, and religious feasts and ceremonies instituted in honor of them, and of the spirits which were believed to preside over them.

This custom is not extinct among Pagan nations; for the "Sacred Ganges" yet receives the worship of millions of Hindoos, and the "Holy Well" in Benares is visited by devotees from all parts of India, with offerings of rice, &c.

Nor have Christian nations escaped this form of idolatry. In Europe the worship of wells was at one time universal; and even so late as the seventeenth century, according to Ewbank, people in Scotland were in the habit of visiting wells, at which they performed numerous acts of superstition. Shaw, in his History of the Province of Moray says, "that heathen customs were much practised among the people, such as pilgrimages to wells, and building chapels to fountains. At the present time, in some parts of England, remains of well-worship are preserved in the custom of performing annual processions to them, decorating them with wreaths and chaplets of flowers, singing hymns, and reading a portion of the Gospel as part of the ceremonies."

These same customs gave rise to the numerous *holy* wells which formerly abounded throughout the old world, and the memory of many of which is still preserved in names of towns.

In the church of Nanterre, near Paris, the birth-place of St. Genevieve, is a well, by the water of which this patroness of the Parisians miraculously restored her blind mother, and many others to sight! St. Winifred's Well, in Flintshire, England, from its sacred character, gave name to the town of Holywell. Mr. Pennant says, the custom of visiting this well in pilgrimage, and offering up devotions there, was not in his time entirely laid aside; "in the summer, a few are to be seen in deep devotion, up to their chins for hours, sending up their prayers, or performing a number of evolutions round the polygonal well."

In all ages and countries, from the most remote periods, a supply of the indispensable article—water—has been an object of solicitude, and various were the means by which it was obtained and diffused. In Asia, the original home of the human race, where rain seldom falls, and rivers and running streams are rare, wells were early devised. The antiquity, indeed, of this mode of obtaining and collecting water, goes beyond the records of history, sacred and profane; and hence we have no clue to the circumstances which led man to penetrate the earth in search of this element.

From very ancient wells which still remain, it is certain that long time anterior to the commencement of history, the knowledge of procuring water by means of them was well understood. On this supposition only can we account for many of them being perforated through rocks, some of the oldest wells known, being dug entirely through that material and to a prodigious depth.*

"The Jews," as is justly remarked by the Abbe Fleury, in his 'Manners of the Ancient Israelites,' "owing to their numerous herds of cattle, set a very high value upon their wells and cisterns, more especially as they occupied a country where there was no river but Jordan, and where rain seldom fell." It is to the East we are indebted for the only known method of sinking wells of depth, through quicksands and loose soil, by first constructing a curb, which settles as the excavation is deepened, and thereby resists the pressure of the surrounding soil.

The readers of the Bible will not need to be told of the well at which Hagar rested, when she fled from the ill treatment of Sarah, nor of the meeting of Rebecca, at the well of Nahor, with Abraham's servant, whom he had sent to procure a wife for his son Isaac, nor of Jacob's well, at which our Saviour met the woman of Samaria.

Numerous wells of great antiquity are still to be seen in Egypt, and among the ruins of Ninevah, a city of which the foundation was laid by Ashur, the son of an antediluvian, is a remarkable well which supplies the peasants with water, to which they ascribe many virtues.†

It was a common practice in those Eastern countries, to erect stations and place guards for the protection of wells against robbers, who, knowing that travellers would of

* Ewbank, p. 25.

† Capt. Rich's narrative of a residence at Koordistan, and on the site of ancient Nineveh.

necessity resort there, made them objects of attack; it is from this circumstance the old traveller, Sandys, speaks of them as "wells of fear."

The ancient Egyptians, resident beyond the reach of the inundations of the Nile, irrigated their land from wells, as do the Chinese to this day.

It was in digging a well in 1711, that the long buried ruins of Herculaneum were discovered, by the accidental striking upon some pieces of marble and statues, which subsequently proved to be part of a temple, situated in the midst of Herculaneum, buried by an eruption of Vesuvius, 1630 years before; and it is a fact interesting in itself and not foreign to our subject, to add, that among the remarkable discoveries of this long buried city, was a well in a high state of preservation, which, having been protected by a covering and surmounted with a curb, had been kept free from the lava and ashes. It still contains excellent water, and is in the same condition as when the last females retired from it, bearing vases of its water to their dwellings, from which they were never to emerge again.

The most remarkable well, probably, ever made by man, is Joseph's well at Cairo, of which we copy from Ewbank this brief and clear description:

"This well, which for magnitude and the skill displayed in its construction, has never been surpassed, is an oblong square, 24 feet by 18, being sufficiently capacious to admit within its mouth a moderate sized house. It is excavated of these dimensions through solid rock to the depth of 165 feet, where it is enlarged into a capacious chamber, in the bottom of which is formed a basin, or reservoir, to receive the water raised from *below*, for this chamber is not the bottom of the well. On one side of the reservoir, another shaft is continued 130 feet lower, where it emerges through the rock into a bed of gravel, in which the water is found, the whole depth being 297 feet. The lower shaft is not in the same vertical line as the upper one, nor is it so large, being 15 feet by 9. As the water is first raised into the basin by means of machinery, propelled by horses or oxen within the chamber, it may be asked how are these animals conveyed to that depth, in this tremendous pit, and by what means do they ascend? It is the solution of this problem that renders Joseph's well so peculiarly interesting, and which indicates such an advanced state of the arts at the period of its construction.

"A spiral passage way is cut through the rock, from the surface of the ground to the chamber, independent of the well, round which it winds with so gentle a descent, that persons sometimes ride up or down upon asses or mules. It is six feet four inches wide, and seven feet two inches high. Between it and the interior of the well, a wall of rock is left, to prevent persons falling, or even looking down into it except through certain openings, or windows, by means of which it is faintly lighted from the interior of the well; by this passage the animals descend which drive the machinery that raises the water from the lower shaft into the reservoir, or basin, from which it is again raised by similar machinery and other animals on the surface. In the lower shaft a path is also cut down to the water, but as no partition is left between it and the well, it is extremely perilous for strangers to descend. The water is raised in earthenware pots attached to endless chains or ropes, that as they pass over the wheel at the top, empty their contents into a trough and descend in a reversed position.

"This celebrated well resembles an enormous hollow screw, the centre of which forms the well, and the threads a winding stair-case round it. To erect of granite a flight of "geometrical" or "well-stairs," two or three hundred feet high, on the surface of the ground, would require extraordinary skill, although in the execution every aid from rules, measures, and the light of day, would guide the workmen at every step; but to begin such a work at the top and construct it *downward*, by excavation alone, in the dark bowels of the earth, is a more arduous undertaking, especially as deviations from the correct lines could not be corrected. Yet in Joseph's well, the partition of rock between the pit and the passage way, and the uniform inclination of the latter, seem to have been ascertained with equal precision as if the whole had been constructed of cut stone on the surface. Was the pit or the passage formed first, or were they simultaneously carried on, and the excavated masses from both borne up the latter? The extreme thinness of the partition justly excited the astonishment of *M. Jomard*, whose account of the well is inserted in the 2d volume of Memoirs of Napoleon's great work on Egypt. It is, according to M. Jomard, but sixteen centimetres, or about six inches, thick! It must have required singular care to leave and preserve so small a portion, while excavating the rock from both sides of it. It would seem no stronger, in proportion, than sheets of pasteboard placed on edge, to support one end of the stairs of a modern built house, for it must be borne in mind, that the massive roof of the spiral passage *next the well*, has nothing but this film of rock to support it, or to prevent such portions from falling as are loosened by fissures, or such as from changes in the direction of the *strata*, are not firmly united to the general mass. But this is not all; thin and insufficient as it may seem, the bold designer has pierced it through its whole extent with semicircular openings, to admit light from the well.

"Opinions respecting the date of this well are exceedingly various. *Pococke* thought it was built by a vizier named Joseph, 800 years ago; other authorities more generally attribute it to *Saladin*, the intrepid defender of his country against the hordes of savages, who, under the name of Crusaders, spread rapine and carnage through his land. His name was Yussef (Joseph).

"By the common people of Egypt, it has long been ascribed to the patriarch of that name, and their traditions are often well founded. *Van Sleb*, who visited Egypt several times in the 17th century, says some of the people in his time thought it was digged by spirits; and he adds, "I am almost inclined to believe it, for I cannot conceive how man can compass so wonderful a work." Some writers believe this well to have been the work of a more scientific people than any of the comparatively modern possessors of Egypt—in other words, they think it the production of the same people that built the Pyramids, and the unrivalled monuments of Thebes, Dendarah, and Ebsamboul.

"Lastly, Cairo is supposed by others, to occupy the site of Egyptian Babylon, and this well is considered by them as one of the remains of the ancient city. Amidst this variety of opinion respecting its origin, it is certain that it is every way worthy of the ancient mechanics of Egypt, and in its magnitude exhibits one of the prominent features which characterize all their known productions.

"Why was this well made oblong? Its designer certainly had his reasons for it. May not this form have been intended to light more perfectly the interior, by sooner receiving and longer retaining the rays of the sun? With what point of the compass its longest sides coincide, has not, that we are aware, been recorded. Should they prove to be in the direction of the rising and setting sun, the reason suggested may possibly be the true one."

To complete this notice of wells, it may be added that in our own country, according to Mr. Flint, ancient wells have been found. "From the highest point on the Ohio, to St. Charles on the Missouri, and far up the Upper Mississippi and Missouri, the more the country is explored and peopled, and the more its surface is penetrated, not only are there more mounds brought to view, but more incontestible marks of a numerous population. *Wells artificially walled*, different structures of convenience or defence, have been found in such numbers as no longer to excite curiosity."

For a long period, the only mode of raising water from wells, was by letting down vases or buckets into them by a cord, but gradually the pulley and windlass succeeded, and even irrigation in Eastern countries, upon which the success of their agriculture depends, was carried on by water thus raised from wells, and borne by laborers to the field.

The excessive labor and inconvenience of this practice, led to the formation of vast tanks for the collection of water, from which it might be conducted in open channels to the points proposed. In comparison with some of these tanks, our largest reservoirs sink into insignificance. "In the Carnatic, it is recorded, that there are tanks *eight miles* in length and *three* in breadth. In Bengal, they frequently cover one hundred acres, and are lined with stone." *Knox*, in his Historical Relations of Ceylon, says the natives formed tanks two or three fathoms deep, some of which were in length above a mile.

The next step in the use of water, was to raise it above its level, and the machines for this purpose are of very ancient date. The *Jantu*, which has for centuries been, and still is, used in Hindoostan to raise water for the irrigation of land, is thus described by Mr. Ward in his History of the Hindoos. "It consists of a hollow trough of wood about fifteen feet long, six inches wide and ten inches deep, and is placed on a horizontal beam supported on bamboos. One end of the trough rests upon the bank, whether of a pond, river or tank, where a gutter is prepared to carry off the water, and the other is dipped into the reservoir or river, by a man on a stage plunging it in with his feet. A long bamboo with a large weight of earth at the extremity, is fastened to the end of the Jantu next the river, and passing over the gallows before mentioned, poises up the Jantu full of water, and causes it to empty itself into the gutter. This machine raises the water three feet, but by placing a series of these one above another, it may be raised to any height, the water being plunged into small reservoirs sufficiently deep to admit the Jantu above to be plunged low enough to fill it. Water is thus conveyed to the distance of a *mile* or more." A more efficient machine than this, and even more ancient is the *Swape*, or common balance-pole, which is employed so universally in the wells of our own country, and which was employed *thirty-four* centuries ago, by the

Egyptians, as appears from sculptures dating back to 1532, B. C., on which these machines are represented, and more especially from the remains of one recently discovered by Mr. Wilkinson in an ancient tomb of Thebes. All nations, ancient and modern, employed this machine; and the Long Island and New Jersey farmer now raises water from his well, by the same contrivance in use in the time of the Pharoah's.

The *Swape* is still in constant use on the Nile, particularly in Upper Egypt, where the banks are more elevated, and in which consequently, successive basins of rock or puddled earth are made to receive the contributions of each bucket. The average lift of the Swape is *seven feet*, and by a series of these, one above the other, the water is finally delivered on the summit of the bank, thence to irrigate the vast plains beyond. The chain of pots is also seen side by side with the Swape, and is the more efficient mechanism, by delivering the water at once at the summit. It is, moreover, worked by animal power—and but that it is taxed by the government double the sum paid by the Swape, would probably supersede it.

The tympanum, the noria or Egyptain wheel, the Persian wheel, the chain of pots, and the screw, all improved devices to raise water, were of very ancient use—and so remained until the introduction of the pump.

The chain-pump, which is in fact only a modification of the chain of pots, by passing the chain through a tight tube, round or square, and for pots substituting wooden or metallic pallets or pistons, fitting the interior of the tube and pushing the water before them, was known in China from the earliest ages, but does not appear to have been introduced into Europe till about the middle of the seventeenth century; they are chiefly used now in an improved form on board ships of war.

The ordinary pump, or sucking-pump, as it was at first called, though evidently known to the Greeks and Romans, and used in their ships, does not seem to have been much employed by them for domestic purposes. It was not till the fifteenth and sixteenth century that pumps became common and superseded the more ancient devices for raising water—and even then the principle upon which the water was raised was little conceived of. The old doctrine of Aristotle, that nature abhorred a *vacuum*, was supposed to explain the whole matter, until one day a Florentine pump-maker having constructed a pump some 60 feet long, was astonished to find that he could not raise water in it more than 32 feet. As the Greek philosopher had not assigned any limits to nature's abhorrence of a *vacuum*, it presented quite a problem, why in a pump it was found to be limited to a height of 32 feet. *Torricelli*, the disciple of *Galileo*, and after him, *Pascal*, the author of the admirable *lettres provençales*, which so victoriously expose the dangerous and insidious doctrines of the Jesuits, by the most beautiful and conclusive experiments, overthrew the long received notion of nature's abhorrence of a *vacuum*, and demonstrated that the rising of water in the chamber of the pump, was produced by atmospheric pressure.

As human beings were aggregated into larger societies, and the progress of civilization and refinement produced new and artificial wants, all the known modes of obtaining water from wells, springs, fountains and rivers, were found insufficient, and it became an object to devise some more compendious as well as abundant system of supply, and hence the resort to aqueducts.

As nearly all the ancient aqueducts, of which there are still any remains, are of Roman construction, it has been generally believed that works of this description were entirely unknown to other people. This, however, is an error. Among the Greeks, some are mentioned by Pausanias and others. But no particular description of these structures has reached us, and we are therefore left to conjecture. As the use of the arch was, according to the received opinion, unknown to the Greeks, as well as the law of hydrostatics, that water will rise to its own level, it seems difficult to understand how they could pass water over valleys or streams; and the inference seems reasonable, that their aqueducts, such as those built by Pisistratus, at Athens, that at Megara, and the celebrated one of Polycrates, at Samos, mentioned by Herodotus, were rather conduits than ranges of buildings like the Roman aqueducts.

But, at a period antecedent probably to the construction of these Grecian aqueducts, King Solomon, one thousand years before the Christian Era, appears by the accounts of modern travellers, to have constructed a similar work.

In the Universal History, vol. II, p. 441, we find the following statement:

AQUEDUCT OF SOLOMON.

"The pools of Solomon, so called, from his being commonly allowed to have caused them to be made, in order to supply not only his palace and gardens, but as some think, even the city of Jerusalem with water, appear still by what remains of them, to have been a work of immense cost and labor, and worthy of that great monarch. The same we may say, of the sealed fountains, which lie opposite to them, towards the north-west corner of the same hill, in the neighborhood of Bethlehem. These pools are three in a row, one over the other, and so disposed that the water of the uppermost may descend into the second, and from the second into the third. They are quadrangular, and of an equal breadth, viz., about 90 paces; but in length they differ, the first being 160 paces, the second, 100, and the third, 220. All three are of a considerable depth, well walled and plastered, and contain a large quantity of water. About 120 paces distant is the spring which supplies them with water. The aqueduct is built on a foundation of stone, and the water runs in earthen pipes, about 10 inches in diameter, which are cased with two stones so as to fit them; these are covered over with other, but rough stones, well cemented together, and the whole is so sunk into the ground on the side of the hills, that in many places nothing is to be seen of it. This work did formerly extend the length of five or six leagues, and appears by the strength and contrivance of it to have been designed to last as long as the world."

Maundrel, an English traveller, and consul at Aleppo, visited Judea in 1697, and published an account of his travels from which we make this further extract, concerning Solomon's Aqueduct:

"At about 140 paces from Solomon's pools, is the fountain from which principally they derive their waters. This the friars believe to be that sealed fountain to which the Holy Spouse is compared, [Cant. 4, 12,] and in confirmation of this opinion, they pretend a tradition, that Solomon shut up these springs and kept the door of them sealed with his signet, to the end that he might preserve the water for his drinking in the natural freshness and purity. Nor was it difficult thus to secure them, they rising under ground, and having no avenue to them but a little hole like the mouth of a narrow well. Through this hole you descend directly down, not without some difficulty, for about four yards, and then arrive in a vaulted room fifteen paces long, by eight broad. Joining to this, is another room of the same fashion, but somewhat less. Both these rooms are covered with handsome *stone arches*,* very ancient, and perhaps the work of Solomon himself. You find here four places at which the waters rise; from these separate sources it is conveyed by little rivulets into a kind of basin, and from thence is carried by a large subterranean passage down into the pools. In the way, before it reaches the pools, there is an aqueduct of brick pipes which receives part of the stream, and carries it by many turnings and windings about the mountain to Jerusalem."

Again, in speaking of the environs of Bethlehem, the same traveller thus more particularly describes this aqueduct:

"About two furlongs beyond David's well, lying west of Bethlehem, are to be seen remains of an old aqueduct, which anciently conveyed the waters of Solomon's pools to Jerusalem. This is said to be the genuine work of Solomon, and may well be allowed in reality, what it purports to be. It is carried all along on the surface of the ground, and composed of stones† —— feet long, and —— feet thick, perforated with a cavity of —— inches diameter, to make a channel. These stones are let into each other with a fillet, framed round about the cavity to prevent leakage, and united to each other with so firm a cement, that they will sometimes sooner break (though of a coarse kind of marble) than endure separation. This train of stones was covered, for its greater security, with a case of marble stones laid over it in very strong mortar. The whole work seems endued with such absolute firmness, as if designed for eternity. But of this strong aqueduct, which

* If this be accurate, and "stone arches," or arches of any kind really existed, then it would decide, that the construction was *not* by Solomon, since in the detailed descriptions of his magnificent temple, no allusion is made to arches, which undoubtedly would, if known, have been resorted to in such an edifice.—[Ed.]

† The traveller evidently supposed the stones in which the earthen pipes were tightly enclosed, to have been the pipes themselves.—[Ed.]

was carried formerly five or six leagues, the Turks have left only here and there a fragment remaining."*

Dr. Pococke, another English traveller, who visited the same region about half a century later, presents a nearly similar account of these works.†

"We spent," says he, "another day in seeing the pools of Solomon. Descending the hills of Bethlehem to the south, we passed over a narrow valley and ascended the opposite hills, on the sides of which there is an aqueduct which conveys the water from the sealed fountain to Jerusalem. It here winds round the side of these hills, and is afterwards carried through the plains to Jerusalem, on a level with the surface of the ground. * * * A little beyond this place, we came to the pools of Solomon, as they are commonly called, for there is a tradition that these were made by him, as well as the aqueduct, which seems to be confirmed by a passage in Josephus, who says there were pleasant gardens abounding with water at Epham, about 50 furlongs, or 6 1-4 miles from Jerusalem, to which Solomon used frequently to go. * * * The Talmudists also mention that the water was brought by Solomon to Jerusalem, from the fountain of Epham, so that it is very probable these are the works of Solomon, as well as the aqueduct, though no express mention of it is made by any author, so as positively to fix it to this place. * * * The aqueduct is built on a foundation of stone, the water runs in round earthen pipes about 10 inches diameter, which are cased with two stones hewn so as to fit them, and they are covered over with rough stones well cemented together, and the whole so sunk in the ground on the sides of the hills, that in many places nothing is to be seen of it."

It seems, however, to have been reserved for Rome and her great race, to exhibit what science, united with labor and wealth, could accomplish in this way for the health, comfort, and luxury of its citizens.

Both Pliny and Vitruvius treat of Aqueducts, and their descriptions are curious, as giving the methods used in the construction of these works, among the greatest wonders of Rome, and as indicating a knowledge of some hydrodynamical laws, the discovery of which is usually assigned to a much later period.

Ducts of water according to Vitruvius, were of three kinds—channels of masonry, leaden pipes, or tubes of fictile ware, according to the following rules; when channels are used they should be made as solid as possible, and the bed of the stream should have a descent not less than half a foot in 100 feet, and they should be arched over, that the sun's rays may not touch the water. When the water arrives at the city, a *castellum* or reservoir is built, and a triple emissary to receive the water is adjoined to it. In the *castellum* are three pipes, equally disposed within the adjoining recep-

* Vide Maundrel, in Pinkerton's Collection—[Asia] vol. iv., p. 350. 1.

† Vide Pococke, in Pinkerton's Collection—[Asia] vol. iv., p. 439.

tacle, so that when there is too much water, it may from the sides be discharged into the middle receptacle. In the middle channel are fixed the pipes leading to all the cisterns or fountains, in another, those to the baths, which pay to the people a yearly tribute, and in a third, those to the private houses, if it be not wanted for public use, for they could not return it if they might have peculiar ducts from the spring head. This disposition is established, because by the tax on the water carried to private houses, the State keeps the aqueduct in repair.

But, should mountains intervene between the city and the spring head, a subterranean passage is to be dug through the earth, having the declivity of one part in two hundred, and should the soil be either gravel or stone, a channel is to be cut into it, but walls are to be built to conduct the water through the earthy or sandy soils. Wells also, or air-holes are to be cut from the top of the water-channel to the surface, for the purpose of allowing the *air* which might *accumulate* in the aqueduct to escape. These wells are directed to be placed at a distance of 120 feet.

If the water be conducted by leaden pipes, a *castellum* or reservoir is first built at the spring head, then the diameter and strength of the pipes being suited to the quantity of water, they are to be carried from the castellum to that which is in the city. The pipes are not to be less than ten Roman feet in length, and were named from the breadth of the lead before it was rounded into a pipe.

The manner of conducting water by pipes is thus regulated; if the spring head had a sufficient current to the city, and no higher hills intervened, the interval is, by walling, raised to a proper level, as mentioned in the description of channels of masonry, or else a circuit round may be taken if not very long; but if there be frequent valleys, the courses are to be directed down the declivities, and when arrived at the bottom, a sub-structure is to be built, but not high, that the *libramentum*, (or level, or counterpoise,) may be as long as possible—this will be the *venter*. When arrived at the opposite declivity, as on account of the length of the *venter*, the water swells gently, it is pressed upward to the top of the ascent; whereas if the venter should not be made in the valley, nor a sub-structure built level, but should be bent, the joints would be destroyed. In the venter, also, *columnariæ* are to be raised, through which the force of the vapors may be dissipated. These columnariæ are supposed to have been always open at the top, and to reach above the level of the aqueduct.

It was not unusual, when the level from the spring head to the city was obtained, to erect a castellum at every 200 actus* distance, that if damage should happen at any place, the whole work needed not to be taken down, and that the defective part might

* The actus is 120 feet, according to Columella and Pliny, as quoted in notes to Vetruvius, p. 170.—[Ed.]

be the more readily found. But those castellums are to be built neither in the decursions, nor in the plane of the venter, nor in the pressures on the part of the aqueduct where the water is raised by the weight or pressure of the descending water, nor in any of the valleys, but always in the even plane. But when it was required to conduct water at less expense, tubes of earthen-ware were made, having a thickness of not less than two inches, and these tubes were so formed that one end being tongued, the one entered the other — then the joints were cemented with quick lime, tempered with oil. In the descents, level with the venter, a stone of the red kind is to be placed at the angles, so perforated that the last tube of the decursions and first on the plane of the venter may be joined to the stone; so likewise at the opposite acclivity, the last in the plane of the venter, and the first of the expressure are to be in the same manner united to the red stone. Thus the tubes on the even plane, as well as those in the decursions, will not be split, for such violent vapors are apt to rise in conduits of water as would even burst through stone, unless the water was at first gently and sparingly admitted from the spring, and the bendings secured with ligatures or weights of ballast; in all other respects they are built in the same manner as leaden pipes. When first the water is admitted, ashes are sent before it, that if any of the joints should not be sufficiently cemented, they may be stopped by the ashes.

Aqueducts of tubes have this advantage — if any damage happen, any person may rectify it, and water from earthen tubes is far more wholesome than that from pipes, as the use of lead is found to be pernicious. We should not, therefore, conduct water in pipes of lead, if we would have it wholesome. The taste also of that from the tubes is better, as is proved by our daily meals; for all persons, although they have tables furnished with silver vases, use fictile ware on account of the purity of the water.

We add to this detailed extract from Vitruvius, the directions of Pliny for water conduits, chiefly because of the explicit assertion it contains of the law, that fluids will always rise to the level of their head.

"If," says this author, "a man would convey water from any head or spring, the best way is to use pipes of earth made by the art of the potter, they ought to be two finger's thick, and one jointed within another, so that the end of the upper pipe enters into the end of the under one, as a tenon into a mortice, or a box into the lid; these pipes ought to be laid even with quick lime, quenched and dissolved in oil. The least level to carry and command water up hill from the descent is 100 feet, but if it be conveyed by one canal only, it may be forced to mount 240 feet. As touching the pipes by means whereof the water is to rise aloft, they ought to be of lead; this is also to be observed, *that the water always ascends of itself at the delivery, to the height of the head whence it flowed.* If it be fetched a long distance, the work must rise and fall often, that the level may be still maintained; the pipes ought to be 10 feet long; the pipes were named from the number of finger's breadths of which the sheet of lead was formed before it was turned into the shape of a pipe, and they were also to be of different thicknesses. In every turning and winding of a hill, the pipe should be five finger's round, and no more, to repress and break the violence of the water in the current."

From this description of the mode in which the Roman aqueducts were constructed, it is obvious that the principles and precautions, which, as is sometimes supposed modern science has discovered and applied to such structures, were known and used at that early day. The declivity given to the channel was indeed greater than that usual in more modern conduits, but in other respects, few or no improvements or alterations in the manner of building and securing such works, seem to have been made.

It will, however, strike the reader with surprise, to find that leaden pipes were used and found equal to resist the pressure of columns of water, even in passing it down and up steep declivities. In subsequent pages, some remarkable instances of this will be presented. Iron pipes seem to have been wholly unknown to the Romans. Indeed, the first castings of iron we hear of, were made in England, as is related by Baker, in his Chronicles of the Kings of England, about the year 1545, in the 35th year of Henry VIII., by Ralph Hage and Peter Bawde.

Pipes of cast iron are now the only ones used for mains, or large distributing pipes. These may be made of almost any diameter, by duly increasing the quantity of metal contained in them. The largest pipes laid down in this city, are of three feet internal diameter, and in lengths of nine feet, weighing from 3,500 to 3,800 lbs. The largest diameter of leaden pipes used by the Romans, was of 12 inches internal bore.

Vitruvius lays down these rules for determining whether the waters that are to be introduced, be eligible: "If it be an open and running stream, you are carefully to observe the manners of men and their conformation, that live around its source — and if they be of robust frame, bright complexion, without deformed limbs, or blear eyes, the stream may be surely approved. Or, if the water thrown into a vessel of Corinthian brass shall leave no spot, it may be pronounced excellent. Or, boiled in a like vessel, and left to cool, if, when poured off, there shall be neither sand nor earth left at the bottom, it may be deemed good. Again, if vegetables boiled in it be rapidly cooked, it is an indication that the water is pure and wholesome."*

For 441 years after the building of their city, the Romans were content to use the water furnished by the Tiber, (the yellow Tiber,† as Horace calls it) by wells, or fountains.

* Vitruvius, chap. v., lib. viii.

† Ode 2, lib. E.

To the latter especially, as in some measure sacred, they showed a marked preference, and believed that bodily infirmities were cured by the salubrity of the waters from such sources ; but when the convenience and abundance of supply from aqueducts was once experienced, the enterprise, wealth, and luxury of the great city, very soon multiplied them, so that in the reign of Nerva, they were nine in number, pouring, without a figure, rivers into every part of Rome.

Of these magnificent and beneficial structures, we have quite a detailed account left us by *Sextus Julius Frontinus*—a man of consular dignity, who was appointed by *Nerva*, superintendent or chief commissioner of the Aqueducts—an office of great dignity as well as responsibility. The *curatores vel prefecti aquarum* were invested with considerable authority. They were attended outside of the city by two lictors, two slaves, a secretary, and other followers. Frontinus, on his appointment, very sensibly concluded, as he tells us at the outset of his treatise, that, "considering in this as in other affairs of life, that the first thing was to know and understand what he had undertaken," he set himself about collecting and noting down in order, all that related to the history, structure, size, and defects of the aqueducts committed to his charge, the abuses to which they were liable, and the laws for their protection.

From the treatise which was the result of this commendable resolution, we now proceed to borrow a description of the nine Roman aqueducts.

The *Aqua Appia* was the first structure of this sort erected at Rome. It was begun about the 442d year of Rome, or 312 years before Christ, and in the 31st year after the Samnite war, under the direction of Appius Claudius Crassus, the Censor, to whom the surname of Cœcus was given. With him was associated C. Plautius, to whom the name of *Venocis* had been awarded, for his zeal in searching out veins or supplies of water. Owing to some intrigue, however, of Appius, Plautius resigned his station before the expiration of two years, and Appius alone, therefore, enjoyed the honor of giving his name to the aqueduct, and to another noble work, which, by prolonging his censorship unlawfully, and through various artifices, he was enabled to complete, the *Via Appia*, from Rome to Capua.

The *Aqua Appia* had its source in the Lucullan territory, at about 700 paces to the left of the *Via Prœnestina*, between the seventh and eighth mile stone, and it ended, after making a circuit of *eleven miles and* 190 *paces*, at the Salinæ, near the *Porta Trigemina*, whence it was distributed about the Aventine Hill. It was all subterranean except 60 paces, which was carried on arches over the *Porta Capena*,* "the moist Capena," as Juvenal thence calls it. It was subsequently supplied by an additional stream,

* Juvenal Sat. iii., 11.

conveyed by Augustus, and called the *Gemellæ*, because of the junction. This began at the sixth mile-stone along the Via Prænestina, and the junction took place near the *Horti Torquatieni.** It is believed no traces of this aqueduct now exist, though Piranesi thought he discovered some conduits under the Aventine Hill, which might have belonged to it.

Forty years after the Aqua Appia was established, in the 481st year of the city, the Censor, Manlius Curius Dentatus, began the aqueduct, which afterwards was known as the *Anio Vetus.* The expense of this great work was defrayed out of the spoils of the Pyrrhic war. The Senate created *Decemvirs* to complete the aqueduct, naming Curius who had commenced it, and as his colleague, Fabius Flaccus. Curius died soon after the appointment, and the glory of terminating the work accrued to Fabius alone. The Anio Vetus began above Tivoli, at a distance of 20 miles from Rome, and before it reached the city, it had run by many turnings, in order to preserve the level, a course of 43 miles. Of this distance 42 miles, 779 paces were subterraneous, and 220 paces above ground.

Burgess conjectures that the remains of a *specus* or water channel near the *Porta Maggiore*, of modern Rome, just visible among the foundation of the walls, is all that now remains of this great work.†

At the end of 127 years, or in the year of Rome 607, Sulpicius Galba, and Lucius Aurelius, being consuls, it was found, owing both to the decay of the existing aqueducts, and the frauds by which individuals intercepted their water, that the supply was insufficient; the Senate therefore gave a charge to *Marcius*, to repair the old aqueducts, and to ascertain if some new supply could not be obtained. This led to the construction of the *Aqua Marcia*, of which Pliny thus speaks:

> "Of all the waters in the world, that which we call the *Marcia*, in Rome, carrieth the greatest name by the general voice of its citizens, in regard both to its coldness and salubrity, and we may esteem this water for one of the greatest gifts the gods have bestowed on our city."

To accomplish this work a sum of *mille et octigenties sestertium*, or, in our money, $3,210,000 was decreed to Marcius, and as the time of his prefecture was too short to bring so stupendous an undertaking to its termination, it was renewed to him from year to year. While the aqueduct was in progress, the Decemvirs, having occasion in relation to other matters, to consult the Sybilline books, ascertained that it was not the Marcian water, but the Anio, that should be conducted to the Capitol—but Marcius persisted, notwithstanding, and after three years delay, the Marcian water was carried thither. The sum appropriated could not have sufficed for finishing this vast undertaking—but we are left in darkness as to the farther means applied to it.

* Burgess, Antiquities of Rome, vol ii., p. 327.

† Burgess, vol. ii., p. 328.

This water, the most wholesome of any conveyed to Rome, was drawn from springs, in the neighborhood of Subiaco, on the Anio, 20 miles above Tivoli, in the mountains. These sources were 36 miles from Rome, on the Via Valeria. The whole length of its course was 60 miles and 710 paces, of which 54 miles 247 paces were subterraneous, the rest being carried over arches as it approached the city. It is the remains* of these arches which produce such a striking effect in the Campagna. "They may be followed, says Burgess,† for nearly two miles without interruption, by proceeding on the road to Albano, and turning a little to the left after passing Tavoluto at about four miles from Rome. They are built of peperine stone, and sometimes rise to a prodigious height to maintain the level of the channel. The 'Specus' of the Aqua Marcia is in many places still perfect, though now useless." Even in the time of Pliny, in the 60th or 70th year of the Christian Era, this delicious water was lost to Rome. "Long ago," complains this writer, "we of Rome have lost the pleasure and commodity of those rills, through the ambition and avarice of some great men, who have turned away the waters from the city where they yielded a public benefit to the commonwealth, and diverted them for their own profit and delight, into their manors and houses, to irrigate their gardens, and to other uses."

Nineteen years after the Marcian, or in the year of Rome 627, the *Aqua Tepula* was introduced by the Censors, Cn. Servilius Cæpio, and L. Crassus Longinus, surnamed Ravilla. It took its rise in the Lucullan, or, as some called it, the Tusculan territory. To arrive at its source, it was necessary to go ten miles in the Via Latina, and then turn off to the right two miles. The name, Tepula, is conjectured, by some, to have arisen from the water being rather warm at the spring, as if "tepida." This stream was conducted over the Marcian arches, as subsequently was another named Julia, in honor of Augustus, and of which Agrippa, in his ædileship, anno urbis, 719, discovered the spring and conducted it to Rome. The length of this aqueduct was fifteen miles, 427 paces, of which seven miles were carried above ground. Indeed, this stream and the Tepula may be considered as belonging to the Marcian aqueduct, they with the Marcian forming a triple course. After collecting a number of little tributary springs, at the distance of seven miles from the city, they flowed on towards Rome, each in its own channel, but over the same arches. The Julia was the highest, the Marcia the lowest of the three.

About thirteen years afterwards, the same Agrippa brought to Rome the *Aqua Virginis*, so called from the circumstance, as related by Frontinus, that when some

* "Why do these aqueducts cross the Campagna in courses so unnecessarily long and indirect? Several reasons have been alleged, all of which may have influenced the ancients; but their chief motive, in my opinion, was, to distribute part of the water to the Campagna itself, and to diffuse it there in smaller veins. Besides this general circuit, the Romans bent their aqueducts into frequent angles, like a screen, not so much to break the force of their currents, as to give stability to the arcades."—[Forsyth, p. 133.]

† Burgess, vol. xi., p. 328.

of Agrippa's soldiers were seeking for water, a young girl pointed out to them certain rills, which, having followed up, they came to a copious supply of water. In a little temple built on the spot, a picture is suspended, commemorating the event. The springs thus found were surrounded with a brick wall, and in their course augmented by several small streams, and the united waters were carried to Rome by an aqueduct of about fourteen miles, of which about three-fourths of a mile are above ground, and one half of the distance on arches.

The *Aqua Alsietina* is the next in order. It was brought to Rome by Augustus, from whom it was frequently called *Augusta.* It was derived from a lake of the same name, about fourteen miles from Rome, and conveyed to the city by an aqueduct twenty-two and one-fifth miles in length, of which 358 paces were on arches. As its waters were neither salubrious nor grateful to the taste, it is conjectured that the object of Augustus in introducing them was to supply the *Naumachiæ*, and thus spare the more wholesome waters; when, however, by reason of repairs to the other aqueducts, the supply was interrupted, recourse was had to the *Alsietina.*

This was the water-course, afterwards adjusted by Trajan, into which he introduced a new stream from the lake Sabbatinus, now the *Lago Bracciano*, and then the name of Alsietina was changed to Sabbatina. It is now the *Aqua Paola*, and supplies the fountains of St. Peter's and the Vatican. Some remains of the original work of Augustus (as is most probable,) may be seen without the Porta S. Pancrazio, in going towards the Villa Pamfili Doria.*

Independently of this work, Augustus, it would appear from one of the three inscriptions on the Porta S. Lorenzo placed over the Marcian aqueduct, that he repaired the channels of all the waters, that is to say, of the seven we have enumerated.

No other structures of this sort were erected at Rome until the time of Caligula, when the seven existing aqueducts being found insufficient for the increase of luxury and population, this emperor, in the 789th year of Rome, began two new ones. These were finished by the Emperor Claudius with great magnificence, and opened for use in the year of Rome 803. The first was named *Aqua Claudia*, and the second *Anio Novus*, to distinguish it from the other Anio, which was afterward called *Vetus*, or the Ancient. The source of the Aqua Claudia was from two fine springs called Cæruleus and Curtius, at a distance of thirty-eight miles from the city, on the Via Sublacensis, 300 paces within on a path to the left. The Aqua Claudia was next in quality to the Aqua Marcia. The whole length of this wonderful aqueduct was 46 miles and 406 paces, of which 36 miles and 210 paces were subterraneous; the remaining 10 miles 176 paces were carried

* Burgess, vol. ii., p. 332.

over arches in different places as the level required, viz: in the more distant parts 3 miles, 78 paces, and at seven miles from the city, those arches began rising in height as they stretched towards the capital, running in some places parallel with the Marcian Aqueduct, and sometimes coming in contact with it, as they both approached their termination. Near the *Arco Furbo*, about three miles on the road to Frascati, the two aqueducts cross one another, and the whole, as seen stretching over the now unpeopled Campagna,* forms one of the most striking objects that can be imagined. It was in the Claudian aqueduct that Sextus V. conveyed the *Aqua Felice.*

Finally, to complete the account of Frontinus, the Anio Novus (also brought by Claudius) took its rise on the *Via Sublacensis*, at the 42d mile-stone. It was, as the name implies, a portion of the river Anio. This river, traversing a rich and highly cultivated region, was mixed in times of rain with a quantity of the soil. On this account a purifying *piscina* or reservoir was interposed between the river and the mouth of the aqueduct, in which the water settled before entering the channel-ways. In spite, however, of this precaution, the water in times of violent floods was frequently discolored, when it reached the city. Another streamlet, called *Herculaneus*, rising on the same road, about 38 miles from Rome, and of which the waters were remarkably limpid, was conducted into the *Anio Novus*, but in time of rain, its advantages were lost by the mixture with the more abundant Anio.

This stupendous aqueduct extended the vast distance of 62 miles—48 miles and 300 paces being subterraneous. The rest was carried over such lofty arches, that in some places they rose to the height of 109 feet.

All these aqueducts were carried to Rome on different levels, and their waters were distributed to the several parts of the city, to which their respective elevations were the best adapted. The *Anio Novus* flowed on the highest line, and the others in this order: the *Claudia*, the *Julia*, the *Tepula*, and the *Marcia;* the waters of all these five aqueducts could, however, be conducted to every part of the city. The *Anio Vetus* was in the sixth rank, as to level, though from the height of its source, it might have been conveyed to the loftiest parts of the city. The *Aqua Virgo*, and *Aqua Appia*, of which the sources were

* *The unpeopled Campagna.*—"The desert which encircles Rome owed its ancient salubrity, not to any natural advantages which it now wants, but to the population and tillage of the Latin States. During the Empire the public ways were lined with houses from the city to Aricia, to Tibur, to the sea. In the interval between these lines, the town and country were so interwoven, that Nero projected a third circuit of wall, which should embrace half the Campagna. At that period the *bad air* infected but a small part between Antium and Lanuvium; nor did it desolate these, for Antium grew magnificent under different emperors, and Lanuvium was surrounded with the villas of the great. At length when a dreadful succession of Lombards, Franks, and Saracens destroyed the houses, pavements, drains, crops, plantations, and cattle which had protected the Campagna from mephitism, it then returned to its own vicious propensity, for both the form of its surface and the order of its soil promote the stagnation of water."—[*Forsyth*, p. 231.]

in the Campagna, were necessarily on a low level, and the *Alsietina*, on the lowest of all, was distributed in quarters about the Tiber, and other flat places. The point of distribution of the *Anio Novus*, above the level of the Tiber, was 158.88 feet; that of the *Claudia*, 148.9 feet; that of the *Julia*, 129.4 feet; and of the *Marcia*, 125.4 feet. The elevation of the *Anio Vetus*, above the Tiber, was 82.5 feet; of the *Virgo*, 34.2 feet; and of the *Appia*, 27.4 feet. The Tiber itself, at Rome, was 91.5 feet above the level of the sea.*

It appears from these statements of the elevation of the different conduits, that the earlier Romans conducted the water on lower levels than their successors, either from ignorance of the mode of ascertaining and preserving the exact level, or as a precaution whereby they were enabled the better to conceal the conduits, by burying them deep in the earth — and thus secure them from notice and destruction by their hostile neighbors, with whom they were in an almost constant state of war.

Moreover, at all periods, the Romans gave a greater declivity to their conduits than is practised by moderns. Vitruvius, in the passage heretofore quoted, assigns the ratio of one foot in 200. According to Scammosi the general practice of the Romans was to allow a fall of 1 in 500.†

A modern engineer who measured some of the remains of these buildings, in order to determine this point, states that he found the *mean fall* of the ancient aqueducts from the purifying *piscinas*, or reservoirs, to the point of distribution, to be about 1 in 663, and that from the source of the stream to these reservoirs, the mean fall was about 0.132 of an English inch to the Roman *passus*, equal to 58.219 English inches.

Thus the *Anio Novus*, the pavement of whose water channel, on its arrival at Rome, is 250.3 feet above the level of the sea, has a fall of 5.2 feet from the purifying piscinas to the point of distribution, and from its source to this reservoir a fall of 568.7 feet, thus showing the source to have been 824.3 feet above the level of the sea. The other aqueducts showed a proportional declivity, between their sources and the points of distribution.

The *piscinas* or reservoirs, to which reference has been made, were placed at a certain distance from the city, and there the waters deposited their sediment, and there also the quantity of the supply was determined by a register; six of the aqueducts were thus emptied into *piscinas;* three of these, the Julia, Marcia, and Tepula were conducted from the purifying reservoirs to the city, over the same aqueduct, as has already been noticed, one above the other. The Anio Novus, and the Claudia also flowed in separate channels over the same arches. The Anio Vetus had a separate series of arches. Neither the Virgo, Appia, nor Alsietina were supplied with piscinas.

* Stuart's Dic. of Archi., art. Aqueducts.

† Stuart's Archi., art. Aqueducts.

At this period it would appear that after a heavy fall of rain, the greater part of the water flowing into the city by all the aqueducts, was discolored by the mixture of earthy matters, even some that were pure and limpid at their sources. This impurity was particularly observable of the two *Anios* that were supplied from a river, which although, flowing from a lake of great transparency, passed through a rich soil, which in seasons of rain rendered the waters turbid. Indecd, the *Anio Vetus* was rarely free from discoloration, but as it flowed on a low level it could not affect the other waters, but the *Anio Novus* being of a lofty level and unfailing in its stream, was occasionally used, when the othcr aqueducts were falling off in their supply, to make good the deficiency, and hence all were more or less contaminated—even the *Marcia,* which was the delight of the Romans for its limpidity and coolness.

The Emperor Nerva undertook to correct this evil. He began by classing the aqueducts according to the goodness of their waters. The Marcia was reserved solely for drinking—others according to their qualities, to other uses, and the Anio Vetus, as the most impure, was reserved for the irrigation of gardens and the cleaning of the streets and sewers. He then caused the water from the Anio Novus to be drawn from the lake itself, instcad of the river; and either because the stream supplying this lake ran over a rocky bed, or that from the depth of the lake, the water was purified by depositing an earthy matter, it issued thence cool and bright, so as to equal in appearance and taste the Marcia, which it greatly surpassed in quantity.

Nerva caused numerous wells to be constructed in the courses of the other aqueducts, in which the waters deposited their sediment. He also framed regulations for the general distribution of the water, by means whereof a more vigilant supervision was exercised, and a considerable increase was effected in the quantity indicated by the registers.

The whole supply furnished by the nine aqueducts is thus stated by Frontinus, the measurement being made at the head of each aqueduct, except of the Julia and Virgo, which are calculated from their registers of delivery:

Anio Vetus,	4,398	quinariæ.	Aqua Appia,	1,825	quinariæ.
Aqua Marcia,	4,690	"	" Tepula,	445	"
" Virgo,	2,504	"	Anio Novus,	4,738	"
" Julia,	1,368	"			
" Claudia,	4,607	"		7008	
				17,567	
	17,567				
			quinariæ	24,575	

The quantity of the *Alsietina* is not given, but it was computed to deliver about 400 quinariæ—making altogether, 25,000 quinariæ.*

* The quinaria is equivalent to about 2000 cubic feet, of about 7 gallons each.

But of this immense abundance, not three-fifths, according to the public registers, were lawfully delivered, the rest being surreptitiously abstracted by individuals. The whole daily supply shown by these registers, was 14,018 quinariæ, equal to about 28,000,000 cubic feet, or *one hundred and ninety-six million gallons!* Notwithstanding this prodigious abundance of water supplied by the aqueducts, which Strabo compares to rivers flowing along the streets and through the sewers, the use of well and spring water was not abandoned.

The population of Rome* at the period when Frontinus wrote, between 70 and 80 years after the Christian Era, may be taken at between 1,000,000 and 1,200,000. Assuming it at one million, the daily supply of water from the aqueducts to each inhabitant, was 196 gallons!

The supply of London, now containing more than two millions of inhabitants, is computed at 37,000,000 gallons, or about one-fifth of that of ancient Rome. The city of Paris is still more deficient in this resource.

The distribution of the water along its course, as well as throughout the city, was regulated with scrupulous care. Besides the *piscina limosa*, or purifying reservoir usually placed at the mouth of each aqueduct, there were frequent *castella*, or wells along the line, which both aided in the process of purification, and permitted water to be drawn occasionally along the route, for the irrigation of fields and gardens, and the supply of baths. The main *castellum* was that in which the aqueduct terminated, and whence the water was distributed through the city. These were vast, solid, and stately architectural structures. The mass of ruins now called "The Trophies of Marius," from some very vague tradition, are undoubtedly the remains of a vast *castellum*, in which, according to the conjecture of Burgess, the *Aqua Julia*, and the *Claudia*, were received. The *Piscina Mirabile*,† near Cumæ, is a "stupendous structure of 200 feet in length, by 130 in breadth, whose vaulted roof rests upon forty-eight immense pillars, disposed in rows, so as to form five aisles within the edifice, and sixty arches."

The *castella* were of three kinds, public, private, and domestic.‡

The public *castella* which received the water of the aqueduct, were such as have already been described, and from them distribution was made: 1st., to the Prætorian camps; 2d., to the fountains, and pools in the city; 3d., the *Munera*, under which head are comprised the places where the public shows and spectacles were given, such as the circus, amphitheatre, naumachiæ, &c.; 4th., public works or establishments, such as the

* See Gibbon, Dec. and Fall, vol. iv., p. 105, *et sequ*, for a computation of the population of Rome.

† Antiquities of Rome, vol. i., p. 199.

‡ Anthon's Dic., art. Aqueducts.

baths, and the trades of fullers, dyers, tanners, &c., which, though conducted by private persons, were deemed public, inasmuch as they were necessary to the general convenience and comfort; 5th. and 6th., under the terms of *nomine Cæsaris*, (in the name of Cæsar,) and *beneficia Principis*, (benevolence of the Prince,) were certain irregular distributions, or extraordinary grants, to places or individuals.

Castella Privata. When a number of individuals, living in the same neighborhood, had obtained a grant of water, they clubbed together and built a *castellum*, into which the whole quantity allotted to them collectively, was transmitted from the *castellum publicum.* These were termed *privata*, though they belonged to the public, and were under the care of the *curatores aquarum.* Their object was to facilitate the distribution of the proper quantity to each person, and to avoid puncturing the main pipe in too many places; for when a supply of water from the aqueducts was first granted for private uses, each person obtained his quantum by inserting a branch pipe, as we do, into the main, which was probably the custom in the age of Vitruvius, as he makes no mention of private reservoirs. Indeed, in earlier times, all the water brought to Rome by the aqueducts, was applied to public purposes exclusively, it being forbidden to the citizens to divert any portion of it to their own use, except such as escaped by flaws in the ducts or pipes, which was termed *aqua caduca.* But as even this permission opened a door for great abuses, from the fraudulent conduct of the *aquarii*, who damaged the ducts for the purpose of selling the *aqua caduca*, a remedy was sought by the institution of *castella privata*, and the public were henceforward forbidden to collect the *aqua caduca*, unless permission was given by special favor (*beneficium*) of the emperor. The right of water (*jus aquæ impetratæ*) did not follow the heir or purchaser of the property, but was renewed by grant upon every change in the possession.

Castella Domestica, leaden cisterns, which each person had at his own house to receive the water laid on from the *castellum privatum.* These were, of course, private property.

The number of public and private *castella* in Rome at the time of Nerva, was 247.

All the water which entered the *castellum* was measured, at its ingress and egress, by the size of the tube through which it passed. The former was called *modulus acceptorius*, the latter *erogatorius.* To distribute the water was termed *erogare;* the distribution, *erogatio;* the size of the tube, *fistularum* or *modulorum capacitus*, or *lumen.* The smaller pipes which led from the main to the houses of private persons, were called *punctæ;* those inserted by fraud into the duct itself, or into the main after it had left the castellum, *fistulæ illicitæ.*

The *erogatio* was regulated by a tube called *calix*, of the diameter required, attached to the extremity of each pipe where it entered the castellum; it was probably of lead in the time of Vitruvius, such only being mentioned by him; but was made of bronze (*æneus*) when Frontinus wrote, in order to check the roguery of the aquarii, who were able to increase or diminish the flow of water from the reservoir by compressing or extending the lead. Pipes which did not require any *calix* were term ed *solutæ*.*

The fact referred to in the last paragraph, of the increase and diminution of the quantity of water flowing through a tube, by altering its shape, is of sufficient interest to authorise some further notice of it. It must be stated in the first place, that more water will flow through a short tube than through a simple orifice of the same diameter. It may be thus ascertained: bore a hole of an inch diameter in a bucket, plug it up, and, having filled the bucket with water, withdraw the plug. On examination of the stream that issues from the hole, it will be found to taper off considerably at half an inch from the distance of half the diameter of the hole. If a short tube of the same diameter be inserted in the hole, the discharge of water will be greatly increased, and if at the distance of not more than two or three diameters, this tube should be made to flare gradually, or assume a conical shape, the volume of water passing would be more than doubled, as compared with the discharge through the hole, without any tube. The principle upon which this is accounted for is that of capillary attraction, for if the interior of the conical tube be smeared with tallow, or any other substance which does not readily coalesce with water, the effect ceases.† This increased discharge is not confined to circular or conical tubes; the sides of a channel may be straight and its section a triangle or square, as well as a circle.

It was to guard against frauds of this nature, that the Roman *Calix* was adopted; a short bent tube of brass or bronze, that formed the communication between the castellum and the leaden pipe for the supply of private houses, which pipe, by a Senate decree, was required to be of the same diameter as the calix, for the distance of fifty feet from the castellum.‡

The proportion in which the prodigal water of the Roman aqueducts was distributed, is given with great minuteness by Frontinus.

The general result is, that of the aggregate supply of 14,068 quinariæ, 4063 quinariæ, were distributed without the city, (*extra urbem*,) of which 1718 were in the name of Cæsar, and the residue to private use.

The remaining 9955 quinariæ were conveyed into the city, and received into 247 *castella* as well public, as private; 3847 quinariæ were appropriated to private use; the rest went to public exhibitions, useful trades, the supply of the camps, of the amphitheatres, fountains, and pools.

* Anthon's Dic., art. Castellum Aquæ. † Ewbank, p. 480. ‡ Ewbank, p. 480.

Lead was universally used for the supply-pipes from the *castella*, and notwithstanding Vitruvius speaks of this metal as objectionable on the score of health, we find in Frontinus no allusion to any evil from its general employment.

The liability of these gigantic works to injury and decay, especially in the portions above ground, is forcibly dwelt upon by Frontinus. The subterranean parts were easily kept in order, as they were neither subject to the action of frost, nor to the action of the summer's heat, which the Romans seem to have considered hardly less injurious to mason work.

Various causes of dilapidation are enumerated by our author; the cupidity of individuals through whose lands the aqueducts passed, and who, for the sake of irrigation, or for domestic uses, were tempted to enlarge any holes through which the water (Aqua Caduca) oozed out; the violence of tempests, the imperfection of the work, especially in the more modern structures, and the softness of the material, *tuffa*, too frequently employed in portions of the mason work, where there was great pressure. The arcades, and especially those which traversed streams, were particularly liable to damage from the violence of storms.

Another considerable source of repair, arose from the adhesion of the sediment to the sides and bottom of the water-channels, forming a thick, hard crust, which materially obstructed the passage of the water, and by eventually raising its level, occasioned breaks in the channel, whence the waters escaping, not only destroyed it, but the sub-structures of every kind in the vicinity.*

All work of repair, was however, as much as possible suspended in the summer season, as then the free use of the water was most needed and agreeable.† The spring and autumn were the working periods. Moreover, a moderate temperature was deemed advantageous, as permitting the masonry to be laid with the degree of humidity deemed essential to its perfection and ultimate solidity, excessive heat and cold being alike unfavorable to such a result. Above all, it was a rule, before beginning any reparation, to provide on the spot, every thing that could be required, and in sufficient quantity to ensure a rapid execution.

Whenever any of the Arcades within seven miles of the city, and by means of which several streams were at once conveyed, were undergoing repair, the stream was continued unbroken through leaden pipes, across that portion of the mason work.‡

To preserve these noble structures from dilapidation, Agrippa, who was the first national superintendent, formed a class of slaves, who were solely employed on the repairs.

* Front, p. 203. Stuart, art. Aqueducts. † Ibid. ‡ Front, 204.

These at first numbered 250 — but at his death he bequeathed them to Augustus, who transferred them to the public. Claudius established another company of *fountaineers*, during the erection of his aqueduct, amounting to about 460 persons, divided into different classes, and with distinct duties. There were the comptrollers, the keepers of the castellum, inspectors, paviours, stuccoers, and other workmen. A portion of these were lodged in the city, in order to execute with promptness such repairs, as, without being extensive, demanded immediate attention. Others were stationed near the reservoirs or castella, or in the neighborhood of the public shows, to supply water to any point where it might be more particularly needed. Their maintenance was paid by the public, by a rate on domains and houses.*

In later days of the Empire, it would seem, five additional aqueducts were constructed, of which the *Alexandrian*,† as the ruins remain to testify, was the chief, and most magnificent.

When, A. D. 535, Rome was besieged by the Goths under Vitiges, *Procopius*,‡ the historian of the Gothic war, records that fourteen streams flowed into the city. It was of course among the means employed by the barbarian invaders to induce submission, to cut off the accustomed supply of water, and Rome, in her 1289th year, and after enjoying for many centuries the lavish prodigality of her fountains and aqueducts, was again reduced to dependence on natural springs, the wells that had not been neglected and suffered to be filled up, and the yellow waters of the Tiber.

The great and permanent changes which such a calamity must have brought about in the habits of a numerous and luxurious people, can hardly be measured. The population, indeed, had been sensibly diminished from the period of Rome's ascendancy, for Gothic and Vandalic conquerors had already despoiled her of most of her wealth, and desecrated the lofty Capitol with the presence of victorious hordes of barbarians. But at the period of which we speak, it is conjectured that the city still had more than 600,000 inhabitants.

This barbarian interruption of these accustomed and hitherto unfailing streams, cutting off not only the luxuries of the baths, and of the fountains in all their daily and hourly uses for domestic purposes, in the gardens and the pools, necessarily changed at once the whole internal economy and arrangements of the city. Perhaps, among the causes which mark the final decay and fall of Rome, few exercised really greater influence than the Gothic destruction of the aqueducts.

* Front., p. 201—Stuart, art. Aqueducts.

† Vide *Fabretti* de Aquis and Aquiduc, dig. ii. Burgess, vol. ii., p. 336.

‡ Procopius, de bello. Gothico. lib. 1., chap. 15.

There does not remain, so far as we have been able to discover, any memorial of the cost of these magnificent erections—nor of the periods respectively occupied for their construction—nor of the nature of the labor employed upon them.

Of the *Anio Vetus*, Frontinus merely relates, that it was built from the spoils taken from Pyrrhus—and of the *Marcia*, he says, the Senate appropriated by decree. "Sestertium mille octingenties," equal in our money to $3,240,000. But whether this sum sufficed to complete the undertaking, or whether slaves or the soldiers were employed on such works, does not appear. Concerning all the other aqueducts, we are left without any indication of their cost, or of the time employed on them.*

The regulations under which these works were, and the laws for their protection, are more known to us.

Respect for private property, in tracing the course of an aqueduct, seems to have been so scrupulous, that it is related by Livy, when, in the year B. C., 179, the Censors, M. Emilius Lepidus, and M. Flaccus Nobilior, proposed the building of another aqueduct, that the scheme was defeated, because Licinius Crassus refused to let it be carried through his lands.†

It is also remarked by Frontinus, that so "admirable was the equity of our ancestors, that when on the line of an aqueduct, any owner of lands was unwilling to sell the portion required for the public work, the whole farm was bought by the State, and after taking what was requisite, the rest was resold."‡

At subsequent periods, it would seem, from a Senate decree, to be presently noticed, that the practice of our own country, on such occasions, was adopted—that of taking private property for public purposes, upon an estimate to be made by "good men."

We have already seen, that the general charge and control of all the aqueducts, was confided to a national superintendent, who was generally of high rank, and who, by a decree of the Senate, was to be accompanied, when going out of the city on official duty, by two lictors, three slaves, architects, secretaries, &c.§

He also, it appears, sometimes had two adjuncts, who were entitled to like honors.

In the earlier period of the aqueducts, all the water was for the use of the people, except what overflowed from the fountains or pools; and it was expressly enacted, "that no private person should divert any water, other than that which overflowed."‖ Even this surplus of waste water was appropriated to baths, fullers, dyers, &c., and for it

* Frontinus, p. 160. † Liv. xl., 51. ‡ Frontinus, p. 207.

§ See decree, in Frontinus, p. 194. ‖ Front. 192.

a stated tax was paid into the public treasury; sometimes by general consent, a portion of this *aqua caduca* was appropriated to the houses of the chief citizens.

The laws are uncertain, as to what magistrate exercised the right of giving, or selling water. Sometimes the Censors, sometimes the Ædiles are found doing so—though it would seem as long as the Republic had Censors, they, rather than others, exercised this power.

The caution with which the distribution of the water was conducted, and the fairness with which its use seems to have been granted, are apparent from many passages in Frontinus. On the latter point particularly he states, that the Curule Ædiles were required to select two persons in each street from those who inhabited it, or owned property in it, who should determine where the public fountain, or hydrant should be placed.

Another strong proof of the regard paid to the comfort and wants of the people, in respect of the use of the waters, is furnished by a Senate decree in the time of Augustus, directing among other things, "that the superintendents of water, whom Cæsar Augustus, by authority of the Senate, had appointed, should give special heed that the public fountains, or hydrants, (*salientes*,) should pour forth uninterruptedly night and day, water for the use of the people."*

While the people were thus gratuitously supplied, and without limit as to quantity from the public fountains, there was a tax levied upon that portion of the waters diverted to private houses and gardens.†

It is remarkable, and quite an object of regret, that Frontinus, whose details as to the aqueducts are in other respects so copious, has left no record of the rate of this tax, of the principle on which it was assessed, or of its productiveness; such a table at this period would have been both curious and instructive.

A grant of water for private use was in all cases personal, and ceased with the life of the grantee. The residents of the same neighborhood united in building a private castellum, into which the aggregate for all the associates was received from the public castellum.‡

Each associate had a pipe from this private reservoir of the dimensions equal to his share, and the *castellarii* who had the supervision, as well of private as public reservoirs, were required to see that all these distributing pipes were inserted on the same level, because if some were above, and some below, a given line, the lower pipes would extract the largest quantity.‖

When, owing to the death of lessees, or other cause, there was a surplus of water,

* Front. 197. † Front. 202. ‡ Front. 198. ‖ Front. 200.

public notice was given, and applicants were supplied in the order of their demands. Where, however, there had been a grant of water to several, holding property in common, the death of one or more of the parties did not vitiate the grant, but it survived as long as any of the parties did.

All the public distributing pipes, or *calices*, were stamped according to their capacity, but a not uncommon fraud of the water purveyors was, when a new grant was made in lieu of one relinquished, or forfeited, to retain the old pipe, from which water was surreptitiously sold, while a fresh one was inserted for the new grantee. Experience having proved, that frequently, when essential and speedy repairs were needed on portions of the aqueducts passing through private property, difficulties and delays arose from the opposition of the owners of the neighboring soil, to any passing through their lands, or deriving materials therefrom, for the work in hand, the Senate passed a law, declaring that as often as the aqueducts required repairs, it should be lawful to take from the adjoining lands of individuals, upon the estimate of good men, any earth, soil, stones, shells, sand, or wood that might be needed, taking care to do the least possible injury to the proprietor. As a thing curious in itself, we give in a note the original of this decree as we find it in Frontinus.*

Another prolific source of injury to the aqueducts, was from the plantations and buildings, with which the proprietors of adjoining lands constantly encroached upon the lines. Often, indeed, country roads were laid out over the subterranean course of the aqueducts themselves. Trees were planted in like manner over, and near them, and these were found most injurious, for their roots penetrating deep, affected the masonry, and loosened the covering soil.

A Senate decree, of which the text is given in the note,† was finally passed to

* QVOD. Q. ÆLIVS. TVBERO. PAVLLVS. FABIVS. MAXIMVS. COSS. V. F. DE. RIVIS. SPECVBVS. FORNICIBVSQVE. JVLIÆ. MARCIÆ. APPIÆ. TEPVLÆ. ANIONIS. REFICIENDIS. Q. D. E. R. F. P. D. E. R. I. C. VTI. CVM. II. RIVI. FORNICES. QVOS. AVGUSTVS. CÆSAR. SE. REFECTVRVM. IMPENSA. SVA. SENATVI. POLLICITVS. EST. REFICERENTVR. EX. AGRIS. PRIVATORVM. TERRAM. LIMVM. LAPIDEM. TESTAM. ARENAM. LIGNA. CÆTERAQVE. QVIBVS. AD. EAM. REM. OPVS. ESSET. VNDE. QVÆQVE. EORVM. PROXIME. SINE. INJVRIA. PRIVATORVM. TOLLI. SVMI. PORTARI. POSSINT. VIRI. BONI. ARBITRATIO. ESTIMATA. DARENTVR. TOLLERENTVR. SVMERENTVR. EXPORTARENTVR. ET. AD EAS. RES. OMNES. EXPORTANDAS. EARVMQVE. RERVM. REFICIENDARVM. CAVSA. QVOTIES. OPVS. ESSET. PER. AGROS. PRIVATORVM. SINE. INJVRIA. EORVM. ITINERA. ACTVS. PATERENT. DARENTVR.

† QVOD. Q. ÆLIVS. TVBERO. P. FABIVS. MAXIMVS. V. F. AQVARVM. QVÆ. IN. VRBEM. VENIRENT. ITINERA. OCCVPARI. MONVMENTIS. ET. ÆDIFICIIS. ET. ARBORIBVS. CONSERI. Q. D. E. R. F. P. D. E. R. I. C. CVM. AD. REFICIENDOS. RIVOS. SPECVSQVE. PER. QVÆ. ET. OPERA. PVBLICA. CORRVMPVNTVR. PLACERE. CIRCA. FONTES. ET. FORNICES. ET. MVROS. VTRAQVE. EX. PARTE. VACVOS. CENTENOS. QVINOS. DENOS. PEDES. PATERE. ET. CIRCA. RIVOS. QVI. SVB. TERRA. ESSENT. ET. SPECVS. VLTRA. VRBEM. CONTINENTIA. ÆDIFICIA. VTRAQVE. EX. PARTE. QVINOS. PEDES. VACVOS. RELINQVI. ITA. VT. NEQVE. MONVMENTVM. IN. IIS. LOCIS. NEQVE. ÆDIFICIVM. POST. HOC. TEMPYVS. PONERE. NEQVE. CONSERERE. ARBORES. LICERET. SI. QVÆ. NVNC. ESSENT. ARBORES. INTRA. ID. SPATIVM. EXTIRPARENTVR. PRÆTERQVAM. SI. QVE. VILLÆ. CONTINENTES. ET. INCLVSÆ. ÆDEFICIIS. ESSENT. SI. QVIS. ADVERSVS. EA. COMMISERIT. IN. SINGVLAS. RES. IN. DENA. MILLIA. DAMNAS. ESSET. EX. QVIBVS. PARS. DIMIDIA. PRÆMIVM. ACCVSATORI. DARETVR. CVJVS. OPERA. MAXIME. CONVICTVS. ESSET. QVI. ADVERSVS. HOC. S. C. COMMISISSET. PARS. ALTERA. MESIA. IN. ÆRARIVM. REDIGERETVR. DEQVE. EA. RE. JVDICARENT. COGNOSCERENTQVE. CVRATORES. AQVARVM.

correct these and other evils, and to establish the space that should be left vacant on each side of the subterranean course of an aqueduct, and about its sources, superstructure, &c. Around the latter, a space was to be left on each side of 115 feet; and on each side of the former, within the city, fifteen feet; "within which," says the decree, "it shall not be lawful, henceforth, to erect any edifice, or plant any trees—and any trees actually growing upon the reserved space shall be cut down"* A heavy pecuniary fine is annexed to the violation of the decree, of which *one half on conviction of the offender, to go to the informer, the other to go into the public treasury.* Another decree also forbids the sowing any grain, or cutting any hay, or feeding cattle, within the specified limits.

The magnificence of the Romans, in these peculiar and most beneficial structures, was not confined to Rome, for few cities of any note in their extended dominions, appear to have been without one or more aqueducts. Among the most important, from their magnitude and actual state of comparative preservation, may be reckoned those erected in Gaul.†

Before noticing these, however, a few words must be given to Carthage, the great rival of Rome, which also had a vast aqueduct—but its date and origin are uncertain. By some it is viewed as a monument of the enterprise and skill of the Carthaginians—others, among whom is Fischer D'Erlach, in his *Architecture Historique*, and Malte Brun, consider it a Roman work, after these haughty conquerors had annihilated Carthaginian power, and founded a second Carthage under Roman auspices.

However the fact be, and whoever the constructors, it was a most magnificent work, carried through mountains, and over valleys, for a space of 70 miles! Near Udena, there is an arcade of more than a thousand arches, some of them exceeding 100 feet in height.

The cement used in building the work is as hard as the stones themselves, and, such is the tenacity of that which coated the water channel, that where flakes of it of 100 feet in length have fallen from the wall, they lie unbroken. The conduit is 6 feet high within, and 4 feet wide, "arched to a point"—says Stuart.

At Ariana, about four miles from Tunis, other remains of this aqueduct are visible. When mountains were tunnelled in its course, at every 60 yards, vertical openings were driven through from the surface of the channel way to the upper air. These openings or ventilators are 4 feet in diameter, walled with hewn stone, and carried up about 4 feet above the surface.

The Emperor Charles V., caused a drawing to be made of various portions of this noble work — the celebrated Titian arranging the designs, to serve as a model for some tapestry to be executed for the Austrian Court.

* Frontinus, p. 206.

† Stuart, Dic. Archi., art. Aqued.

Of the Roman works in Gaul, we borrow our account from Stuart:

"The aqueduct at Nismes, is probably one of the earliest that was constructed by the Romans out of Italy. Its origin is attributed to Agrippa, who was invested by Augustus with the government of this city, which had become a Roman colony. Flattered by the attentions of the citizens, Agrippa made their city his place of residence, and he adorned it with new city walls and magnificent baths. Those who suppose that the object of the aqueduct was to conduct water to the amphitheatre only, instead of being appropriated to the domestic uses of the inhabitants, have not regarded with attention the peculiarities of its construction. The simplicity and unornamented style of its architecture, perfect, however, in its proportions, and just in every point of its design, marks the very character of these works of Agrippa. The waters about the colony of Nemausis, from the disturbed state of the springs in winter and spring, from the muddied flow of the torrents in times of flood, and the deficiency in times of drought and summer, were precarious, unhealthy, and insufficient; a colony so placed would be left very imperfect, nay, defective, without the means of obtaining salubrious water; accordingly, we find an aqueduct and fountain at Nismes, bringing a constant and copious supply, unmixed with any of the streams or rivers that might spoil it. To avoid this, it was brought from the mountains, excluding all communication with the waters of the country through which it passed, and where it became necessary to pass the deep valley in which the river Gardon runs, it was conducted across that valley by a bridge of two stages of arcades, at a height of 150 feet above the ordinary level of the river, that is, measuring to the top of the second range of arcades, which perfected Agrippa's erection, the water being conducted on the top of the second arcade. The third story, part of which is now remaining, raised upon a range of arcades, has been thought to be a building of a very different age from the two main ranges, in its materials, in its structure, and proportions; and even in the placing of its parts, it does not correspond with the old original bridge on which it was erected. The style of the architecture is also said to be very different, and very inferior to the rest. Although an adventitious addition, it is clearly Roman work, probably of a much later age.

The length of this aqueduct, as far as discovered, is about six French leagues, or 15 miles, in a direction resembling a horse-shoe, and derives its water from the spring of Eure, and Airau, near the village of Uzes. The Pont du Garde is in the middle of its course; the greater part of the ancient line can now be traced, and much of what remains is in a fine state of preservation. The observation made with regard to the parts of the aqueducts of Rome which were under ground, being in the best state of repair, applies with still greater force to the aqueduct at Nismes, the subterranean parts being even now in perfect preservation. The line was carried along the sides of the hills, which were occasionally perforated to shorten the distance, and, where necessary, the lesser valleys were crossed by the erection of small bridges, or arcades, preserving the level of the aqueducts. The greater portion of the excavated part has been cut through the stone strata of which the hills are composed, in some places at a distance of about 13 feet beneath the surface.

The *Pont du Garde*, is that part of the aqueduct of Nismes which traverses the deep valley in which runs the Gardon or Garde, between the mountains near Vers and St. Bennet.

This part, considered even alone, is one of the grandest erections made by the Romans in Gaul. The first row of arcades, beneath which runs the Gardon, is composed of six arches; the second row has eleven arches, and the third range has thirty-five. All these arches are semi-circular, springing from piers, more or less high; it was upon the third range that the water channel was formed according to some antiquaries.

According to the measurement of a French engineer, the height of this aqueduct bridge is about 157 feet above the low water level of the river. Its length on the level of the moulding terminating the first range of arcades, is 561 feet, and 876 feet on the level of the moulding terminating the second story.

The total height, according to the same author, is 161 feet; namely, 66 feet for the first range, 66 feet for the second range, and 29 feet for the third range to the top of the flags covering the water channel; the width of the bridge is 21 feet at the first range, 16 feet on the second, 10 feet on the third; this forms a considerable offset on each stage; the five piers of the first range of arcades were formed with salient angles or becs. The division of the arches on the first and second stories is the same; the middle arch of the first range, under which the river passes, and which is the centre of the entire aqueduct, is 70 feet in diameter; three on each side are of smaller dimensions. All the arches on the third range or story are equal, being 15 feet in diameter; the piers of the first and second series of arches are 15 feet in front; those of the third range vary according to the diameter of the arches of the range beneath them, four arches of the third range corresponding with the middle or water way of the lower story.

As the two mountains forming the valley of Gardon are not of equal height at the points in the line of aqueduct, that on the left side of the river being lower than the level of the aqueduct, while the right side is more elevated, the conduit on one side is carried onwards by continuing the third range of arches, and on the other side, the range terminates in the side of the mountain.

The Pont du Garde is constructed entirely with hewn stone; no rubble work is introduced even into the filling up of the piers, or spandrils of the arches. The masonry has been finished and put together without lime, or any other kind of cement, and owes its stability to the mass of each block, and the precision of the faces in their beds and joints. The canal of the aqueduct is in fact the only part which is not constructed with hewn stones, being made with a sort of jointed rubble on the outer and inner faces of the canal, but of the common rubble in the filling up. This work, where the cement has not been sparingly used, forms a mass absolutely impenetrable to any passage of the water. The inside facing of the walls, and the bottom hollowed in the form of an arc of a circle, were covered with a coat of cement about two inches in thickness, composed of quicklime, fine sand, and pulverised bricks. This cement is at the present day of a consistence equal to that of the hardest and most compact stone, and without the slightest crevice or flaw to be any where seen in it. This first coat of cement was covered with a second layer of mastic, very fine and very thin, of a deep, dark, red color. The width of the canal between the outer coats was four feet, and its height the same.

The general declivity of the bed of the aqueduct was about four centimetres for one hundred metres, or one and one-third inches to three hundred and twenty-eight feet.

The aqueduct has been constructed with the same care throughout its great length, the only difference being that, in the parts exposed, the aqueduct was covered with slabs, and in the subterranean portion it was covered with a semi-circular arch, of a species of rubble roughly squared in the joints, nearly two feet in thickness.

In examining the water channel, a strong concretion is observable, adhering to the cement on the sides and bottom. This petrifaction is nearly twenty-nine centimetres thick, or 11 and one-third inches, and from this it appears, that the general height of the stream of water in the channel was about three feet nine inches.

This interesting monument of ancient Roman magnificence was demolished at its two ends, some time about the beginning of the fifth century, by the barbarians who then besieged Nismes, and who, by this means, endeavored to force the citizens to surrender. It remained in this state until the beginning of the eighteenth century, when the Duke de Rohan, in order to make a passage for his artillery, perforated the piers of the second arcade, and by some other operations directed to the same end, the Pont du Garde was rapidly falling to pieces. Considerable rents in the walls, and deviations from the perpendicular, exciting public attention, the provincial States took the matter into consideration, and by a series of judicious repairs, they succeeded in restoring this ornament of Languedoc to the state in which it was, before the dilapidations of the Duc de Rohan.

In 1746, the project of building a bridge near the site of this aqueduct was, fortunately for its further stability, modified so as to be built adjoining to it. M. Petot proposed to form this bridge on the eastern face of the Pont du Garde, and rigorously following the dimensions of the piers and arcades of the ancient aqueduct, this was shortly afterwards erected.

Aqueduct at Lyons. Nothing gives us a higher idea of the ancient splendor of the city of Lyons (Lugdunum,) under the emperors, than the remains of its ancient buildings, temples, palaces, amphitheatres, naumachias, baths, and, above all, its aqueducts, erected during the reigns of Augustus, Tiberius, and Claudius, to supply that part of the city with water, which was situated on the heights. The oldest, that erected by the troops of Marcus Antoninus, drew its waters by two branches, from the group of hills, called in modern times, *Mont d'Or:* this stream having been found inadequate for the proper supply of even the highest division of the city, a second aqueduct was constructed, which drew its water from the Loire. The third aqueduct was formed under, to conduct water to the highest part of the city, on which was erected the palace built by the Emperor Claudius. Remains of other minor aqueducts, built in the same age, are of the same construction, the arches and parts apparent being of the masonry called by the ancients *opus reticulatum.* A fourth aqueduct, formed along the bank of the Rhone, appears to have been the source from which the lower city received its supply of water; and from its remains there is little question but that it also was constructed by the Romans. The Claudian aqueduct, being that which has most attracted the attention of antiquaries, will be described more in detail.

The body of the work, that is, the arcades that carried the aqueduct across the valleys, is built of masses of rubble stone and cement, faced, as has been stated, with the *opus reticulatum.* In this instance, this kind of work is supposed to have been formed by laying a bottom of brick, of two, three, or four layers, then a caisson of wooden sides was applied to it, and fixed thereon. The caisson was first lined with the squared stones which were to form the face; the middle was then filled with rubble stones, into which a liquid cement of lime, fine gravel, and water, beaten up to a perfect degree of incorporation in its liquidness, so as to become a binding cement, was poured, and in that state entered into every interstice of the rubble work. This operation being repeated, the whole was wrought into one incrusted rock, harder than either of the materials themselves separately were. One can conceive, says a learned antiquary, how a careful beating together of these materials had the effect of creating so binding a cement, since we know from our own practice, that puddling earth, fine gravel, and water together, form a lining for a canal, that becomes impervious to water when once settled, and it was probably from this puddling, and not from any secret as to the materials of the mortar, not now known, that this ancient cement owed its cohesive strength. When this square was set, the sides of the caisson were taken off, and another layer of bricks was then laid, and so another caisson, and so on. The bricks used in this construction were one foot nine inches long, one foot broad, and one and a half inches thick; the cement of one of the aqueducts at the bottom is six inches thick, and one and a half thick on the sides; about two feet above the floor of the canal were fixed, on each side, cramps of three lines square, at two and a half feet distance from each other. The utmost breadth of the piers of the aqueduct of Chaponost, which carried a canal of three feet broad, by six feet high, is not more than six feet, while the breadth of the aqueduct which passed over the river Baunan, and which has no canal, is 24 feet broad, consisting of two piers, each five feet, supporting an arch 14 feet in diameter.

M. Delorme, in his account, (Séance de l'Academie, 1759,) traced three of the aqueducts of ancient Lugdunum to their source, in three several tracks, of many miles each. He examined their general level, and the level of each part, as they ran above and under ground, along the sides of the mountains, and sides of valleys, and over the bridges where they passed the valleys; he observed the apparent care which the architects of these edifices took to avoid the building of works, enormous in bulk, height, and expense, by carrying the walls up into the narrower and shallower parts of the valleys. Where smaller bridges would serve, and where they could carry the waters over a bridge by a rectilinear canal, they always built up bridges to that level, but where that would become too high, and yet where a bridge was necessary, they built bridges of a height sufficient to carry the water over in syphons of easy curvature.

The sources of supply of the aqueduct of Mont de Pile, were from the waters of the river Gievre, from the rivulet of Sauon, and probably from the river Tanon, to which were joined those of the rivulet Langoneau; after these waters were united in one stream at the aqueduct bridge of the little Varizelle, they make a long detour on the sides of the mountains and hills, till they arrive at the valleys, which they must pass; yet here they are seen trained along the sides of these valleys, until they come to situations which are not so deep or so wide. It is then that the architects built bridges across the valleys, over which to conduct the waters, either in rectilinear canals, or in syphons; had this latter precaution not been taken, the construction of such bridges would have been of necessity so high as to become enormous, both in work and expense; yet, notwithstanding all these precautions, there were in the aqueduct which takes its sources in Mount Pile, and determines at the gates St. Irenæus, nine bridges carrying aqueducts, and three calculated to carry syphons.

The ninth is in a very deep and wide bottom, on the heights of Soncieu. The aqueduct, when it arrives at this bottom, is terminated with a reservoir at the south edge of the valley of the river Garon. The mode by which the water passed this profound chasm, was by causing it to flow from a reservoir on the one side, in leaden pipes, bedded in the sides of the valley along part of the descent; it then flowed in continued

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pipes of the same sort, bedded on a bridge, whose top course was built in a descending or reversed curve; having thus passed over this bridge, when they came at a certain height, on the opposite side of the valley, they were protruded up in pipes, bedded as before, on the opposite sides of the valley, and the water was delivered in another reservoir on the top of this opposite hill, called the reservoir of Chaponost. From this reservoir, the water entered into the aqueduct of Chaponost, which runs under ground along the west side of the village. It emerges on the north, and flows over a bridge composed of ninety arches, of which more than sixty, in Delorme's time, were remaining. This was terminated by a reservoir, whence the water, in like manner as before, descended by pipes into another valley, and in part passed it and the river Baunan, over a bridge of a reversed curvature, and mounted again on the opposite side, there entering a second reservoir at St. Foi.

The waters flowed hence in a canal, carried by a bridge for some way above ground, and then became subterraneous, and continued thus along the heights to the point near the gate of St. Irenæus. Here another reservoir was situated; hence the waters flowed in leaden pipes, which descended into the fosse of St. Irenæus, and passing along the bottom of it, rose again, and emptied themselves in a reservoir, built near a spot which can be traced in the walls of the city, at the Mall of Fourviere, above the gate of Trion, on the south side of a square tower. These pipes were not carried across this ditch and valley upon a bridge, as has been stated by some authors; there are not the least vestiges of such; but they were bedded on a massive course of masonry. This aqueduct has a course of more than 13 leagues, or about 33 miles; its distance in a right line, is about eight leagues, and its descent from the bridge of the little Varizelle to the Fourviere, is 360 feet.

Delorme next describes the nature of these reservoirs placed on each side of those valleys, across which the waters were passed in syphons over a bridge of reversed curvature. The one is for holding up, or receiving, and thence emitting, the waters which are to be conveyed in pipes, and the other is to receive a sufficient quantity of water for distribution to the succeeding canal.

The emitting reservoir of the Garon aqueduct bridge is placed upon a quadrangular tower fourteen feet long, and four and a half feet broad. The wall of the side next the valley, is pierced at nine feet above the bottom of the reservoir, with nine apertures, nearly oval, of 12 inches in height, and 10 in width. The piers of the walls between these openings were 7 inches thick. It was through these openings, that the waters passed out of the reservoir by as many leaden pipes, which descended into the valley in part along the sides, and in part over arches rampant, that is, arches whose successive tops formed an inclined plane, which declivity was so regulated as not to have too sudden a descent. Hence they passed to, and over the bridge, and rose again on the opposite side in the same manner, and were inserted in the wall of another receiving reservoir. This receiving reservoir differed from the emitting one only in this, that it held the waters flowing towards the bottom of its basin, and the emitting one poured them out from the upper part, about three feet from the bottom, so that while the water rose in the emitting reservoir to three or four feet, that in the receiving one would not rise more than two feet. The nine leaden pipes through which the water flowed, had each eight inches diameter in the clear; the thickness of the lead of which they were composed was about one inch.

Delorme also mentions a circumstance in this syphon aqueduct, which has given rise to much discussion among those who have examined the subject; he states that these syphon pipes, after having descended about 75 feet, each divided itself into two branches, and that thus the waters are carried the rest of the course over the bridge in eighteen pipes, and until they rise again, on the opposite side, to a height of about 70 feet, at which point they are again united, and the waters pass on, and enter the receiving reservoir in nine pipes.

In opposition to this opinion of Delorme, another eminent architect, who examined the aqueduct, thought that the receiving and emitting reservoirs had the same number of pipes, and that the nine pipes which proceeded from the one to the other, preserved the same dimension throughout.

Delorme says that the water in the emitting reservoir, was higher by one foot than that in the receiving one; but Mr. Villar, a man of science, resident at Lyons, took the level, and found, as might have been expected, that the water in the receiving reservoir was higher by at least 12 inches than that in the emitting reservoir.

To construct these individual aqueducts, says another architect, the Roman architects began by forming a trench five feet wide, and ten feet deep, having a uniform slope of one foot in 600. In this trench they formed the aqueduct or water channel of masonry, keeping the same dimensions in the parts excavated from the rock, as in those which were cut into the clay or ground soil.

The bottom of this trench was laid with masonry, a foot thick; on this, two walls were erected, each 1 1-2 feet thick, and 5 feet high, and having a space between them of 2 feet, which formed the canal for the passage of the water; this space was enclosed on the top by a semi-circular arch 1 foot thick, and then covered with a layer, 2 feet thick, of earth. The bottom of the canal had a coat of cement 6 inches thick, and a coat of 1 1-2 inches on the sides, which reduced the intervals between the walls to 21 inches. The angles were formed by the sides and bottom, rounded by cement. The walls were constructed with small rough stones, from 3 to 6 inches in thickness, laid in a bed of mortar, so that no void was left between the pieces. It would appear that the use of stones larger than 6 inches, was avoided, as the walls formed of small stones, well bedded in mortar, formed, in the estimation of the ancient Lyonese architects, masses of greater compactness, than those built with larger pieces.

The builders also used gravelly sand for this kind of masonry, in preference to fine sand, which is proper only for the cement; and when they were obliged to use the finer sand, they took care to mix it with pulverised bricks, a practice adopted also in cases where coarse sand was mixed in abundance; lime burnt from good stones was used with unsparing profusion.

The cement employed for the sides and bottom of the aqueduct, was composed of pieces of brick the size of peas, for the first coats, and somewhat finer for the finishing plaster. That on the bottom of the canal, is made of pieces as large as nuts, and in many places the size of eggs; the composition was made with lime fresh slaked. That which contributed to make good cement, as well as good mortar, in their opinion, both in the one and the other, was the effectual mixing of the ingredients, so as that the mass should be all of the same temper, which is known when the composition was of the same color throughout.

In the aqueducts not built in the earth, the walls are from 22 to 24 inches thick, the exterior faces formed of reticulated work, the lozenges being from 3 to 6 inches square, without any course of bricks. The arch of the water channel, where it was not covered with earth, was somewhat curved, to throw off the rain, but yet so flat as to serve for a road of communication between the reservoirs, and within the aqueduct, and which was entered through iron doors placed in the arch of the reservoir, and also in that of the one or two places of the arch channel aqueduct bridge. The subterranean channels had similar entrances, like square pits, the mouths of which were elevated 2 or 3 feet above the surface of the ground they were driven into.

The entrance of the water into the aqueduct was regulated by a vane, or sliding valve, of a certain dimension, as only a certain quantity was allowed to flow into each branch. This does not appear ever to have exceeded 21 inches of elevation, which was sufficient to fill all the syphons; without this precaution the volume of water, which might have risen to 4 feet, would have been too great. It is probable that the regulating vane or sluice could be raised, or lowered, at pleasure to allow for the increase of head, and that the superfluous quantity was at times permitted to flow into some other channel.

Where the aqueduct was carried above ground, it was built on a footing of masonry 6 feet thick, even where the elevation above the surface did not exceed 6 or 7 feet; but when it was greater, arches were formed, and also piers, when the elevation was considerable; on this elevation depended the span of the arches, the thickness of the piers, and their height. For an opening of 18 feet in height the width is 12 feet, and the piers 6 feet, sustaining a semi-circular; when the inequality of the surface did not allow the piers to have an equal height of 18 feet to each opening, the piers were shortened, and the other parts remained of the same general dimensions. The piers of the arches in some places, are rather less on the face than 6 feet, varying from 5 feet 8 inches to 6 feet; and in other cases they are 7 feet 9 inches. The arcade which conducts the water into the reservoir called St. Irenæus, is 31 feet high, its width is the half of this, and the faces of the piers are 7 feet 9 inches. As the upper part, containing the canal, is only 6 feet thick, there is an offset of 6 inches on each face at the impost of the arches. On this off-set there is a projection, or pilaster, 10 inches thick, and 3 feet wide, which acts as a counter-fort, to strengthen the sides of the water channel.

The foundations of the piers having the smallest elevation, are sunk between three and four feet below the surface of the ground, and between six and eight feet for those of the greatest height.

All the different supports of the aqueduct are of the same kind of masonry, formed of small, rough, squared stones, laid in a thick bed of mortar, with the apparent faces of reticulated work. This kind of masonry was bound, at every four feet of its height, by two courses of "great bricks," each brick being 22 inches square, and two inches thick. The angles of the piers, formed of small square slabs of stone, offered, in many instances, an insufficient resistance to the lozenge masses which they terminated, and their displacement has been apparently the main cause of the ruin of the greater number of the piers, for these have been formed by a sort of encasements, of the thicknesses of four feet of the *opus reticulatum*, without being properly bonded by stones large enough at the quoins. The arches are semi-circular; the arch stones are slabs (thick slates) of stone, three inches thick, alternating with a "great brick;" the *extrados* of the arch is finished by a row of bricks, which forms a fillet; on this fillet is laid a double horizontal row of bricks, which runs through the entire length of the aqueduct, without, however, forming any projection. It is upon these bricks, as a pavement, that the water channel is laid, or bedded.

Of the arcades forming that part of the aqueduct called Langoneau, only seven piers remain, and these of the common reticulated masonry. The valley between Soncieu and Chaponost is about 200 feet deep. Five ranges of arcades, placed one over the other, for a length of 2400 feet, conducted the water across the valley; the valley through which the river d'Izeron flows, between Chaponost and St. Foi, is nearly 300 feet deep, and was crossed by a series of arcades having eight ranges in height. The third valley, formed by the small hill of St. Foi, and that of Fourvieres, had three ranges of arcades.

These prodigious substructions must have occasioned an outlay so enormous, as under almost any circumstances would have completely arrested the completion of the undertaking; and the more so, as these valleys were neither all, nor the greatest across which the

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water had to be conducted. The resources of the architects here become conspicuous, in their substitution of leaden pipes, forming syphons, already described, which were laid at an expense comparatively trifling, to what must have been incurred by following the other and more usual method.

In describing the passage of the valley of the Garon, the aqueduct arriving at the summit of the hill, was stated to deliver its water into a tank, or reservoir, placed in a square tower.

This reservoir, fourteen feet long by four and a half feet wide, is seven feet high to the summit of its arch ; the walls are four and a half feet high to the springing of the arch, and two feet three inches thick. The arch is pierced in the centre by an opening two feet square, which serves as a passage into the reservoir. The bottom is lined with a coat of cement, six inches thick, with a curve at the angles of concourse of the sides and bottom ; there were two ranges of iron rods about one third of an inch in diameter, to strengthen the walls, and probably also to serve as a kind of stair by which to descend into the reservoir.

This syphon bridge is disposed in the same manner, and has the same proportions, as the other arcades, the width of the arches being 18 feet, and the height of their opening 36 feet; but this part is somewhat different from the others, from its width, which is 24 feet, and by its piers apparently terminating at the impost or springing of the arches, forming an elevation of considerable elegance, and a covered passage under the bridge. The arcades pierced in the piers for this road or gallery, are four feet wide, and 21 feet high, their arches being formed of voussoirs of thin stone, alternating with great bricks ; the facing is of reticulated masonry, and being built with black and grey pieces, has much the appearance of a chess-board. However, these openings having weakened too much the higher piers, the builders were under the necessity of strengthening some of them, by counter-forts of the same sort of masonry. Two arcades in the valley of Bannau fell in 1757, from this precaution not having been taken ; from these piers, after their fall, it was observed that the arches were divided into compartments in their depth, by voussoirs formed of a double row of great bricks.

The quantity of water, according to Delorme, which was furnished by this aqueduct in twenty-four hours, was 1,323,000 cubic feet. This author, however, did not appear to have made any corrections for the diminution of velocity on account of friction, and other circumstances affecting the motion of fluids ; after these have been made to bear on his calculation, the quantity has been estimated as not being greater than about 172,800 cubic feet, or about 1,209,600 gallons.

The receiving reservoir for the valley of Bannau is eighteen feet long, and 6 feet wide. It was pierced, according to Delorme, with twelve openings, for as many syphons, this increase in the number of pipes being made on account of the valley being deeper than that of the Garon, and, as he thinks, as the pressure increases, while the depth is augmented, that the architects multiplied the number of syphons, to divide this force by diminishing their diameter in proportion—a circumstance which, if accurate, would clearly decide that the difference between the weight and the pressure of water, was unknown to the Roman architect. The rest of the syphon bridges are similar to that of the Garon. There is now no vestige of the emitting reservoir of St. Foi. The receiving reservoir of St. Irenæus is also much dilapidated, and also that of Soncieu. Delorme conjectured that its side was pierced for a smaller number of syphons than that of Soncieu; but these pipes were of a greater diameter than those of the others, as appears by the parts at present in existence; and Delorme thinks that the emitting reservoir was like the receiving tanks, which are seen near the wall of the city of Lyons, and conducted the water by an aqueduct to the reservoir, now called the *Maison Angelique.* This reservoir was also furnished with the usual opening. The emitting reservoirs had an opening at a height of four and a half feet above the level of the pavement, to turn, if required, the flowing water to the bottom of the tower, and to facilitate their cleanings and reparations.

The great reservoir of the *Maison Angelique*, the bottom of which is now buried in the ground, was supported by a series of vaults, separated by partition walls two and a half feet thick. Five of these vaults are still entire. They are semi-circular, built of small, rough, square stones, with courses of bricks in the voussoirs, in each ten and a half inches, and they appear to have been laid without mortar. A fall, or step, of one and a half foot, arched to a height of four feet, is still seen in a wall seven and a half feet thick. The water here descended by a well, or tank, one and a half foot square, which joins the south side, where it has a thickness of more than ten feet.

Decolonia (in his Histoire Litteraire de la ville de Lyons,) says, that thirty leaden pipes, of from 15 to 20 feet in length, marked by the initials, TI. CLA. CAES. (Tiberius Claudius Cæsar,) were found in this part. He had no knowledge of the reservoir discovered by Delorme, to which it is probable these pipes belonged, and in which they were used for distributing the water to the buildings and gardens of the palace of the Emperor Claudius.

The aqueduct of Metz is another of the great works of the Romans, though of what precise date seems uncertain—possibly of the period when the legions of Cæsar held possession of Gaul. The water which it conducted into the town was taken from the valley above Gorze—distant about 23 miles—now called *Les Bouillons.* The construction of the work was essentially similar to those already described. It was in its whole length a close conduit of masonry, and carried over valleys by lofty arcades, no recourse being had to syphons or leaden pipes.

Spain, too, yet preserves some splendid aqueducts of Roman origin. That at Segovia—the most remarkable—has an arcade of 159 arches, 94 feet high, and extending across a valley 700 yards in width. This work is ascribed to Trajan.*

Upon a level at its origin with the rivulet it receives, and supported at first by a single range of arches not more than three feet high, it proceeds to the summit of a hill at the other extremity of the city, and gradually increases its height in proportion to the declivity of the ground. In its highest part a bridge has been thrown across an abyss. It has two branches which form an obtuse angle with the city. At the commencement of the angle it becomes a grand object. Its two rows of arcades rise majestically above each other, and the spectator is surprised at its gigantic height, and the lightness of its piers. It has stood 1600 years.

Nor can we pass by the extensive works at *Grenada*, though of comparatively modern date, for supplying, with Arabian magnificence, the waters of the various baths, fountains, and apartments of the famed *Alhambra*. The Square of Cisterns encloses numerous reservoirs, kept constantly filled with water by an aqueduct from a neighboring hill, distant two or three miles. The largest of these reservoirs or cisterns, is 102 feet long and 56 wide, enclosed by a wall six feet thick, and protected by an arch forty-seven and a half feet high in the centre. There are two openings, or ventilators, to this cistern, three and a half feet in diameter, and carried up several feet above the surface, for the admission of air and light.

From these cisterns the water was distributed as desired. The grand fountain in the Court of the Lions was thus fed. The fountain was in the centre of this magnificent court. Twelve lions support on their backs an alabaster basin, richly decorated, elevated above which was a smaller basin. A great volume of water rose through pipes into the upper basin, which fell into that below, and was thence conducted through the mouth of the lions, to a black marble reservoir, from which, as a fountain head, the water was distributed in marble channels to different apartments.

This palace, and its luxurious and expensive adornments, date back to the twelfth century.

Constantinople had its aqueducts, also, of Roman construction, by the Emperor Valens, in the 4th, and Justinian, in the 6th century, of which the remains in the valley of Bourgas, still exist.

One of our own countrymen, Dr. Dekay, in his sketches of Turkey in 1831—2, thus describes the remains of these aqueducts:

* Bourgoanne, Spain, vol. i., p. 19.

Under the Greek emperors, Constantinople was supplied with water by the means of aqueducts, and large reservoirs were established in different parts of the city. These latter, however, have now gone into disuse, as expensive and inadequate for the purposes intended. Under the present system, all the water-works about Constantinople are under the management of an officer, termed the *soo naziri*, or inspector of waters. It is his business to keep them in good repair, and he is responsible for any accidents which may obstruct or diminish the supply. As no time is to be lost to repair injuries, this officer is clothed with great power, and he compels every one to assist in restoring the line of communication. This resembles the corvée of old France in some measure, but is much more oppressive; for the *soo naziri* fines most rigorously all who dwell in the vicinity of any breach, or injury, unless they give immediate information of the disaster. So important are these water-courses considered, that the sultans have always been in the habit of making annually a formal visit of inspection, which is accompanied with much ceremony, and ordering such improvements and alterations as are deemed necessary.

"It is impossible to travel any where in the vicinity of Constantinople, without being struck with the great pains taken by the Turks to treasure up every rill, or the minutest trickle from the face of the rocks. These are carefully collected in marble or brick reservoirs, and the surplus is conveyed by pipes to the main stream. In passing through sequestered dells, the traveller frequently comes suddenly upon one of these sculptured marble fountains, which adds just enough of ornament to embellish the rural scene. They are frequently decorated with inscriptions, setting forth the greatness and goodness of Providence, and inviting the weary traveller to make due acknowledgement for the same. Unlike our civilized ostentation, the name of the benevolent constructor never appears on these sculptured stones. The quaint Turkish adage, which serves as a rule of conduct, is well exemplified in this as well as in many other instances; "Do good and throw it into the sea; if the fishes don't know it, God will."

"Among the hills at various distances, from fifteen to twenty miles from the city, are constructed large artificial reservoirs. These are termed *bendts*, a word of Persian origin, and are built in the following manner: advantage is taken of a natural situation, such as a narrow valley or gorge between two mountains, and a strong and substantial work of masonry is carried across, sufficiently high to give the water its required level. Four of these *bendts* were visited and examined, but there are several others which we did not see. A description of one of the largest will give an idea of the manner in which they are constructed.

"A solid wall of marble masonry, eighty feet wide, and supported by two large buttresses, rises to the height of a hundred and thirty feet from the bottom of the valley. It is four hundred feet long, and the top is covered with large marble slabs of dazzling brilliancy. On the side next the reservoir, a substantial marble balustrade, three feet in height, gives a finish to this Cyclopean undertaking. A tall marble tablet indicates the date of its erection, or more probably of its repair or reconstruction. From the date, 1211, it appears to have been built about forty-six years ago. It is called the *Validay Bendt*, and is said to have been built by the mother of the reigning sultan. It is furnished with a waste gate, and, at a short distance below, the water from the reservoir is carried across a ravine by a short aqueduct. About two miles from this is another *bendt*, erected in 1163, which corresponds to the year 1749. This is also a magnificent work, although inferior in size to the preceding. They both supply the aqueduct of Batchikeui, which, as has already been stated, furnishes the suburbs of Pera and Galata with water. Beyond Belgrade are other reservoirs which will be elsewhere noticed. These supply Constantinople proper, with water.

"In order to convey a clear idea of the direction of these various hydraulic works, it may be advisable to follow each singly. Beyond Belgrade is a large *bendt*, which sends its waters into a basin already partially supplied from another reservoir. A mile farther on, the water is carried across two aqueducts, the larger of which is known as the aqueduct of Mustapha III. From this it is conveyed into the aqueduct of Justinian. This is twelve miles from Constantinople. It consists of two tiers of arches, each forty-two feet wide. The arches are four in number; the total length of the aqueduct, with its abutments, is seven hundred and twenty feet, and its greatest height a hundred and ten feet. A gallery pierces the square pillars, forming the first story of arches, and allows a passage through its whole length. There are four small arches at each end of the first story, about twelve feet wide. The precise epoch of the construction of this aqueduct is not known, although it is commonly attributed to the Emperor Justinian II. This aqueduct receives also water from two others, the principal of which is known under the name of Solyman. This is sixteen hundred feet long, and eighty feet high, and consists of two stories of fifty arches each. It is a Turkish work. Another aqueduct also conveys water into that of Justinian, and is generally supposed to be of the age of Constantine. It is three stories high; the lowest tier consists of thirty-three arches, fifteen feet wide, the second of twelve arches, and the uppermost of four. It is three hundred and fifty feet in length. All these magnificent and costly structures are intended for the supply of Constantinople alone, and we will now trace the course of the water. Leaving the aqueduct of Justinian, it follows the right bank of the Cydaris, and receiving in its course various tributary rivulets from the neighboring hills, it enters within the walls of Constantinople near the *aygry kapoosi*, or crooked gate, whence it is distributed over the city. It was impossible to ascertain the quantity of water furnished through this series of hydraulic works; but, judging by comparison with that which supplies the suburbs, it cannot be less than fifteen millions of gallons within twenty-four hours.

" We will now return to the aqueduct of Batchikeui, and follow the direction of its waters. These are carefully brought round the heads of the valleys in covered canals, in which there are at certain intervals, sudden breaks or alterations in the level, which answer the double purpose of agitating the water in contact with air, and of precipitating its impurities. It likewise affords fountains on the road for the use of cattle and weary travellers. When hills intervene, tunnels are boldly driven through, at the depth of fifty, eighty, and in some places a hundred feet. The course of these tunnels may be traced on the road between Pera and Buyukdery by numerous pits, which were about two hundred feet apart. These pits were convenient for giving air and light beneath, and also afforded a ready means of getting rid of the excavated earth and rocks. It is possible, that at the period when these tunnels were made, the pits were previously dug, in order to enable them to give the necessary direction and level to the subterranean passage. Branches from this main stream are continually thrown off to supply the villages, and the palaces of the sultan along the Bosphorus. Notwithstanding all these expensive works, it sometimes happens, after long droughts, that the supply becomes scanty in the suburbs ; and during my residence here, I have known water to be sold at Pera and Galata at from two to six cents a pail-ful. This, however, never occurs in the city itself, which is abundantly supplied at all seasons of the year.

" Where a valley of great extent is to be crossed, the Turks have resorted to an ingenious contrivance, which I have nowhere seen clearly described, but which, from its simplicity and value, merits a more particular notice. From the want of sufficient mechanical skill to manufacture water-pipes strong enough to bear the weight of a large column of water, they adopted the following plan : in the direction of the proposed water-channel, a number of square pillars are erected at certain short intervals ; they are about five feet square, constructed of stone, and, slightly resembling pyramids, taper to the summit. They vary in height, according to the necessities of the case, from ten to fifty feet, and in some instances are even higher.

" They form a striking peculiarity in Turkish scenery, and it was some time before the principle upon which they were constructed was apparent. The water leaves the brow of a hill, and descending in earthen pipes rises in leaden or earthen ones, up one side of this pillar, to its former level, which must be, of course, the summit of the pillar, or *sooteray*, as it called by the Turks.* The water is here discharged into a stone basin as large as the top of the sooteray, and is discharged by another pipe, which descends along the opposite side of the pillar, enters the ground, advances to the next sooteray, which it ascends and descends in the same manner ; and in this way the level of the water

* This word is from the Turkish *sooteraysoo*, which means the levelling of the water, and expresses very well the object of the sooteray.

may be preserved for many miles over large ravines or plains, where an aqueduct would be, from its expensiveness, manifestly out of the question. In the city of Constantinople, the old ruinous aqueduct of Valens, which no longer conducts water in the usual manner, is converted into a series of sooterays, and permits one to examine their structure in detail. The stone basin on the summit is covered with an iron plate, to prevent the birds from injuring the water. This is connected by a hinge, and, upon lifting it up, the basin is found to be divided into two parts by a stone partition. Several holes are made in this partition near its upper edge. The water from the ascending pipe is allowed by this means to settle its foreign impurities, and the surface water, which is of course the most pure, flows through these apertures into the adjoining compartment, from whence it descends, and is carried to the next sooteray, where the same process is repeated. A number of projecting stones on the sides facilitate the ascent of the person who has charge of these sooterays, and whose business it is to remove the deposites from the water in the stone basins.

" This ingenious hydraulic arrangement seems to possess advantages which might recommend its adoption elsewhere. As the pressure is thus divided among this series of syphons, the necessity for having very strong and costly pipes is obviated. As they are from three to five hundred yards apart, the cost is probably much less than by any plan which could be devised, where, in addition to the cost of a canal or series of pipes, we should be compelled to raise it again, by the expensive agency of steam or some other costly apparatus. The frequent exposure of the water to air and light at the summit of these sooterays, is another very important advantage which cannot be too strongly insisted upon ; as it is now well known that nothing tends more to purify water, than the presence of these two agents. The arrangement, likewise, of the basins on the top of the pillars, is well adapted for getting rid of much of the matters deposited from turbid waters. Lastly, to the descending pipe a small cock is attached near the ground, by which the flocks and herds of the adjoining villages and fields, are furnished at all times with a copious supply of water.

" On the heights of Pera there is a large reservoir, 200 feet square, built of the most solid and substantial masonry ; from this reservoir the water is distributed through the suburbs of Fundukli, Pera, Galata, and Cassim Pacha.

" After a deliberate survey of the various hydraulic contrivances for supplying Constantinople with water, one is at a loss to know which to admire most, the native good sense which pointed out the necessity and importance of furnishing the capital and its suburbs with pure and wholesome water, the ingenuity displayed in conquering almost invincible obstacles, or that wise and liberal economy which considered no expense too enormous, no sacrifices too great, in comparison with the health and comfort of the people.

The various water-courses about Constantinople must exceed fifty miles in length, and the expenses of the various reservoirs and aqueducts could not have been less than fifty millions of dollars."

In addition to its aqueducts the ancient city used water gathered into enormous subterranean cisterns, which still exist, and in some instances are yet supplied with water.

In Gyllius's Antiquities of Constantinople, the exploration of one of these vast ancient cisterns, of which the construction is ascribed to Constantine the Great, is thus related:

"The whole ground was built upon, and made it less suspected that there was a cistern there. The people had not any notion of its existence, although they daily drew their water *out of wells that were sunk into it.* I went by chance into a house from which there was a descent into a cistern, and embarked in a little skiff on its waters. The master of the house having lighted torches, rowed us to and fro between the pillars, which lay very deep in the water. He was very intent upon catching fish, with which the cistern abounds, and speared some of them by the light of the torches. A faint light descends from the mouths of the wells, and is reflected upon the water, and here the fish usually go for air. This cistern is 363 feet long, and 182 broad; the roof, arches, and sides are all brick work covered with terrass, and not in the least impaired by time. The roof is supported by three hundred and thirty-six marble pillars, of about forty and three quarter feet high, with spaces of intercolumniation of twelve feet. They stand lengthwise in twelve ranges, and twenty-eight in the breadth. Their capitals are partly finished after the Corinthian model — part of them are not finished.

"There are abundance of wells falling into the cistern. When it was filling in the winter time, I have seen a large stream of water falling from a great pipe with a mighty noise, till the pillars have been covered with water up to the middle of the capitals."

Dr. Walsh, whose travels in Turkey are so late as 183–, visited this subterranean reservoir, and confirms the account of Gyllius.

Modern Rome is almost as bountifully supplied with water as the ancient city, notwithstanding the destruction or decay of the old aqueducts. But the Romans of this day are but a handful — perhaps 150,000 — to the populousness of the elder time; and this comparatively small number possess, without enjoying as they might, the advantage of overflowing fountains.

The anarchy of the middle ages, as has been already stated, led to the destruction, among other works of art, of the aqueducts, and the Romans were again reduced to wells and springs, and the Tiber. A precarious supply of purer element had been occasionally obtained by repairing an ancient conduit — but neither the resources of the State, nor the skill of individuals, were equal to the undertaking of a permanent reparation. It was not until the pontificate of Nicolas V., that a restoration of an ancient aqueduct was attempted; the *Aqua Appia* was then begun, and the work continued by Sextus IV., was completed by Pius IV., in 1568.

At this period, the three channels by which water of the restored conduit arrived at

Rome, were conducted into, and distributed from, a reservoir without any architectural ornament. Clement XII. began its decoration on the side of the modern Palais Conti, from the designs of Nicolo Salvi. This beautiful monument and masterpiece of its author, was finished under Benedict XIV., and received the name of *Trevi*, from the water being conducted into its basin by three channels, and also from its position at the meeting of three streets. Of the three modern aqueducts, the *Aqua Virgine*, is accounted the most salubrious, and best adapted for culinary purposes. The pipes of this water are, on this account, sold at a higher price than the others.

The aqueduct which furnished, at the time of *Frontinus*, 2,504 *quinariæ*, (50,000 cubic feet,) now furnishes nearly 65,782 cubic metres in twenty-four hours, and this quantity is distributed by seven principal conduits into thirteen public, and thirty-seven common fountains.

The present *Aqua Felice*, is part of the water of the ancient Aqua Claudia and Aqua Marcia, united with some other springs collected under the pontificate of Sextus V. The stream begins from the Campo Colonna, situated to the left of the Palestrina road, fourteen Roman miles from Rome, and enters the city through that remarkable ancient remain, called the monument of the Aqua Claudia. This water follows a course approaching to that of the Aqua Marcia and Aqua Claudia, but is on a lower level than either, as its sources are not so high up as the Anio. All the waters of which the Aqua Felice is composed, were united by Urban VII. in one immense reservoir, and several smaller ones, whence they were conducted into the conduit by an aperture named *fistola urbana*, formed in a block of marble. According to Fontana, this stream is equal to a hundred superficial "pouces d'eau." The quantity of water has been estimated at 20,537 cubic metres in twenty-four hours, distributed in sixteen public, and eleven common fountains.

The fountain from which its water is distributed to the city, is adorned by a statue of Moses striking the rock, and two other figures, with four Ionic columns of granite, and two Egyptian lions of basalt, which formed part of the ancient decoration of the Pantheon. Its name, Felice, is derived from Felice Peretti, which was that of the family of Sextus V.

The Aqua Paola.—In 1694, the Cardinal Orsini, having proposed to the Papal government to bring water from the Lake Bracciano (anciently Alsietinus) to Rome, in the ancient channel of the Aqua Alsietina, the architect, Paglia, examined the levels, and stated that a sufficient quantity of water could be obtained and directed into the channel as projected by the Cardinal. Permission was accordingly given to the Orsini family to commence operations, on condition of furnishing about a third part of the water for the supply of one of the new public fountains, and dividing with the apostolic chamber, the revenue which would arise from the disposal of the remainder.

The cavalier Bernini, having the direction of the new fountain before St. Peter's and wishing to ascertain, by means which appeared to him less exceptionable than those employed by Abbé Paglia, whether the quantity which had been stated, as being at his disposal, could be obtained or depended upon, committed the examination of the levels to his brother, who gave his opinion against the practicability of obtaining that quantity which the Cardinal anticipated, on account of the small declivity of the channel of the aqueduct, and the variations in the levels of the lake itself. The Pope having directed new experiments and observations to be made, it was found that although the level of the lake was about one and a half palms above the surface of the ancient reservoir which fed the aqueduct, that this additional head was insufficient to produce the velocity to furnish the supply which was considered to be desirable. To obtain this velocity, a weir or dam was erected across the mouth of the lake to preserve its waters at the proper height, and the usual means of regulating the head, and disposing of the superfluous water—by sluices—was resorted to. The aqueduct now received the name of Aqua Paola, from the name of the pontiff, Paul V., in whose reign it was brought to Rome. It is a remarkable proof of the stability of the old Roman works, that when, 1000 years after the interruption of this water course by the Goths, water was again let into it by direction of Cardinal *Orsini*, it flowed on through a length of ten miles without obstruction or leakage.

The quantity of water furnished by this aqueduct is estimated at about 94,184 cubic metres in twenty-four hours.

Thus, from the three modern aqueducts not less than 180,500 cubic metres of water are daily introduced into Rome; yet the want of cleanliness is remarkable in every street and corner of the city. The water is not conveyed by pipes into the upper floors of the houses, but into a common fountain in their courts. In order to raise it to these stories, a strong iron wire is fixed with one end above the fountain, and another above the window; a bucket is made to slide along this wire, having a rope attached to it by which it is let down into the fountain, and passed over a pully above the window; the end of the rope is held by the person in the window, and when the bucket is filled, he draws the rope, and it slides along the wire as a guide, until it arrives at the window, where it is disengaged by the attendant.

But although in their houses the modern Romans profit little by their abounding supply of water, in their public fountains they excel all other cities. We shall be excused for quoting the fine account of them, given by Eustace in his classical tour.

FOUNTAINS.

"From the obelisks, we pass to the fountains, because they are generally employed in the decoration of the same squares, and sometimes united as in the Piazza Favona and St. John à Lateran, to set each other off to more advantage. Three only of the ancient aqueducts now remain to supply modern Rome, and yet such is the quantity they convey, and so pure the sources whence they derive it, that no city can boast of such a profusion of clear and salubrious water. Artificial fountains in general, are little better than ornamented pumps, which sometimes squirt out a scanty thread of water, and sometimes distil only a few drops into a muddy basin. Those on a greater scale, now and then throw up a column, or pour a torrent as occasion may require, on certain state days, or for the amusement of some distinguished personage, and then subside till a fresh supply enables them to renew the exhibition. Such are in general the fountains and cascades that adorn public walks and palace gardens; and such the so much celebrated water-works of St. Clond, Marli, and Versailles—inventions which can be considered only as pretty play-things, calculated, like a theatrical decoration to act an occasional part, and to furnish a momentary amusement, but too insignificant to be introduced into the resorts of the public, or into the walks of princes, where we have reason to expect solid magnificence, founded on nature and reality.

"How far the ancient Romans carried this species of magnificence, we may easily judge, when we consider that they had, undoubtedly, both the taste and the materials requisite for it. Their aqueducts, which supplied them with water, even to prodigality, still remain, striding across valleys, penetrating mountains, and sweeping over immense plains, till they meet in the heart of the city. The edifice where they united, and whence they separated to water their destined quarters, was called Castellum; and if we may judge by that which remains (the Porta Maggiore) was generally a fabric of great solidity and magnificence; and, as appears from the ruins of one discovered near the church of St. Ignatius, sometimes cased with marble and adorned with marble pillars. The number of these towers anciently, as well as of the towers springing from them, must have been prodigious, as Agrippa alone, if we may believe Pliny, erected one hundred and thirty of the former, and opened one hundred and five of the latter, and adorned them with three hundred brass and marble statues. The modern Romans, though inferior in numbers and opulence to their ancestors, have shown equal taste and spirit in this respect, and deserve a just eulogium, not only for having procured an abundance of water, but for the splendid and truly imperial style, in which it is poured forth for public use in the different quarters of the city. Almost every square has its fountains, and almost every fountain has some peculiarity in its size, form, or situation, to attract attention. The three principal, however, will suffice to give the reader an idea of the variety and of the beauty of such edifices.

"The Fontana Felice, in the Piazzi dei Termini, on the Viminal Mount deserves to be mentioned first, because first erected. It is supplied by the Aqua Claudia drawn from the Alban, or rather Tusculan hills, and conveyed to Rome by channels under, and aqueducts above, ground, some of which are ancient, and some modern. It discharges itself through a rock, under an Ionic arcade built of white stone, and faced with marble. It is adorned by several gigantic statues, the principal of which represents Moses striking the rock whence the water issues. On the one side, Aaron conducts the Israelites—on the other, Gideon leads his chosen soldiers to the brink of the torrent; below, four lions, two of marble and two of basalt, ornamented with hieroglyphics, hang over the vast basin, as if in haste to slake their thirst. The restoration of this noble fountain, and the ornaments which grace it, are owing to the spirit of Sixtus Quintus, and it bears the name of Aqua Felice, and is supposed to be now, as anciently, peculiarly wholesome. Nearly opposite, but beyond the Tiber and on the brow of the Janiculum, rises an arcade supported by six pillars of granite. Three torrents rushing from the summit of the hill, tumble through the three principal arches of this arcade, and fill an immense marble basin with the purest water. They then roll down the side of the mountain, turn several mills as they descend, and supply numberless reservoirs in the plain along the sides of the river, and even beyond it, in the Campus Martius. The lofty situation of this fountain, renders it a conspicuous object to all the opposite hills. The trees that line its sides, and wave to the eye through its arches, shed an unusual beauty around it; and the immense basin which it replenishes, gives it the appearance, not of the contrivance of human ingenuity, but almost the creation of enchantment.

"In the Piazza di Trevi, (in Triviis) on a rough and broken rock, rises a palace, adorned with Corinthian pilasters, and supported in the centre by Corinthian pillars. It is ornamented with statues, representing the salubrity and fertilizing powers of the waters; the beneficent Naiad herself, holds a conspicuous place among them, and seems to behold with complacency, the profusion of her springs. In the middle of the edifice, between the columns, under a rich arch, stands Neptune on his car, in a majestic attitude, as if commanding the rocks to open before, and the waters to swell around, him. Two sea-horses, conducted by two tritons, drag the chariot of the god, and emerging from the caverns of the rock, shake the brine from their manes; while the obedient waves burst forth in torrents from all sides, roar down the clefts of the crag, and form a sea around its base. In the heats of summer, they overflow their usual limits, fill the whole marble concavity round the fountain, and rise to a level with the square, where, after sunset, the inhabitants of the neighboring streets assemble, to enjoy the united freshness of the waters and of the evening.

"Such is the celebrated Fontana di Trivi, the noblest work of the kind in Rome, and probably the most magnificent fountain in the world. The basin itself is of white marble, and the vast enclosure around it is flagged and lined with marble of the same color. A flight of steps of white marble leads down to this basin; and to prevent accidents, a chain, supported by large blocks of granite, encloses the exterior border. I know that the architectural part of the Fontana di Trivi, and indeed of the Aqua Paola and Aqua Felice, has been severely criticised; and in candor, I must acknowledge, that the criticism is in many respects well founded: for instance, it must be allowed that the elegance and lightness of the Corinthian, or Ionic, is ill adapted to the simplicity of a fountain where Doric would be more appropriate, because plainer and more solid. It will be admitted also, that these edifices are broken and subdivided into too many *little* parts; a process in architecture, as in painting and in poetry, diametrically opposite to greatness and to sublimity. In fine, it cannot be denied, that the superstructure is, in *all* three, too massive for the order, and too much encumbered with coats of arms and other supernumerary decorations. Yet, notwithstanding these faults, and they are not inconsiderable, while the spectator sits on the marble border of the basin, and contemplates the elevation of the columns, the magnitude of the edifices, the richness of the materials, the workmanship of the statues, and, above all, the deluge of waters poured round him, the defects are lost in the beauties, and criticism subsides in admiration."

It would swell this essay to an unreasonable length, if we were to notice in detail all the remarkable modern aqueducts of Europe, and passing by, therefore, that of the Prince of *Biscari*, in Sicily, which served at once as a bridge and a conduit, those of *Tarregona*, *of the plains of Anover*, and of *Almasora*, in Spain, that of *Caserta*, commenced in 1753, by the King of Naples, which boasts of a line of arcades 1618 feet in length, and 178 high—divided into three stages—with numerous and long tunnels, lighted and ventilated from the depth of 250 feet, by conical shafts of 50 feet diameter at bottom, and four feet at top, and others of inferior note, we select for more special description and detail, the chief water works of England, and of France, and the magnificent aqueduct of Lisbon.

London, like Rome, was already a large and populous city, before its supply of water was copious or convenient.

In the reign of Henry II., about the middle of the twelfth century, the inhabitants relied on the Thames, or wells in the city, and on springs rising in the elevated grounds, north and west of the city. Fitz Stephens thus refers to this last fact in his " Description of London in the reign of Henry II." "Round the city again, and towards the north, arise certain excellent springs at a small distance, whose waters are sweet, salubrious, and clear, and whose

Runnels murmur o'er the shining stones.

Among them, Holywell, Clerkenwell, and St. Clement's well, may be esteemed the principal, as most frequented, both by scholars from the schools, and youth from the city, when in a summer's evening they are disposed to take an airing."

The antiquarian, *Stowe*, who published his " Survey of London," in the reign of Queen Elizabeth, gives this account of the source and supply of water to the city :

" Anciently, until the Conqueror's time, and for 200 years afterwards, the citie of London was watered (beside the famous river of the Thames on the south part,) with the river of *Wels*, as it was then called, on the west ; which water is called Wallbrooke, running through the midst of the citie into the river Thames, serving the heart thereof : with another water or bourne running through Langbourne Ward. In the west was another great water called Oldborne. Then there were three principal fountains, or wells in the other suburbs ; Holywell, Clement's well, and Clerke's well. * * * Besides which, they had in every gate and lane of the citie, divers faire wells and fresh springs—and after this manner was this citie then served with sweet fresh waters ; which being since decayed, other means have been sought to supply the want. * * * * *

" The first cistern, castellated with stone in the citie of London, was called the *great conduit in Westcheap*, which was begun to be builded in the year 1235."*

The water for this cistern was derived from Paddington, and ran a distance of 1100 rods, or about three and three quarter miles, through leaden pipes, this being the first record of such a mode of distribution. This not extensive work occupied fifty years in the construction !

Another supply was soon after obtained from Tyburn, which was in like manner distributed by a leaden pipe of six inches diameter. Those living near the Thames, used

* Hydraulia.

its water, "fetching it," says Stowe, "by many lanes that led to the water side in divers wards of the city."

This right of passage-way was finally converted into a source of revenue by the owners of the soil, who exacted a duty from those who passed to and from the river.

As the city increased, new schemes were constantly resorted to, and new sources of supply brought into use. The Paddington springs, and those near Islington, were trained through pipes into the city. At subsequent periods, springs at Hackney, Hampstead Heath, Marylebone, and Muswell Hill, were resorted to. An act of Parliament, in 1544, invested the mayor and commonalty of the city of London, with ample power "to enter into the grounds and possessions of the king, as well as every other person and persons, bodies politic and corporate, where they shall find or know any such springs to be, or may be found, (so that it be not under their houses, gardens, orchards, or places enclosed with stone, brick, or mud walls,) and there to dig pits, trenches, and ditches, to erect heads, lay pipes, make vaults, and do all and every such thing, in the same place and grounds, which shall be meet, proper and necessary, only for the conveyance of the said water and springs to the city, and the suburbs of the same; and also to have free ingress, egress, and regress in and to all such places where such heads, pipes, or vaults shall be erected, laid, or made; to view and see from time to time said heads, pipes, suspirats, and vaults, and them to amend, repair, translate, and do all things necessary and convenient, as well for the finding of new springs, as for the conveyance of any water or springs now found, or hereafter to be found, to the city and suburbs aforesaid, without interruption, let, or impediment, of the owners of the ground, their lessees, assigns, or ministers, or any other person."

All ground, however, needed for the use of these conduits, or aqueducts, was, by the same act, to be appraised by three or four indifferent persons, appointed by the Lord Chancellor, and to be paid for within one month after possession was taken. A special reservation, moreover, was made of the spring at the foot of Hampstead Hill, which was used by the inhabitants of the town of Hampstead.

Slow was the progress of this Hampstead work, for in 1590 it was still unfinished. It was, however, finally accomplished; a succession of reservoirs at different levels was constructed, each communicating with the other, and through two mains of seven inch bore, the neighborhood of St. Giles was supplied.

Originally these works belonged to the city of London, but in 1692 they were transferred to a company incorporated by the name of the *Hampstead Water Co.*, which now furnish a daily average of 150 gallons of water each to about 2500 houses on the Hampstead Road, Kentish-town and Camden-town—all suburbs of the city.

Lambe's Conduit, was constructed at his own cost, by a gentleman of the name of *Lambe*, who belonged to the chapel royal of Henry VIII., and who thus conferred great advantage on the populous neighborhood of *Snow Hill*. Numerous other conduits were established, from different spring heads, and at different times. These conduits were for the most part small, circular buildings, with a spacious basin within, into which flowed the water through leaden pipes, from the source, and thence was carried by watermen, who made it a business, or by the servants of the neighboring houses; the vessels in which water was carried about were called *tankards*, holding about three gallons, and resembling in shape the cans used by milk-sellers.

All the conduits were under the special supervision of the city authorities, whose annual visit to inspect their condition was quite a festival; the aldermen proceeding on horseback, and having the diversion beforehand, of hunting the hare—the ladies following in wagons, to partake in the sport—and all assembling afterwards in the true spirit of corporation enjoyments, at a good dinner.*

Like the Arabian fountains in the *Alhambra*, too, these conduits were made to promote moral instruction, by short sentences inscribed on them. We annex one or two specimens:

Upon the Conduit in Grateous (Gracechurch) *Street.*

"Let money be a slave to thee,
Yet keep his service if you can;
For if thy purse no money have,
Thy person is but half a man."

On that in Cornwall (Cornhill).

"Bread, earned with honest, lab'ring hands,
Tastes better than fruite of ill-gotte lands."

"A man without mercy, of mercy shall misse,
And he shall have mercy, that merciful is."

On that in Cheapside.

"Life is a debt which at that day,
The poorest hath enough to pay."

The whole supply of these conduits was soon found insufficient; and, moreover, they furnished, not any of them, water *within* the houses. The desire of this convenience, and of a more abundant supply, led in 1581, the 23d of Queen Elizabeth, to a grant by the Lord Mayor and Commonalty, of a lease for 500 years, to a Dutchman named *Peter Morice*, who undertook, by machinery constructed under the first arch of London Bridge, to force water above its level, into a reservoir that should distribute it into the upper parts of the adjoining houses. This was the origin of the London Bridge Water

* Stowe; Survey of London.

Works, which for centuries afterwards furnished the chief supply of the city. The Dutchman succeeded so well with his first wheel—for it was nothing else than a water wheel, driven by the tide and acting upon a series of forcing pumps—that two years afterwards, a similar lease of 500 years was granted to him for the second arch.

In the *Philosophical Transactions*, for the year 1731, Mr. Beighton, an engineer, gives a detailed description of the London Bridge Water Works, which, though increased in extent and number of wheels, preserved the original design of Morice. There were then three water wheels, each operating upon 16 pumps. The wheels and machinery were fixed in a strong frame of oak, that rose and fell with the tide, which, whether ebbing or flowing, imparted motion to the wheels. The whole yield of all the pumps was 1954 hogsheads per hour.*

The lease and management of these works, continued in Morice's family till 1701, when, finding the profits diminished by the competition of the *New River Company*, the proprietor sold out for £38,000, to one Soames, citizen and goldsmith of London, who made a joint stock of the concern, and obtained from the corporation the lease of another arch. Subsequently the use of two more arches was granted to the company, and thus enlarged, the works were vigorously carried on—a considerable portion of the inhabitants of the city, both experiencing and acknowledging their utility. The revenue, however, was not large, as the distribution had originally been made through wooden pipes, which were found incapable of sustaining the pressure necessary for conveying water to the upper stories of lofty houses. The disadvantage under which this company labored, in competition with the New River Company—whose distribution was through iron pipes—still further diminished the returns. The company, therefore, dragged feebly on, till the building of the New London Bridge, in 1822, entirely annihilated their works.

The region they supplied is now furnished by the New River and the East London Water Works.

By a return made to Parliament in 1821, the London Bridge Company, just previous to the final destruction of their works, supplied 10,417 houses with 26,322,705 hogsheads per annum, at a rental of £12,266—about $61,000.

The New River Company purchased all their rights and leases for an annuity of £3750, to continue 200 years.

The *New River* was the work of one public spirited individual. "Master Hugh Myddelton, citizen and goldsmith of London," in March, 1609, after having in vain urged the corporation to the enterprise, obtained from them a transfer of the right conferred upon them by an act of Parliament, to bring a stream of pure water into the city from the springs of Amwell and Chadwell, in Hertfordshire. He immediately commenced the

* A hoghshead is equal to 63 gallons.—[Ed.]

work, and, by the aid of a loan from King James I., who stipulated that one moiety of the property should be conveyed to him for security, and triumphing over many obstacles from landholders, through whose possessions the river was to pass, and the greater obstacles arising from deficient skill in engineering, he accomplished it in five years; and on the 29th September, 1613, the water entered the reservoir now known as the *New River Head*, in the parish of Clerkenwell.

The execution of such an enterprise in that age was not only arduous, but deemed wonderful. *Stowe* thus alludes to some of its difficulties: "the depth of the trenches in some places descended full thirty feet, if not more, whereas in other places it required a sprightful arte again to mount over a valley in a trough between a couple of hills—and the trough all the while borne up by wooden arches, some of them fixed in the ground very deep and rising in height above 20 feet."

One of these troughs, or wooden aqueducts, near Bush Hill, was 660 feet long, and in width and depth, five feet, and lined with lead. Another similar trough of 462 feet, 17 feet high, conducted the water over a valley near Islington, and was called the *boarded river*. Owing to leakage, decay, and constant repairs, incident to such structures, they have been superseded by artificial mounds of earth and clay, preserving the natural flow and level of the river.

The old Chronicler, Stowe, thus relates the rejoicings, on the occasion of first letting the water of the New River into the cisterns or reservoirs prepared for it.

"Being brought to the intended cistern, but not, as yet, the water admitted entrance thereinto; on Michaelmas day, anno. 1613, being the day when Sir Thos. Myddelton Knt. (brother of Sir Hugh) was elected Lord Maior of London, for the year ensuing; in the afternoon of the same day, Sir Wm. Swinnerton, Knt., and Lord Maior of London, accompanied with said Sir Thomas, Sir H. Montague, Knt., the Recorder of London, and many of the worthy Aldermen rode to see the cistern and the first issuing of the river thereinto, which was performed in this manner.

"A troop of laborers to the number of sixty or more, well apparallelled, and wearing green Monmouth caps all alike, carried spades, shovels, pick-axes, and such like instruments of laborious employments, marching after drums twice or thrice about the cisterns, presented themselves before the mount, where the Lord Maior and worthy company stood to behold them, and one man in behalf of all the rest, delivered a speech in verse, narrating the progress of the work. It thus concluded:

At the Opening of the Sluice:

"Now for the fruits then, flow forth precious spring,
So long and dearly sought for—and now bring
Comfort to all that love thee; loudly sing,
And with thy crystal murmurs, strook together,
Bid all thy true well-wishers welcome hither."

At which words, the flood-gates flew open, and the stream ran gallantly into the cistern; drums and trumpets sounding in triumphant manner; and a brave peal of chambers gave a full issue to the intended entertainment."

The accomplishment of this noble and disinterested enterprise, has justly immortalized the name of *Hugh Myddelton.* The Goldsmith's Company, of which craft he was, has his portrait among the decorations of their Hall, and in the year 1800, Robert Mylue, Esq., the engineer of the Company who own the river which Myddelton has taught to pour its salubrious stream into the heart of London, erected on an islet in the basin at Amwell, a monument to his memory, one side of which bears this inscription:

SACRED TO THE MEMORY
OF SIR HUGH MYDDELTON, BARONET,
WHOSE SUCCESSFUL CARE,
AIDED BY THE PATRONAGE OF HIS KING,
CONVEYED THIS STREAM TO LONDON:
AN IMMORTAL WORK,
SINCE MEN CANNOT MORE NEARLY
IMITATE THE DEITY,
THAN IN BESTOWING HEALTH.

The documents connected with the cost of this most useful work, were destroyed by fire; but, from conjectural estimates, it is calculated at between one and two hundred thousand pounds.

The New River Company was incorporated under James I., in 1619, and Sir Hugh Myddelton, was appointed Governor.

For the purpose of avoiding hills and valleys, the New River has a meandering course, and hence the various windings render its length considerable, although the springs at its source if measured in a direct line, are distant only about twenty miles from London. The line of the river is very nearly thirty-four miles. More than one hundred and sixty bridges cross it—some of brick, some of iron, and some of wood. There are about sixty culverts that pass beneath its bed the various brooks and rivulets which it traverses in its course. The descent is about three inches to the mile. Both its depth and width vary—the former seldom exceeding five feet, the latter averaging eighteen feet.

The springs which originally supplied this river, were, as has been before mentioned, in the villages of Amwell and Chadwell, in Hertfordshire. But these were found unequal to the increasing demand, and recourse was had to the river *Lea*, which runs in a copious stream near the new river.

An act of Parliament in 1738, authorised this use of certain portions of the waters of the Lea, on condition of a present sum paid down, and a perpetual annuity, for the improvement of the navigation of that river.

The quantity of water to be abstracted from the Lea, was regulated by a balance engine of which the channel was 14 feet long, 6 broad and 2 deep.

When the reservoirs at New River Head, at Clerkenwell, are full, they stand at a level of eighty-four and a half feet above high water in the Thames; which, however, only enabled the Company to fill the cisterns in the basement stories of the houses they supplied. Hence, in 1810, resort was had to steam engines to throw the water up, and then a head was thus obtained 144 feet above the level of the Thames, and high enough for the loftiest houses. Another consequence of employing the steam engine, was the replacing the wooden tubes through which the water was first conveyed, by iron pipes. At one time this company had 400 miles laid down of wooden tubes, of which about twenty miles, on an average, required to be renewed every year, thus causing the whole to be renewed every 20 years. This was a monstrous annual drain, besides the public inconvenience of constantly breaking up the great thoroughfares to replace these tubes. The smallness of the bores, moreover, of the tubes, seldom exceeding eight inches, required a great multiplication of trains to transmit the needful supply of water. In 1810, *nine trains* were laid side by side in one street.

In the course of the next ten years, all the wooden tubes were replaced by iron, at a cost of *one and a half million dollars.*

In addition to the supply from the New River, this company, in fulfilment of their contract with the London Bridge Water Works Company, have a steam engine of 100 horse power on the banks of the Thames, between Blackfriars and Southwark iron bridge, which, through a main 33 inches in diameter, extending into the river, can pump up 5000 hogsheads per hour; so as in any contingency to ensure a supply to those families deriving water from the Bridge Company. This engine, however, though always ready for use, is not used.

The present capital of the New River Company, in amount actually expended, is about £1,250,000, or six and a quarter millions of dollars.

The Chelsea Water Works were next established, and by act of Parliament in 1723, the Company was incorporated. The works are situated at the north-east part of Chelsea reach, on the banks of the Thames, whence all the water is derived. It is now pumped up by two steam engines into the reservoir, whence, after passing through a filtering bed, occupying nearly an acre, and filled with gravel and sand, and capable of clarifying daily, 2,240,000 gallons, it is dispensed to the consumers.

This company distributes daily over 2,000,000 gallons, to about 13,000 houses, and can raise it 128 feet above the level of the Thames.

The cost of this work, with its improved filtering system, was about £70,000, or $350,000.

The West Middlesex Works, after the lapse of nearly a century since the erection of the Chelsea Works, were completed in 1811. They are situated on the north bank of the Thames, near Hammersmith, and about nine and a half miles from London Bridge. The whole water is procured from the river by conduit pipes of 36 inches diameter, extending into the channel of the river. It is pumped up by three steam engines, one of 105 horse, the other two of 70 horse power each, into two capacious reservoirs—one at Kensington, 122 feet above the low water of the Thames, the other at Barrow Hill, 188 feet above the same level. The Kensington reservoir is 309 feet long, 123 wide, and 20 feet deep. The Barrow Hill reservoir will contain 88,000 hogsheads. This lofty receptacle, with its mains and appendages, cost $300,000, and supplies the houses around Regent's Park.

The utmost distance to which the water is conveyed from Hammersmith is about 10 miles; the number of houses supplied exceeds 15,000, with an average daily quantity of 150 gallons of water.

The cost of these works exceeds two and a half million of dollars.

The Grand Junction Water Company was authorised by act of Parliament, in 1798, but was not undertaken until 1811, when a subsidiary act having been passed, incorporating separately from the Grand Junction Canal Company, the persons who were to construct the water works, the scheme, amid many difficulties, of which the chief was want of money, was carried out, and a sum of £312,000 was expended therein.

At first the supply of water was derived from the Grand Junction Canal, which was fed from the rivers Colne and Brent, and from a large reservoir of nearly 100 acres, filled by the various streams of the vale of Ruislip, in the north-western part of Middlesex. The quality of this supply was complained of, and, moreover, as the sphere of operations of the company was extended, the quantity abstracted from the canal became a source of inconvenience to its trade. An effort was made to substitute the waters of the Regent's Canal for those of the Grand Junction, but the quantity was quite insufficient, and therefore the unfailing Thames was resorted to, and from its exuberant bosom has been drawn ever since 1820, the whole supply of these works.

Their steam engines, two of 100 horse power each, are erected at Chelsea, between the Royal Hospital and the Chelsea Water Works. From mains laid into the channel-way of the river, they pump up water into three spacious basins, at Paddington, each of different dimensions and elevations. The *north* reservoir, containing 153,465 hogsheads of water, is 91 feet 10 inches above high water mark of the Thames. The *south* has a like relative altitude of 85 feet 10 inches, and will hold 139,921 hogsheads, while the *engine* reservoir is only elevated 70 feet 10 inches, and holds 65,063 hogsheads. The water from the higher, can be let into the lower reservoirs. The water settles in these reservoirs, and, having deposited its sediment, passes off into the mains. 3,000,000 gallons are daily supplied to about 8000 houses by this company, of which two-thirds are delivered at heights varying from 90 to 110 feet, and the remaining third at from 110 to 150 feet above high water in the Thames. Of course, to effect this, resort is had to a steam engine, which elevates the water 61 feet 2 inches above that in the south reservoir.

The East London Company, incorporated in 1807, succeeded to the old Shadwell Works, which used to supply the district north of the Thames, and east of the city. The capital at first deemed necessary was £100,000. Yet, within four years, nearly four times that amount was expended—a fact more or less true of each of the other companies—and upon which *Matthews*, in his *Hydraulia*, thus remarks: "whether it be an insurmountable difficulty to form a statement, which in the first instance shall approximate to the real cost of a great undertaking, is a problem that yet remains to be solved."

The water for this company was drawn from the river *Lea*. Four reservoirs were constructed on its banks, two on the east side, about 10 feet deep, so that their bottoms were on a level with the bed of the river, two on the west side sunk 5½ feet below the bed, and therefore 15 feet below the surface of the water at medium tide. The water flows into these reservoirs from the Lea, through eight channels, averaging 7 feet in width, but differing in depth, two being 4.6 feet deep, three 4 feet, and three 3.6 feet. An aqueduct under the river connects the reservoirs.

In 1829, desiring to increase their supply of water, the company obtained an act of Parliament, granting them authority to draw water from Lea Bridge Mills, and to add £120,000 to their capital.

The water supplied by these various works, is conveyed to the height of seventy feet by steam engines.

About 45,000 houses are supplied with 170,000 barrels daily by this company, which has laid down between 2 and 300 miles of iron pipes, some of which cost 7 guineas per yard, or 21 guineas, equal to $105, for a length of 9 feet. The pipes vary from 36 inches to 6 inches, but are mostly of large calibre.

The greatest distance to which the works extend, is three miles, and although the pressure at the engines is estimated at 120 feet, yet the resistance from friction usually prevents the water from ascending higher than 60 or 70 feet. The expenditures of this company have been about half a million pounds.

The south side of the Thames is supplied by two companies, the Southwark and the Lambeth, both deriving their supply of water from the river, pumping it up by steam power, and distributing it through iron pipes.

The *Southwark Company* supplies about 7,000 houses daily with 1,500,000 gallons of water, on a capital invested of £66,400.

The *Lambeth Company*, whose works are situated in the Belvidere Road, a short distance from Waterloo Bridge, supplies some 16,000 houses with 1,500,000 gallons. This company has incurred considerable expense, by constructing reservoirs on Brixton Hill, one at an elevation of 150 feet above tide—and two others at different and lower elevations, one of which was a *filterer*, and transmitted the water to the other much purified.

One other enterprise only remains to be noticed—The *South London Water Works*, for which a charter was obtained in 1805. The principal establishment is on Kennington Common, near Vauxhall, and, like the other works, it derives its supply from the Thames, and raises and distributes it through iron pipes, by steam power. The main of this company was, in 1832, laid into the Thames, of *four feet* diameter, the largest iron pipe any where employed probably in water-works. The water flows through this main into a reservoir in Kennington Lane, from which it percolates through a filtering bank, composed of layers of coarse and fine gravel and sand, prior to its entering into another reservoir, where it also remains some time, before it is passed into the well of the distributing steam engine.

The supply of this company extends to 12,000 houses, and exceeds 5,000,000 gallons daily.

To complete this view of the works, which supply London and its suburbs, containing probably nearly 1,200,000 inhabitants, we annex, in a tabular form, extracts from a more extended return, made by these companies in 1834, to Parliament. It exhibits the number of houses supplied, the average quantity to each, the aggregate of the whole supply of every company, and all the companies, the level at which it is furnished, and the average cost to the consumer.

A TABLE,

Showing the number of Houses supplied by the Water Companies of London, according to returns made to Parliament, in 1824.

Names of Companies.	No. of Houses.	Height of Supply above Thames.	Average Daily Supply to each House.	Average Charge per House.	Total of gallons by each Company.
New River,	73,212	145 feet.	241 gallons.	£1 6s 6d	17,644,092
Chelsea,	13,891	135 "	168 "	1 13 3	2,833,688
West Middlesex,	16,000	155 "	185 "	2 16 10	2,960,000
Grand Junction,	11,140	151¾ "	350 "	2 8 6	3,899,000
East London,	46,421	107 "	120 "	1 2 9	5,570,520
South London,	12,046	80 "	100 "	0 15 0	1,204,600
Lambeth,	16,682	185 "	124 "	0 17 0	2,068,568
Southwark,	7,100	60 "	156 "	1 1 3	1,107,600
	196,492				37,289,168

All the companies but two derive their supply from the Thames *abreast of the city*, and where the sewers empty into it, and all the filth of a crowded population. They all have recourse to steam engines, to raise their supplies to a height sufficient for distribution.

The large iron mains, which project out nearly half across the river in some instances, are laid upon the bottom; a method that could only be resorted to with safety in a river where there is but boat and barge navigation, as is the case with the Thames above London Bridge; otherwise, these pipes would be in constant danger from the anchoring of vessels.

Liverpool is supplied with water copiously by two companies, the Liverpool and Harrington Works, and the Boothe Water Works; both rely upon natural springs, and both pump up the water to their reservoirs by steam.

Manchester has also its water-works, the supply being drawn from the river Madlock, about a mile and a half from the town, which, by being dammed up, filled reservoirs prepared for it, whence it is, by steam power, raised to higher reservoirs. Unfortunately for the first undertaking, relying upon the judgment of Mr. Rennie, they laid down stone pipes, which, on the first application of the pressure of the head of water, burst or leaked to such an extent, as to defeat, for a time, the whole enterprise, and ruin the projectors. The works, however, passed, into other hands—iron pipes were substituted, and the town is now well supplied.

Water Works of Edinburgh.—These works were commenced in 1819, and completed in 1824, at a cost of £145,000, or about $725,000; the water is brought from the Crawley Springs—natural sources issuing from a bank of gravel; they are collected in a stone reservoir, called the Fountainheads, at an elevation of 564 feet above the sea, at Leith, and 230 feet above Castle Hill. The distance from the source to the Castle Hill reservoir, in a direct line, is six miles and a quarter, but, by the line of the aqueduct, eight and a half miles. The water is conducted the whole distance through iron pipes, varying in diameter from fifteen to twenty inches, and in thickness from half an inch to one inch and a quarter—in lengths of nine feet—and formed by *spigot* and *faucet*, that is, the end of each pipe is widened, in order to receive within it the *intrant* end of the preceding pipe, which is called the spigot, the joints being then made tight, in the usual way, by a caulking of oakum or clay, and molten lead.

The pipes were all proved by the forcing pump, before they were laid. The process is simple: the pipe is filled with water, and firmly plugged at both ends, leaving at one end a communication with the forcing pump. In this state the pipe exhibits no leak, but after a few minutes' working with the forcing pump, creating a pressure of from ten to twenty tons upon every part of the pipe, if the casting be not perfect, water is seen to transude, and if very faulty, the pipe bursts. In either case the pipe is useless.

It is remarked in the account of the works from which we derive these particulars, "that the shaking of pipes by carting, effectually tries them—for that of two similar parcels of pipes, equally well cast at first, that which has been carted twenty miles before it was proved, will exhibit a greater number of defective pipes than that which has been proved at the manufactory. Hence pipes should always be proved at the place where they are delivered, and not where they are made."

The whole supply from the Fountainhead, is conveyed in a single line of pipes, commencing at twenty, and tapering off, as the descent increases, to fifteen inches; the daily delivery is estimated at about 1,600,000, gallons. Mr. Telford, the engineer, computes the full supply for a town, at nine gallons for each inhabitant. The population of Edinburgh and Leith, at the time these works were completed, was about 153,000, of whom those in the country parts, intervening between Edinburgh and Leith, and on the outskirts of both, derived water from wells, springs, and rivulets.

The remarkable features of this aqueduct, are:

First. A large and beautiful compensation reservoir, formed by constructing a vast mound, 450 feet in thickness, 120 feet high, and 300 in length, across a valley, in order to collect and store up the flood waters of the valley, and subsequently to distribute them to the mills below, in *compensation* for the water of the Crawley Springs, diverted from their former destination.

Second. Its tunnels: the first of them, in the city, passed under Watson's and Heriot's hospital, at the depth of 70 or 80 feet below the surface. The second, at the Castle Wynd, which passes obliquely through the solid rock of the castle, emerging at the west side of the mound. This tunnel is 700 feet long, and passes *under* the reservoir (which, nevertheless, is supplied by a pipe from it, ascending on the outside of the rock,) at the depth of 120 feet.

Glasgow, more populous than Edinburgh, is supplied by steam power from the waters of the Clyde. The peculiarity of the principal works of this city, for there are two—the Glasgow works of which we are first to speak, and the Cranston Hill Works—is, that the channels and reservoirs into which the water, percolating through a sandy soil, passes from the river, are on the left, or south bank of the Clyde, while the most of the machinery, and the city itself, are on the other bank; of course the water for the engine well must be conducted across the river. The difficulty of such a transmission, at first sight so great, was obviated by the genius of *Watt*, to whom application was made.

"This celebrated engineer devised a flexible main of iron pipes, so connected as to adapt its form to the bottom of the river. That part laid across the bed of the river, consisted of pipes, nine feet in length, exclusive of the joints, and having a diameter of 15 inches. Some of the joints were formed in the usual manner, others were made similar to those commonly called ball and socket, or universal joints.* By means of these, the whole train of pipes being properly and firmly connected, the main was laid upon massive wooden frames, consisting of logs laid parallel, and joined together by very strong iron hinges. The pipes and frame were put together on the south side of the river, and the end of the pipe intended for the north side, was stopped with a plug, when a trench having been previously prepared to receive them, by the assistance of machinery, the flexible conduit, with its bed of wood, was hauled across the river, the moveable joints of the pipes, and the hinges of the frames allowing the whole range to assume the form required by the bottom of the Clyde. The operation was aided by pontons, and the machinery employed to haul it into its place, was of course, fixed on the north side of the river. When the plugged end of the main emerged from the current, it was immediately opened and connected with the pipe leading to the reservoir of the forcing pumps. For the purpose of protecting this main from any injury from vessels passing along the Clyde, the whole of the part under water was covered with gravel and stones. This ingenious and useful contrivance was executed in 1810—but one main being found insufficient for the demand on the works, in 1818, another of 28 inches diameter, and subsequently a third of 36 inches, was laid across the river. The two last conveyed *filtered* watered only."†

There are six engines at Dalmarnock, which propel the water across the Clyde, which is there about 100 yards broad, into the reservoirs in the city of Glasgow, to a height of 157 feet above the level of the river. The houses are generally very high,

* Hydraulia, p. 149.

† An early instance of this mode of transmitting water across a navigable river is recorded by *M. Gautier*, a French engineer, in a work published in 1778, upon the construction of roads.

M. Gautier had been employed to devise means of supplying the harbor of Rochefort with good water. He discovered a copious source on the side of the *Charente*, opposite to that on which the town stands. He proposed accordingly, to bring it across by iron pipes laid on the bottom of the river, protected by wooden frames against the risk of accident from the anchors of vessels. The project was rejected as impracticable or inexpedient.

"Some years after," says M. Gautier, "when I had charge of the roads on the Rhone, and other works in Languedoc, while at Arles, I heard that a vessel had cast anchor in the Rhone, opposite the city, but when the commander wanted to sail again, he could not raise his anchor. This circumstance attracted much attention; and the captain, unwilling to lose his anchor, sent down a man to find what was the matter. The diver reported that the anchor was hooked under something round, but he could not tell what it was. By aid of a capstan the anchor was raised, and brought up a leaden conduit pipe from the bottom of the Rhone, which crossed it from the city of Arles towards Trinquetaillade, at a depth of 42 feet, and where the river is some 550 feet broad. I saw some pieces of this conduit of lead, five or six inches in diameter, about *one third* of an inch thick! in joints of six feet, soldered lengthwise, and covered by a strip or sheet of lead of the same thickness, covering the first solder about two inches. The conduit was soldered at the joints, six feet apart, by the same material, which made a swell at that distance. On each joint were these words in relief, C. CAINTIUS POI HINUS. F., apparently the name of the maker, or of the architect who laid down the pipes in the time of the Romans. My project of laying pipes along the bottom of the Charente, would not have been half so difficult, as it had no doubt been to lay them across the Rhone, where this was found. Hence it may be believed, as I now think myself that many things supposed to be new, and now for the first time invented, may have been thought of long before, even in remote ages.—*Traite de la Construction des Chemins*, p. p. 129–30.

consisting of stories, each of which is occupied by a separate family, with a stone stairway in common; but such is the arrangement and power of the Glasgow works that abundance of water is distributed into every story. A considerable quantity is also supplied to fountains, or hydrants, on the side-walks, and in the alleys, or closes.

The Cranston Hill Works, made many and costly experiments, as to the best mode of filtering the water, which they, too, drew from the Clyde, and eventually so impaired the capital of the company, that in 1834 they were fain to sell out to the Glasgow Company. The experience thus dearly purchased, was, however, productive of benefit to the community, for the water now supplied, about 3,500,000 gallons daily, is thoroughly filtered.

Greenock, which may be called the seaport town of Glasgow, is most prodigally supplied with water, and, like Edinburgh, without the intervention of machinery, being situated at the foot of mountains, from which issue numerous streams. Mr. Thom, a skilful engineer, in 1824, devised a plan by which he gathered into vast reservoirs various mountain rills, and after passing them through filters, conducted them in great profusion to all parts of the town; and not only furnished in this way, water for all domestic uses, but enough for the operations of several mills. The filtering reservoirs are 200 feet above the level of the town. The receiving reservoirs are capable of containing 700,000,000 cubic feet. The number of inhabitants of Greenock is 25,000, receiving each two cubic feet, or about fourteen and one-tenth gallons daily.

Paris will next occupy our attention—and considering the skill in all departments of engineering, which on all hands is acknowledged to belong to the French, it is remarkable that their capital, and, as it is often called, and really considered, the capital of Europe, is so much behind England in its contrivances for an adequate supply of water.

The early supply of this city, like others, having a fresh river running through it, was from that river, and from wells. Nevertheless, as the Romans had constructed an aqueduct at Arcueil, for the supply of Paris, it seemed reasonable to endeavor to restore what Norman fury, in the ninth century, had left of it—accordingly, Henry IV.,

"Seul Roi dont le peuple ait gardé la memoire,"

in 1609, caused researches to be made for the ancient conduits, but it was soon ascertained that it would be easier to rebuild, than to attempt to repair, and, under the regency of *Marie de Medicis*, in 1613, the work was undertaken, and completed in 1624, occupying nearly 12 years. The architect was *Jacques de Brosses*, the same who furnished the design for the *Louvre*. The quantity of water, however, thus obtained, was so small as scarcely to compensate for the expense of the work. At subsequent periods, additional supplies were connected with this aqueduct, and the united streams led to the reservoir at the Observatory in Paris, whence they were distributed to the fountains.

Two smaller aqueducts, that of the *Pre St. Gervais*, and that of *Belleville*, of ancient, but unascertained date, furnished a small additional supply of water, but it became apparent, as the city grew, that resort must be had to other sources.

The *Seine* was naturally looked to, and a Fleming, in Paris, as a Dutchman had in London, first provided the means of raising the waters of that river above its level.

*John Lintlær** proposed to Henry IV., the construction of a pumping machine in the Seine, to be set in motion by the flow of its current, and, being engaged to perform the work, he succeeded in raising the water above the *Pont Neuf*, and thence, in distributing it to the Louvre, and the Tuilleries. This machine, or pump, was called the *Samaritan*, from the metal figures which decorated it. The success of this experiment led to the construction, in 1670, and 1671, of two similar machines at the Pont Neuf. It was not till 1778 that steam engines superseded this more cumbrous, and less efficient machinery. In that year, *M. Perier* erected two engines, one at *Gros Caillou*, the other at *Chaillot*, which forced up water in greater abundance, and supplied both fountains and other public and private establishments.

Various schemes were from time to time put forth, to add to the supply of Paris, but without any result, till, in 1802, M. Girard, an eminent engineer, proposed to bring to the city, the waters of the river *Ourcq*, in an open canal. Bonaparte, then first consul, warmly approved this project, and a decree for its execution was signed in 1802, and M. Girard was charged with the work. The water is taken from the *Ourcq*, at sixty miles from Paris. In its course, the canal receives the tribute of the *Grisette*, the *Mai*, the *Therouanne*, and the *Beuvronne*,† all which streams flow into its channel, which terminates in a spacious reservoir, near the Barrier *de la Villette*, This basin is about 3660 feet long, 366 broad, and 7 deep. Its banks are ornamented with a double row of trees.

Two smaller canals flow from it, one to the arsenal, the other to St. Denis.

Loami Baldwin, Esq., an eminent engineer of our own country, who constructed the naval dry docks at Charlestown, Mass., and at Norfolk, Va., has from personal examination, given this description of the *Canal de L'Ourcq*, and of the quantity and annual cost of water supplied to Paris:

"The great and only considerable undertaking for supplying the city is the Ourcq Canal, which has been nearly twenty years in completing. It affords an abundant

* Hydraulia, p. 270.

† Hydraulia, p. 273.

supply. The canal begins at the River Ourcq, above 58 miles from Paris, and in its course takes in five or six other streams, or feeders. The trunk of the canal is 36.08 feet (11 *metres*) wide; depth 8.20 feet (2.50 *metres*) depth of water 4.92 feet (1.50 *metres*) and slope of the banks 1.50 base to 1 rise. The velocity of the water is calculated to be nearly thirteen inches a second, and the slope of the Canal about three and a half inches a mile.

"It terminates in a large basin near the Barriere of Villette. From the south-west corner opens the St. Martin Canal, communicating with the Seine on the east side of Paris, and a short distance before coming to the basin, the St. Denis canal is opened, passing down to the Seine near that city, on the north side of Paris.

"At the north-west corner of the basin is taken out the water for supplying the city by a subterranean canal or aqueduct on the north side of Paris, (aquéduc de ceinture,) nearly two miles and three quarters long. The work is in stone masonry, and the canal for the water is three feet three inches wide at bottom, five feet three inches deep, and four feet six inches wide at top. On one side is an off-set four inches wide, and on the other a foot-walk one foot six inches wide, making the whole breadth between the side walls above the trunk six feet four inches. These walls rise four feet six inches, covered with a semi-circular arch. At various points there are galleries and staircases, to descend to the subterranean aqueduct. I descended to examine the work with M. Girard, the engineer, by a flight of steps from the cellar of a house where one of the guardians resided.

"Convenient arched passages are constructed under three principal streets, where one may walk, and where are laid the different mains taking water from the aqueduct, to conduct it to the various fountains and other points for distribution. They are laid upon stone blocks or cast iron frames, so that they may be easily examined all round, from one end to the other. The beautiful fountain in the Garden of the Palais Royal, that in the Boulevard of Bondy, &c. are supplied from this water.

"The canal is estimated by Mr. P. S. Girard the engineer who constructed it, and had the whole superintendence of distributing the water in Paris, at 4000 inches of water, (*pouces d'eau de fontainier.*) An inch of water is so much as will flow through a hole one inch diameter, French measure, in a minute, under a head of 7-12 of an inch above the centre of the aperture, and is equal to 813 1-2 cubic inches in a minute, or 678 cubic feet in 24 hours, amounting to 2,711,680 feet for the 4000 inches daily, or over 20 million gallons.

"The quantity of water necessary for a given number of inhabitants has not been accurately fixed. In France it has been generally estimated at 19,195 *litres* (one inch) for 1,000 inhabitants. The Scotch engineers do not consider the supply complete at less than nine gallons a day for each individual in a city. If we compare the distribution of water in London with the population, the supply is at the rate of 20 gallons for each person. But there are no public fountains in that city, and the people receive no water but what is furnished by independent companies. At Paris, 4000 inches of water of Ourcq are appropriated for fountains and for cleaning streets, so that water is raised from the Seine for domestic use. The actual quantity thus used does not exceed 200 inches. (equal 135,584 cubic feet daily,) and it costs, from an accurate and detailed estimate, the enormous sum of 4,265,756 francs, equal to $767,836. To supply the want of Seine water, on account of its cost, pumps are employed in nearly all private houses, and spring and well water is used, although it does not possess the qualities suitable for mechanical industry.

" Great inconvenience arises among engineers and hydraulicians, from the want of a standard unit, to denote the quantity of water flowing in a given time. The fountaineer's inch (*pouce d' eau de fontainier*) is used by all French writers upon the subject, though admitted by most of them to be very indefinite. It is perhaps sufficiently correct for practical purposes, but not adopted in philosophical investigation. Genieys says, it is ' equal to the quantity of water a pipe an inch in diameter would furnish in a minute, so placed that the centre of orifice should be seven lines below the surface of the reservoir to which it is adapted. To estimate the quantity it is still necessary to determine the length of the pipe or thickness of the side of the vessel in which the aperture is made, through which the water is discharged. Now this has never been done in such a way as that all agree upon the exact amount; but it is generally admitted to be equal to 15 pints, or 13.33 litres a minute, or 19,195 litres in 24 hours.'

" The above are French measures. The *litre* is equivalent to 61,028 cubic inches; hence the fountaineer's inch is 813 1-2 cubic inches a minute, or 678 cubic feet a day. Gallon, as used by English writers, is also a very ambiguous term, when applied to hydraulic discharges. The gallon which I employ in this report,= 231 cubic inches; the beer gallon,= 282; and the imperial gallon,= 277,274 cubic inches.

" Mr. Geniey's statement is that 19,195 litres (one inch) is generally estimated in France, as a supply for 1000 inhabitants; which gives 0.6779 cubic feet, or a little over 5 gallons to each daily. Seine water is distributed by carriers in hogsheads or carts, for which they pay at the pumps or filters 6305 francs the inch, and retail again to the inhabi tants for 30,462 francs. The amount thus paid by the Parisians is annually 2,864,504 francs. Another class of water-carriers are those who carry it in buckets, (*Porteurs d' eau á bretelles*), hung to straps connected with a kind of yoke over the shoulders. These take water gratuitously from fountains of the second class, from the Seine, or from the filtering establishments on the quay of the Célestins, sell it for 10 centimes the *voire*, or two pailfuls of water; about two cents for four and a half gallons. In this manner the water-porters receive 1,405,252 francs, thus making the total sum of 4,266,756 francs, = $767,835, as before stated, paid annually by the citizens of Paris for a daily supply of 135,584 cubic feet, or 1,013,168 gallons. Mr. Genieys says ' a company might furnish for domestic use ten times the quantity for the same cost.' "

The class of water-carriers in Paris, who retail water from the fountains is numerous. There is also another set in the employ of a filtering company, which, drawing its water from the Seine, and elevating it by steam power into the filtering reservoir, distributes it by carts like the, now obsolete, water-carts of New-York, among its customers.

The fountains in the streets and public places of Paris, are frequent; and among the unfinished projects of Napoleon, is that of the great Elephant fountain, which he designed to erect on the site of the *Bastile.* The model of the colossal elephant under a shed close by, attests at once the grandeur of the design, and the mutability of fortune.

We conclude with the recent *Artesian Well*, on a large scale, in the plain of Grenelle, which is thus described:

THE ARTESIAN WELL AT GRENELLE, PARIS.

"Artesian wells are so called from the probability that they were first constructed in Artois, although from the authority of several ancient writers, they appear to have been in use in the earliest ages. The Artesian well at Grenelle, has lately been completed, after eight years of constant labor and repeated difficulties. The south-western portion of Paris was but very poorly supplied with water, and at Grenelle, a suburb immediately adjoining the city, this deficiency was so seriously felt, that it became an object of the greatest importance to find means of remedying the evil. M. Mulot, an experienced geologist, being consulted as to the practicability of constructing a well on the Artesian principle, stated that the perforation would necessarily be of extraordinary depth, owing to the nature of the district. We extract from the "Magasin Pittoresque" the following geological description of the basin of Paris: "Two conditions, as it is well known, are requisite for the formation of an Artesian well: first, the existence of a pervious stratum, such as gravel, placed between two impervious strata, such as clay; secondly, the percolation of the water through the pervious stratum, from a point higher than that to which it is required to rise. The basin of Paris is in the form of a hollow plate, formed by a stratum of chalk. In this basin have been successively deposited the tertiary strata, in the centre of which Paris is situated. On a circular space bounded by the towns of Laon, Mantes, Blois, Sancerre, Nogent-sur-Seine, and Epernay, these strata appear at the surface, and conceal the chalk, but on the other side of the towns we have mentioned, the edge of the basin being passed, the chalk is found generally on the surface." If we look at the order in which the tertiary strata occur, we shall then comprehend the obstacles M. Mulot had to overcome, and the probability of the ultimate success of his undertaking. Leaving unnoticed the surrounding hills, we will examine the nature of the soil which composes the Plain of Grenelle. On the surface it is formed of gravel, pebbles, and fragments of rock, which have been deposited by the waters at some period anterior to any historical record. Below this surface M. Mulot knew, by geological inductions and previous experience, that at Grenelle marl and clay would be found in the place of the limestone which in general forms the stratum immediately beneath. M. Mulot was aware that he must bore about four hundred and forty yards in depth, before he should meet with the sources which flow in the gravel below the limestone, and supply the wells of St. Ouen, St Denis, and Stains. Beneath the marl and clay, the boring-rods had to perforate pure gravel, plastic clay, and finally chalk, which forms the bottom of the basin in which the tertiary strata have been deposited. No calculations or geological knowledge could determine the thickness of this stratum of chalk, which, from its powers of resistance might present a nearly insurmountable obstacle. The experience obtained in boring the wells of Elbeuf, Rouen, and Tours, was in this respect but a very imperfect guide. But supposing this obstacle to be overcome, was he sure of finding a supply of water below this mass of chalk? In the first place, the strata below the chalk possessed, as we shall see, all the necessary conditions for producing Artesian springs, namely, successive layers of clay and gravel, or pervious and impervious beds. M. Mulot confidently relied upon his former experience of the borings of the wells at Rouen, Elbeuf and Tours, where abundant supplies of water had been found below the chalk, between similar strata of clay and gravel.

"But one other condition is requisite to effect the rising of the water in an Artesian well, viz. that the point of infiltration should be higher than the orifice above which the water is to rise. This also was the case at Grenelle. In fact, M. Arago had shewn that the water of the spring in question would necessarily rise to the surface, because, in the well at Elbeuf, which is nearly nine yards above the level of the sea, the water rises from twenty-seven to twenty-nine yards above the surface of the earth, and consequently from thirty-six to thirty-eight yards above the level of the ocean. Now, as the orifice at Grenelle is only thirty-four yards above this same level, it follows that if the same spring were met with, the water must rise above the surface of the earth at Grenelle.

"The necessary works were now commenced with boring-rods about nine yards long, attached to each other, and which could be raised or lowered by mechanical means; and an ingenious method was adapted for giving them a circular motion. The diameter of the bore hole was about six inches. The instrument attached to the end of the lowest boring-rod, was changed according to the different strata which were successively reached, the form adapted for passing through the softer materials of the surface, being unsuitable to boring through the chalk and flint, a hollow tube being used for the former, while the latter was penetrated by a chisel-shaped instrument. The size of the rods diminished in proportion to the depth, and as the subterranean water was not reached so soon as was expected, it became requisite five several times to enlarge the diameter of the bore, to admit of the work being successfully continued. Accidents occurred also, which tried the utmost patience of the projectors. In May, 1837, when the boring had extended to a depth of four hundred and eighteen yards, the hollow tube, with nearly ninety yards of the boring-rods attached to it, broke, and fell to the bottom of the hole, and it was necessary to extract the broken parts before any further progress could be made. The difficulty of accomplishing this may be conceived, when it is stated that the different fragments were not withdrawn until after the lapse of fifteen months. A description of the ingenious mode by which this was effected, would be too technical for our work. Again, in April, 1840, before it could be recovered, several months were spent in excavating round it. A similar occurrence created an obstacle which impeded the work for three months, but instead of being withdrawn, the detached part was driven literally into the stratum, which happened to be gravel. At length, in February, 1841, after eight years' labor, the rods suddenly descended several yards; they had pierced the vault of the subterranean waters of which M. Mulot had been so long in search. In the course of a few hours the water rose to the surface and discharged itself at the rate of 600,000 gallons per hour. The depth attained was six hundred and two yards. The pipe by which the water reaches the surface has recently been carried to a height, nearly on a level with the source of supply. At present the water flows into a circular iron reservoir at the top of the scaffold, and it is thence conveyed by another pipe to the ground. The water is of good quality, and well adapted for culinary and domestic purposes. There is no fear of the supply proving deficient, as it is derived from the infiltration of a surface of country nearly two hundred miles in diameter. The Artesian wells of Elbeuf, Tours, and Rouen, which were formed many years ago, flow in an invariable volume. The ancient Artesian well at Lillers, in the Pas de Calais, has for above seven centuries furnished a constant and equable supply. When the source of supply is less extensive, these wells may be subject to variations, but the probability of this may generally be foreseen by the geologist and the engineer.

"The opportunity of ascertaining the temperature of the earth at great depths was not neglected during the progress of the works at Grenelle. Thermometers placed at a depth of thirty yards in the wells of the Paris Observatory invariably stand at 53° Fahrenheit. In the well at Grenelle the thermometer was 74° at a depth of four hundred and forty-two yards, and at five hundred and fifty yards it stood at 79°. The depth attained being six hundred and two yards, the temperature of the water which rose to the surface was 81°, corroborating previous calculations on the subject. Now that the patient labor of so many years is brought to a close, the neighbors regret that it was not necessary to go to a depth of about one thousand yards for a supply, as the water would then have been at a temperature of 104°, and immediately applicable to bathing establishments and other places in which warm water is required."

THE AQUEDUCT OF LISBON.

The aqueduct of Lisbon has been long admired for the excellence of its construction, and, in point of magnitude, is not inferior to any similar edifice which the ancients have left us. That part of it situated in the valley of Alcantara, about a mile from Lisbon, consists of thirty-five arches, by which the water is conveyed over a deep vale, formed by two opposite mountains. The dimensions of it in the deepest part of the valley are as follows: height of the arch from the ground to the intrados, 230 feet, 10 inches; from the vortex of the arch to the extrados, exclusive of the parapet, 9 feet, 8 inches; from the extrados to the top of the ventilator, 23 feet, 4 inches; making a total height from the ground of 263 feet. Span of the principal arch, 107 feet, 8 inches; breadth of piers of the principal arches, 28 feet; and thickness of the piers in general, 23 feet, 8 inches.

The arches on each side of the principal one diminish in breadth, as the piers whereon they rest decrease in height, with the declivity of the ground; they do not, however, decrease by any regular progression, neither are the curves employed in the arches of one kind, fourteen of them being in the Gothic or pointed style; the rest are semi-circular, a variation adopted by the architect, Manuel dal Maga, from an apprehension, that making the five principal arches semi-circular, he would considerably add to the expense. In the rest of the edifice, much judgment has been displayed; no part of it has failed, or appears to have received the least injury.

This aqueduct was finished in 1738. The great earthquake, which in 1755, destroyed thousands of lives, in Lisbon, numerous houses, palaces, and churches, and shook all the peninsula, had no effect upon this noble structure, which continued to pour its waters into the ruined city, with the same equal flow, after, as before that great catastrophe.

Over the arches there runs a vaulted corridor, 9 feet 6 inches high, by 5 feet broad internally. A continued passage runs through the centre of it, for the people who constantly attend to keep it in order, and a semi-circular channel or conduit of 13 inches diameter at each side, through which the water is conveyed. It is worthy of remark, that these channels are laid not in an inclined direction, as in other aqueducts, but horizontally; to compensate for this, a small depression is made, at certain intervals, by which the water is impelled along the horizontal line, a manner, supposed by the natives, to require less declension in conveying water than an inclined line. There are two thoroughfares for foot passengers along the aqueduct, one at each side of the corridor, which is 5 feet wide, defended by a stone parapet. From some remains of the Romans on this spot, it is supposed they either did, or attempted to, construct an aqueduct in this situation.

The honor of erecting this noble structure is due to John V. This munificent prince laid the foundation of it in 1713, and in thirteen years the whole was completed.

The city of Lisbon, in testimony of gratitude raised an arch to his memory, bearing a flattering inscription, in the Latin tongue, importing that he had not only conferred wealth, glory, strength and peace on his kingdom, but that, overcoming nature as it were, he had introduced perennial waters into the city, and hailing him therefore as the best of princes, and the author of a great and useful public work.

Manuel dal Maga was the architect, and the expense was defrayed in part, by a tax of *one rei*, something less than one tenth of a cent, on every pound of meat sold in the capital. Murphy, in his travels, in recording this fact, states the quantity of butchers meat sold in Lisbon, in the year 1789, at 12,212,160 pounds.

" The consumption of flesh," he adds, " is greatly reduced here, by the quantity of fresh and salt fish with which the markets are constantly supplied."*

It is singular that Murphy, who was an architect, should not have furnished details of the mode of construction, nor of the cost of this noble work, nor given any hint of the quantity of water brought into the city by it.

The supply of this aqueduct is derived from the mountains of *Cintra*. Its course is between 8 and 9 miles, and it terminates in the city, in a *Chateau d'Eau* or *Castellum*, whence the waters are distributed to numerous fountains. Lisbon is built upon the slope of a hill, over the top of which, the waters of the aqueduct are introduced. Lofty, therefore, as are the houses, there is head enough to carry a supply up to the attics, yet here, as in Rome, not a pipe, as is believed, is laid to any house in the city ; a corps of water carriers, of Spanish descent, and from their province of Gallicia, taking the name of *Gallegos*, effect the distribution of the bountiful outpouring of this noble aqueduct, and are to be seen at all hours of the day, toiling up the stone stairways of the loftiest houses, bearing on their head or shoulders, an earthen vase, containing almost a barrel of water.

With this grandest of modern *European* aqueducts, we terminate our notice of such constructions in the Old World, and turn to America, where, earlier than is recorded, aqueducts have existed.

AMERICAN AQUEDUCTS.

In the southern portion of our continent, a race more civilized than any of the aboriginal inhabitants of that portion of America, now constituting the United States,

* Murphy's Travels in Portugal, 4to ed., p. 183.

had constructed extensive conduits or aqueducts, for the irrigation of their arid soil, and in some cities, for culinary and other domestic use.

Humboldt and *Garcilasso de la Vega*, speak with admiration of the aqueducts of Peru. Garcilasso, who was a Peruvian by the mother's side, and who wrote his Commentaries in 1560, records of Viracocha, the seventh Inca, that he constructed "an aqueduct, 12 feet in depth, and 120 leagues in length. The source of it was in springs on the top of a high mountain between Parca and Picuy, which were so plentiful, that at the very head of the conduit they seemed to be rivers. The current of water had its course through all the country of the Rucanac, and served to water the pasturage of those uninhabited lands, which are about 18 leagues in breadth, *watering almost the whole country of Peru.*"

"There is," says the same author, "another aqueduct, which traverses the whole country of Cuntisuya, running above 150 leagues from south to north. Its head is from the top of high mountains, and the water falling into the plains of Quechuas, greatly refresh their pasturage, when the heats of the summer and autumn have dried up the moisture of the earth. There are many streams of like nature which run through divers parts of the empire, which, being conveyed by aqueducts, at the charge and expense of the Incas, are works of grandeur and ostentation, and recommend the magnificence of the Incas to all posterity; for these aqueducts may well be compared to the miraculous fabrics, which have been the works of mighty princes, who have left their prodigious monuments of ostentation to be admired by future ages, for indeed, we ought to consider that these waters had their sources and beginning from vast high mountains, and were carried over craggy rocks and inaccessible passages; and to make these ways plain, they had no help of instruments forged of steel or iron, such as pickaxes or sledges, but served themselves only of one stone to break another. Nor were they acquainted with the invention of arches, to convey the water on the level from one precipice to another, but traced round the mountain, until they found ways and passages at the same height and level with the head of the springs.

The cisterns or conservatories, which they made for these waters at the top of the mountains, were about 12 feet deep; the passage was broken through the rocks, and channels made of hewn stone of about two yards long and one high, which were cemented together and rammed in with earth so hard, that no water could pass between, to weaken or vent itself by the holes of the channel.

The conduit of water which passes through all the divisions of Cuntisuya, I have seen in the province of Quechuas, which is part of that division, and considered it an extraordinary work, indeed surpassing the description and report which had been made of it.

But the Spaniards, who were aliens and strangers, little regarded the convenience of these works, either to serve themselves in the use of them, or to keep them in repair, nor yet to take so much notice of them, as to mention them in their histories, but rather out of a scornful and disdaining humor, have suffered them to run into ruins beyond all recovery. The same fate hath befallen the aqueducts which the Indians made for watering their corn lands, of which two-thirds at least, are wholly destroyed, and none kept in repair, except some few that are so useful, that without them they cannot sustain themselves with bread, nor with the necessary provisions of life."

One might suspect Garcilasso, himself descended from the Incas, of some exaggeration of these great works, but Humboldt, whose impartiality and exactness are alike well established, confirms his testimony.

In a note to page 31, of the New York edition of Black's Translation of the Essay on New Spain, this passage occurs:

"The largest and finest construction of the Indians in this way, is the aqueduct of the city of Tezcuco. We still perceive the traces of a great mound, constructed to heighten the level of the water.

How must we admire the industry and activity displayed by the ancient Mexicans and Peruvians, in the irrigation of arid lands. In the maritime parts of Peru, I have seen the remains of walls, along which water was conducted for a space of from 5 to 6000 metres, from the foot of the Cordilleras to the coast. The conquerors of the 16th century destroyed these aqueducts, and that part of Peru has become, like Persia, a desert, destitute of vegetation. Such is the civilization carried by the Europeans among a people whom they are pleased to call barbarous."*

In a very clever and elaborate volume on "American Antiquities," by Alexander W. Bradford, Esq., of New York, we find this brief but explanatory statement concerning the extent and structure of the Peruvian aqueducts:—

"'I have had various opportunities,' says a recent traveller, 'of closely examining one of these canals, which is formed at the source of the river Sana, on the right bank, and extends along a distance of 15 leagues, without reckoning sinuosities, and which consequently supplied a large population, particularly one city, whose ruins still remain in the vicinity of a farm named Cojal.'

"These aqueducts were often of great magnitude, executed with much skill, patience, and ingenuity, and were boldly carried along the most precipitous mountains, frequently, according to Ulloa, to the distance of 15 or 20 leagues. Many of them consisted of two conduits, a short distance apart; the larger of these was for general use; the other and smaller to supply the inhabitants and water the fields, while the first was cleansing, a

* New Spain, vol. ii., p. 46.

circumstance in which they bear a striking resemblance to those of Mexico. They also conveyed water to the most distant places, by subterranean conduits. Garcilasso describes five fountains that existed in the Temple of the Sun, at Cuczo, and which were used for sacred purposes, one of which he saw flowing, the others having become dry.

" It is probably one of these fountains that now supplies the *Hospital de Naturales ;* its pipes are buried under the earth, and cannot be traced, and, as in the time of the Peruvian historian, its sources are unknown. At Lanasca, there is also a fountain supplied through subterranean conduits, the source of which has never been traced. Many of these great works became useless after the conquest, from their very magnificence, for their pipes being made of gold, excited the cupidity of the avaricious Spaniards, and others were destroyed from mere wantonness." *

In the same volume we find these additional notices of the Mexican aqueducts, and of the Vandal destruction of them by the Spaniards.

" The aqueduct of Chapoltepec, consisted of two conduits, formed of solid mason-work, each five feet high and two paces broad, by which the water was introduced into the city for the supply of various fountains. Olid and Alvarado commenced the siege of Mexico, by attempting to cut off this supply of water, an enterprise which the Mexicans endeavored to prevent. " There appeared on that side," says De Solis, " two or three rows of pipes, made of trees hollowed, supported by an aqueduct of lime and stone, and the enemy had cast up some trenches to cover the avenue to it. But the two Captains marched out of Tacuba with most of their troops, and though they met with a very obstinate resistance, they drove the enemy from their post, and broke the pipes and aqueduct in two or three places, and the water took its natural course into the lake." †

One cannot but recall here the like destruction by *Vitiges* and his Gothic hordes, of the noble aqueducts of Rome ; nor restrain the indignation with which such acts of barbarism, perpetrated by Christians and civilized men, against those whom they denounced as pagans and savages, should be regarded and recorded.

The following farther description of the aqueducts of ancient *Mexico*, is given by Cortes, (the conqueror) in a long despatch, addressed to the Emperor Charles V., dated at Segura, in Mexico, October 30th, 1520, and soon after printed at Seville, (Spain.)

" Along one of the causeways that lead into the city, are laid two pipes, constructed of masonry, each of which is two feet in width and about five feet in height. An abundant supply of excellent water, forming a volume equal in bulk to the human body, is conveyed by one of the pipes, and distributed about the city, where it is used by the inhabitants for drinking, and other purposes. The other pipe, in the meantime, is kept empty until the former requires cleansing, when the water is conducted into it ; and it continues to be used till the process of cleansing is completed.

* Bradford's Antiquities of America, p. 136, 7.

† Bradford's Antiquities of America, pp. 106, 7.

"As the water is necessarily carried over bridges, on account of the passage of the salt water, (of the lake) across the causeway, at different points, reservoirs resembling canals are constructed on the bridges through which the fresh water is conveyed; these reservoirs are of the breadth of the body of an ox, and of the same length of the bridges. Thus the whole city is supplied. The water is also carried in canoes through all the streets, for sale, being taken from the aqueduct in the following manner; the canoes pass under the bridges, on which the reservoirs are placed, and men stationed above fill them with water, for which service they receive a suitable compensation."

We are indebted for this translation to Mr. Folsom, the Librarian of the New York Historical Society; who is preparing for the press a complete English version of Cortes' Letters.

Gomara, the Chaplain of Cortes, whose "Chronicle of New Spain" was published in 1552, states in addition to the above, that "the water was brought from a place called Chapoltepec, three miles distant from the city, where it sprang from a hill, at the foot of which stood two statues wrought in stone, with bucklers and lances, the one representing, (it is said,) Montezuma, and the other his father, Oxayaca." *

Cortes, in his 5th letter to Charles V., speaks of the springs of Amilco, near Cherubasco, of which the waters were brought to the city by pipes of burnt earth. We still, says Humboldt,† perceive the remains of this great aqueduct, which was constructed with double pipes, one of which received the water, while they were employed in cleaning the other.

De Solis, the historian of the Conquest of Mexico, speaking of the magnificence of *Montezuma*, and of his works, thus refers to the waters and aqueducts of the city:

"In all these gardens and pleasure houses, he had many fountains of sweet and wholesome water, conveyed from the neighboring mountains, by different canals as far as the causeys, whence in covered pipes, it was introduced into the city; for the use whereof there were some public fountains; and he permitted some of the meaner sort of people, though not without paying a considerable tribute, to sell about the streets what water they brought from other springs. The conveniency of fountains was very much increased in the time of Montezuma; for the great conduit which conveys a current of fresh water to Mexico, from the mountains of Chapoltepec, about a league distant from the city, was a work of his; and by his order and contrivance, a vast cistern of stone was made for a reservatory; raising the same to such a height as the delivery of the current required. After this he gave orders for a very thick wall, with two open canals, made of stone and lime, of which one was always in use when the other required cleaning. A building extremely useful; and Montezuma valued himself so much upon the invention, that he ordered his own effigies and that of his father, which bore a pretty near

* Cronica de la Nueva-Espana, por Francisco Lopez de Gomara; Madrid, 1749; p. 79, (originally printed at Saragossa, 1552.)

† Humb. N. Spain, vol. ii., p. 31.

resemblance to his, to be engraved on two stones, with an ambition to perpetuate his memory by so signal a benefaction done to the city." *

Montezuma's reign commenced A. D. 1502. The city was captured on 13th August, 1521—196 years after its foundation by the *Aztecas*. *Clavigero* mentions another aqueduct constructed by the predecessor of Montezuma, *Ahuizoth*, from Copoacai to Mexico—of which the chief object was to supply the failing waters of the salt water lake that surrounded Mexico—and which had become difficult of navigation.† "The water," says our author, "was conveyed with many superstitious ceremonies, some of the priests offering incense, others sacrificing quails, and anointing the lip or border of the aqueduct with blood; others sounding musical instruments, and otherwise solemnising the arrival of the water. The high priest wore the same habit with which they represented *Chalclichuitlical*, goddess of the water."

A very rainy season succeeded which caused the lake to rise and overflow—doing much damage. In consequence the new aqueduct was *destroyed*.

Iztacpalapa, a town of 10,000 houses, on one of the causeways leading to the city of Mexico, was, says *de Solis*, noted for "many fountains of sweet and wholesome waters, conveyed by several aqueducts from neighboring mountains." ‡

Our adventurous and intelligent traveller, Stephens, in describing his visit to *Palenque* in ruins, thus commemorates its *aqueduct*:§

"The exploration of the aqueduct, Pawling and I attempted together. It is supplied by a stream which runs at the base of the terrace on which the palace stands. At the time of our arrival, the whole stream passed through this aqueduct. It was now swollen and ran over the top, and alongside. At the mouth we had great difficulty in stemming the torrent. Within it was perfectly dark, and we could not move without candles. The sides were of smooth stones about four feet high, and the roof was made by stones lapping over like the corridors of the buildings. At a short distance from the entrance, the passage turned to the left, and at a distance of 160 feet it was completely blocked up by the ruins of the roof which had fallen in. What was its direction beyond, it was impossible to determine, but it certainly did not pass under the palace, as has been supposed."

A fine modern aqueduct was built at Rio Janeiro, in 1740, in imitation of that of Lisbon, and in some of its proportions, is hardly less imposing.

"It consists," says McLuccock, "of two walls about six feet, arched over, with suf-

* P. 78, Book iii., of De Solis' History of Mexico—done into English by Thomas Townsend, London, 1775.

† Clavigero in Cullen's translation, vol. ii. p. 204., London Edition in 4to. 1787, p. 204.

‡ Book iii., Class x., p. 55, Townsend's translation.

§ Stephens' vol. ii, p. 321., at Palenque.

ficient space for workmen to enter it occasionally and pass through its whole length. At suitable intervals, there are openings for the admission of light and air. Within it, is laid the canal, about eighteen inches wide, twenty-four deep, and three miles long. It commences at the bottom of the lofty conical peak of the Corcovado, where the waters flowing from that mountain, are collected into a covered reservoir, and thence conveyed into the canal. Their course from the summit is through deep and shady woods, and the canal is defended from the sunbeams, and thus, until they reach the city, little of their freshness is lost." *

This water supplied the fountains, whence it was distributed for sale by water carriers—none being conveyed by pipes into the houses. The largest public fountain is in the square fronting the palace, and close to the harbor. This supplies the shipping, and it is constantly surrounded by sailors of all nations. Captain Cooke expressed doubts about the goodness of the water for long voyages ; but Dr. Von Spix, a Bavarian traveller, who visited Brazil in 1818, states, that it had been conveyed to India and back, and found uncorrupted. The supply of water from this source and all others, is spoken of as scanty, for such a population ; but no account is given of the quantity.

In the United States, as earliest and grandest in design, we mention the *Water Works of Philadelphia.*

The first water works were commenced in 1799, (the year in which the Manhattan Company was incorporated for supplying New-York with water,) and consisted of forcing pumps, worked by steam engines, which raised the water from the Schuylkill into a reservoir, constructed at an elevation of fifty feet on the banks of the river, from which it was conveyed to the city in wooden pipes. In 1811 the city councils appointed a committee to devise means for procuring a more perfect supply than those in use afforded ; and shortly after, two steam engines and pumps were established at *Fairmount*, another point of the Schuylkill, about two and a half miles from the city. A reservoir 318 feet in length, 167 in width, and 10 in depth, was made at an elevation of 98 feet, into which the water was forced from the river by the engines and pumps.

The great expense attending this mode of raising the water, caused the city authorities to cast about for some more economical, as well as effective, expedient, and accordingly in 1819, a contract was made with Capt. Ariel Cooly, for damming the Schuylkill. For the sum of $150,000, he undertook to throw a dam of sufficient height across the river to create the requisite head of water, to construct the locks and canal for the accommodation of the navigation, to build the head arches of the race-way for the water power, and to excavate the race out of the solid rock. The whole length of the dam, including the

* Notes on Rio de Janeiro, by Jno. Luccock, 1820.

head arches, and the water pier, exceeds 1600 feet, and it backs the water up the river about six miles.

By the water power thus created, operating upon eight wheels and pumps, it is estimated that ten million gallons may be daily thrown into the reservoirs; the flow of the river in dry seasons was supposed to be 440,000,000 gallons in the 24 hours, and allowing for leakage, wastage, &c. it is calculated that 40 gallons upon the wheels will raise one into the reservoir—which would give a result of 11,000,000 gallons a day.

"On the east side of the river, the whole of the bank was a solid rock, which it was necessary to excavate to the width of one hundred and forty feet, to form a race as a site for the mill houses running parallel with the river. The length of the mill race is four hundred and nineteen feet, the greatest depth of excavation sixty feet, and the least sixteen feet. The gunpowder used, alone cost the contractors upwards $12,000. At the upper part of this excavation were erected the head arches, three in number, which extend from the east end of the mound dam, to the rock of the bank, thus forming a continuation of the dam.

"On the west of the excavation are erected the mill houses, forming the west side of the race, which is supported on the other side by the rock, rising above it seventy or eighty feet perpendicular. The south end of the race is also of solid rock, and the mill houses are founded on rock, so that nothing can be contrived more secure in all respects.

The race is about ninety feet in width, and is furnished with water through the head arches, which allow a passage of water sixty-eight feet in breadth, and six feet in depth, to which the race is excavated below the overfall of the dam, and of course, room is allowed for a continual passage of four hundred and eighty square feet of water; these arches are on the north of the race, and the mill buildings being on the west, the water passes from the race to the wheels which discharge the water. The mill buildings are of stone, two hundred and thirty-eight feet long and fifty-six feet wide; the lower section is divided into twelve apartments, four of which are intended for eight double forcing pumps; the other apartments are for the forebags leading to the water wheels. The pump and forebag chambers are arched with brick, and are perfectly secure from the inclemency of the weather. Those now in use, are kept warm by means of two large iron stoves, heated to great advantage and economy with Schuylkill and Lehigh coal.

It has been from the commencement determined, for the present, to erect only three wheels and pumps, which are now completed, and with them the most important parts of the duty of the committee. The first of the wheels is fifteen feet in diameter and fifteen feet long, working under one foot head and seven feet fall. This was put in

20

operation on the 1st of July, 1822, and it raises one and a quarter million of gallons of water to the reservoir in twenty-four hours, with a stroke of the pump of four and a half feet, a diameter of sixteen inches, and the wheel making eleven and a half revolutions in a minute. The second wheel was put in operation on the 14th of September, and is the same length of the first, and is sixteen feet in diameter; it works under one foot head and seven and a half feet fall, making thirteen revolutions in a minute, with a four and a half feet stroke of the pump, and raises one and one third million of gallons in twenty-four hours. The third wheel went into operation on the 24th December, 1822, and is of the same size as the second, and works under the same head and fall, making thirteen revolutions in a minute with a five feet stroke of the pump, and raises one and a half million gallons of water in twenty-four hours. It is not doubted that the second wheel can be made to raise an equal quantity, thus making the whole supply upwards of four millions of gallons in twenty-four hours.

The wheels are formed of wood, and put together with great strength; the shafts are of iron, weighing about five tons each. The great size and weight of the wheel give it a momentum which adds greatly to the regularity of its motion, so necessary to preserve the pumps from injury under so heavy a head as they are required to work, which is a weight of 7,900 lbs., the height ninety-two feet.

"The pumps are placed horizontally, according to a design of Mr. F. Graff, and are worked by a crank on the water wheel; they are fed under a natural head of water, from the forebags of the water wheel, and are calculated for a six feet stroke; but hitherto it has been found more practicable to work with not more than five feet. They are double forcing pumps and are connected, each of them, to an iron main of sixteen inches diameter, which is carried along the bottom of the race to the rock at the foot of Fairmount, and thence up the bank into the new reservoir. At the end of the pipe there is a stop-cock, which is closed when needful for any purpose. The shortest of these mains is two hundred and eighty-four feet long; the other two are somewhat longer. The reservoir next the bank is one hundred and thirty-nine feet by three hundred and sixty feet, is twelve feet deep, and contains three million of gallons; it is connected at the bottom with the old reservoirs by two pipes of twenty inches diameter with stop cocks. This reservoir contains four millons of gallons. All the water, being raised into the reservoirs one hundred and two feet above low tide, fifty-six feet above the highest ground in the city, is thence conveyed to the city, by iron pipes."

On 24th October, 1822, the steam engines of the old work were stopped, never again, we presume, to be wanted. The actual consumption of water in Philadelphia, is stated at 2,000,000 gallons in winter, and 3,000,000 in summer, "when the streets are washed."

The distribution of the water from Fairmount, is by two iron mains of 20 inches diameter, to the junction of Chestnut and Broad Streets; and thence by intersecting pipes through various parts of the city; superceding the wooden pipes, or bored logs, of the first works.

The whole expense of this admirable work was $426,000, exclusive of the distribution pipes from the reservoir. The city had previously expended in experiments more than a million of dollars—raised by a general tax on the property assessed for other city expenses.

Cincinnati, the imperial city of the west, next claims our notice, from the extent of its water works. From a valuable volume, by *Charles Cist*, entitled *Cincinnati in* 1841, we take the annexed account of them.

"This important establishment was originally projected by Col. Saml. W. Davies, in the year 1817. In May of that year, he obtained from the city council a charter, granting the exclusive privilege of laying pipes, &c., in the streets of the city, for the term of 99 years.

"A suitable building for his operations was commenced in 1819, on the bank of the river, a short distance above Deer creek. This edifice, which is appropriated to the machinery for raising water, has its foundation laid deep and strong in the rock which, at this place, forms the bed of the Ohio. Its walls, commencing about ten feet above low water mark, are built of limestone. They are eight feet thick at the foundation, diminishing gradually to a height of thirty-five feet, where they are five feet thick. Here the brick work commences. The building on the river side is ninety feet high. A well, which has been excavated in the solid rock beneath the building, communicates by a canal with the deep water, and thus guarantees a constant supply at the lowest possible depression of the river. The water is raised from this well by lifting-pumps to a point above high water mark, and is thence forced up to the *reservoirs* on the hill, a distance of about seven hundred feet. These reservoirs are elevated one hundred and fifty feet above low water mark, and about thirty feet above the upper plane of the city. The machinery employed for the purpose is a forty horse power steam engine.

"The largest of these reservoirs is one hundred and three feet by fifty feet, and the smaller ninety-four feet by forty-five feet. The average depth of the whole is twelve feet, and their capacity one million six hundred thousand gallons. The water is carried through cast iron pipes, under the bed of Deer creek, to the intersection of Broadway and Third street, where it is distributed along all the principal streets, through pipes of oak logs with iron joints. About twenty-four miles of pipe have been already laid, and they are constantly extended as rapidly as public convenience and patronage require. The price of water varies according to the quantity supplied to a hydrant, the minimum rate being ten dollars. Those who take the water are at the expense of conducting it from the main pipe in the street, and furnishing hydrants, as well as keeping them in order.

"Until 1826, the works were carried on individually. In that year, under the necessity of increasing its operations, the ownership was transferred to others, who became incorporated under the title of 'The Cincinnati Water Company,' and who, after repeated efforts to sell out to the city since, accomplished that arrangement, under the sanction of a public vote of the citizens, in 1839.

The report of the superintendent of the works, for 1840, will serve to explain their present condition.

Satement of the Condition of the Water Works, on the 15*th of December*, 1840.

There are now in the city,	
Wooden pipes, from $1\frac{1}{2}$ to $2\frac{1}{2}$ inches in diameter,	$19\frac{1}{2}$ miles.
Iron pipes, from 4 to 20 inches in diameter, - - -	$4\frac{1}{4}$ "
Making in all, - - - - - - - - - - - - - -	$23\frac{3}{4}$ "
There have been laid since the purchase of the works by the city,	
Wooden pipes of $2\frac{1}{2}$ inches diameter, - - - - - -	3,337 feet,
Iron pipes of 4 to 10 inches diameter, - - - - - -	3,311 "
Making in all - - - - - - - - - - - - - -	6,648 "

being all the pipes laid down in that period, except the ordinary *repairs of logs*, the expense of which *equals* the cost of *three inch iron pipes;* and in view of this fact, I again respectfully suggest to the committee, the importance of *abandoning the putting down the logs entirely*, and laying nothing but iron pipes. It is at once seen, that although the original cost of *logs* is much cheaper than iron, yet the *repairs* of such logs cost as much as the first cost of *iron pipes of double the capacity;* as regards economy, therefore, there can be but one opinion, and that is in favor of good *iron pipes*. Another disadvantage from the use of logs, which is severely felt in the upper part of the city, is the impossibility of supplying through them, as much water as the wants of the citizens require; being necessarily of small diameter, and the draft on them constant, the water will not rise in the upper part of the city to within twenty feet of the height of the reservoir. In cities, such as Philadelphia, where the *average height of their reservoir is less than in our own city, they have an abundant supply of water*, not only for domestic purposes, but in *case of fire* also, which I deem one of the first objects of well regulated water works. The reason of this abundant supply is obvious, as in Philadelphia they have iron pipes of capacity sufficient for all their wants. They suffered formerly at Philadelphia in the same manner as ourselves, when at one time they had six lines of *wooden pipes* leading their water to the city, which they finally abandoned, and substituted *iron pipes* of large diameter.

" There have been discontinued since the city came into possession of the water works —of wooden pipes, seven thousand eight hundred and seventy-one feet. Of this amount, three thousand three hundred and eleven feet have been replaced with *iron pipes*, and four thousand five hundred and sixty feet have been discontinued on streets where the former company had laid down iron pipes, and still continued the use of the logs. The attachments were therefore changed to the iron pipes, and the logs abandoned, by which considerable leakage and many repairs have been avoided.

" The consumption of water in the city has averaged for the last year, one million and eighty thousand gallons daily, which has been distributed to three thousand tenants, being an average daily supply to each tenant of three hundred and sixty gallons. This large average supply is attributable, partially, to the constant practice throughout the city of families, and other establishments, supplying themselves with water from the hydrants and pipes without authority, which has become a very serious drawback upon the revenue of the works. But the large average supply (so greatly beyond the wants of the citizens) is principally owing to the innumerable leaks from the *wooden pipes*, which it is impossible to discover, as the water descends into the gravel and into the numerous *sink holes*, so common on the upper plane of the city.

"As the iron pipes are substituted, this waste will diminish, and I have no doubt, when the wooden pipes are all abandoned, and some prompt measures enforced against such as take water without authority, that the present amount of fuel consumed by the engines, will supply double the number of tenants.

"The average supply of water to each tenant in the city of Philadelphia is one hundred and seventy-seven gallons daily, being less than half the quantity supplied from the works of this city.

"The present engines and pumps can supply, by working twelve hours each day, twenty-one million gallons of water, by running both engines at the same time.

Respectfully submitted,

S. H. DAVIES, Superintendent.

In Boston about 1000 families are supplied with water by the Boston Aqueduct Company, at an annual charge of from ten to twelve dollars to each family. The water is conveyed from the Jamaica pond, through wooden logs, and thence into the houses by its own head.

The distinguished engineer, *Loami Baldwin*, at the request of the city authorities, had some few years ago, surveyed the ground between Boston and the Long Pond, distant about ten miles from the city, and reported a plan quite feasible, and, considering the advantages promised, of reasonable cost, by which a perpetual and abundant supply to the whole city, could be derived from that source and delivered at a sufficient elevation, to supply the upper stories of the houses.

Absorbed possibly in other great public works, especially the Western Rail Road, the city of Boston has not as yet decided to attempt the new aqueduct.

The city of Albany is partially supplied with water by a chartered company. The water is procured from a creek between two and three miles north of the city, and brought to the distributing reservoir through a line of six inch iron pipe. About 1200 dwelling houses are supplied from this source, and the rates charged for the use of the water vary from $8 to $16.

Troy, in this State, has also its water works. The stream selected for the purpose of supplying the citizens, is the *Piskawin Creek*, and the distributing reservoir is placed on its margin, about one third of a mile east of the city, and at an elevation of 100 feet above tide, and about 73 feet above the plain upon which most of the city buildings are erected. The reservoir will hold about 1,900,000 gallons; and the minimum supply of the creek at an unusually dry time, was 840,000 gallons per diem, which will allow 56 gallons per day to each soul, estimating the population at 15,000.

The main, which first receives the water, is sixteen inches in diameter where it enters the reservoir, tapering down to twelve inches at the other end. The mains running through the several streets, vary from twelve to three inches in diameter, according to circumstances. It has been ascertained at Troy, that a 12 inch main, with a head of 73 feet, will discharge from the reservoir, and deliver into the city 1,500,000 gallons every twenty-four hours.

The whole cost of the Troy Water Works, viz., for the purchase of land and water rights, building the reservoir, and laying the main pipes through the city, will amount to about $115,000. The annual expense of attending the works is but $800; five hundred to a superintendent, and three hundred to a clerk.

Providence, in Rhode Island, is partially supplied by an aqueduct, but on no very extensive scale.

Richmond, the capital of Virginia, derives water from the James river by works planned by Mr. Albert Stein, who was among the engineers originally employed to survey the courses of, and make estimates for, the Croton Aqueduct.

An engine house 56 feet long and 58 wide, built of stone, on the banks of the river, cover two wheel pits and two pumps, constructed like those at the Fairmount works.

The water-wheels are of cast iron, with the exception of the buckets and soling, 18 feet in diameter to the point of the buckets, 10 feet wide between the shroudings, and 14 inches depth of shrouding. The cast iron shaft of the water-wheel is 10 inches in diameter in the journals, and 16 feet 6 inches long.

The head and fall of the water is 10 feet. Each pump is calculated to raise in 24 hours, 400,000 gallons into the reservoir 160 feet above the pump. The reservoir will contain one million gallons, and is divided into four apartments, two of which are for filtering.

We now come to our own great work—THE CROTON AQUEDUCT.

MEMOIR

OF THE

CROTON AQUEDUCT.

MEMOIR

OF THE

CROTON AQUEDUCT.

AT A very early day the want of a sufficient supply, and a convenient distribution of good water, was felt by the citizens of New-York.

Before the declaration of independence, considerable expenditures had been made in order to satisfy this want.

In July, 1774, the proposal of *Christopher Colles*, to erect a reservoir and to convey water through the several streets of the City, after having been sometime before the Common Council, was finally adopted and ordered to be carried into effect.

The scheme of Mr. Colles, was simply that since adopted by the Manhattan Company, of digging large wells, and from them pumping the water up into reservoirs.

The ground selected, was on the east line of Broadway, between Pearl and White streets, where a spacious reservoir was constructed. On the 8th of August, 1774, the following resolution was adopted by the Common Council :—

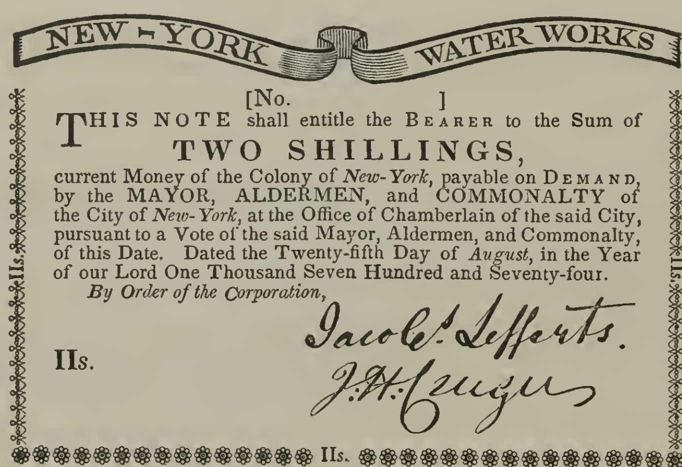
Ordered—That the northerly part of the property of Augustus Van Cortlandt and Frederick Van Cortlandt, fronting on Great George street, be purchased at £600 per acre, for a RESERVOIR, provided, that upon sinking a well there, good water be found. If not, the well to be filled up by the Corporation.

The quality of the water proving satisfactory, on the 25th of August, the former resolution of the Board accepting the proposals of Mr. Colles was confirmed, and Treasury notes to the amount of £2,500, were ordered to be issued to meet the expense.

Notes to that amount were, accordingly, issued of the following denominations :—

4000 of six pence each	£100	4000 of four shillings each	£800
4000 of one shilling "	200	2500 of eight " "	1000
4000 of two " "	400		

At the bottom of this page will be found an engraved fac-simile of one of these notes. The back of the note represents the machinery by which the water was to be raised, undoubtedly one of Newcomen's Atmospheric Engines, which, since the commencement of the century had been in general use, in draining mines in all parts of Europe, and one of which about 1760 was imported by the proprietors of the old copper mines near Belleville,


NEW-YORK WATER WORKS

[No.]

THIS NOTE shall entitle the BEARER to the Sum of

TWO SHILLINGS,

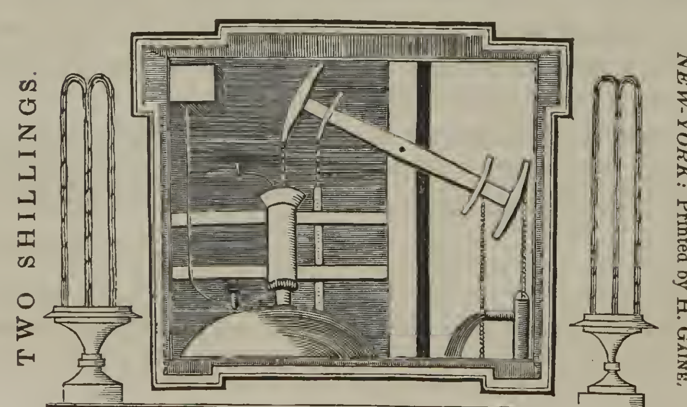
current Money of the Colony of *New-York*, payable on DEMAND, by the MAYOR, ALDERMEN, and COMMONALTY of the City of *New-York*, at the Office of Chamberlain of the said City, pursuant to a Vote of the said Mayor, Aldermen, and Commonalty, of this Date. Dated the Twenty-fifth Day of *August*, in the Year of our Lord One Thousand Seven Hundred and Seventy-four.

By Order of the Corporation,

Jacob L. Lefferts.

IIs. J. H. Cruger

IIs. IIs. IIs.



New-Jersey; this engine it is very probable Mr. Colles had seen, and designed to use for raising water into the reservoir.

On the 15th of November, this entry appears in the minutes of the Common Council:—

The clerk of the Board produced three bonds from the Corporation, two of which to Augustus Van Cortlandt and John Fay for £700, and the other to Frederick Van Cortlandt for £350, bearing five per cent. interest, being the consideration money of the ground this Board purchased for the Water Works, which said bonds were read, approved, and signed by Mr. Mayor, by order of the Common Council.

We have in our possession a copy of the deeds given by the Messrs. Van Cortlandt's, for the land thus sold. The boundaries are thus described.

"All that certain piece or parcel of land situated lying and being partly in the west ward, and partly in the out ward of the said city, beginning on the east side of Great George Street, at the westermost corner of Mr. Peter Jay's land, and runs thence along the same, south, fifty-three degrees, east six chains and twenty links to a meadow, thence along the meadow, south sixteen degrees and thirty minutes, west two chains and seventy-seven links, thence north fifty-three degrees, west seven chains and twelve links to Great George Street aforesaid, thence along the east side thereof north thirty-seven degrees and thirty minutes, east two chains and sixty-four links to the place of beginning; containing one acre and three quarters of an acre, together with all and singular the profits, hereditaments, &c. &c."

The conveyance is to the Mayor, Aldermen and Commonalty of the city of New York, and their successors and assigns for ever, for the consideration of £1050.

The deeds are signed on the eighth day of October one thousand seven hundred and seventy-four, by Augustus Van Cortland, Catharine Van Cortland, and Frederick Van Cortland. The witnesses to the signature, as well as to the receipt of the consideration money £1050, are Frances Van Cortland and James Van Cortland.

The acknowledgement was taken, on the same day, by Henry White, Esq., one of his Majesty's Council for the State of New York, and the deeds were recorded in the Office of the Secretary of State, at Albany, on the 25th November, 1774—at the request of the Mayor, Aldermen and Commonalty of New York.

At that period, Governor Tryon ruled over the Colony, and among his other prerogatives was that of appointing the Mayor and Sheriff of the City. It may not be without interest at this day, to see who then were the fathers of the City. They were for 1775,

WHITEHEAD HICKS, Mayor.—JOHN WATTS, Jr., Esq., Recorder.

Francis Filkins, Benjamin Bragge, Andrew Gautier, George Brewerton, Jr., John Dickinson, Jacobus Lefferts, William Waddell.	Aldermen.	Benjamin Huggett, Theophilus Hardenbroek, Henry Brevoort, Andrew Hamersley.	Assistants.

An additional sum of £2,600, was in this year ordered to be issued, as appears from this entry.

Common Council, 2d of August 1775.—Ordered by the Board, that a number of printed notes to the amount of £2600 be immediately struck of the several denominations following:

3000 of eight	shillings	£1200
4000 of four	"	800
5000 of two	"	500
2000 of one	"	100

Which notes when signed, are to be applied towards carrying on the New-York Water Works.

The revolutionary struggle which had even then commenced, and of which the City of New-York felt the full effects, appears to have put an end to this enterprise for furnishing water, before it had made any great progress.

Scarcely, however, had peace returned, with Liberty and National Independence achieved, than our citizens again busied themselves about good water.

In April, 1785, Samuel Ogden made proposals to the Corporation for erecting and establishing Water Works to supply the City. In January, 1786, proposals for a like object were presented by the Hon. R. R. Livingston and John Lawrence, Esq. Both projects were submitted to a committee, who, in February, made a report thereon, and concluded with advising, that the Board advertise for proposals for supplying the City with water.

This suggestion was adopted; and on the 19th of April, the Clerk informed the Board, that he had received three sealed packets said to contain proposals for supplying the City with water. In this stage of the business, the inhabitants seem to have interfered, for the aldermen and assistants being called upon for the opinions of their constituents, reported as the sense of the people of their respective wards, *that the Corporation ought not to grant the privilege of supplying the City with water to individuals*, but that the same ought, if possible, to be undertaken by the Corporation.

In consequence of this manifestation of public sentiment, it was *ordered*,—

That the proposals remain unopened with the Clerk, until the further order of the Board, or that they be returned at the option of the parties offering them.

Ordered, further, That the Aldermen and Assistants, be requested to set on foot, in their respective Wards, representations to this Board, in writing, and subscribed by the citizens, in order, more fully, to ascertain their sense, whether the Corporation ought to grant to individuals, the privilege of supplying the City with water, or whether the same ought to be undertaken by the Corporation, and that the monies necessary for the purpose, should be raised by tax on the citizens.

These proceedings were ordered to be published, but, owing to the imperfection of the records of that day, the result of the application to the people does not appear, neither is there any trace of what the plans proposed by Messrs. Ogden, Livingston, and Lawrence, were, for the supply of water.

In January, 1788, the matter was again agitated, upon the petition of a great many of the inhabitants of the city, who complained of the want of a sufficient supply of water, and asked that the plan of Mr. Colles, for distributing it by pipes, be adopted, or any other that the Board might deem more expedient. Nothing came of this application.

In January, 1789, a Committee of the Rumseian Society, in Philadelphia, addressed the Board, informing them, that the founder of their society, Mr. Rumsey, had invented an engine superior to any other for supplying towns with water; that he was then applying for a patent for his discovery, and that when completed, they would make proposals to the Board, for a contract for furnishing the city of New York with water.

The Board adopted a resolution expressive of their desire to encourage Mr. Rumsey's invention, and to enter into a contract for the supply of the city with water, and inviting proposals, to the end, that if approved, the necessary preparations might be made for providing the means.

This project seems to have had no farther result, and we hear no more of any schemes, till, in February, 1792, we find it recorded in the minutes of the Corporation, *Richard Varick* being Mayor, that a proposal was received from Zebina Curtis, and others, for supplying the city with water, which was sent to the Street Committee, and there apparently died.

In March, 1795, like proposals were made by Amos Porter, and a specific plan was submitted by Samuel Crane, to lead water from the tea-water pump, through Roosevelt-street. Another project was also presented by Benj. Taylor.

On 1st February, 1796, a Committee, consisting of Aldermen Lenox, Roosevelt, and Beekman, were directed to advertise for proposals for supplying the city with water; they reported in December the proposals received, which were from Jos. Brown and associates, to supply the city by means of pipes.

Next month, January, 1797, sealed proposals for supplying the city by means of pipes, were advertised for, and in May, some seven or eight different applications were received; among them, one from Christopher Colles, who had undertaken the work in 1774. These were all referred to a committee.

In December, of next year, 1798, we find R. J. Roosevelt, and Judge Cooper, of Otsego, making new applications.

On the 17th of that month, we have in the annexed report, the first indication that a supply of water from without the city was looked to. Before that, the waters of the Collect or of the tea-water pump, or from wells dug for the purpose, had been relied on.

In Common Council, December 17, 1798.

The following Report was made and approved by the Board :

The Committee appointed to investigate the subject of supplying the city 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 Dr. Jos. Brown, for conveying the waters 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 of 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 farther Report, That they have considered the several matters 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 the sales at auction, in 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, December 17, 1798.

Jno. B. Coles,
Gabriel Furman,
Jno. Bogart,
Jacob de la Montagnie.

This Report was accepted, and the Mayor was directed to write to Mr. Weston. A law, such as contemplated by the Report, was prepared by the Recorder, Richard Harrison Esq., approved by the Board, and confided to the members of the Legislature from the city; and 500 copies of the proceedings of the Board, and of Dr. Brown's project for supplying the city with water were ordered to be printed in pamphlets.

This looked like earnest; and as Mr. Weston accepted the appointment, and in March, 1799, made a favorable report on the practicability and sufficiency of the supply from the Bronx river, as recommended by Dr. Brown, the way seemed clear for at once undertaking the work.

The memorial of Dr. Brown, argued the question on the score of health, safety, and comfort. The yellow fever had made great ravages in the city, and Dr. Brown, who believed in the domestic origin of the disease, demonstrated that its virulence was much aggravated by the insufficiency of the supply of water, and its impure quality. He declares emphatically, "I do not presume to say that the introduction of a large quantity of water into the city, would alone prevent the rise and spreading of putrid diseases, but I am well warranted in saying that, under Providence, it would, more than all other things, contribute to this most desirable end." He also dwells upon the comparative immunity from fire, which such a supply would afford.

The preference of the great mass of the inhabitants at that time, as appears both by Dr. Brown's memorial, and Mr. Weston's report, was for the waters of the Collect, owing, mainly, to their superior coolness. This preference both these gentlemen earnestly resist.

Dr. Brown thus discourses concerning it:

"The large stagnating, filthy pond, commonly called the Collect, which now is, or soon will be, the centre of the city, has been looked to by some people, as a fund from whence an adequate supply might be obtained, by means of a steam engine, for all the purposes already spoken of. I cannot undertake to say, that this source would at present be incompetent to all the preceding purposes, for which a supply of water is wanted; but if the quantity naturally discharged from this pond, be the whole that is furnished by its springs, then I might say with propriety, it is infinitely too small for those uses. But admitting, that at present it might be competent, the time will come, and that very shortly, from the growth of the city, when this source will most certainly be very inadequate to the demand. And again, supposing the pond to contain and furnish enough, it is a consideration well deserving attention, whether a pond, into which the filth from many of the streets must, without very great expense and care, be constantly discharged, and to which the contents of vaults, &c., will continually drain, is a desirable source from whence we should like to take water for drinking, cooking, &c., without taking into the account its noxious qualities, medically considered; although it may be laid down as a general rule, that the health of a city depends more on its water, than all the rest of the eatables and drinkables put together."

Mr. Weston, in like manner, says:—"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 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 seemed very strange to me."

The Bronx river was the source whence both Dr. Brown and Mr. Weston recommended that the supply of water should be drawn.

Dr. B., however, greatly underrated the quantity needed, and still more greatly, the expense of the work. He considered 362,800 gallons as an ample daily supply, and $200,000 as the utmost expenditure required for bringing the Bronx to the city, for laying down twenty miles of pipes in the streets, and erecting two public fountains.

His plan is thus briefly described in his memorial:

"About half a mile below Williams' Bridge, over the Bronx, is a piece of low meadow ground, in which rise two springs, one of which runs easterly and empties itself into the Bronx, and not more than four hundred yards from its origin. The other spring empties itself into the Harlem river, traversing a distance of about six miles. The place on which those springs originate, are not more than five feet above the level of the Bronx; and sometimes part of the river, when raised by a considerable freshet, has run over part of this meadow and emptied itself into the Harlem river. From these reasons, then, it is obvious, that by building a dam five feet high across the Bronx, and below where the first mentioned spring empties itself into, and by digging a canal four hundred yards in length, through the meadow, the whole of the Bronx might be, if necessary, diverted from its old route and thrown into Harlem river, and about eight miles distant from the City Hall."

The spring to which he alludes, is the Morrissania creek. The point at which the work was to commence is fifty feet above tide, and the City Hall was the old building in Wall-street. He also says:—

"When I first interested myself on this subject, I was in hopes a place sufficiently high might have been found, from whence the waters of the Bronx could have been conducted to New York, in pipes of conduit, without any previous machinery; but I am now satisfied no such place exists, for although water in an open aqueduct will run with tolerable fluency, having only six inches fall in the mile, yet in a pipe, or conduit, it requires five feet fall to produce the same effect; and even this fall is insufficient where the pipes of conduit are of considerable length and of small diameter ,for the friction that is occasioned by the sides of the pipe of conduit, is in a quadruple ratio with its length. Now as the ground in the city of New York, to which water ought to be conveyed to a principal reservoir, is about forty feet above high tide, which is ten feet only below the level of the river Bronx, where it may be diverted, I consider it a fall perfectly inadequate to any design of conveying the water in a line of pipes; it then becomes necessary, that the water of the Bronx should be elevated by the means of some machinery."

By this plan the water was to be elevated eighty feet above the level of Harlem river; the machinery for the purpose, was to be propelled by the surplus water from the Bronx, which was estimated to discharge 1200 cubic feet, or 7400 ale gallons per minute. There was to be one water wheel of 20 feet diameter, and four forcing pumps of six inch bore, which would, it was calculated, pump up the required quantity of 362,800 gallons in the 24 hours. This was to be delivered into a reservoir at the Dove, a public house about five miles from the city, and thence conveyed by pipes, to a distributing reservoir to be constructed in the Park, or some, then open ground, north of the Hospital.

Mr. Weston's plan was to take the water of the Bronx river, at Lorillard's snuff factory, to raise a dam six feet high, which would turn the water through a low swamp into Mill brook, to follow the north bank for three miles, and then to cross in an aqueduct to its opposite side, and continue that level to the Harlem river. He states the distance to be from the Bronx to the Park, 14 miles and 7 furlongs, and the descent twenty-three feet. He says, "It appears from examinations that have been recently made, that the Bronx is sufficiently elevated above the highest parts of the city to introduce its waters therein without the use of machinery, and the intermediate ground, though very irregular, presents no obstacles which art and industry may not surmount." He also says, "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."

Mr. Weston estimated that the city would require 3,000,000 gallons of water a day. He states that the Little Rye pond contained fifty acres, and the Big Rye pond, five hundred acres; those ponds he proposed to convert into reservoirs, by building a dam six feet high, which would make more than six hundred acres, and would contain 959,713,920 gallons, would afford an annual supply of 8,000,000 of gallons for one hundred and twenty days, and leave a surplus of 5,000,000 of gallons for the mills. It will, however, be remarked, that he estimated the area of the ponds double what they actually present. The water was to be brought in an open canal to the Harlem river; that stream was to be crossed by a cast iron cylinder of two feet diameter, with a descent of eight feet. His reservoirs were to be divided into three parts, and two of them again subdivided. The first two divisions he called the reception apartments, which were to be filled with the water from the cylinders; while one was filling, the other would deposite the impure particles contained in the water. In every twenty-four hours, one of these chambers was to be drawn off in one of the subdivisions, which he called the reservoir of filtration, and from thence into the division of distribution, after percolating through a bank of gravel and loose sand; this last division of the reservoir was to be arched over to insure its coolness.

Mr. Weston offered no estimates of the cost of the work he recommended, but urged very earnestly, that no time should be lost in securing, at any rate, the right to use the Bronx river, which then might, as he supposed, be had for a reasonable compensation; but which from the great advantages for manufacturing purposes that it offered, and its proximity to the city, he argued would rise very much in value.

It is deserving of notice, that among the various uses to which, Mr. Weston says the surplus water might be applied, he specially instances, "the supply of dry docks, which may be constructed to receive the largest ships."

When all appeared to be thus ready and ripe for the accomplishment, by the Corporation, of a work so long projected—private interest stepped in, and paralyzed the whole proceeding.

It was at this period, that Aaron Burr* had conceived the plan of organising an association, which, on the condition of accomplishing what was so ardently desired—the supplying the city with pure and wholesome water, should obtain from the Legislature the concession, in perpetuity, of banking privileges. The provision to this latter effect was, indeed, skilfully kept out of prominent view; the great object purporting to be the supply of water; the surplus only of the capital, after effecting this object, was to be employed in banking operations.

These views of private interest and speculation, were aided by the real difficulty, which intelligent and practical men apprehended, in raising the money needed for such an undertaking as the introduction of the Bronx river into the city, and hence with that of Aaron Burr, we see associated the names of Alexander Hamilton, Gulian Verplanck, John Murray, and others, in remonstrance to the Common Council against the bill they had sent to the Legislature, asking for authority to execute the work.

We shall stand excused, by the interest of the subject and the great names involved, for copying in detail from the city records, the particulars and result of this influence.

At a meeting of the Common Council, held 25th February, 1799:

25th February.—The Mayor, Richard Varick, informed the Board that on Friday last, Mr. Burr, one of the members from this city in the Assembly, together with John Murray, Esq., as President of the Chamber of Commerce, Gulian Verplanck, Esq., as President of the Office of Discount and Deposite of the Bank of the United States, in this city, Peter H. Wendover, as President of the Mechanics' Society, together with Major General Hamilton and John Broome, Esq., according to an appointment by Mr. Burr, called on him, and stated to him, in presence of the Recorder, who was also requested to attend for the purpose, that great difficulties had arisen in the minds of members of the Legislature, touching the power requested to be vested in their Board, by the bill for supplying the city with water, and the bill for investing the Board with adequate powers in relation to the health of the city, and that it was problematical whether those bills could pass in the form proposed, and he therefore submitted the propriety of this Board requesting the Legislature, if these bills respectively should not be deemed proper in the form proposed, that the Legislature should make such provisions on the several subjects thereof, as to them should appear most eligible.

That after some conversation with Mr. Burr and the other gentlemen accompanying him, the Recorder and himself requested that the proposition might be stated in writing, to be communicated to the Board as on this day; and Mr. Recorder now laid before the Board a paper without signature, which he stated to the Board he had received from Major General Hamilton, as the proposition for their consideration this day, which being read—

Resolved, that before the Board proceed upon the said propositions, they ought to be

* Mr. Burr was then one of the members of Assembly from this city, and was employing the influence of his station, and all the address by which he was characterized, in obtaining, under the pretext of furnishing water to the city, perpetual corporate powers for a Bank.

sanctioned by the signature of the parties recommending the same, and that the nature and circumstances of the difficulties which have attended the several applications on behalf of the Board to the Legislature should also be stated.

Resolved, Further, that the above resolution be communicated to Mr. Burr, and Major General Hamilton, without delay, and as the objects above alluded to are of great importance to the welfare of the city, the Mayor be requested to call a special meeting of the Board, as soon as he shall receive the proper communication in consequence of the above resolution.

28*th February.*—Mr. Mayor laid before the Board a letter from Major General Hamilton, together with a written communication from him, which were read in the words following:

New-York, February 26, 1799.

Dear Sir:—I last night received your letter, dated yesterday; the resolutions of the Common Council discover a mistake as to the character under which the gentlemen named in them, made their communication to yourself and the Recorder.

They did not pretend to appear in an official capacity, but intended to be considered merely as private individuals. As such they gave information which they thought might be useful to the city. Specific propositions in writing were requested from, not proposed by, them; they were sent in an informal shape, because it was not meant to attach formality to their interposition. Having been digested by me, as the sum of a previous conversation among ourselves, I have no objection to authenticate them by my signature—and I freely add, that the changes in the plan of the Corporation, which they suggest, have the full concurrence of my opinion,

With respect and esteem,

I am, dear sir, your obedient servant,

Richard Varick, Esq. A. HAMILTON.

Communication accompanying this Letter.

Among the objects agreed on all hands to be necessary towards preserving the city from pestilential disease, are the following:

1. The conveyance of water in pipes through every part of this city, as well for the more convenient cleaning and washing of streets, alleys and lanes, as for the supply of the inhabitants. Then follow four other provisions as to draining low grounds, filling up slips, &c.

As to the first point, the plan proposed by the Corporation is, that the business shall be executed by the Corporation for their own benefit; and that, towards enabling them to do this, the Legislature shall grant to them for a term of years the revenue arising from sales at auction. No other fund is indicated by the bill. Probably it is contemplated that loans may be obtained on the foundation of the revenue to arise from the supply of water, and the deficiency, if any, may be made up by taxes on the city.

The success of this plan is problematical. It is doubtful whether the Legislature diminished, as are some of the sources of the revenue on which it has for some time relied, will be willing to grant the fund arising from auctions for the *profit* of the Corporation, for such a term as will make it go far towards accomplishing the object. Computing its annual amount at $30,000, if granted for 20 years, which is as much as can be hoped, it would be equal only to a capital of $344,097, 60, interest at 6 per cent.

But it is hardly to be expected that money can be borrowed at so low a rate. How far short will this be of the sum probably requisite? This cannot be safely estimated at less than a million of dollars, if the business be done on a scale sufficiently extensive.

The amount of the revenue, to result from the supply of the water, must be for some time uncertain, and under this uncertainty, extensive loans on this basis ought not to be counted on. To raise what may be wanted, by taxes, to carry on the enterprise with vigor, might be found so burthensome to the citizens, as to occasion the operation to languish.

It is not to be doubted, that it will promote the convenience of the citizens, and secure the final success of the object, to let in the aid of a capital to be created by the voluntary contributions of individuals.

This may be obtained on a plan like the following:

Let a company be incorporated, of all those who shall subscribe to the fund, with a capital not exceeding a million of dollars, to be composed of shares of $50 each; the affairs of which to be managed by seven Directors, annually chosen by the subscribers, except that the Recorder of the city, for the time being, always shall be one.

Of this capital, a privilege to be reserved to the Corporation of the city to subscribe for any number of shares not exceeding one third; to enable them to do which, a grant of the auction duties to continue to be solicited, and a power to be asked to raise on the city, an annual revenue equal to the interest and gradual reimbursement of the principal of such additional loans as may be found necessary.

The Company to have powers similar to those which the draft of the bill contemplates to be given to the Corporation.

The residue of this paper, which is signed *Alexander Hamilton*, relates to the health laws, &c.

After the communication was read, the Board came to the following determination:

Whereas, By the Report of a Joint Committee from this Board, from the Chamber of Commerce, and from the Medical Society, with the Commissioners of the Health Office, dated 14th January last, a variety of regulations and improvements in this city were recommended as of primary importance to the health and welfare of the inhabitants; and whereas, the introduction of a copious supply of pure and wholesome water into the city has long been contemplated by the Board, and is esteemed by the said Committee, "one of the most powerful means of removing the causes of pestilential diseases;" and *whereas*, the Board, in order to carry the objects of the said Report into effect, and with a view to obtain such supply of fresh water for the benefit of the citizens in general, and in pursuance of the recommendation of said Committee, has directed certain bills to be prepared and submitted to the Legislature, by means of which, the care and duties of this Board, as such, would be considerably extended, and the members thereof, be subjected to great additional trouble, without any emolument to themselves; and *whereas*, objections have arisen to the said bills, upon the ground, that a Company would be best adapted to the business of supplying the city with water, &c.

Resolved, That this Board is truly anxious that the measures recommended by the said Joint Committee, and every other measure which may promote the health and welfare of the city, be pursued in the way that may be most likely to secure these important ends; and although the members of this Board have not been unwilling to subject themselves to great trouble and responsibility from a sense of duty, yet having no private motives to wish for any peculiar agency in the business, they will be perfectly satisfied if the objects in view are pursued in any way that the Legislature may think proper, by which their fellow-citizens may be benefited in the most easy, safe, and effectual method, and the charter rights of the city remain inviolate.

Resolved, That a copy of the above resolutions, under the Common Seal, together with the papers and proceedings of the Board, relating to the subject, be transmitted to such members of the Board as are at present in the Legislature.

This seems to have removed the chief obstacle to the success of Mr. Burr's plan for obtaining a charter for the Manhattan Company. The sequel may be best told by again referring to, and quoting from, the minutes of the Common Council.

Under the dates respectively annexed, we find the following entries:

15*th April.* A letter from D. Ludlow, Esq., President of a Company lately established by law, called *the Manhattan Company*, for the purpose of supplying this city with water, together with a copy of their charter, were respectively read, and the consideration of the steps to be taken by this Board thereon was postponed till next meeting.

22*d April.* The Board having determined *nem. con.*, to subscribe for the 2000 shares reserved for the Corporation by the Charter of the Manhattan Company, resolved as follows:

Whereas, By an act of the Legislature of the State of New York, passed 2d April, inst., entitled an act, for supplying the city of New York with pure and wholesome water, "it is among other things enacted, that it shall and may be lawful for the Mayor, Aldermen, and Commonalty of the city of New York, to subscribe to the stock of the President and Directors of the Manhattan Company, any number of shares, not exceeding 2000, and *whereas*, this Board have, as aforesaid, resolved to subscribe to the said stock, 2000 shares.

Therefore, Resolved, That the Treasurer, or Chamberlain, of the city, be and he is hereby authorised and empowered for, in the name, and on account and behalf of the Mayor, Aldermen, and Commonalty of the city of New York, and their successors, to subscribe 2000 shares to the said stock, as aforesaid, and at the time of said subscription, to pay to the said Company, such sum or sums of money on account of such shares, as may be required by the said act, and the rules, orders, and regulations of the said Company.

Ordered, That a copy of this resolution, with the Common Seal affixed and subscribed by Mr. Mayor, on behalf of the Board, be delivered to the Treasurer or Chamberlain.

Ordered, That a loan of $5000 be made of the Bank of New-York, and that a bond for the payment thereof, with interest at 6 per cent., be made with the Common Seal affixed and subscribed by Mr. Mayor on behalf of this Board.

Thus for the contingent profit upon 2000 shares of the stock in this Company, the Corporation parted with the power, which, from 1785 up to 1799, repeated expressions of opinion, both by the people and by the Common Council, had declared, should of right, be exercised only by the public authorities of the city—that of procuring and distributing a supply of pure and wholesome water.

From this time forth, for many years, no serious attempt was again made to effect the great object, which had so long occupied the attention of the citizens, and their rulers. It was indeed soon felt that the promise of a supply from the Manhattan water was delusive. Although privileged by their charter to go over the whole island of New York, and into West Chester County, to seek for good water, the Company contented themselves with sinking a large well at the corner of Duane and Cross-streets, in one of the most thickly settled portions of the city, and thence pumped up that which they called pure and wholesome water, but which was necessarily most impure.

This Company, moreover, confined the supply to the letter of the contract, for at a season when pestilence was apprehended, the water, by order of the then Mayor, Edward Livingston, being used to cleanse the streets, we find this entry in the minutes:

Common Council, 19th August, 1802.

A resolution was passed appropriating $750, to compensate the Manhattan Company for cleaning the gutters with water from their reservoir.

In 1804, indeed, under the mayoralty of De Witt Clinton, another effort was made, and a committee was appointed to report upon the practicability of supplying the city with pure and wholesome water, and especially to confer with the Manhattan Company as to the terms upon which they would cede to the Corporation their works and privileges of supplying water; but nothing seems to have come of it.

From that period up to the year 1816, the whole subject was apparently lost sight of, notwithstanding that for several of the intervening years, the growth of the city was more rapid, and its prosperity, and increase in wealth, more obvious than ever before.

In 1812, the causes of dissatisfaction between this country and Great Britain, which had long been gathering strength and irritation, resulted in war. At such a season all local enterprises requiring credit and capital were postponed.

Early in 1816—peace having been concluded at Ghent, in December, 1814—the subject of supplying the city with water was resumed, and at a meeting of the Common Council in March—Jacob Radcliff being Mayor—a committee was appointed, "to consider and report upon the propriety of making an application to the Legislature at their present session, to invest the Mayor, Aldermen, and Commonalty of the city with all necessary powers and authority to supply the city with water."

This movement would seem to have had no results, at least the minutes show no report from the committee, nor is there, until 1819, any farther mention made of the general subject.

In August of that year, C. C. Colden being Mayor, a memorial from Robert Macomb was presented, for permission to supply the city with water for all domestic purposes, and asking the appointment of a committee—and one was appointed—to confer with him.

Early in the ensuing spring, the committee reported that they had repeated conferences with Mr. Macomb, and being satisfied that he and his associates had the requisite means to carry their project into effect, they reported resolutions to this effect:

Resolved, That Robert Macomb, and his associates, be permitted to lay down pipes in the roads and streets of this city, whenever it appears to the Common Council that a sufficient quantity of water is collected at a reservoir at Harlem river; provided, that in so doing, they do not interfere with the rights of others.

Resolved, That Robert Macomb, and his associates, shall bind themselves and their successors, in a contract with the Common Council, to transfer at any time when required, after the expiration of 40 years from the completion of the water works, all right and interest therein, to the Mayor, Aldermen, and Commonalty of the city, for which, they shall receive the cost of constructing the said water-works, after deducting a proper allowance for use and wear.

Resolved, That the Committee on lands and places, together with the Counsel of the Board, be instructed to prepare a contract, and make arrangements with Robert Macomb and his associates, in conformity with the preceding resolutions, and report the same to this Board, and that no rights or privileges be conveyed by these resolutions, but only by the contract contemplated to be entered into.

John Hone,
J. B. Taylor,
W. A. Davis,
R. McQueen.

These resolutions were agreed to; an amendment having been adopted, on motion of Mr. Stevens, that there be inserted in the contract, a clause regulating the price at which water is to be furnished to the citzens and the public.

The scheme of Mr. Macomb and associates, was to bring the water from Rye pond, and they professed their ability to complete the work in two years, *without any compensation or aid from the Common Council*, asking only the privilege of laying down the pipes and selling the water.

The minutes show no farther proceedings under the above resolutions; of course, therefore, no contract was made.

In December, 1821—S. Allen being Mayor—another resolution was adopted, for the twentieth time perhaps, for inquiring into the best means for supplying water, and a Committee was appointed, with authority to procure plans, estimates, &c., provided the expense thereof should not exceed $200.

In April, of next year, the Committee, consisting of Stephen Allen, Judah Hammond,

H. I. Wyckoff, and H. Mead, reported that they, in company with Mr. Carrol, who had examined the Rye pond and the Bronx river, at various sites, and particularly at its junction with Mill Brook, where, according to the plan of Mr. R. Macomb, it is to be diverted, carried through Mill Brook, thence through a deep cutting to the valley of the Morrisania Creek, and so, to Macomb's Dam. The water to be taken from the Bronx, at an elevation of 52 feet, the requisite additional elevation of 70 feet to be given by machinery, propelled by the Harlem.

They had caused the waters of the Rye pond to be guaged by Mr. C. White, and they were found to yield 1,000,000 of gallons in the dry season, every 24 hours, the quality of it very good.

The Committee declined giving an opinion as to the expediency or feasibility of the plan on such a light examination, but prepared a resolution to appropriate $500 for a survey and profile of the route, and for an estimate of the cost of constructing an aqueduct. This was carried.

Next year, a new set of schemes seems to have been started, one was to bring the Housatonic river to New York in an open canal, as well for purposes of commerce, as for supplying water to the city, and an act of incorporation was obtained by some citizens of Connecticut, for this enterprise.

This project, however, soon gave way to that of constructing a canal to the city from Sharon, in Connecticut, in which the citizens of Dutchess, Putnam, and Westchester Counties, in this State, and those of the Western part of Connecticut, adjoining these Counties, took a deep interest.

Gen. Ward, of Westchester County, brought the plan to the notice of the Corporation, in a letter which will be found in the minutes, under date of March 10th, 1823, where also appears, the Report of the Special Committee to whom it was referred, consisting of Stephen Allen, S. Cowdery, and H. I. Wyckoff. The report was favorable, and they presented a memorial, and then drafted a law, which was accepted and sent to Albany.

In their memorial, the Common Council, in urging that an act of incorporation be granted to the applicants, took care, while reserving a right to subscribe for a portion of the stock, to guard themselves against any obligation to do so.

They at the same time, in the bill accompanying the memorial, sought to provide a fund, on the faith of which they might borrow such sums as they should subscribe, by asking authority to raise, for that purpose, 1-2 of 1 per cent. on sales at auction within the city, in addition to the duty then paid to the State.

In consequence of the assent of the Common Council, the Legislature granted to the applicants, an act of incorporation, with power to make a canal from the western boundary of the State of Connecticut, to the city of New York.

The route of this canal commenced in the State of Connecticut, at the junction of the Oblong river with a small stream which flows from the Mudge and other ponds. It followed the course of the Oblong river to Dover, thence entering the valley of Swamp river, and passing through the towns of Paulding, Patterson, and south-east to Crawford's Mills on the east branch of the Croton, making a distance of forty miles. From Crawford's Mills, the route by an undulating course, requiring the construction of two tunnels, one 1,320 yards in length, and the second 1,760 yards, reached Macomb's dam, at an elevation of 97 feet above tide; the length of this part of the work would be 52 miles.

This scheme, like so many preceding ones, seems not to have found favor with those who were to furnish the means, which circumstance together with the misconduct of the first President, and the failure of several of the Directors, and withal an expensive law suit, prevented any progress in the work. Accordingly, we find the Common Council again occupied next year with the ever recurring, and ever unsatisfied, want of an adequate supply of water.

Canvass White, at the request of the Mayor, S. Allen, had made an examination of the various sources of supply, and estimates of the cost of bringing water to the city by the different routes. The Report was presented to the Common Council in April, 1842. It looked to the Bronx as the source of supply. The instructions to Mr. White, were, that the water should be brought to the city at a height of 30 feet above the level of the Park.

Mr. White presented various plans and estimates, some for an open canal to Macomb's dam, and thence the water to be raised by means of the water power furnished by the dam to the requisite elevation on the New York shore; another, for taking the water of the Bronx at the higher elevation of the Westchester cotton factory pond, and conducting it in an arched tunnel of masonry to the Harlem river, and passing it over by its own head through iron pipes.

Mr. Benj. Wright, who was associated with Mr. White, gave a decided preference to the latter plan, notwithstanding its greater comparative cost. The estimate was $1,949,542. That for either of the other routes through open canals, and the use of power to lift the water at Harlem river, did not exceed *one million of dollars*.

The quantity of water which the Bronx would deliver, even in the dryest season, was stated at 3,000,000 gallons daily, which could be more than doubled by damming the Rye ponds, the source of the Bronx. The experience of Philadelphia had indicated 27 gallons per head, as an adequate daily supply for the inhabitants, at which rate a population of 244,000, much beyond that then contained in the city of New York, would be accommodated.

Notwithstanding the expense which the city had incurred by these preliminary surveys and estimates, no farther action seems to have been taken in the matter, for on 17th January, 1825, we find the Recorder presenting to the Common Council a resolution for enquiring into the expediency of vesting in the Corporation exclusively, the right to introduce water into the city.

This course was adopted in consequence of an application then before the Legislature for supplying water to the city, concerning which the Corporation had not been consulted. The matter was referred to a committee, who reported in conformity with the resolution, and dwelt with emphasis upon the inconveniences and wrong to the city, that might result from conceding to a private association, the right to tear up the pavements to lay down pipes. A memorial, was in consequence, forwarded to the Legislature, urging upon it, the protection of the corporate rights of the city.

With strange inconsistency, on the 28th of February, only a fortnight after the above report, the Common Council retraced their steps, and actually approved a plan presented to the Legislature by Gideon Tucker and others, for supplying the city with water through the agency of a private association.

The result of all this was the incorporation, by the Legislature, of the New York Water Works, with authority to supply the city with pure and wholesome water. Canvass White was employed by the Company as Engineer, and in his report to the directors, recommended that the Bronx river be the source, and that the water, being taken at Underhill's Bridge, would yield a daily supply of 9,100,000 gallons, at an expense for the whole construction, of $1,450,000. They were to be conveyed in an arched conduit of masonry to Harlem river, and thence across the river and to the city by iron pipes.

Benjamin Wright, who was invited to examine Mr. White's plans and estimates, expressed his entire concurrence in their accuracy.

The charter of this company proved so defective in practice, that they were unable to proceed in their work, and accordingly they applied to the Legislature, in 1826, for an amendment, authorising the company to take such of the waters, lands, and materials as they needed, by appraisement of indifferent persons.

In this application they were defeated by the opposition of the Sharon Canal Company, who claimed under their charter, all the water on the route of their Canal. The Water Works Company, unable to proceed, surrendered their charter in 1827.

Tired, apparently, of relying upon sources of water at a distance, a committee of the

Common Council, in March 1826, was directed to inquire whether "water of the best quality, and in quantity sufficient to supply the wants of the city, cannot be obtained from wells sunk, or to be sunk, on Harlem heights." This led to the incorporation by the next Legislature, in 1827, of a fourth company, called the New-York Well Company. The water was to be procured on the island, by sinking wells in the most elevated grounds.

The Company made several attempts to procure water, but being satisfied by their experiments of the impracticability of the undertaking, the enterprise was abandoned.

The hope next embraced was that of Artesian Wells. Mr. Levi Disbrow had about this time succeeded, by boring to a great depth through earth and rock, in procuring a copious supply of good water, at the Manhattan Reservoir, corner of Bleecker and Mercer streets. The diameter of this perforation is eight inches; its depth, 442 feet. A tube extends from the top to near the bottom, in order to exclude any springs that may be met with in the descent, and of which the quality might impair that of the main supply. Mr. Disbrow made several other borings, varying from 72 to 250 feet in depth.

Encouraged by his success, Mr. Disbrow proposed to supply the city by an Artesian well and reservoir in each ward. But, inasmuch as the product of these wells is limited, even supposing, what is by no means certain, that the multiplication of them at different levels would not diminish the supply, and drain the sources of the more shallow to the deeper perforations, it seemed obvious that the cost of such an enterprise, taken in connection with the uncertainty of the result as to the adequate supply, forbade the undertaking. Nevertheless, the Corporation caused various perforations to be made in the public markets, and in Jacob-street, in the Swamp. In this last, at the depth of 128 feet, a mineral water was obtained, unfit for domestic purposes; but which, for a time, was supposed or represented, to possess valuable medicinal qualities.

After so many years of fruitless resolutions, enquiry, and experiments, in March, 1829, the first positive step towards something like action on the part of the Corporation, was taken on the recommendation of the Fire Department. More than $600,000 of property, had, in the preceding year, been destroyed by fire; mainly because of the difficulty of procuring water. And in consequence, a report made by Alderman Samuel Stevens, in favor of the establishment of a well and reservoir in Fourteenth-street, whence water might be distributed, was accepted and acted upon.

In that Report, Mr. Stevens says:

Various Institutions have been chartered for the purpose of bringing water into the city, but none have as yet ever complied with the main object of their charter, so far as the public was interested; and the Committee remark, that similar incorporations of private individuals, whether they propose at their commencement to furnish pure and wholesome water, or pure and first quality gas, are soon found to have an eye only to the profits of their incorporations, and the public suffer under their monopolies.

The water pipes of the Manhattan Company extend to such parts of the city, as they may deem advisable to put them, on the score of profit; and the upper part of our city, although not possessed of good water, have it, however, of a quality superior to that supplied by the Manhattan Company, and therefore they are unwilling, generally, to take the Manhattan water. The result is, that all that part of the city lying above Grand-street on Broadway, or Pearl-street on the east side of the city, has not the use of the Manhattan water for the purpose of extinguishing fires. It has therefore become absolutely necessary for the Corporation, in some manner, to give to the upper part of the city, a supply of water for that purpose.

The breadth of the island at Grand-street, is about two miles; and does not materially differ as high up as Fourteenth-street. It will be perceived, that the extreme distance from the rivers, of the part of the city between Grand and Fourteenth-streets, is one mile, or 5280 feet. Now, to bring the water from either river, at the extreme distance by engines, would require 26. Our whole engine establishment would not form two lines. This mode of furnishing water by engines from the rivers, is not only too limited, but too laborious for the firemen, to be at all relied on, for the section of the city referred to.

Another mode of supply is by cisterns; and this to a certain extent, is already in operation. The Corporation has at present, 40 public cisterns, which have cost on an average $600 each, making in all a cost of at least $24,000. They usually contain 100 hogsheads each. Now to provide for the section of the city between Fourteenth and Grand-streets on Broadway, and Fourteenth and Pearl-streets on Chatham-street, on the east side of the city, by cisterns, would require the construction of at least 60 additional cisterns, supposing that each thousand feet square required a cistern, and if we estimate them at $600 each, (including expenses of assessments,) it will make the sum of $36,000. The cisterns would probably not last longer than 20 or 25 years, and would require considerable expense in repairs of leaks, and for leaders, &c., during that time.

Your Committee have come to the conclusion to recommend to the Board, the laying down of two lines of iron pipes, for the security against fires, of the section of the city above described. They propose that the Corporation should lease three or four lots of the Sailors' Snug Harbor estate, or near there. The elevation of the surface there, say Broadway and Fourteenth-street above the levels of the rivers, is 39 feet. The highest part of the city below Fourteenth-street, does not exceed 42 feet.

A rise, or additional head at Fourteenth-street, (as a starting point,) of three feet, would give the necessary head to make the water flow over the surface of the highest streets in the city, and would give an excess of head over four-fifths of the section of the city referred to, of at least fifteen feet. But as a reservoir would be necessary to hold the supply of water, an additional head of 20 feet is proposed to be in this manner obtained for 2,000 hogsheads (equal to twenty cisterns,) which will be contained in a reservoir.

This quantity of water, with that held in the tubes, would give an ample supply for any fire.

Your Committee propose to lay one line of tubes from about Fourteenth-street, through the Bowery to its termination at Chatham-street, a distance of about 6500 feet; and also a line of tubes commencing at the same place, through Broadway to Canal-street,

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a distance of 5500 feet. The diameter of the tubes to be 12 inches. The cost of the tubes will be $1 14 cents per foot, or 6.020 per mile. The expense of laying down will be eighty-six cents per foot, or $4640 per mile. The distance of these two lines will be about 12,000 feet, or $2\frac{1}{4}$ miles; and the aggregate expense of tubes, laying down, and $500 for plugs or hydrants, will amount to $24,500.

The expense of a wooden reservoir containing 2000 hogsheads, (equal to twenty cisterns,) it is estimated would not exceed $1500, making in all $26,000. It is believed that the power of a single horse will be sufficient to pump the water into the reservoir, and the annual expense of a horse and a man ought not to exceed $700.

The Committee did not omit to urge as an additional motive for laying down iron pipes, that whenever the long desired object of supplying the city with water for domestic purposes, should be carried into effect, these same pipes would serve.

A reluctant assent was wrung from the Common Council to these recommendations, and a Committee was empowered to provide the necessary site for the reservoir, and to contract for the iron pipes.

From this feeble and economical beginning, sprang our noble Croton Aqueduct; for the immense and immediate advantages in cases of fire derived from this reservoir, impressed more vividly upon the public mind the far greater advantages that would result from having a river at command.

Early in 1830, we find a motion made in the Common Council, to apply to the Legislature for all needful power to supply the city with water, and to create two millions of stock to defray the cost thereof; this did not prevail—but attention was earnestly aroused to the subject, and all sorts of schemes were suggested.

A memorial from *Francis B. Phelps*, on May 17th., proposed four different sources of supply:

1st. To bring the water from Rye Pond, the whole distance through, in 28 inch iron pipes—estimated cost $2,600,000.

2d. To bring in the Croton river by an open canal, to cost $1,834,000; or by iron pipes, at an expense of $3,060,000. Of course no regular survey had been made.

3d. To bring the water of the Passaic, taken above the falls at Paterson, New Jersey—and to cross the Hudson by iron pipes laid on the bottom of the river—to cost $1,932,000.

4th. A plan of his own, of which the particulars are not given, but which seems to look to wells and springs, on Manhattan Island—the cost $792,000.

A communication was received, in September, from Benjamin Wright, having the same object in view; while a report made to the Board, concerning the supply by the

Manhattan Company, showed how inadequate that was in quantity, and how impure in quality.

The subject continued to be agitated during the year without any decisive action.

Early in the ensuing year, January, 1831, Alderman Stevens, who seems to have followed up systematically, and perseveringly, the purpose of procuring a supply for the city, proposed the following resolution:

Resolved, That the Counsel of the Board, prepare a memorial to the Legislature, setting forth the wants of the city, in relation to a full and ample supply of water, as necessary for the safety of the city against fire, and to be of a pure and wholesome quality, as necessary for the preservation of the health and lives of our fellow-citizens, and further setting forth, that the Manhattan Company, although chartered in the year 1799, for the express and apparently sole purpose of furnishing the city with these inestimable blessings, have not in the opinion of the Common Council, complied with the conditions of their charter, and stating, that under such circumstances, it has become necessary for the Corporation to do that which the Manhattan Company has failed to perform, and that the Common Council, finding that there exist powers in the acts relating to this Company, authorizing them to take by process of law, all streams of water, and to divert water courses from their natural channels, and also in like manner, to possess themselves of other property, which, however, the Manhattan Company have wholly failed to use, therefore asking a repeal of the said powers now vested in said Company, and the vesting, exclusively, all such powers for the purpose aforesaid in the Corporation of the city of New York, and further enabling the Corporation to raise by loans, a sum not exceeding $2,000,000, for introducing an ample supply of pure and wholesome water.

This was followed by a petition from numerous brewers, complaining of the impure and noxious qualities of the Manhattan water—of which this analysis, made in 1831, by the chemist, *Chilton*, furnishes abundant proof:

ANALYSIS OF THE MANHATTAN WATER.

The sample was obtained from the pump at the works before its entrance into the cistern, sp. gr. 1011.

One wine quart was slowly evaporated to dryness. The dry mass weighed 31.45 equal to 125.80 of solid matter in the gallon, consisting of

Muriate of Soda, - - - - - - - - - - - -	45.20
Muriate of Magnesia, - - - - - - - - - - -	40.
Sulphate of Magnesia, - - - - - - - - - -	6.
Carbonate of Lime, with a little Carbonate of Magnesia, - -	12.80
Sulphate of Lime, - - - - - - - - - - -	4.
Extractive Matter, with Combined Water, - - - - -	17.80
	125.80

November 25, 1831.

GEORGE CHILTON.

The quantity of foreign matter in the waters of the Bronx, and of Rye Pond, was, on an analysis by the same chemist, less than two grains!

On the 28th February, the resolutions of Alderman Stevens were debated and adopted, except that which asked permission to raise two million of dollars—which was opposed and lost.

At the same meeting, Mr. Townsend presented a report from the Lyceum of Natural History, in New York, in answer to queries addressed to that Society, relative to the probable supply and quality of water which Manhattan Island might furnish.

As a disposition then existed in some quarters, and perhaps even still lingers, to rely upon the water and wells of the island, the facts and reasonings of the Report (drawn up, we believe, by Dr. Dekay,) cannot be uninteresting, however startling to the fastidious, some of the statements may appear.

Of the Purity of the New York Waters.

All waters, it is well known, which are not decidedly of a mineral character, are divided into two classes, *hard* and *soft*. With the latter we have nothing to do in the present communication, as none of it occurs in the thickly settled parts of the island. Hard waters are such as contain a sensible quantity of foreign ingredients, the chief of which are Carb. of Lime, Sulph. Lime, or (Plaster of Paris,) Mur. Sod. (or Common Salt,) Mur. Magnes, Iron, and extractive or animal and vegetable matter. We accordingly find that all the water in the city contains these, and occasionally other ingredients. For the following analysis of pump waters in various parts of the city, the Committee are indebted to one of its members. When it is recollected that the hardest spring water seldom contains so much as one thousandth part of its weight of any foreign body in solution, it would seem that the term, mineral water, would be a more correct designation for the ordinary waters of this city.

Results of analysis of various mineral and pump waters in the city of New-York, by George Chilton, chemist:

No. 1. A pint of water yielded 10 grains of solid matter, consisting of

Mur. Magnes.	3 50
Mur. Sod.	4
Sulph. Lime,	0 25
Carb. Lime and Magnesia,	1 25
Carb. Potass and Extractive,	0 75
Loss,	0 25
Total,	10

No. 2. A pint yielded 7 grains of dry residue, consisting of

Mur. Magnes.	2
Mur. Soda,	2
Sulph. Lime,	1

Carb. Lime and Magnes.,	1 25
Extractive Matter and Loss,	75
Total,	7

No. 3. A pint yielded 4 50 grains composed of

Mur. Soda,	1
Mur. Magnes.,	2
Carb. Lime,	1
Sulph. Lime and Extractive,	0 50
Total,	4 50

No. 4. A pint yielded about 4 grains composed of

Mur. Lime. Mag. and Extractive,	1 80
Mur. Soda,	1
Sulph. Lime,	0 25
Carb. Lime,	1
Total,	4 05

No. 5. Contained Sulph. and Mur. Lime, with a little coloring matter.

No. 6. Contained Sulph. Lime, Sulph. and Mur. Soda, with Extractive.

No. 7. Was not disturbed by Nitrate of Silver, Sulph. Silver, Ammonia, nor Barytic Salts.

From whence, then, are derived those foreign ingredients? It has been already stated, that the sand bed of this island may be regarded as a filter or sponge, which, under ordinary circumstances is saturated with fresh water from the atmosphere. If this spongy mass was originally free itself from any mineral impregnations, and its surface always open, the water would of course remain pure for any definite period. When this filter itself contains foreign ingredients, and the free transmission of pure water is prevented, its quality must be impaired. From accurate data, these obstacles to the transmission of water from the surface, by dwellings and pavements, are estimated to carry off into the river nearly one half of the water which falls from the atmosphere. In the neighborhood of large open squares, it is consequently observed that the wells are more pure, but they must sooner or later partake of the same deterioration. The water in the immediate vicinity of the park, although very impure, is nevertheless of a better kind than that from more distant wells; and we have been informed that the well of the Manhattan Company is mostly supplied from that quarter. It has been observed, also, that the vicinity of grave yards communicates a ropy appearance to the water; and the water from such wells, becomes, in warm weather, very offensive in the course of a few hours. If the above facts be well founded, we must naturally anticipate a deterioration of our waters, proceeding *pari passu*, with the increase of the city; and we accordingly find this to be the case. Until within the last few years, the water on the elevated ground in Broadway, was considered to be the best in the city. In the progress of improvement, this water is now hard and unpalatable. Indeed, we know of families living above Broome-street, in Broadway, who are now supplied throughout the year by water carts from the country; and in the direction of Laurens-street, we have been informed that this foreign supply is required still farther to the north of Broome-street. But we are now to allude to another cause, which must greatly impair the purity of our waters:—Into the sand bank, underlying the city, are daily deposited quantities of excrementitious matter, which, were it not susceptible of demonstration, would appear almost incredible. With our present population, there is put into this sand about 100 tons of excrement every 24 hours. In these deposites we may find all the ingredients detected by analysis, and which destroy the purity of our waters. But in this estimate we do not include an equal amount of urine, for the following reason: This liquid, when *stale* or *putrid*, has the remarkable property of precipitating the earthy salts from their solution, or in other words, it makes hard waters soft. Although the fastidious may revolt from the use of water thus sweetened to our palate, it is perhaps fortunate that this mixture is daily taking place, for otherwise the water of this city would become, in a much shorter space of time than it actually does, utterly unfit for domestic purposes. We cannot take leave of this part of the subject without adverting to the various and contradictory opinions which have been expressed on the purity of our waters. We must impute to long use and the influence of habit, the opinion that our water is sufficiently pure for domestic purposes. We have known our citizens, upon going into the country, express a marked disrelish for pure spring water. The popular expression on such occasions is, "This water is like wind—there is nothing substantial in it; nothing to bite upon." This powerful influence of habit is exemplified even among animals. At one of our watering places, (Saratoga,) cattle have been observed to prefer the strongest mineral water known, to that derived from a pure source. The coldness of our pump waters is another cause which conceals their impurities when swallowed. This may be tested by allowing it to stand until it has acquired the ordinary summer temperature; its various ingredients become then manifest, palpable. These impurities are not caused by the additional heat; they exist at all times in the water; their presence is only disguised for the moment by its coldness, and its injurious properties are in no wise diminished.

Your inquiry as to the effects of impure water upon the human system, falls more properly within the province of the medical philosopher than the naturalist; we do not, therefore, feel ourselves called upon in this place to enter upon this subject farther than to state, that in several diseases, such as dyspepsia, and those bowel complaints of children, which carry off so many annually, the cure is retarded by the daily use of bad water. In the latter disease, in particular, the mode of cure often resorted to, is a change of air, which is supposed to be the chief agent in removing the disease. It is within the knowledge of some of the committee, that the use of pure water alone, without removal, has produced an almost immediate and beneficial change.

From all which has been previously stated, you will learn that it is the unanimous opinion of the committee, *that no adequate supply of good or wholesome water can be obtained on this Island, for the wants of a large and rapidly increasing city like New York.* The various perforations which have been made, in the absence of all other proof, would sufficiently establish this position. These have been undertaken without any acquaintance with those immutable laws of nature, which regulate the position of rocks, and their utter uselessness is now sufficiently obvious. They may be carried to any assignable depth in this rock, and when completed, will be merely reservoirs to receive the drainage from above.

Both the citizens and city authorities now went to work in earnest, and in December a report was made by Mr. Samuel Stevens, in behalf of the committee of fire and water, that reviewed the whole ground, the various plans that had at different times been projected, and indicated that, which, in the judgment of the committee, was most feasible.

The possibility of supplying the city from springs or wells on Manhattan Island, is considered, and discarded. Independently of the uncertainty both as to the quantity and quality of the water which might thus be obtained, the multiplication of wells and steam engines that would be required to produce the supply needed—estimated at 4,000,000 gallons, daily—was a decisive objection. The Artesian well of the Manhattan Company, at Thirteenth-street, which is considered as a very successful experiment, yields but 20,000 gallons daily, and it would require 200 such wells, with steam power at each, to supply four million gallons.

The plan for relying on the Croton, admitted to be that which ensured the most abundant supply, was put aside by reason of the great cost of the work, and because the Bronx river presented an adequate resource nearer by, and at less expense.

The minimum daily supply from that river, was estimated by accurate measurement and survey, made by *Canvass White*, in 1826, at 4,302,720 gallons, and by damming the Rye ponds, an additional supply of 4,798,000 gallons would be obtained, so as to make a daily aggregate of 9,100,000 gallons, equal to the wants, at 20 gallons per head, for a population of 450,000 persons.

The committee, therefore, unhesitatingly recommend, that the Bronx river be the source, and thence proceed to consider the mode in which the water should be conducted to the city. Three plans were suggested: an open canal, an arched brick tunnel, and iron pipes. The first is condemned, because of the impurities, which, in its course it would be liable to gather; and upon the whole, the preference is given to the arched tunnel, which, according to an estimate of Canvass White, might be constructed, of five feet diameter, for $31,174 per mile, making the whole cost, from the point where the water was taken from the Bronx to Macomb's dam, $400,000. Independently of superior cheapness, as compared with iron pipes, a tunnel of the size proposed, would supply the greatest quantity of water that could be required.

But in all these plans, the water was to be forced up by machinery at the Harlem river, to the height requisite to its introduction, with a sufficient head into the city. The tide water of the Harlem river, was relied upon for the power, and the cost of the bridge and dam, to raise and pass the water, was estimated at $50,000. The machinery for lifting, and the reservoirs on Harlem heights, which were to be 120 feet above tide, were to cost $50,000 more. And the three lines of twelve inch iron pipe, calculated to convey 2,000,000 gallons daily (an adequate supply for the then population), were to cost $10,000 per mile each. The distance from the receiving reservoir at Harlem to that at Thirteenth-street, being four miles, the whole cost of the pipes would be $120,000.

The whole expense of the work, including the extinguishing of rights, the purchase of lands, mason-work tunnel, iron pipes to connect the reservoirs, and distributing pipes through the city, is estimated by the committee, with the concurrence in judgment, of Canvass White and Benj. Wright, at two millions of dollars.

The Report sets forth as follows, the means of paying this amount:

For this expenditure, our inhabitants will have water, pure and wholesome, not only as a beverage and for culinary and domestic purposes, but an ample supply for cleaning the streets and sewers of our city, and for the extinguishment of fires. And it must not be forgotten that the estimated loss by fire in the year 1828, was $600,000.

Your Committee are of opinion that the expense of this undertaking, the advantages of which will be lasting and permanent in their character, should be provided for by a loan, and they view the present or coming season as one at which this money can be procured at a low rate of interest, probably not to exceed four per cent., redeemable in thirty years. It would be well secured, as due from a city whose taxable property is rated at $125,000,000, and is worth much more. To provide for the $80,000 interest, supposing the expense to amount to two millions, we should have a fair charge on our present citizens.

It is believed that we have, or within a year or two will have, 35,000 houses and buildings, all of which are obliged to build and keep cisterns, while many of our citizens purchase water, and all are at the expense of sinking wells and erecting pumps, at an average annual charge, including all these expenses, it is believed, of exceeding eight dollars per house. Now if we estimate that we can charge each house, on an average, four dollars, we have $140,000, nearly double the whole interest. If it should be thought that four dollars is too much for some houses, it may be remarked, that several families, in limited circumstances, generally reside in one house, and that this being the case, the landlord might well afford to pay four dollars per annum; but as this calculation of four dollars per house, is an average charge, it will be seen that some houses can be charged more than double that rate, while the rate of others can be proportionably reduced.

We should have, also, what might be chargeable on livery stables, breweries, dying establishments, manufactories of all kinds, making of mortar for building, and the supplying our shipping, to create a sinking fund for the final liquidation of the loan; and we should not forget that the income referred to is from nearly our present population, which is rapidly increasing, which increase the works would supply with little increased expense. The New River establishment at London charges all dwellings at the rate of five per cent. on the rent of the same, which appears to be a good criterion to regulate the charge, and this rate would produce a revenue to the city.

The committee also suggest that the superintendence and execution of the work they propose, requiring, as it would, uniformity and steadiness of views, and close attention, should not be confided to members of the Common Council, who are continually changing, but to a Board of Commissioners, appointed and paid for the purpose.

The Report concludes with the draft of a law embodying the views therein expressed, and asking authority to borrow two millions of dollars.

In January of next year, 1832, the Common Council approved the report and the accompanying draft of a law, and resolved that, on the law being passed by the Legislature, they would undertake to supply the city with pure and wholesome water.

The bill thus sent, did not become a law, owing to the unwillingness of the Legislature to authorise the raising of such a sum of money, until it should be satisfactorily ascertained that the object in view, both as to the quantity and quality of water, could be accomplished by the expenditure proposed.

The project, however, was too far advanced, and the city was too much committed, to draw back. Another lingering effort to procure water on the Island itself, was encouraged by an appropriation, in October, of the sum of $1000, to defray the cost of further examinations; but of course, nothing satisfactory came of it, and the reports of Dr. Brown, made in 1798, and of Mr. Weston, in 1799, being reprinted by order of the Common Council, and both of these ridiculing the idea of supplying a populous city with water from its own bowels, the minds of all reverted to the streams of Westchester.

On 10th November, the Joint Committee on Fire and Water, passed this resolution:

Resolved, That Colonel De Witt Clinton be requested and authorised to proceed and examine the continuation of the route from Chatterton Hill, near White plains, to Croton River, or such other sources in that vicinity from which he may suppose that an inexhaustible supply of pure and wholesome water for the city of New-York may be obtained; also, his opinion of the best mode of conducting the same to the city, and the probable expense, as well as the practicability, of bringing the water across Harlem River, and the most suitable point where the same shall be, and the best mode of doing it, and that he be authorised to employ two assistants to aid him in the undertaking.

James Palmer, *Chairman*,
Charles Henry Hall,
William Mandeville,
George W. Bruen,
Peter S. Titus,
Dennis M'Carthy.

On the 22d December, Col. Clinton presented his Report, which is very voluminous, but necessarily from the fact that the routes he recommends, were not surveyed, his estimates are conjectural.

He examines in detail, all plans previously proposed for supplying the city, and comes to the conclusion deliberately, that on the *Croton* should the city rely; a conclusion, which, differing as it did from that of all antecedent engineers, and from the views of Committees of the Common Council, is creditable to his sagacity and self-reliance.

The great inducements stated in the Report, for resorting to the Croton, are, the purity of its waters, their unfailing abundance for any possible population in the city, and the elevation of their bed, which would give a sufficient head to convey them to the distributing reservoir in the city, at a height sufficient for all purposes of supplying the loftiest dwellings, and of extinguishing fires. Mr. C. had strong confidence in the practicability of delivering the water at 137 feet above tide. It actually stands now in the distributing reservoir at 115 feet, an approximation which, considering the fact already noticed, that no actual surveys were made, indicates the accuracy of that Engineer's *coup d'œil.*

Mr. Clinton's plan was to make an open canal, from which he stated it was easy to exclude the wash of the soil, and rains, and upon the flow of which, by being made narrow and deep, the frost of winter would have little effect.

He preferred the open canal to the closed tunnel, both on account of the expense of constructing the tunnel, and the danger of leakage or breakage. He also feared that in such a crooked line as the work would be obliged to follow, the angles of the masonry would be weak, while the velocity of the water, by reason of the crooks in the channel, would be much retarded.

Recurring to the apprehended impurity of an open canal, the Report thus reasons :

"Many persons have suggested that the water in the open canal, by its passage through it, would become impure; I cannot see the force of the objection, as I have already stated the manner that those impurities can be avoided. It must also be recollected that the principal supply of the city of London is procured from the New River and the River Lea, by the means of an open canal. The canal, to maintain its level, meanders a distance of thirty-nine miles, although the source of supply in a direct line, is not more than twenty miles from the city. Those united streams supply 28,774,000 gallons in twenty-four hours, and provide for 177,400 houses. In 1816, there were on the canal, forty-three sluices, and 215 public bridges over it. There are also several subterraneous passages under roads; one is two hundred yards long. At Islington the canal is fourteen and a half feet wide, and four and a half feet deep. From the New River head reservoir, which is fifty-eight feet above the River Thames, the water is raised thirty-five feet by steam engines, into two reservoirs. One is situated near Pentonville, and the other near Tottenham Court road. They each contain five acres, and are ten feet in depth.

As a matter of fact, however, we can state from our own experience, that this new river is freely used for bathing, and that too, within a very few miles of London.

Finally, as to cost, the Report says :

"From the best opinion I can form, I am satisfied, that the waters of the Croton River may be taken at Pine's Bridge, and delivered on the Island, for a sum not exceeding $750,000, in an open canal, and with stone linings, ditching, and walls, and including damages and other contingencies, it may swell the cost to $850,000. The expense of distribution and reservoirs on the island, may amount to $1,650,000 more, which would make the whole cost of the work $2,500,000.

The fact before alluded to, that no accurate survey of the route was made, will sufficiently account for the inadequacy of these estimates ,as since proved by the actual cost.

Contemporaneously with the exploration, by Col. Clinton, of the Croton route, Timothy Dewey and Wm. Sewal, under the direction of Benj. Wright, then Street Commissioner of the city, explored a route from Macomb's Dam to the Bronx river, with the expectation of being able to bring the water of that river to the dam, at an elevation of 120 feet above tide. This was found to be impracticable; the waters of the Bronx, the Rye Ponds and Wampus Pond were guaged, and the ground between them and the Harlem river examined, and the conclusion of the engineers was, that a superabundant supply from these sources could be relied on. And further, "that a canal or tunnel on a high level is not the best or safest mode of obtaining water, and that it ought not to be attempted." It is added, "that the Croton cannot be brought in by this route, and cannot ever be needed, seeing that the quantity which can be obtained at a moderate cost through the valley of the Bronx, will be sufficient for all city purposes."

An analysis of the Bronx water was made at the same time by different chemists, Messrs. Chilton, Ackerly and Griscom, which showed it to be of remarkable purity, not containing more than two grains of foreign matter in a gallon.

With these various plans before them, the Common Council received a report from their Committees of fire and water, on 24th December, which, without passing judgment upon any of the projects, recommended, "inasmuch as enough has been ascertained for the satisfaction of the Committee, that no time be lost in obtaining authority from the Legislature to raise, by loan, such a sum as shall be requisite for so desirable an object," and they accordingly prepared the draft of a law to be sent to the Legislature.

This report was referred back, and next month, January, 1833, the Committee reported a bill to be sent to the Legislature, and by way of guarding against the objections before made to granting the authority asked by the Corporation, the bill required simply the appointment of Commissioners, who should be invested with full power to examine all the plans hitherto proposed, to cause actual surveys to be made, to have the water tested, to estimate the probable expense, and generally to do whatever in their judgment may be necessary to arrive at a right conclusion in the premises." It also suggested five as the number of Commissioners; that they be appointed by the Governor and Senate, and make reports of their proceedings both to the Common Council and the Legislature.

This report was adopted by the Common Council, and an application in conformity therewith, was immediately made to the Legislature.

The Legislature, on the 26th of February, did pass the act, to be in force one year. The Commissioners were to report the result of their examination, both to the Common Council and the Legislature; the city was to defray all reasonable expenses.

The Governor, with the consent of the Senate, appointed Stephen Allen, B. M.

Brown, S. Dusenberry, S. Alley, and W. W. Fox, the Commissioners; and, on the 5th of June, the Common Council having appropriated $5000, to enable them to carry into effect the objects of their appointment, the Commissioners engaged Canvass White and Major Douglass formerly Professor of Engineering at the United States Military Academy, to undertake the requisite surveys, examinations, and estimates. Mr. White, from his engagements on the Raritan & Delaware Canal, was prevented from acting, but Major Douglass, with his party, made a complete *reconnoissance* during the summer, of the various routes, and of the different sources of supply, and in November following, made report to the Commissioners, which was by them communicated to the Common Council.

This report may be considered as having determined the long mooted question of the source of supply, and through all variations of opinion afterwards, Major Douglass adhered unfalteringly to the conviction, that the Croton, and the Croton only, should be looked to and relied on. Like the Roman Marcius, of whom we have spoken in the Preliminary Essay, who, when the Decemvirs and Sybils indicated the *Anio*, as the stream which the Gods preferred for the supply of his aqueduct, still adhered to the cold, pure, and abundant springs from the mountains of Tivoli, so Mr. Douglass, disregarding difficulties, real and imaginary, and heeding not at all the efforts still to cause the Bronx to be preferred, stood fast for the Croton.

The instructions of the Commissioners to the Engineers were, to make "examinations of the Croton, Sawmill, and Bronx rivers, in the counties of Westchester and Putnam, together with their several tributaries; and to furnish the Commissioners with a map and profile of the country, and their opinion of the quality of the water, the supply that might be depended on in all seasons, and the practicability of conveying it to the city at an elevation of sufficient height to preclude the use of machinery, and answer all the purposes contemplated.

The Engineers were also instructed to designate the best and most feasible route for conducting the water, the most fit and proper manner for constructing the conduits and reservoirs, the probable amount of damage that would be sustained by the proprietors of the water to be taken, and of the land it might be necessary to occupy in constructing the required conduits and reservoirs, together with the total amount of cost to the city for completing and putting into operation, the whole project.

Mr. Douglass began his surveys late in June, and they occupied him and his party until late in September, and the result was as above stated, a firm conclusion that the Croton should be the source of supply. Two routes, out of many examined, were decided on and estimated for, "The Inland," and "The Hudson River" route.

The first of these lines followed the valley of the Sawmill river; its length from the confluent reservoir at Wood's bridge, over the Croton, to the distributing reservoir on

38th street, was a little more than 43 miles—the height above tide, at which the water would stand in the latter reservoir was 117 feet, with a *minimum* daily supply of about 16,000,000 gallons of running water, and 11,000,000 gallons obtainable from stored water—and at a cost of *four and a half millions* of dollars for the whole.

The Hudson river route was traced wholly along the undulating side of the Croton and Hudson valleys, passing through Sing Sing, Sleepy Hollow and Tarrytown, and so on till it touched the line of the inland route in the valley of the Sawmill river.

The length of the route is nearly 47 miles, at an expense of $4,768,197.

The plan of construction recommended, was a continuous tunnel or aqueduct in masonry—as preferable both in economy and durability to iron pipes—an open canal being entirely repudiated. The reasons for the preference are thus stated:

"On an aqueduct the water flows with an easy natural motion, acting upon its channel with nothing more than its own proper weight, and a friction scarcely appreciable; and if by an accident its motion should be obstructed, the water having room to expand, would back up and check the velocity of the approaching current without any sensible revulsion upon the sides of the aqueduct: but in a close pipe, having such a depression as would be necessary in the present instance, say 130 feet below the head, the action upon the sides of the pipe, would be about 60lbs. to the inch. The water being also confined laterally, any impediment would necessarily react in some degree upon its *whole* volume, as far back as the nearest vent, and it should be observed that a mile of pipe contains more than 700 tons of water. It is true that the probability of any serious impediment is very remote, but even the friction upon so inelastic a substance as water, and under this high pressure and impetus, is a force which at no distant period must impair the stability of the work."

The principle of the work was, that the water of the Croton should be taken at such height above tide, as to afford a sufficient head to force it across the Harlem river, and to deliver it at the distributing reservoir in the city, at an elevation equal to the supply of the loftiest edifices.

The engineer contents himself with having established the practicability of delivering the Croton into the city at a comparatively reasonable cost, and leaves it to be determined by future and more minute examination, what route shall be adopted.

Of the quality of the Croton water, Mr. Douglas gives this account:

"The supplies of the Croton are derived almost exclusively from the elevated regions of the 'Highlands' in Westchester and Putnam counties, being furnished by the pure springs, which so remarkably characterise the granitic formation of that region. The ponds and lakes delineated on the map, and spoken of in a former part of this report, are among the number of these springs; many of them 3 or 400 acres in extent, and one as large as a thousand acres. All these ponds are surrounded by clear upland shores, without any intermixture of marsh; and the surrounding country, cultivated as it is generally, in grazing farms, presents an aspect of more than ordinary cleanness. The water, as might be expected under such circumstances, is perfectly soft and clear, much superior in the former respect to the waters of our western lakes, and fully equal in the latter.

The Croton, fed by such springs, could scarcely be otherwise than pure, and the fact of its purity was strongly verified by the experience of the party in every stage of the water during the season. Specimens were taken up both in the high and low state of the river, and have been analysed by Mr. Chilton, and the results obtained fully corroborate these statements. It appears from his report annexed, that the quantity of saline matter, probably the salts of lime and magnesia, does not exceed two and eight-tenths grains in the gallon; a quantity, he observes, so small, that a considerable quantity of the water would be necessary to determine the proportions. About two grains of vegetable matter were also suspended in the water, in consequence of the rapid current in which it was taken up, and which would of course subside in the receiving reservoir."

The Report next proceeds to speak of the Bronx, and of the capabilities of, and objections to, that source of supply.

The lower line taking the water from the Bronx near the mouth of the stream, so as to leave Underhill's Mill and the valuable cotton factory at Tuckahoe, untouched, would reach the bank of the Harlem river at 50 feet above tide. But it being required to deliver the water in the receiving reservoir at 123 feet above tide, reliance must be had on the power of the Harlem to raise it 73 feet. Upon calculating this power, however, it was found incapable of raising more than 5,000,000 gallons daily, and as this would leave a *deficit*, even for present purposes when the work should be finished, of two or three millions of gallons a day, it was thought unnecessary to pursue the examination of that route.

Another line commencing at Popham's Calico Factory, was carefully surveyed. By rebuilding and raising the dam, a head of 142 feet above tide would be obtained, and no serious obstacles occur in the route before intersecting those laid out for the Croton. But upon guaging the streams of supply, it was at once perceived that no reliance could be placed upon a sufficient quantity from them.

"On the 15th of August," says Maj. Douglas, "I guaged the outlet of the Rye ponds, and found it discharging 950,400 gallons per day. On the 20th, and again on the 5th September, it was discharging very nearly the same quantity; but between the last two dates, a period of 15 days, it had fallen, having been drawn down by the proprietor two and six tenths inches.

This draught, calculated upon the surface of the pond, = 205 acres, gives a daily decrease of 957,500 gallons in the volume of the pond; showing that, during the time observed, the supplies of the pond, from whatever quarter they come, were in quantity about 7,000 gallons per day *less* than the evaporation.

By damming the valley, about three-fourths of a mile below the small pond, so as to back up the water to three feet above the ordinary level of the *upper pond*, a reservoir of 360 acres will be formed; and by deepening the outlet of the upper pond, so as to command a draught of five feet in all, we shall obtain a volume of 705,672,000 gallons, or 3,920,400 gallons daily, for 180 days of drought. Deducting from this the daily loss by evaporation = 1,633,500 gallons, which is the lowest admissible calculation for the six warm months, we obtain a disposable surplus of 2,286,900 gallons per day. This is believed to be the maximum which should be calculated upon from the *storage* of the Rye ponds; and the writer is not aware of any source from which it might be *advisedly* augmented. A small additional supply is doubtless obtainable from Byram river, if it were not necessary, in availing of it, to resort to the territory as well as the waters of another State.

The *running* supply of the Bronx was ascertained on the 4th and 5th of September. It was necessary to repeat the guaging several times in order to separate the accidental flow of the mills from the regular discharge of the river. The latter, however, was at length satisfactorily ascertained, viz. 4,331,880 gallons; and reducing this in the ratio of one-fifth, for the reason heretofore mentioned, we get 3,465,504 gallons as the daily summer flow in seasons of extreme drought. Add to this, the quantity above estimated from the Rye Pond reservoir, = 2,286,900 gallons, and we have the aggregate of 5,752,404 as the amount of all that can *safely* be depended upon from this quarter."

In communicating the Report to the Common Council, the Commissioners strongly urge the importance to the health, security, and comfort of the city, of an adequate supply of pure water.

"The utility," say they, "of the undertaking being acknowledged, as the Commissioners believe it is, by a large majority of the citizens, the only questions of importance which can arise on the subject, are, first, the source from which the water is to be brought; second, the manner of bringing it; and third, the difficulties to be encountered, and the expense of the project.

With the information in the possession of the Corporation, should they decide to carry the project into effect, the first and second considerations may safely be left to the judgement of those who shall be selected to superintend and direct the operations.

The difficulties to be encountered, are much less in the opinion of the Commissioners, than those which have been overcome, both in this county and in Europe.

As to the cost, necessarily large, owing to the situation and construction of the island on which the city is built, and the distance from which the water is to be brought, there cannot be a doubt, in the opinion of the Commissioners, but that the operation will prove a saving concern if properly and judiciously conducted, and eventually, when the population of the city shall have reached its *maximum*, result in great profit to the proprietors."

Thus encouraged and stimulated, the Common Council resolved to proceed in earnest, and the Manhattan Company joining in the general impulse, made a proposition to the Common Council for the sale to it, of all their immunities, rights and privileges of every kind, relative to supplying the city with pure water, and of all the property, steam engines, pipes and hydraulic works, of every sort employed therein.

This proposition was frankly met by the Common Council, who, on 6th February, 1834, adopted a resolution accepting the proposal of the Manhattan Company, to enter into negotiation, for the aforesaid purpose.

On the same day, 6th February, 1834, the Common Council resolved to apply to the Legislature for a law authorising a loan of two and a half millions of dollars, by the creation of a stock to be called "The Water Stock of the city of New York," at five per cent., interest.

The law of the preceding year, authorising the appointment of Commissioners having expired, it became necessary to renew it, and accordingly on the 2nd May, the Legislature passed an act embracing this object, and that of the Common Council, for authority to raise money.

As this act lies at the foundation of the noble enterprise of which we are recording the progress and accomplishment, it is given entire.

AN ACT

To provide for supplying the City of New York with pure and wholesome Water.

(Passed May 2, 1834.)

The People of the State of New York, represented in Senate and Assembly, do enact as follows:

§ 1. The Governor shall nominate, and with the consent of the Senate, shall appoint five persons, to be known as the Water Commissioners for the city of New York, who shall be citizens and inhabitants of the said city.

§ 2. It shall be the duty of the said Commissioners to examine and consider all matters relative to supplying the city of New York with sufficient quantity of pure and wholesome water, for the use of its inhabitants.

§ 3. The said Commissioners shall have power to employ engineers, surveyors, and such other persons as, in their opinion, may be necessary to enable them to perform their duties under this act.

§ 4 The said Commissioners shall adopt such plan as, in their opinion, may be most advantageous for procuring such supply of water; and shall ascertain, as nearly as may be, what amount of money may be necessary to carry the same into effect: and for such purpose, they shall have power to make conditional contracts, subject to the ratification of the Common Council of the city of New York, with the owner or owners of all lands, tenements, hereditaments, rights or privileges whatsoever, which may be required according to such plan, for the purchase thereof, at stated prices; which contracts shall be so drawn as to be binding upon the said owners, respectively, in case the same shall be ratified by the said Common Council within two years from the passage of this act.

§ 5. The said Commissioners shall make a report of their proceedings, under the foregoing sections of this act, containing a full statement and description of the plan adopted by them; an estimate of the expense thereof, together with an estimate of the probable amount of revenue to accrue to the city, upon the completion of the work; with the reasons and calculations upon which their opinions and the said estimates may be founded: and all such other information, connected with the object of their appointment, as they may deem important.

§ 6 Such report shall be made and presented to the Common Council, by the Commissioners, together with all such conditional contracts as may have been made by them by virtue of this act, on or before the first day of January, which will be in the year one thousand eight hundred and thirty-six.

§ 7. In case the plan so adopted by the Commissioners, shall be approved of by the Common Council, they shall appoint a poll to be open on the days upon which the next annual election for charter officers is by law appointed to be held; and the inspectors of said election shall provide a ballot box, with suitable lock and key, and the electors shall express their assent or refusal to allow the Common Council to proceed in raising the money necessary to construct the works as aforesaid, by depositing their ballots in the box provided for that purpose in their respective wards. And those electors who are in favor of granting the necessary power to the Common Council, shall each deposite a ballot containing the word "yes," written or printed thereon; and those who are opposed, shall each deposite a ballot containing the word "no," written or printed thereon. And a canvass and return of the votes shall be made by the inspectors of the election, in the same manner as is now prescribed by law, in regard to the canvass and return of votes for charter officers.

§ 8. If a majority of the said electors are found to be in favor of the measure, it shall then be lawful for the Common Council to instruct the Commissioners to proceed in the work: and it shall also be lawful for the Common Council to raise by loan, from time to time, and in such amounts as they may think fit, a sum not exceeding two million five hundred thousand dollars, by the creation of a public fund or stock, to be called, "The Water Stock of the City of New-York," which shall bear an interest not exceeding five per cent. per annum, and shall be redeemable at a period of time not less than ten, nor more than fifty years, from and after the passage of this act.

§ 9. It shall be lawful for the said Mayor, Aldermen and Commonalty to determine what shall be the nominal amount or value of each share of the said stock, and of what number of shares the same shall consist; and they are hereby authorized to sell and dispose of such shares, at or above the par value thereof, either at public auction or private sale, or to raise the said sum of money by subscription for such stock, in the mode in which the stocks of banking and insurance companies are usually subscribed for.

§ 10. The provisions of the act entitled "An act to regulate the finances of the city of New-York," passed June 8, 1812, which are not repugnant to, or incompatible with any provision in this act contained, shall apply to the said stock.

§ 11. The moneys to be raised by virtue of this act, shall be applied and expended to and for the purpose of supplying the city of New-York with pure and wholesome water, according to the plan so adopted and ratified, with such immaterial alterations as may be necessary, and by and under the direction of the said Commissioners.

§ 12. The said Commissioners are hereby authorized to enter upon any land or water, for the purpose of making surveys, and to agree with the owner of any property which may be required for the purposes of this act, as to the amount of compensation so paid to such owner.

§ 13. In case of disagreement between the Commissioners and the owner of any property which may be required for the said purposes, or affected by any operation connected therewith, as to the amount of compensation to be paid to such owner, or in case any such owner shall be an infant, a married woman, or insane, or absent from this state, the Vice Chancellor of the first circuit may, upon the application of either party, nominate and appoint three indifferent persons to examine such property, and to estimate the value thereof, or damage sustained thereby, and to report thereon to the said court without delay.

§ 14. Whenever such report shall have been confirmed by the said Vice-Chancellor, the said Commissioners shall, within two months thereafter, pay to the said owner, or to such person or persons as the court may direct, the sum mentioned in said report, in full compensation for the property so required, or for the damage sustained, as the case may be; and thereupon the said Mayor, Aldermen and Commonalty shall become seized in fee of such property so required, and shall be discharged from all claim by reason of any such damage.

§ 15. The said Commissioners, in behalf of the said Mayor, Aldermen and Commonalty, and all persons acting under their authority, shall have the right to use the ground or soil under any street, highway or road, within this state, for the purpose of introducing water into the city of New-York, on condition that they shall cause the surface of such street, highway, or road, to be restored to its original state, and all damages done thereto to be repaired.

§ 16. If any person shall wilfully do, or cause to be done, any act, whereby any work, materials, or property whatsoever, erected or used, or hereafter to be erected or used, within the city of New York, or elsewhere, by the said Mayor, Aldermen and Commonalty, or by any person acting under their authority, for the purpose of procuring or keeping a supply of water, shall in any manner be injured, such person, on conviction thereof, shall be deemed guilty of a misdemeanor.

§ 17. All contracts for materials, or for the construction of the work, shall be made in writing, and of each contract three copies shall be taken, which shall be numbered with the same number, and endorsed with the date of the contract, with the name of the contractor, and a summary of the work to be done, or materials furnished.

§ 18. One of such copies shall be retained by the Commissioners, another shall be deposited with the Comptroller of the city.

§ 19. Public notice shall be given of the time and place at which sealed proposals will be received for entering into contracts.

§ 20. All sealed proposals for contracts shall be for a sum certain as to the price to be paid or received; and no proposition, which is not thus definite and certain, or which contains any alternative, condition, or limitation as to price, shall be received or acted upon.

§ 21. No more than one proposition shall be received from any one person for the same contract, and all the propositions of the person offering more than one, shall be rejected.

§ 22. Every person who shall enter into any contract for the supply of materials, or the performance of labor, shall give satisfactory security to the Commissioners for the faithful performance of his contract according to its terms.

§ 23. All materials procured or partially procured, under a contract with the Commissioners, shall be exempt from execution; but it shall be the duty of the Commissioners to pay the moneys due for such materials to the judgment creditor of the contractor, under whose execution such materials might otherwise have been sold, upon his producing to them due proof that his execution would have so attached, and such payment shall be held a valid payment on the contract.

§ 24. The Common Council shall authorize the Commissioners to draw upon the Comptroller of the city for any sum in favor of, and to be paid to, the owner of any lands, water streams, or property acquired by virtue of this act, and in favor of, and to be paid to, any contractor, for any sum due upon his contract, and also for their incidental expenses. Such drafts shall specify the objects for which they are drawn, in the manner provided in the seventeenth section of this act, as nearly as may be; and the Common Council shall make it the duty of the Comptroller, to pay such drafts in every case where a deed or other voucher is delivered to him, or a copy of a contract has been filed in his office, and a duplicate receipt of the contractor for such drafts shall be presented therewith.

§ 25. They shall also require the Comptroller to report to them a list of all the payments made by him, upon the orders of the Commissioners, once in every six months, and previous to such reports, shall have the accounts of the Commissioners and of the Comptroller examined by the Finance Committee of the Board of Aldermen.

The Governor and Senate re-appointed the same Commissioners, and on the 19th of May, they announced the fact to the Common Council, accompanied with a brief synopsis of the law, and asking their decision, "whether any further expense would be incurred or not," in prosecuting the work.

On July 23d., the Common Council appropriated $5,000 for the purpose of paying engineers, surveyors, and other persons employed by the Commissioners, to enable them further to perform their duties, under the above act, and to make another report to the Common Council, which report shall specify as near as may be, the probable supply of water which can be obtained within the county; also for paying the necessary expenses of the Commissioners in the performance of their duties under the act.

The Commissioners entered zealously on their duties, and as the report they made to the Common Council in Feb., 1835, gives a very intelligent view of their proceedings, and those of their engineers, and examines moreover, with acuteness, various, projects, that had been agitated in opposition to that of constructing an Aqueduct from the Croton, we make copious extracts.

To the Honorable the Common Council of the City of New York:

The Water Commissioners appointed under the Act of the Legislature of this State, entitled, "An Act for supplying the City of New York with pure and wholesome water," passed the 2d. of May, 1834, respectfully

REPORT:

That the undersigned were appointed Commissioners, under an Act of the Legislature, entitled "An Act for the appointment of Commissioners, in relation to supplying the City of New-York with pure and wholesome water," passed February 26th, 1833, and that on the 12th of November, of the same year, they had the honor of submitting to the Common Council a report, in which they recommended the Croton river as the only sure source of supply; both on account of its capacity and the purity of its waters. Two plans were proposed for conducting the water by aqueduct to the city, one through the interior of the county of Westchester, by the valley of the Sawmill river, and the other through the valleys of the Croton and Hudson rivers, until the two lines meet a few miles east of the village of Yonkers.

They avoided, for the reason stated in the report alluded to, making any selection of the route preferred between the interior and Hudson river routes, presuming that the main object of their appointment was to ascertain,

1st. Whether a sufficient quantity of good and wholesome water could be obtained for present and all future purposes.

2d. The practicability of its introduction into the city, at an elevation that would preclude the use of machinery. And

3d. The total cost of completing the projected work.

It will be seen, as they think, by a reference to their report of November, 1833, that they have conclusively shown that the supply from the Croton will be abundant, the quality of the water unquestionable, and the facility of introduction beyond dispute.

The act under which they hold their present appointment requires of them,

1st. To examine and consider all matters relative to supplying the city of New York with a sufficient quantity of pure and wholesome water; to adopt such plan as in their opinion will be most advantageous for securing such supply, and to report a full statement and description of the plan adopted by them.

2d. To ascertain, as near as may be, what amount of money may be necessary to carry the same into effect.

3d. To report an estimate of the probable amount of revenue that will accrue to the city, upon the completion of the work, and the reasons and calculations upon which their opinion and estimates may be founded ; such report to be made and presented to the Common Council of this city, on or before the first day of January, 1836.

The Commissioners have presumed, however, that a paramount object of their re-appointment was a close and thorough re-examination, under such additional lights as time and further reflection may have produced, of the plans they have proposed, and of the estimates they have entered into, extending their inquiries to any new matter alluded to by the act of the Legislature, referred to them by the Common Council, or suggested to them by others, for effecting the object in view, or, as improvements upon the plans and estimates proposed by their former report.

With these views of what would be required of them, and in order to test the correctness of the plans proposed by their report of November, 1833, the Commissioners engaged David B. Douglas, Esq., to re-examine his surveys, levels and calculations, and to ascertain whether lines for an aqueduct may not be designated that will require less labor and expense than those recommended by the report of 1833 ; whether a more economical method of constructing the aqueduct may not be adopted ; whether the cost of building culverts and bridges, making excavations and embankments, erecting the reservoirs, estimating the damages to water rights, &c., may not be reduced ; whether the expense of equalizing reservoirs may not be dispensed with ; and finally, whether the waters of the Croton may not be introduced from some different head, or by some other method, and at a much less cost, than that estimated in the report of 1833.

On the 31st of December, 1833, something more than a month after we had presented our report to the Common Council, Mr. D. S. Rhodes addressed a communication to the Board of Aldermen, proposing, for one million seven hundred thousand dollars, to introduce, through iron pipes, from the mouth of the Croton river, six million gallons of water every twenty-four hours ; and for two million seven hundred thousand dollars, to introduce sixteen million of gallons into the city of New York, at an elevation of 125 feet above low water, (see Corporation Document, No.54 ;) he presented another communication on the 6th of January, 1834, objecting to the plan proposed by our engineer in 1833, for conducting the waters of the Croton to the city, stating, " that the most serious objection he has to urge against the plan is, that the water, however pure it may be at the fountain head, must inevitably become contaminated with some deleterious substance passing over such a variety of soils, and amalgamating so many mineral substances." He then proposes constructing a dam near the Quaker Bridge, on the Croton river, 45 feet high, which will give an elevation or head of 125 feet above tide of the Hudson ; " from this dam the pipes will rise gradually until they pass Sing Sing," and from thence descend to the shores of the Hudson, which, (as he states) " forms almost a straight line to the city, and very few obstacles to overcome ; the Harlem river will be crossed at very little expense." (See Document, No. 57.)

On the 20th of January, 1834, Mr. Rhodes addressed a letter to the Chairman of the Commissioners, in which he says, " The natural abutments and high hills near the Quaker Bridge, will give an elevation of 200 feet above the tide, if required. The canal to Sleepy Hollow will be on a level with the dam, which gives us the same head at Sleepy Hollow as we have at the dam. By my plan we arrive at Sleepy Hollow, travelling only eight miles with the whole of the Croton."

On the 18th of April, 1834, Mr. Rhodes addressed a communication to the Committee of the Common Council, on "Fire and Water," in which he proposes to build a dam at a point about four miles above the Quaker Bridge, of 32 feet high. From this he is to take the water in a canal 10 feet at bottom, 34 feet at top, and 8 feet in depth, on the same line nearly as that proposed for the Hudson river route, in our report of November, 1833, to a reservoir near Harlem river, and from said reservoir to cross Harlem river by iron pipes, to the receiving and distributing reservoir on the island of New York; the Corporation to pay all damages for water and land rights, and $1,700,000 in cash, when the work is finished according to contract; but to allow him interest as the work progresses. (See Document, No. 109.)

It will not be expected, as we presume, either by Mr. Rhodes or by the Common Council, that the Commissioners should place much reliance upon the plans and propositions of a gentleman, who appears to have given the subject but a very superficial consideration at most.

How he is to convey either six or sixteen millions of gallons of water from the mouth of the Croton, in accordance with his first proposition, and at an elevation of 125 feet above low water, at the city of New York, it would puzzle the most expert proficient in hydraulics to tell.

By his communication of the 6th of January, 1834, he proposes raising a dam of 45 feet in height, near the Quaker Bridge, which is two or three miles above the mouth of the Croton, from whence the water was to be taken, as first contemplated. From this dam the water is to be carried in iron pipes, and to rise gradually until they pass Sing Sing, and from thence descend to the shores of the Hudson, and so on to the city. He states that these shores "form a straight line, and very few obstacles to overcome;" but the map of the river shows several promontories and bays, with no less than sixteen streams, some of considerable magnitude, to be passed. When he states that the water can be delivered in the city, at an elevation of 125 feet, while his fountain is only of that height; that the pipes will rise gradually until they pass Sing Sing, which, in effect, would be making water run up hill, and that he will deliver six million of gallons of water, in iron pipes, for $1,700,000, when the lowest calculation for laying a line of 30 inch pipes, 40 miles in length, will cost $2,798,400, and will only deliver about three millions of gallons every twenty-four hours; we ask, what confidence can be placed in the calculations and estimates of the proposer?

By his letter of the 20th of January, 1834, he says, his canal to Sleepy Hollow will be on a level with the dam; and by this canal, having no descent whatever, he calculates to be enabled to carry the whole of the river for eight miles, and thus continue the same elevation at the end of this eight miles, that he has at his fountain!!

By his communication of the 18th April, 1834, he makes a total change in his projects, and states that he will build a dam about four miles above the Quaker Bridge, of 32 feet in height, and from thence conduct the water by an open canal of 10 feet bottom, 34 feet top, and 8 feet deep, to the height near Harlem River. His first proposition was, to take the water from the mouth of the river; second, from near the Quaker Bridge; and third, at Garritson's Mill, about four miles above the said bridge. Now, although this last proposition carries with it the semblance of feasibility, there is, nevertheless, nothing new in it: for he only offers to remove the dam from the place selected by our engineer, to a position some miles below it, while he follows the precise line designated by our report, and adopts the very objectionable plan of carrying the water in a large open canal, instead of a closed aqueduct of masonry as proposed by us. His objections to the aqueduct proposed by our report, on account of the water running through it becoming contaminated with some deleterious substances, and his decided preference to iron pipes, appear to have departed from his memory altogether; for he now recommends an open canal of large dimensions, subject, as it would be, to the numberless casualties incident to such constructions, besides being the receptacle of much filth in its long passage, the wash of the country, and the dissolving of the mineral and other substances combined with the earth through which it passes. The complaint raised in London against the water of the New River, is "that being an open canal, it is subject to the drainage of the country through which it runs, in consequence of a right claimed by the proprietors of the adjacent lands, and which the company have no means of obviating, neither have they any power to prevent persons from bathing in their aqueduct." Mr. Rhodes, however, has altogether misconceived the construction of the aqueduct proposed by our report, for instead of its admitting any of these substances or impurities, it was to be impervious on three sides to any external fluid or substance whatever, and on the fourth, the proposition was, to have it covered with a board or shingle roof.

These several inconsistencies have tended to destroy the confidence of the Commissioners in the projects of Mr. Rhodes; and they would not have spent so much time on their examination, had it not been their opinion that the Common Council would expect some notice of a proposition that offered to effect the important object of supplying this city with pure and wholesome water, at a cost two-thirds less than that estimated by our engineer, in his report of 1833. They have, therefore, deemed it their duty to ascertain by actual survey, whether a dam may not be raised at some point nearer the mouth of the river, than that proposed by their report of 1833, from which might be drawn an equal quantity of water, and at the same time save much in the expenditure.

To effect the aforesaid object, the Commissioners engaged John Martineau, Esq., civil engineer, to make the necessary surveys, levels, and estimates, having special reference to the erection of a lofty dam at some station on the river nearer its mouth than the place selected by Major Douglas; to ascertain the damage that would ensue by overflowing the land and injuring the mill seats; and to estimate the expense of erecting such dam and compensating those injuries; to ascertain and report the best plan for conveying the water from said dam to the city; the quantity per diem that will be conveyed by the plan recommended; the cost of the necessary excavations, embankments, bridges, culverts, and reservoirs, required to deliver the water on a declivity of fifteen inches to the mile, to a receiving reservoir on the high grounds near Harlem river, and from thence across said river to another reservoir of sufficient elevation, near Manhattanville, (should he be of opinion that these reservoirs will be necessary,) then to a distributing reservoir three or four miles from the City Hall, near Thirty-eighth-street and the Fifth Avenue, preserving an elevation of 117 to 120 feet above tide at said reservoir; but if any of the reservoirs named can be dispensed with, or if additional ones be required, to report the reasons why, and to conform the estimate to the alterations in the plan, should any be commended: to furnish a report in writing, with a profile and map of the survey, showing the water line of the basin formed by the dam; the land that will be overflowed on both sides of the river; the line traced for the aqueduct; the depth of excavations and the height of embankments, &c., in order that a plain and comprehensive view of the whole subject may be given. To ascertain whether the cost of erecting a high dam, at or near Garretson's mill, and the consequent damage that will accrue by the overflowing of the land and injuring mill privileges, will be greater than the cost of taking the water from a higher source up the river.

The Commissioners have also employed George W. Cartwright, Esq., a civil engineer, residing at the village of Sing Sing, and who possesses much local knowledge of the Croton and its vicinity, to run levels on both sides of said river, starting from Garretson's mill, at a height of thirty-eight feet, and carrying his levels up until they loose themselves at the surface of the water, in order to ascertain what quantity of land would be overflowed with water by the erection of a high dam at the aforesaid station.

The next subject which claimed the attention of the Commissioners was the duty imposed upon them by the Ordinance of the Common Council, passed the 24th of July, 1834, which requires them to specify in their report "the probable supply of water that can be obtained within the county."

The Commissioners have presumed that this provision of the Ordinance has no allusion to the water that may be obtained by deep boring in the rock, or from the sinking of wells, as that subject was thoroughly examined by them in their report of 1833; and they have had no reason, since that period, to change the opinion then formed. They have understood, however, an idea has been entertained by some of the members of the Common Council, that a large quantity of water may be obtained from springs originating in the high lands near Harlem and Manhattanville. It was no doubt this opinion which, in 1826, induced the application to the Legislature, by several of our citizens, for an act of incorporation. This act was passed on the 18th of April, 1826, and is entitled "An act to incorporate the New-York and Harlem Spring Water Company." Anson G. Phelps and James Renwick, Esquires, and their associates, are declared a body corporate for the purpose of supplying the city of New-York with pure and wholesome water. The Directors named are gentlemen of respectability and character, who would not have requested a charter, unless they intended to carry it into effect, if practicable. The water was to be taken from wells near Harlem Commons, where it was supposed abundance of the pure element existed. Experiments were accordingly made by sinking shafts, &c., but no water was found in sufficient quantity to warrant any further expense, and the company ceased to exist by *nonuser*.

In order to be satisfied for ourselves, however, as to the reality of the supposition that water was to be obtained in any considerable quantity in that part of our island, the Commissioners carefully inspected the grounds and situations alluded to, and are fully convinced that no dependence can be placed upon the receipt of a supply of water from those sources, any more than from deep boring or the sinking of capacious wells. There was a well under the operation of boring, near Yorkville, on the day the Commissioners made their examination. The augur had penetrated 90 feet from the surface of the earth, and no water was produced, and it was intended to descend fifty feet in addition, if found necessary. Several of the wells on Harlem flats were found to average from sixteen to eighteen feet in depth, and to contain from two to three feet of water. At Manhattanville, one of the wells, on the slope of the public road, was forty-two feet in depth, and no water; another, three or four hundred feet below on the same road, was seventeen feet deep, and contained two feet of water. The Commissioners also examined several small springs issuing from the high hills near Manhattanville, and one near the Hudson river, and were informed there were several others that had disappeared, caused, as was supposed, by the filling up of a portion of the Harlem Canal. The Commissioners were also informed, that in excavating this canal, which sunk several feet below tide, the wells in the vicinity were deprived of water. The fact is, as the Commissioners think, that the same principle in respect to the obtaining of fresh water, operates in every part of our island, namely, that the earth becomes so saturated, at a depth on a level with the tide on the East and North rivers, that water will not descend lower; and in the digging of wells, where the rock does not interfere, water is uniformly found at that depth.

Any supply from the sources alluded to, therefore, would be entirely inadequate to answer all the various purposes of domestic consumption; to supply the numerous manufactories that would spring up in the northern and eastern parts of the city, the increasing number of shipping daily departing from this port, the extinguishment of fires, and the washing and cleansing of the streets and sewers of this metropolis. Nothing less than a river, distributed through thousands of channels, and brought to the premises of every householder, will be commensurate to the wants of a population such as the city of New York contains, and will contain.

If further evidence was required, the Commissioners might refer to the experience of other populous cities and villages, both in our own and other countries. Their example ought, surely, to have some weight with us, when making up an opinion on this subject. To suppose that they would expend millions of money to procure water from a distant source, or to raise it from their rivers by powerful machinery, when at the same time they could obtain a sufficient supply, and as good an article, at a comparatively trifling expense, by sinking wells within the bounds of the city or village, is to suppose them destitute of common sense and prudence.

By a "report on the subject of introducing pure and wholesome water into the city of Boston, by Loami Baldwin, Esq. Civil Engineer," it appears that a careful investigation was made of the character, quality, and uses of the water taken from the city wells. The whole number of wells in that city was ascertained to be 2767. The water from 2085 of these wells was drinkable, though brackish and hard, and 682 of them were bad and unfit for use. There were only seven of the city wells which yielded soft water, occasionally used for washing, and from thirty-three of them the water was obtained by deep boring. "Within a few years, (says the report,) it has become common in Boston, and the vicinity, to bore for water, and to make what is called Artesian wells. But no certain or valuable result has grown out of these endeavors. I cannot find that any geological science has been acquired by any one to guide or check these fruitless attempts; and great sums of money are idly expended every year upon mere projects founded on guess-work. There are thirty-three bored wells, only two of which are stated as furnishing soft water." With very little variation, as the Commissioners think, this description of the wells in Boston, will not inaptly apply to the situation of the public wells in this city, the most of which produce nothing but hard and brackish water, and no one of which, so far as the Commissioners are informed, is sufficiently soft to authorize its use in washing clothes, &c.

On the 27th of October, 1834, the Board of Aldermen referred to the Commissioners a communication from John Hunter, in which he states that he has matured a plan, by which an abundant supply of water may be obtained, on very reasonable terms; that he proposed applying to the Legislature for a charter, and if the Common Council would consent to the application, and render such facilities for its success as may be in their power, they may have such control over the company as will cause a forfeiture of the charter, in the event of any neglect in fulfilling its provisions. But if the Common Council are determined to keep the project in their own hands, the plan he has to propose, is the most certain and cheapest that can be adopted, and can be commenced immediately, and put in operation in a shorter time than any other.

The Chairman of the Commissioners waited on Mr. Hunter accordingly, in order to obtain some idea of the plan he alluded to. He declined an explanation, however, but appeared willing to communicate his views to two or three of the Commissioners, in confidence. This was declined on our part, on the principle that the Commissioners were bound to report to the Common Council any and all the information they possessed on the subject of supplying this city with water, and they could not therefore receive any communication under the injunction of secrecy.

On the 8th of November, Mr. Hunter, in accordance with a previous arrangement, met the Commissioners at their room in the Hall of Records. That portion of the act of the Legislature, which requires the Commissioners to "make a report, containing a full statement and description of the plan adopted by them, and an estimate of the expenses thereof," was read to Mr. Hunter, and he was at the same time informed, if he communicated his plan to the Commissioners, and if they adopted it, they would so report to the Common Council; if they rejected it, they would so report, with their reasons for such rejection. Mr. Hunter finally promised to communicate his views to the Commissioners in writing.

On the 17th of November a communication was received from Mr. Hunter, stating, among other observations not material to the matter in hand, that he deemed it necessary to make his communication preliminary to a full development at a future time; that his object in withholding his communication from the Commissioners was, that he may have some assurance from the Common Council, that his plan will not be made use of without his consent and approbation. He states that he "will now develope a part of the plan, and then make a proposition to carry it into effect, not expecting that it would be accepted without a full development, but merely to bring the subject to a tangible point." He then proposes to deliver a sufficient supply of pure water for all present purposes, "in a permanent aqueduct, of sufficient capacity, at the base of Harlem heights, below the surface on the north side, ready and suitable to be elevated to the height that it may be necessary for conveying it to the city." He further states, that he will build a reservoir of sufficient capacity, and erect the machinery for raising the water to the reservoir, for one million seven hundred and fifty thousand dollars; the Corporation to pay all damages for land and water rights; to receive the water from the said reservoir, and to construct such other reservoirs and fixtures, for distributing the water, as they may deem necessary. The plan of Mr. Hunter, as he states, "would embrace all the water the engineers show in their surveys and reports, or, in fact, all surface or running water of the county of West Chester." "That the whole can be completed within four years from the time it is commenced, and a partial supply may be had in a shorter time, and before the whole is completed."

This is the substance of the information communicated to the Commissioners by Mr. Hunter, which, without further remark, is respectfully submitted to the Common Council, together with his communication, which accompanies this report.

In addition to the foregoing, the Commissioners have received a communication, dated the 21st of November, 1834, from Mr. Bradford Seymour, of Utica, suggesting the following plan for supplying the city with water.

Mr. Seymour proposes to erect a permanent dam in the Hudson river, extending from this city, at or near the site of the old State Prison, at the foot of Amos-street, to the Jersey shore, so as to elevate the surface of the water within the said dam, from 18 to 24 inches above high tide. He estimates the expense of this erection at one million two hundred and fifty thousand dollars, and for the construction of as many ship locks as may be proper, at one hundred and forty thousand dollars each. If deemed necessary to build a lock in the centre, or channel of the river, it would add to the expense from one to two hundred thousand dollars more.

The advantages to be derived, Mr. Seymour states, will be, 1st. That the waters of the Hudson, coming from the high lands around the Sacondagoand Mohawk rivers, are the purest in the United States. 2d. That a hydraulic power equal to thirty thousand horses, may thus be obtained, twenty-seven thousand of which may be employed for manufacturing purposes, and three thousand used for elevating the water to the reservoir for supplying the city. 3d. That by raising the water in the city above said dam to the height he proposes, all overslaughs and bars will be removed by the down current, and any vessel capable of entering the harbor of New York, may proceed to Albany and Troy without obstruction. 4th. That a safe and easy communication between this city and Albany, on the ice, for three months in the year, may be effected. That no injury will be caused to the land on the banks of the Hudson, as the water within the dam will never be higher than it now is in high tides and freshets. Another of the advantages is, that solid and pure ice may be obtained at a small expense.

On the 29th of November Mr. Seymour made a further communication, in which he states, that the grounds upon which he desires to be understood, are, that his estimate is predicated on the supposition that he is at liberty to select the site of the dam, to build the coffer-dam as he may desire, and the lock or locks of such dimensions as he may deem necessary for the useful navigation of the Hudson river.

That he will build the said dam for one million five hundred thousand dollars, and the said locks for one hundred and fifty thousand dollars each, and the coffer-dam for two hundred thousand dollars. If a different site from that he has named, shall be selected, then he will build the dam for any price agreed upon by referees, composed of Civil Engineers, furnish the requisite security, and guarantee its durability for five years; he will require two years, from the first of August next, to form the dam up to low water line; let it settle the third year, and finish the whole by the first of August, 1839.

The powers delegated to the Commissioners, and to the Common Council of this city, by the act of 2d of May, 1834, cannot extend to a project which contemplates erecting a dam in the Hudson river, beyond the boundary line of the State of New York. It is true, the act makes it the duty of the Commissioners to examine and consider all matters relative to the supply of this city with pure and wholesome water; to adopt a plan, and to report it to the Common Council. If the Common Council approve the plan, it is to be submitted to the ballot-box, and if concurred in by a majority of votes, the Common Council may borrow the money, and the Commissioners may proceed to carry the plan into effect. The operation, however, must be performed within this State, and under the jurisdiction of its government, and not extend into the territory of another State, as the plan for damming the Hudson evidently does. The Commissioners have not deemed it their duty, therefore, to incur any expense, by engaging Engineers to ascertain the most eligible site for a dam, reservoir, &c., or for sounding the river, or estimating the expense of erecting the dam, locks, reservoir, mill-buildings, sluices, pumps, &c., but have confined themselves to a mere outline of the plan, as proposed by Mr. Seymour, and to a brief statement of some of the difficulties to be overcome, which have appeared to them inevitable, and which they will now proceed to designate.

1st. The great and leading object of the act of the Legislature is, to procure a plentiful supply of pure and wholesome water for the use of the inhabitants of this city. Now, although the Commissioners have no reason to doubt that the waters of the upper Hudson are perfectly pure, and that by building a water-tight dam across the river, from this city to the shores of New Jersey, the salt water will be ejected, and the fresh will take its place above the dam, yet we fear, that, in locking vessels up, more or less of the salt water below the dam will follow them, and although the quantity may be comparatively small, the constant repetition of the operation, by the hundreds of vessels going through the locks, both day and night, may, perhaps, be the means of unfitting the water, in a measure at least, for domestic use.

2nd. The project cannot be carried into effect, except by an Act of the Legislature of New Jersey, as well as by this State, and perhaps by the Congress of the United States. If all navigable rivers are common highways, it is a question at least, whether obstructions can be placed in them without interfering with the powers of Congress to regulate the Commerce of the Nation.

3rd. It must be conceded, as the Commissioners think, that the building of the proposed dam would be an obstruction of more or less magnitude to the navigation of the river; for although a vessel may be locked through in 10 or 15 minutes, as asserted by Mr. Seymour, still, if we revert to the great number of vessels passing and repassing the proposed site of the dam, it can hardly be otherwise, but that there would be much detention.

4th. Not having found any data in the office of the Street Commissioner, by which to estimate the difficulties to be encountered, in building the contemplated dam, we can only refer to the known obstructions frequently experienced in sinking piers and bulkheads in both the East and North rivers, owing principally to the large accumulation of mud at the bottom of those rivers, which offen baffles the calculations and art of the builder. We have been informed too that the water, 400 feet from the shore, some distance above the site of the proposed dam, is about 30 feet in depth, and the mud at the bottom not less than 8 or 10 feet: and it is conjectured, that in the channel of the river, the water and mud is not less than 40 or 50 feet deep. The width of the river is more than a mile across, and whether a dam of sufficient solidity and strength can be erected in a river of this width, and with a current running at the rate of the Hudson, and capable of withstanding the pressure of the immense body of water that would be behind it when the tide is down, are questions the Commissioners are not prepared to answer.

5th. Mr. Seymour is of opinion that no injury will be done to the land on the banks of the Hudson by the rise of water within the dam; but, the Commissioners think, the rising of the water permanently, two feet above its ordinary level, together with the occasional freshets which occur, must cause a covering with water, on some of the low lands lying on the margin of the river, for several miles above the city. Whether the damming the river at the place proposed, will be the means of removing the alluvial bars below Troy and Albany, or permitting vessels of a large class to proceed to Albany and Troy, without obstruction, as contended by Mr. Seymour, the Commissioners have no means of deciding.

6th. If the river, as low down as the proposeds ite for the dam, will be closed by a covering of ice for three months in the year, we should think the cutting off so much of the navigation would produce more injury than the privilege of proceeding to Albany on the ice, or of procuring a supply of that article for the use of those who require it, would produce benefits.

7th. The shad fishery on the Hudson is considered of much importance to those who follow the business, as well as to those who consume the article, and we should presume the erecting of the contemplated dam would totally destroy the fisheries, and ruin the business of those who depend on it for a living.

8th. In addition to the above, the Commissioners have obtained the opinion of Frederick Graff, Esq. the Superintendent of the water works at Fairmount. He thinks a dam of 24 inches above high tide will not answer the purpose intended, as the space of time that the wheels could work in pumping the water to the reservoir, would be entirely too short to insure a supply. That although the dam on the Schuylkill river is raised six feet six inches above the highest tides, the delay in pumping, occasioned by the tides, average seven hours out of the twenty-four; and in full moon tides, from eight to nine hours. He considers the impediments to the trade on the river, by locking vessels through the dam, so objectional, that he is induced to conclude that the project cannot be beneficial. To raise the dam higher, appears to be out of the question, as it would not only destroy all the wharf and store property of the city, above the dam, but would also destroy so much land as to occasion the damage claims alone, a reason for abandoning the project. He thinks the advantages calculated on by the proposer of the plan, if they could be trebled, would not compensate for the injury to the navigation of the river; and after having incurred the expense, we should still be deficient in the primary object of giving to New York a copious and wholesome supply of pure water. He is of opinion, if a bridge could be built across the Hudson, without injury to the trade of this great river, a supply of water might be obtained from the Passaic Falls; but, as that, in all probability, will not be done, it appears to him that the only safe resource to be relied on is the Croton, which may be introduced at a less expense than the proposed object of damming the Hudson. The elevated situation of the Croton will allow the artizan to make it applicable and certain to give a copious supply of water without hazard The plan proposed, he says, could not be effected but at an expense of more than four millions of dollars. It would still be insufficient for a permanent water power. It would destroy the navigation, and it would not benefit the shoals near Albany; he is of opinion, therefore, that it would do all harm and no good; it would dissipate the funds that might ensure a copious supply of water from another source, and which could be relied on, provided the work shall be properly executed.

Thus much, the Commissioners have deemed it expedient to say on this important subject, leaving it to the Common Council to decide, whether the inquiry shall be further prosecuted, or whether they will adopt the plan which the Commissioners may recommend pursuant to the letter and evident intentions of the act of the Legislature, by which they have been guided in their examinations and researches, and under which they hold their office.

The Commissioners then proceed to present a synopsis of the report made by Mr. Douglas, Mr. Martineau, and Mr. Cartwright, as well as the results of information obtained by them from Mr. A. Stein, relating to the route, modes of construction, and cost thereof, of an aqueduct from the Croton, that on all hands being adopted as the only advisable plan. As in a subsequent part of this Memoir, we shall have occasion to detail with some minuteness, the particulars, on all these heads, of the route finally adopted and perfected, our readers will feel that analagous details here would be superfluous.

Suffice it here to say, that upon striking an average of the various estimates of the cost of introducing and distributing the Croton water, the Commissioners report it at five and a half millions of dollars.

They next estimate the source and amount of revenue.

Proceeding upon the facts furnished, and by the experience of other cities, both in the United States and Europe, and upon calculations founded in most cases upon information derived from personal inquiry at the houses, hotels, taverns, livery stables, shipping, &c., as to the amount annually paid for water obtained from the water carriers, and other sources of supply, and as to the sum that would willingly be paid for water, if brought to the premises or establishments of the persons inquired of, the Commissioners compiled the table, on the following page, relative to the probable receipts from the Croton water.

After entering into copious details in justification of their estimate, they still further justify their calculation by this statement.

An opinion is gaining ground with many of those who require large quantities of water for conducting their business, that the supply on this island is annually diminishing. The Commissioners have understood that at the chemical works on the North river, at 33d street, and at an extensive turpentine distillery on the East river, some distance above the Alms House, water cannot be procured in sufficient quantity from the large wells on their premises, where but a few years past, it was obtained in abundance; and, consequently, they are now compelled to cart a portion of their water from a distant place on the island. At the gas works, situated on the Collect grounds, where they have a well twenty feet in depth, by eighteen feet in diameter, which, until the present season, furnished water freely, enabling the engine to raise 20,000 gallons in ten hours, now requires fourteen to sixteen hours to raise the same quantity; and in order to continue the supply it has been found necessary to return the water to the well after using it for condensing the gas. The Commissioners are also informed, that the Corporation well on 13th street, which formerly yielded 120,000 gallons of water each day, will now only produce from five to ten thousand. To remedy this evil, a well has been sunk at Jefferson Market, which has deprived most of the wells in that vicinity of water; thus drying up one source of supply, in order to increase that of another. These are important facts, and ought not to be lost sight of by the municipal authorities, or by the people of this metropolis.

As if to leave nothing unexamined or unsaid that might determine the authorities and citizens of New York to undertake this noble and useful enterprize, which it was made the duty of their Commissioners to report upon, the effect of bad water upon the health of cities is illustrated by many striking examples, and the report, marked with great research and ability, and pervaded throughout by an earnest spirit, thus concludes:

The quantity of water, in order to be effectual, in preserving the city from disease, must not be limited to the ordinary wants of domestic consumption merely, nor ought it

Description of Water Takers.	Number of water takers.	Average per annum paid by each water-taker.	Total of the payments
Dwelling houses, - - - - -	20,000	$8 00	$160,000 00
Back tenements, - - - - -	2,000	4 00	8,000 00
Taverns, - - - - - -	2,646	15 00	39,690 00
Baths, - - - - - - -	2,000	4 00	8,000 00
Livery stables, - - - - -	86	52 00	4,500 00
Horses, - - - - - - -	4,000	1 50	6,000 00
Manufactories, - - - - -	70	90 00	6,300 00
Bake houses, - - - - - -	267	12 00	3,204 00
Hatters, - - - - - -	73	15 00	1,095 00
Sugar houses, - - - - - -	7	150 00	1,050 00
Brew houses, - - - - -	12	300 00	3,600 00
Tanners, curriers, and morocco manufacturers, - - -	20	40 00	800 00
Dyers, - - - - - -	20	30 00	600 00
Distilleries, - - - - - -	63	100 00	6,300 00
Printing offices, - - - - -	178	10 00	1,780 00
Steam engines, - - - - -	60	35 00	2,100 00
Slaughter houses, - - - - -	100	12 00	1,200 00
Soap and candle factories, - -	58	60 00	3,480 00
Porter cellars, - - - - -	10	10 00	100 00
Marble and stone cutters, - -	43	35 00	1,505 00
School houses, - - - - -	68	15 00	1,020 00
Large hotels, - - - - -	40	150 00	6,000 00
Boarding houses, - - - - -	240	10 00	2,400 00
Boarding schools, - - - - -	22	10 00	220 00
Victualling and refectories, - -	100	25 00	2,500 00
Shipping, - - - - - -	4,534	8 00	36,272 00
Gas Works, - - - - - -	2	1,000 00	2,000 00
Chemical works, - - - - -	1	800 00	800 00
Total, - - - - - - -			$310,516 00

be restricted to the poor, or those in moderate circumstances, by a high charge for its use; but, on the contrary, the quantity supplied should be abundant, the quality good, the cost moderate, and to the poor gratis.

In order to effect the aforesaid object, a portion of the interest, at least, on the capital necessary to complete the project, and the annual expense attending the delivery of the water, should be paid by a tax on the real and personal estate of the city, in the same manner that the watching, lighting, and repairing the streets and roads, are paid; or as the expense of the police, criminal courts, board of health and public schools are paid. These are matters in which the poor man partakes equally with his rich neighbor, all being proper and necessary municipal expenses for preserving the peace, health, comfort and morals of the community; and are of no greater importance in a public point of view, than a copious supply of pure and wholesome water, an element admitted on all hands to be as necessary as any of the municipal measures we have enumerated.

We spend millions for erecting and ornamenting our public buildings, while a fourth of the money would raise structures equally convenient, but not equally ornamental. We open public squares and enlarge and widen our streets at an immense expense, in order to increase the health, convenience and beauty of the city; all of which might be saved, if we were content to live, as our ancestors did, in narrow streets, without parks, squares, or public places. In thus adding to the convenience and beauty of the city, however, and increasing its salubrity, we act wisely, because it improves the health, accommodation and comfort of the inhabitants; but with the most unaccountable inconsistency, we submit to the use of water which entails upon its recipients more insidious evils than narrow streets, plain buildings, or closed parks and squares, merely because the cost of procuring a pure and wholesome article may add to our taxes a few cents on each hundred dollars of property annually.

It was impossible to resist such statements; and, accordingly, we find the Joint Committee of Fire and Water, to whom was referred the communication of the Commissioners, with its various accompanying documents, reporting in a few days (on the 4th March) a full concurrence in the views of the Commissioners, and a recommendation that measures be forthwith adopted to take the sense of the citizens, as required by law, as to whether the great work should be undertaken. The report of this Committee, drawn, we believe by Wm. S. Johnson, pays only a merited compliment to the Commissioners, when it says "if any confidence is to be placed in man, or any deference yielded to his opinion as mere authority, these Commissioners are entitled to it. They consist of five of our most respectable, intelligent, and public spirited citizens; they have, for two successive years, devoted a large portion of their time gratuitously to the subject matter of the report, looking for their reward only to the approbation of their fellow citizens, the perfection of a great public good, and the gratitude of posterity. Acting on such principles, we may without hesitation accord to them our full confidence, and may adopt their conclusions with safety."

The following conclusions are derived from the Commissioners' report:

1. That all the water of the Croton may be taken from near its mouth and brought to the city of New York in an aqueduct, declining 15 inches in a mile, and delivered in a reservoir on Murray's Hill, 114 feet above high water line, which is near 7 feet 10 inches higher than the roof of the highest building in the city.

2. That in the driest seasons, and at the lowest or *minimum* flow of water, the Croton will supply thirty million gallons daily, and ordinarily more than fifty million gallons.

3. That the water of the Croton is limpid and pure, and fit for use at the place where they propose to take it from the river.

4. That the whole river can be brought to Murray's Hill in a close aqueduct of masonry, at an expense of $4,250,000, and there deposited in reservoirs ready for distribution. And,

5. That the revenue which would accrue to the city, from very low charges, for supplying the water, would overpay the interest on the cost of the work.

"These," say the Joint Committee of the Corporation, "are the great facts upon which the Common Council are now called upon to act, and in the first place to pronounce the judgment, *whether the work shall or shall not proceed.* The Commissioners have most fully discharged their duty, and with great ability. It remains for the Common Council to do theirs. The Commissioners have examined and canvassed every plan, and even every proposition, which has been suggested for supplying the city with pure and wholesome water; and after the most mature consideration, recommend that the Croton be brought to the city in a covered aqueduct of masonry, and that the water be taken from the river at Halman's or Garritson's mill, near its mouth. THIS COMMITTEE CONCUR IN THE RECOMMENDATION."

After presenting at length and with ability, the motive of *public health* and *public safety*, which should influence the community to undertake the work, the report concludes with the following resolutions:

Resolved, That the plan adopted by the Water Commissioners for the city of New York, for supplying the city of New York with a sufficient quantity of pure and wholesome water for the use of its inhabitants, and described in the their report, made to the Board of Aldermen, the 16th day of February last, be, and the same is hereby approved.

Resolved, That a poll be, and hereby is appointed to be opened on the days upon which the next annual election for charter officers for this city, is by law appointed to be held, to the end that the electors may express their assent or refusal to allow the Common Council to proceed in raising the money necessary to construct the work as aforesaid, by depositing their ballots in a box to be provided for that purpose, in their respective wards, according to the provision of the act, "To provide for supplying the city of New York with pure and wholesome water."

These resolutions were immediately adopted by the Board, 2nd March, on the 11th approved by the Mayor—and in conformity with the second, a poll was ordered to be held on the 14th, 15th, and 16th, of the ensuing month of April.

No provision having been made, however, for printing the tickets, by which the voters were to signify their pleasure—this at political elections being always done by the respective political parties—and party having nothing to do with this great question—there was danger that the actual sense of the people might not at the polls find the means of expression.

The moment this was hinted, several hundred dollars were contributed by some eight or ten individuals, mostly of large landed estates, to ensure a full and regular supply of tickets at each poll, favorable to an affirmative vote; thus exhibiting another fine incident in the progress of this great work, that they whose property would, in all probability, be most largely taxed to defray its cost, were most solicitous to ensure its accomplishment.

This precaution was crowned with complete success, as the following returns, taken from the County Clerk's office, will show.

I, Nathaniel Jarvis, Clerk of the City and County of New York, do hereby certify, that the votes given at a General Election held on the 14th, 15th, and 16th days of April, 1835, in the respective wards of said City, in pursuance of "An act to provide for supplying the City of New York with pure and wholesome water," passed 2d May, 1834, the inspectors' returns of which, are on file in my office, were as follows, viz:

Wards.	Yes.	No.
1	1417	27
2	1248	25
3	1456	42
4	1794	51
5	1675	152
6	1305	103
7	1303	561
8	1511	703
9	631	1015
10	966	1030
11	880	873
12	545	136
13	654	739
14	1233	209
15	712	297
	17,330	5,963

From which it appears that "Yes" received 17,330 votes, and "No" 5963 votes. In pursuance of said Act, the Board of Canvassers of the votes taken at said Election, adjudged and determined that a majority of the Electors of the City and County of New York, were found to be in favor of the measure.

In witness whereof, I have hereunto subscribed my name, and affixed my Seal of Office, [L.S.] this 28th day of March, 1843.

NATHANIEL JARVIS, Clerk.

To complete this view, and to show that the wards which contributed the largest amount of taxes, gave also the largest vote in favor of the Croton project, a list is annexed, from the books of the City Comptroller, of the taxes paid by each ward for the year 1835:

Taxes for 1835.

1st Ward	$246,181 14
2d "	73,187 38
3d "	86,828 36
4th "	50,278 29
5th "	59,177 02
6th "	49,315 30
7th "	57,031 06
8th "	51,529 09
9th "	33,698 53
10th "	26,834 79
11th "	45,060 17
12th "	60,032 55
13th "	15,847 69
14th "	37,150 06
15th "	73,451 51
	$965,602 94

In three wards, the 9th, 10th, and 13th, the negative vote preponderated. In all the others, the affirmative by large majorities.

Then as to proportion between taxation and the affirmative vote, the first ward paying $246,181, records but 27 negative, against 1417 affirmative votes, whilst the 10th ward, paying little more than one-tenth of the taxes of the first, records 1030 negative, against 936 affirmative votes.

The popular voice having thus pronounced, by an overwhelming majority, in favor of the Croton Aqueduct, the Corporation lost no time in passing an ordinance, dated 7th of May, instructing the Commissioners at once to proceed in the work, according to the plan adopted by them, and authorizing a loan for two millions and a half of dollars, at 5 per cent interest, to provide for the expenses thereof. We subjoin the last section, as indicating the understanding and intention of the Common Council at that time, both that a revenue should be derived from the water furnished to the inhabitants of the city, and that such revenue, whatever it might be, should go to the Sinking Fund for the redemption of the debt.

§ 9. The provisions of the ordinance, entitled, "A Law providing for the redemption of the City Stock," so far as the same can be applied to the "Water Stock of the city of of New York," shall be applicable to the same: and all revenue to be received for water, to be procured by the said work and furnished to the inhabitants of the city of New York, shall be specially appropriated as a Sinking Fund towards the redemption of the said Water Stock.

Another ordinance was passed on the 15th of May, fixing the salary of the Chairman of the Water Commissioners at $1500 per annum, and that of each of the others, at $1000, to be paid as part of the contingent expenses of said work.

The Commissioners went to work zealously; on the 2d of June, they appointed D. B. Douglas, Esq., their chief engineer, and directed him to organise a corps of engineers as soon as practicable. The party, consisting of seventeen, took the field on the 6th of July, 1835. Their first care was to stake out the land that was to constitute the lake, formed by damming the Croton, the line to include one rod of land above that which would be overflowed by the backing of the water. The next step was to stake out the whole line, from the Croton to the Harlem, in order to show its direction, and the width of land required for building the aqueduct and culverts, and forming the necessary excavations and embankments.

The urgency of these preliminary operations arose from the fact, that by the law the Commissioners were restricted from using any land, until it was acquired by purchase or appraisement. Hence, therefore, they were compelled to ascertain the quantity and situation of the land needed, before they could enter into any negotiation for the purchases.

The quantity requisite for the lake that would be formed by damming the river, was reported by Mr. Cartwright, who was specially employed to survey it, at 496 acres, of which some was obtained by purchase, the residue through the intervention of appraisers.

The engineers kept the field till January, 1836, and returned to it in April. The whole line was re-surveyed during the summer, being the fourth survey and level, under the direction of Mr. Douglas. Some important improvements in the course of the aqueduct resulted from this re-survey; distances were shortened, and curves lessened, and by the middle of June, maps were prepared of the whole line, setting forth how much land would be needed, and to whom belonging.

Great opposition began now to be manifested by the land owners in West Chester, along the route proposed for the Aqueduct, at the prospect of being dispossessed of their lands, although to be paid for them liberally. Cupidity in some, real unwillingness in others to have their farms broken up, and dread, probably, on the part of the great majority, of tumult, disorder, and numberless petty annoyances, from the throng of laborers, who, it was perceived, would find employment on the work, led to public meetings, unfriendly resolutions, and memorials to the Legislature. The chief propositions of the applicants to the Legislature were—

1st. That the legal possession and use of the land should remain with the original owners, *after being paid for by the Corporation!*

2d. That if not used for the purposes of the Aqueduct, the land should revert to its original owners.

3d. That provision should be made to prevent trespasses on the property of the inhabitants.

4th. That the persons, through whose lands the Aqueduct should pass, should have the right to use the water, by allowing reasonable compensation for it.

5th. That the Judges of the County Courts should act as Appraisers, instead of Commissioners appointed by the Vice Chancellor.

The Legislature very properly refused to accede to propositions such as these, but in order to quiet apprehensions, that land taken for the Aqueduct might be used for other purposes, and to insure to the owners, through whose possessions the water passed, free and convenient access to all portions of their farms, as well as for other purposes, they passed the annexed law.

AN ACT

To amend an act entitled "An act to provide for supplying the City of New York with pure and wholesome Water," Passed May 2, 1834.

(Passed May 25, 1836.)

The People of the State of New York, represented in Senate and Assembly, do enact as follows:

§ 1. The lands situated in the county of Westchester, which may be taken by the Corporation of the city and county of New York, by virtue of the act hereby amended, shall be held and appropriated by the said Corporation only for the use and purpose of introducing water into the city of New York and for purposes necessarily incident thereto, and for no other uses or purposes whatever, any thing in the act hereby amended to the contrary thereof notwithstanding.

§ 2. In case said Corporation of the city of New York should use any of said lands situate in the county of Westchester, for purposes other than in the last preceding section permitted; or in case said lands should not be required for the purpose of introducing water into the city of New York, such lands so improperly used or not so required, shall become revested in the individual from whom the said Corporation obtained it, as fully and perfectly as though the act hereby amended had never been enacted, upon repaying to said Corporation the amount originally paid for the same, after deducting from such amount the damage sustained by such individual, by reason of any alteration or work which the said Corporation may have made upon said land.

§ 3. The Corporation of the city of New York shall, at the expense of the said Corporation, erect and sustain all fences which may be required to protect said works from injury.

§ 4. The Corporation of the city of New York shall, at the expense of the said Corporation, erect and sustain convenient passes across or under the aqueduct to be erected by virtue of the act hereby amended, whenever said aqueduct shall intersect the land in the said county of Westchester, belonging to an individual or individuals, for the farming and other purposes of the land thus intersected.

§ 5. So much and such parts of the act hereby amended, as is inconsistent with this act, is hereby repealed.

This concession did not satisfy the complainants along the line, and at a public meeting held at Tarrytown, it was resolved, among other things, that the taking of the lands of individuals as authorised by the state law, was unconstitutional and ought to be resisted, and that the case should be carried up to the Supreme Court of the U. S.

Yet, according to all sound reasoning—independently of the near interest which Westchester County has in all that tends to add to the security, preserve the health, and enhance the advantages of the city of New York—the enormous expenditures for wages, provisions, and other necessaries, for the great number of men that would be employed on the aqueduct, should have been deemed by the neighboring residents much more than an equivalent for any temporary inconveniences, or imaginary loss.

The consequence of this discontent was, that the Commissioners were unable to make any purchase, by private contract, of lands along the line, and were therefore compelled to resort to the Vice Chancellor for the appointment of Commissioners, to take by appraisement whatever was needed.

In July of this year, the Corporation began their part of the work by ordering pipes, agreeably to the size adopted by the Commissioners, to be laid down in Barclay-street, from the intersection of Chapel to Greenwich-street, along Greenwich to Cedar, and up Cedar to Broadway.

The Legislature also passed a law authorizing the construction of the aqueduct through lands belonging to the State, at Sing Sing.

In their Report of 9th January, 1837, the Commissioners reiterate the account of their difficulties in conciliating the inhabitants of Westchester, along the line, to the great work in hand, complain of the delays incident to the process of appraisement, and finally of what they considered "lack of energy in the operations of their engineer department." "We took occasion," says the Report, "to state in our communication of the 1st of August, that on the 23d July, certain information was requested of the chief engineer, which he had promised to furnish as soon as possible, and that on the production of it, we were still in hopes of being enabled to place some part of the work under contract, before the close of the year. These hopes, however, have not been realized, and the Commissioners having felt much dissatisfaction at this disappointment, and for other causes, they finally determined to make a change in the office of chief engineer." Accordingly, on the 11th of October, 1836, Mr. J. B. Jervis, who had been engaged in most of the public works constructed by this State, was appointed chief engineer, at an annual salary of $5000.

We cannot but pause in our narrative for a moment, to express regret that a great enterprise like this, of which the plans and details were digested by Major Douglas, which even in its consummation, must still be deemed mainly to be his work, should, owing to any misunderstanding or incompatibility of temper between him and the Chairman of the Board of Commissioners, have been committed to other hands.

It is only just to add, however, that those other hands have proved themselves abundantly competent, and that Mr. Jervis has shown equal activity and skill in perfecting the great undertaking. He entered immediately upon his duty, traversed and inspected the whole line of the Aqueduct between the two rivers, and so far as he was able to judge without instrumental verification, approved of it. Garretson's Mills, he considered under the circumstances, the best position for the dam.

By direction of the Commissioners, who were anxious to place some of the work under contract for the opening of the working season, shafts were sunk at the site of the dam, and along the line of the Aqueduct as far as Sing Sing, eight miles, in order to exhibit the nature of the ground to be excavated, for the information of all parties; this, as well as examinations on the same line for stone fit to be quarried and used in the construction, was successfully accomplished.

The number of acres required for a Croton Reservoir and Aqueduct from river to river is stated by the Commissioners at 813.

Just previously to this period, some dissatisfaction had been expressed in the Board of Assistant Aldermen, at what seemed to be the irresponsibility of the Commissioners to the Common Council.

This topic is thus adverted to at the close of this Report:

"It has appeared by the proceedings of one of your honorable Boards, as published in the newspapers some time since, that censure has been cast upon the Commissioners for some unknown cause, and that, in debate, it had been stated they were under no accountability, either to the public, or the Common Council, and that a resolution had been proposed, to apply to the Legislature for an act compelling them to make quarterly reports to the Common Council. There seems to be some mistake in this matter, as the fact is, the Commissioners consider themselves both accountable to the public and the Common Council. To the public, they are accountable for an honest and upright discharge of their duty, and to the Common Council, they are accountable for a vigilant superintendence over those employed under them, and for the strictest economy in the expenditure of the funds placed in their hands. In order that your honorable body might see that their funds were properly disbursed, the Commissioners have uniformly, as has been before observed, reported to the Comptroller a detailed account of their receipts and expenditures at the end of every six months since the commencement of their operations. The Commissioners, have, in addition, always left their books open to the inspection of any member of the Common Council who might choose to examine them, and they have uniformly expressed to the Comptroller, a readiness to appear before the finance Committee, or any other Committee of your honorable body, and produce their vouchers for the expenditure incurred."

The Commissioners, in conclusion, after stating that they are not conscious of ever having withheld information sought by any member of the Common Council, and expressing their surprise that any doubt should exist of their willingness to report quarterly, if desired, to the Common Council, instead of semi-annually, to the Comptroller, express the hope that no misunderstanding between the co-operating parties may mar the object all have in view.

The result of this little discussion was, that in a bill asked for by the Common Council and passed by the Legislature, for the purpose of authorising the water Commissioners to take possession upon agreement or due appraisement, of lands or roads overflowed by the construction of the dam, and to make new roads and bridges in lieu of those rendered useless, the following clause is inserted:

§ 11. The said Water Commissioners shall, semi-annually, or at any time, if required by the Common Council, report to the Corporation of the city of New York, a general exhibition of the state of the work, including a full detail of the amount expended, and of the progress made by them in the furtherance of the contemplated object.

In their next semi-annual Report of July, 1837, the Commissioners courteously refer to this section and say, "in complying with this provision of the act of May, 1837, which we do with great cheerfulness, we shall only be carrying out an arrangement previously decided on, as a matter of propriety and duty."

It was in the spring of this year, 1837, that the work fairly began; the maps, drawings, and working plans having been completed during the winter, advertisements were, on 28th February, published in the newspapers of New York, Albany, Utica, Hartford, Ct., and Philadelphia, inviting proposals until 26th April, "for furnishing the materials and completing the construction of *twenty-three sections of the Croton Aqueduct*, including the dam in the Croton, the aqueduct bridge over Sing Sing Kill, and the necessary excavations and tunnelling on the line of about 8½ miles from the Croton to Sing Sing village."

On the day appointed, abundant offers were opened for all the sections, but owing to the condition of monetary affairs, only 13 sections were let, and those at prices considerably above the original estimate for the cost of the work.

Three years were allowed for the fulfilment of these contracts, which were to be always under the special and constant inspection of the resident engineer and his aids, the particular examination of the chief engineer, and the general supervision of the Commissioners.

The following judicious, and indeed essential condition, was inserted in all the contracts—"that the contractors will not themselves, nor by their agents, give or sell any ardent spirits to their workmen, or any person at or near the line of the aqueduct, or allow any to be brought on the works by laborers, or any other person, and will do all in their power to discountenance its use in the vicinity of the work by persons in their employ; and that they will not allow any person in their employ to commit trespass on the premises of persons in the vicinity of the work, and will forthwith, at the request of the Commissioners or engineer, discharge from their employ any that may be guilty of committing damage in this respect."

Previous to commencing operations, the whole line was divided into four districts, and a competent resident engineer, with the requisite number of assistants, was assigned to each.

On the first, extending from the Croton ten miles southerly, Edmund French was appointed resident; on the second, including the next 10½ miles, Henry T. Anthony; and the third, 10 miles more, to Fordham church, and the fourth, from Fordham church to the distributing reservoir in the city, 10½ miles, were for the present considered as one division, and put in charge of Peter Hastie.

We are thus particular in giving the names and stations of the engineers, because in so grand a work, and which, so far as yet tested, has proved so thoroughly well constructed, it is just that they who, though in comparatively subordinate stations, contributed largely to its excellence and sufficiency, should be commemorated.

The Commissioners present this brief but clear sketch of the respective divisions of the aqueduct line, and of the great natural difficulties to be overcome:

The country through which our line of aqueduct has to pass, affords, perhaps, as few facilities for the avoidance of labor and expense as any other portion of the State; we are met at every step with deep ravines, which must be passed, either by embankment or bridge, or elevated hills which must be pierced by a tunnel of more or less extent. The most prominent objects of labor and cost on the first division are, first, the dam across the Croton River. This dam will be fifty feet high, from the bed of the river, and about forty feet from low water level; the top, or lip of the dam, about one hundred feet across; breadth at the bottom about seventy feet, and on the top or lip, seven feet, averaging about forty feet in thickness. The down stream course will slope one and a quarter to one, and the up stream will be carried plumb. The abutments twelve feet thick; the top and down stream slope to be covered with heavy coping, well clamped together with iron anchors and straps, &c. In fact, the whole structure is to be a mass of substantial stone masonry, combined together with hydraulic cement; and, when completed, will be one of the most stupendous erections of the kind to be found in any part of this or any other country.

The next important work in order, is the Aqueduct Bridge, across the valley of Sing Sing Kill. This requires an arch of eighty feet span and twenty-five feet rise, resting on abutments of stone masonry, and is intended to be a work of great strength and solidity. In addition to these, there are several large culverts to be built, for crossing the streams and brooks running through this section of the works; some pretty lofty embankments to be made, and four tunnels, of from 300 to 800 feet in length, through hills of more or less altitude.

The most prominent work on the second division, is the crossing Mill River, which must be effected, either by an aqueduct bridge, of heavy stone masonry, or by a large culvert and embankment, the latter of which the Commissioners have preferred. There are also two tunnels in this division, of considerable length, with a number of small culverts for crossing the several ravines and brooks on the line of the aqueduct.

In the third division, the crossing of Saw Mill River and Tibbit's Brook occurs, a pretty formidable part of the work. There are two tunnels; one at Yonkers, for entering the valley of Saw Mill River, and the other for entering the valley of Tibbit's Brook.

The fourth division embraces some highly important works. The most imposing is the crossing of Harlem River, either by an aqueduct bridge, or by inverted syphons; next, carrying the aqueduct over Manhattan Valley; and last, though not least, the erection of the receiving and distributing reservoirs in this city.

Here we have a formidable array of work, to exercise the talents of our chief engineer, in planning, and the ingenuity of our mechanics and laborers in executing; and if to this be added the great length of the aqueduct to be built, and the large amount of excavation to be effected, in many places from fifteen to thirty feet in depth, and that through a soil abounding with rock, stone, and cemented earths, it cannot be wondered at if the estimates of the engineers, originally employed to make the necessary examinations shall fall far short, as the Commissioners have now good reason to think they will, of the sum necessary to bring the project to a successful termination. The Commissioners wish it to be understood, therefore, by your honorable body, as their settled opinion, based upon the result of the bids for that portion of the work offered for contract, and the very high price they have been compelled to pay for land and other privileges required for the works, that the total cost of the project will far exceed the estimates reported to the Common Council, founded upon the data adopted by the engineers, in their reports dated the 1st of November, 1833, the 25th of January, 1835, and the first of February, 1835.

The intimation here given that the first estimates by Major Douglas, Mr. Martineau, and other engineers, who had examined the route, would be greatly exceeded, is followed up by a request that the Common Council would, at an early day, adopt measures to raise more money, taking it for granted, that as the people of the city had deliberately decided through the medium of the ballot boxes, and by a large majority, that the necessary funds should be raised for prosecuting the work, there could be no doubt that it was to be proceeded with.

They also, in this Report, advert to the expenditure that would be occasioned by furnishing and laying pipes in the streets, of which, estimating that 152 miles in length, in addition to the 15 then laid, would be required, they calculate the expense at $1,261,627. The cost of this branch of the work, it is very properly suggested, should be included in the farther amount for completing the aqueduct, which it was proposed to ask permission from the Legislature to raise.

In view of the length of time which the construction of the aqueduct would occupy, of the vast sums that would be expended, and of various and perplexing questions that could not fail to arise in the progress of the undertaking, in the shape of claims from persons supposing themselves aggrieved, by contractors for extra allowances, &c., &c, the Commissioners suggest, for the consideration of the Common Council, the adoption of a plan similar to that adopted by the State in respect to the construction of, and expenditures on, the canals, viz.: constituting two Boards, one, *Commissioners of the Water Fund*, to be composed of the Mayor, the Comptroller, the Counsel of the Board, the Street Commissioner, and the City Chamberlain, who shall have charge of all financial arrangements in raising and borrowing the necessary money, securely investing it until wanted, &c.; the other, the *Water Works Board*, to consist of the Water Commissioners and the Commissioners of the Water Fund, whose business it should be to adjust and settle all such claims and complaints as are above alluded to.

On January 4th, the Commissioners made their next semi-annual Report, which, with its accompanying documents, is of great interest and importance. In the course of the autumn, contracts were made for the ten sections of the first division which were before unlet, and for 27 sections of the second division, making an aggregate of 53 sections, which, with the dam, were to cost $2,823,691.

A change, too, was made, on the recommendation of the chief engineer, in the position of the dam in the Croton; a place about 400 feet down the stream being supposed more suitable for the purpose. This change led to another in the structure, lessening materially the mason work of the dam. The contractors availed themselves of the alteration to abandon their contract, and, accordingly, this portion of the work was re-let for $85,386, a saving over the first contract of $32,169.

The difficulties interposed to the progress of the work by the opposition of the landholders on the route, and the alarming stories spread of the lawless disposition and practices of the laborers on the line, form a prominent subject of detail in this report, which insists, however, and successfully, as it seems to us, that neither drunkenness, nor robberies, nor abuse nor insult of casual visitors, could be traced to these laborers.

Great delays, however, were occasioned by the slow process of appraising the lands, and the slower progress in confirming the awards by the Chancery Court; and hence, it frequently happened, that when contractors had erected shanties and other buildings, and brought their teams and materials on the line, they were unable to go to work, because the lands were not as yet in the legal possession of the Commissioners. Nor could this have been foreseen by these officers, for every measure on their part had been taken to ensure prompt settlement of the appraisements.

As keeping up the record of the progress of the work, we subjoin the statement of this year's work:

The following statement comprises the principal portions of the work which have been performed during the last season, say from the first day of June to the first day of December last.

Two thousand four hundred and fifty-five feet of the aqueduct is now complete.

There have been erected also about 400 feet of inside wall of the aqueduct, ready for springing the arch.

The amount of open cutting and excavation in earth, is 146,760 cubic yards, and the same description of work in rock is 18,272 cubic yards.

The tunnellers had penetrated the rock four hundred and six feet on the first of December, and on the first of January, inst., they had extended the work to 653 feet. It is confidently anticipated that several of these tunnels will be completed during the present winter, the work progressing through the intervention of a relay of hands both day and night. The tunnel under contract to Scott & Young, in the village of Sing Sing, is now within a few feet of seeing daylight through it, and a short tunnel of 150 feet under contract to T. N. Ferrell, is cut through from end to end.

Six of the culverts are completed, and five partly finished. They vary in dimensions from two to ten feet span of the arch, and from 50 to 150 feet in length. The inverted arch or floor of the incomplete culverts is finished, so that the flow of water through the brook, passes them freely; and sufficient of the upper arch has been laid to permit the crossing of the valley with the stone embankment.

The foundation wall of the aqueduct, amounting to 12,050 cubic yards, and back filling to 10,200 cubic yards, has been executed.

In addition, a large amount of materials has been procured for the work, and many items of work performed.

Here is a respectable amount of work, considering the time in which it has been performed. Its execution has not only given general satisfaction, as to its permanence and durability, through the mechanical operations of combining the various materials into a whole, but also that the practicability of completing the undertaking in a manner and style that will be an ornament to our country, and of the highest credit to the public spirit of the City of New York, and its corporate representatives, from whom the project emanated and has received a uniform support, is now beyond a doubt.

A very small number of our citizens, comparatively, have any idea of the magnitude of the work and its progress; the immense amount of mere manual labor which has been, and is to be performed, in excavating and tunnelling through an almost impenetrable rock, or of mechanical labor in preparing materials, and in the erection of the bridges, culverts, stone and foundation walls, together with the aqueduct for conveying the water to the city, and other erections of a permanent and durable character, to attempt a description of which, by words, is out of the question; they must be seen to be properly understood; and the Commissioners think they may appeal with confidence to those members of your honorable body, who made an excursion over the line of aqueduct in the month of August last, for the correctness of this opinion.

The operations of the masons were suspended on the 8th of November last, and the work placed in a condition to secure it against the frosts of winter. Provision is made in the contracts, that no hydraulic masonry shall be laid up between the 15th of October and the 1st of April; but the weather continuing mild, the importance of forwarding this part of the work, as far as possible, with safety, induced an extension of the date of suspension to the 8th of November aforesaid.

It will be observed there is a much larger quantity of excavation or open cutting performed, than of any other description of work. This was owing, in a measure, to the pressure of the times, which brought forward a great number of laborers seeking employment; and to meet this emergency, permission was given to proceed with this description of labor, in order that as many of these people as practicable might be employed, rather than confine the contractors to the more important mechanical operations, on which only a few, comparatively, could be engaged.

The contractors have been urged to procure as much of the stone for the erection of the culverts, to be prepared during the winter, as practicable, in order that no delay may occur in their construction at the opening of the next season. That part of the work requiring no mortar, such as stone wall for foundation and protection, rock excavation, tunnelling, and earth embankment, will progress during the winter months without abatement.

The first and second divisions, which are included in the contracts made, embrace a line of aqueduct of 21 miles in length, and the Commissioners were only waiting for the possession of the land, then just adjudicated to them, extending to Harlem river, to put under contract so much of the third and fourth divisions, as should carry the aqueduct over that river.

But to enable them to effect their object, *more money* would be required—especially if, as seemed to be the wish of many citizens, the plan of Major Douglas, of passing the Harlem on a high bridge, maintaining the level of the aqueduct, be adopted.

We quote the reasoning of the report on this subject, and as to the conveyance of the water over York Island, together with a new estimate of the cost of the whole work:

With a view of deciding the question, as to the best manner of bringing the Croton water across the Harlem River, the chief engineer was instructed to furnish the Commissioners with an estimate of the cost of crossing said river by an aqueduct bridge, on an inclined plane; and also by an inverted syphon, with iron pipes, on a low bridge. The following is a synopsis of so much of the report alluded to, as relates to the plan of construction, and some other matters connected with the subject.

It appears the width of the river, on the high water level, was found to be 620 feet; and the distance across the valley of Harlem River, from the grade of aqueduct in the county of Westchester, to the grade of the same in the county of New York, is 1450 feet. The depth of the river, to the rock bottom, was found to be 32 feet below high water line, near the south shore; and only 20 feet on the north shore.

The aqueduct bridge will have an elevation of 163 feet above the rock at the bottom of the river, or an average of about 138 above tide. The span of the arches over the river must be 80 feet, and will regularly diminish to 50 feet span, for those to be built on the land. All the piers are to be constructed hollow, except those of 50 feet span, which are to be built up solid. The piers to be built of large stone, of uniform thickness in each course, and the joints not to exceed two and a half eighths of an inch. The work generally to be performed in the most approved manner practicable.

In making an estimate of the cost of this structure, the chief engineer observes, that he had been governed by the value of work of much similitude, estimated by several of the most competent men in this department of masonry; that there is no work under contract precisely similar, or of the same magnitude, or which, from its elevation and inconvenience of access, will be so expensive in laying up, or requires so great a portion of large stone, or the same exactness of execution; at the same time, there is sufficient resemblance to constitute a guide; which, with careful application, will not lead astray materially in computing the expense.

The estimate is given in the report in detail, and amount in the aggregate, as follows:

Estimate for a high bridge, maintaining a uniform inclination of aqueduct - $935,745

The plan of carrying the water across Harlem River by an inverted syphon, is next considered. It is proposed to erect a semi-circular arch, of 80 feet span, resting on abutment piers. The total height of the arch from the level of flood tide, to the under side of it, will be 50 feet. This arch is placed on the New York side of the river, and will form a sufficient channel way for navigation.

From the north abutment of the arch, to the Westchester side of the river, will be constructed an embankment of stone, by casting them into the river until a sufficient bed shall be formed to support the foundation wall of the aqueduct. From the south abutment pier of the main arch, on the New York side of the river, an arcade, of three arches, will be built, one of 35, one of 30, and one of 25 feet span; and, connected with this, a foundation wall will be carried up to the ascent, until it reaches the grade level, where the foundation and side walls are to be laid, to receive the pipes entering the effluent pipe chamber. The foundation walls, extending from the arcade of arches, and from the abutment of the channel arch, are to be formed of dry masonry, except two feet, constituting the face, and two feet across the top, to form the bed for the iron pipes, all of which to be laid in cement mortar.

A parapet wall will be laid on each side of the bed of the pipes, to support the earth covering, which is to be four feet deep above the pipes, to protect the water from the effects of frost.

There will be an influent pipe chamber at the termination of the aqueduct on the north, or Westchester side of the river, in which the pipes are to be inserted. Commencing on this side of the river, at the influent pipe chamber, the pipes descend nearly with the slope of the hill, forming an angle near its base, and thence to the lowest level; which determines the top of the foundation wall for the pipes, at four feet above flood tide. This level is continued to the angle, before rising to the channel arch, from whence an inclined plane carries the pipes to the effluent pipe chamber, on the New York side of the river.

It is proposed to arrange the structure of the chambers, and foundation for the pipes, to accommodate four 36 inch cast iron conduits, whenever so many shall be required. Four *three feet pipes*, according to the calculation of the engineers, will deliver 49,843,984 gallons of water every twenty-four hours; which is about the quantity calculated to be delivered by the aqueduct, and nearly the average quantity running in the Croton River. It is proposed, therefore, to insert only two of these pipes at present; they being deemed more than sufficient to supply the city with water for many years to come.

This estimate is reported in detail likewise, and amounts in the aggregate as follows:

General estimate for plan by inverted syphon and iron pipes - - $426,027

The following is a comparison between the two plans as to the estimated cost of both of them.

1st. The High Bridge, maintaining its established inclination over the river,	$935,745
2nd. Iron Pipes, supported by a low bridge, - - - - - - -	426,027
Excess of expense for the high bridge, - - - - - - - -	$509,718

In addition to the report of the chief engineer, the Commissioners directed a contracted plan of the two methods of crossing the Harlem River, to be prepared by Charles B. Pearson, Esq., an architectural draftsman, now in the employ of the Commissioners, which are herewith submitted for the inspection of your honorable body.

The chief engineer expresses a decided opinion in favor of the plan by inverted syphons or pipes; and the Board of Commissioners, after due deliberation, have adopted said plan, as, in their opinion, far preferable to that for crossing by a high bridge and inclined plane.

The reasons which have governed the Commissioners in this decision, are as follows:

1st. The difference in the cost of carrying an aqueduct over the river, on a bridge of 163 feet in height, on seven immense stone piers, sunk in the water and mud, on an average of 25 feet below tide, with 80 feet span of arches, and that of conducting the water over a low bridge, requiring only one pier in the river, with an abutment, is sufficient of itself, in the opinion of the Commissioners, to decide the question.

2d. All the purposes and objects to be obtained by the project, will as well be attained by the plan of a low bridge as by that of the high bridge, and at an expense of more than half a million of dollars less.

3d. The experience in sinking piers in so great a depth of water and mud, in order to reach the rock bottom, being very limited, and their great number and immense height from the rock to the spring of the arches, although their construction is practicable, it must be attended with many unforeseen difficulties and casualties; and should the least variation from plumb occur, or the least settlement on the foundation take place, it would carry with it very injurious results to the work; while with the low bridge and iron pipes, the same occurrence would be attended with but trifling injury, and could very soon be repaired.

4th. The water in the large aqueduct of masonry would, with much more uncertainty, be protected from frost on the high bridge, from the greatly elevated exposure and difficulty in surrounding it with a sufficient quantity of earth, than when constructed on the land; while the iron pipes, from their comparative size, may be bedded in earth of sufficient depth and compactness, to avoid all possibility of being affected by the frost.

5th. The effects of leakage have been found very injurious to the aqueduct bridges on our canals, and it is therefore a part of our contract to line the aqueduct, when the crossing of streams on bridges is necessary, with plates of cast iron, in order to avoid the possibility of repairs, which might require the shutting out of the water while effecting them, and thus be attended with serious consequences to the city. This evil will be entirely avoided by the use of iron pipes; but should anything occur to injure one of the pipes, the other would still be kept in operation, and conduct a sufficient supply of water through the aqueduct to the reservoir for all ordinary purposes.

6th. The time necessary to complete the high bridge, would be considerably more than what would be required for constructing the low one, and a saving of time in bringing to the city a sufficient supply of the Croton water, is a consideration worthy of attention.

7th. If the river should ever be made navigable, by the removal of the mills at Kingsbridge, and of the obstruction of the dam at Macomb's Bridge, the facility afforded by the low bridge, of an archway of 80 feet in width, and 50 feet in height above full tide, will admit the passage of vessels of sufficient burthen and capacity, for every useful and necessary purpose, and the high bridge could do no more.

Although the Commissioners have thus decided, based upon the foregoing reasons, and in accordance with what they deemed their duty, they nevertheless admit, so far as architectural display is involved, that the high bridge has the preference; and if your honorable body should be of opinion, notwithstanding the great additional expense, that the aqueduct should cross the Harlem River on a high bridge, and will fortify that opinion by an ordinance, passed by both Boards, and approved by the Mayor, the aqueduct shall be constructed in accordance with the provisions of such ordinance.

The necessary surveys and levels, to ascertain the most suitable course for the aqueduct on the island of New York, have only recently been effected; some demonstration, however, towards completing a plan, had been made, under the direction of Major Douglas; but it was found necessary to go over the whole ground again, in order to arrive at a result satisfactory to the present chief engineer; and an earlier attention to the subject was prevented by the pressing necessity of preparing the first and second divisions of the aqueduct for contract, and also the great care required in a work of such magnitude and importance, that the first portions of the project should be well and permanently executed, as a guide and example for the future.

The result of these examinations carries the aqueduct from the Harlem River to the receiving reservoir as follows: it commences on the New York side of the river, at the effluent pipe chamber, on land belonging, or lately belonging, to the estate of Stephen Jumel, where a tunnel of 200 feet is contemplated. It then takes a southerly course, crossing the land of Mr. Watkins; then runs westerly on the land of Carman and Connor, and enters the 10th avenue at 151st street, where a tunnel, averaging 45 feet below the surface, must be made from 140th to 135th street inclusive. The line then continues in the 10th avenue to 107th street, and makes a curve easterly to 104th street, and from thence runs parallel with, and 125 feet from, the northerly line of the 9th avenue to 90th street, where another curve occurs, carrying the line to 85th street, where it enters the receiving reservoir. From this reservoir it is proposed to conduct the water, through the 5th avenue, to the distributing reservoir on Murray Hill, by iron pipes.

In following the line of aqueduct as above described, its grade will, in several places, be above the present surface of the ground, and from 102d to 95th street inclusive, in order to accommodate the carriageway and sidewalks, archways must be erected over the streets, and the aqueduct carried on a stone embankment of from 33 to 48 feet in height; and in passing through the 5th avenue with the iron pipes to the distributing reservoir, a portion of the carriageway must be graded, in order that the pipes may be sunk to a proper depth below the surface of the street not to be out of the reach of repairs, should any be at any time required, nor so near the surface as to be exposed to the action of frost.

The Commissioners submitted an estimate to your honorable body in their report of the 3d of July last, of the probable cost of completing the first and second divisions of the aqueduct, and promised to report an estimate of the total amount that would be required to complete the whole project, including the receiving reservoir between the 6th and 7th avenues and 79th and 86th streets, and the distributing reservoir on Murray Hill, in order that authority might be obtained from the Legislature to raise the additional funds required. The chief engineer has, accordingly, at the request of the Commissioners, furnished them with his views on the subject, so far as they relate to the operations of his department of the works, including the most substantial and economical mode of construction, with the probable expense of such construction; and the Commissioners have added the actual cost of the land paid for, and the probable cost of that still to be acquired; also the sum paid for the temporary use of land for roads and embankments, and the probable expense of what may still be required, with other damages and probable charges for water and land, incident to the undertaking; also the amount already paid for salaries and other incidental expenses of the Commissioners already incurred, and including the amount that may be incurred, the estimates thus embracing every expenditure already made and to be made, from the commencement to the final completion of the work. In bringing together the several items which compose this estimate, an attempt has been made to cover every positive and probable expense, in the hope, at the same time, that the actual cost will be less than that stated, which the Commissioners will use every means in their power to effect, and thus a third application to the Legislature be avoided.

By a reference to the report of the chief engineer, alluded to above, it will be seen that the crossing of the valley at Manhattanville, with the aqueduct, and the erection of the receiving and distributing reservoirs, are works of great magnitude and cost. For crossing the Manhattan Valley, three lines are designated, and an estimate furnished for carrying the aqueduct on a high bridge from the north to the south grade. The first line runs diagonally from 128th street in the 9th Avenue, to between 118th and 119th streets, in the 10th Avenue. The second line crosses the valley, and runs parallel with, and 125 feet from, the 10th Avenue. The third line continues through the centre of the 10th Avenue.

The crossing of all these lines is to be effected by means of a bridge, with semicircular arches of 50 feet span.

The length of the three lines from grade on the north, to grade on the south side of the valley, are as follows :

First, or diagonal line, - - - - - - - -	3,300 feet.
Second, running 125 feet east of 10th Avenue, - - -	3,700 feet.
Third line, running through the 10th Avenue, - -	3,700 feet.

The maximum elevation of the bridge above the natural surface of the ground to grade line, is about 103 feet, and to the top of the parapet wall 116 feet. To erect a bridge on the first or diagonal line, as per estimate, will cost - - $983,000 00

The same for the second line, - - - - - - - - - -	1,286,880 00
The same for the third line, - - - - - - - - -	1,286,020 00
	$3,555,900 00

It thus appears that making an average of the cost of crossing the valley on an arched bridge, by the three lines designated, and continuing the aqueduct on its regular inclination, will amount to $1,188,633.

An estimate is then presented, for crossing the valley with pipes, or inverted syphons, of three feet diameter. The estimate proceeds upon the principle, that only two pipes will be required at present, which will supply about nineteen millions of gallons per day, and allow thirty gallons to each person, of a population of 600,000 inhabitants ; and in order to show the economy of the plan of crossing the valley by pipes, instead of an aqueduct bridge, a sum or capital is added to the estimate, the interest of which will pay for any additional number of pipes that may, in future be required, from time to time, as the population increases, sufficient to carry the whole produce of the Croton river to the reservoirs.

The estimate for crossing with four pipes of 3 feet diameter, all laid, amounts to	$453,670
For two pipes of the same dimensions - - - - - - - - -	303,926
For five pipes, all laid down - - - - - - - - - -	550,988
For only two pipes of the five laid down - - - - - - - -	346,372

It thus appears, if it should be deemed necessary to lay down four pipes in the first instance, at a cost of $453,670, which would furnish 38 million of gallons every twenty-four hours, there would still be a saving in the expense, by carrying the water over the valley by pipes, of $734,963, adopting the average cost of carrying it by an aqueduct bridge; and comparing the cost of building the bridge on the diagonal line, which is the cheapest, with the estimate for laying two pipes that will carry 19 millions of gallons daily, there is still a saving by the latter plan of $679,074.

The Commissioners were in hopes, as they had abandoned the idea of crossing the Harlem river with an aqueduct bridge, that they would have been enabled to recommend the building of a similar structure for carrying the water over the Manhattan Valley; a work that must have been an ornament to the city and a credit to the Corporation, as well as to the individuals having charge of its execution; but the vast difference in the cost, has put it entirely out of the question, and they have accordingly adopted the plan of carrying the water over the valley, by pipes, or inverted syphons.

In adopting the foregoing plans, for conducting the water over the Harlem river, and in crossing the valley at Manhattanville, on the island of New York, both the Commissioners and engineers have been governed by a wish to reduce the cost of the work to the lowest possible sum, consistent with its durability and permanence. The plan, however, may be modified, both in those particulars as well as others, if deemed expedient by your honorable body, and a high bridge may be substituted, instead of the syphon at the Harlem river and Manhattanville, by incurring an additional expenditure of *one million, one hundred and eighty-eight thousand, seven hundred and ninety-two dollars;* and by delivering the water in the city, at a much less elevation than what has been contemplated, a lower grade may be adopted for the aqueduct, that would prevent its rising above the present surface on this island. The Commissioners, however, do by no means recommend this deviation from the plan proposed; but as some of their fellow citizens have expressed a solicitude that the water might be carried on an aqueduct bridge with architectural display, the Commissioners are disposed to be guided by the opinion, legally expressed, of your honorable body on the subject.

That the permanent grade of the several streets and avenues, adjacent to the line of the aqueduct, ought, as far as practicable, to be made to conform to such line, the Commissioners think must be admitted; and they trust, therefore, that the whole subject may be specially referred to a Joint Committee of both Boards and the Street Commissioner, with authority to take measures for opening and fixing the grade of such streets and avenues through which the water is to pass, and to adopt such modification of the plan, on the island of New York, as shall seem most conducive to the end in view; and the Commissioners and chief engineer promise to co-operate with such committee, and to lend them all the assistance in their power.

The estimate for erecting the receiving reservoir, to have a depth of 20 to 25 feet of water, and to contain 158,000,000 of gallons, is - -	$310,500, 00
The distributing reservoir of Murray Hill, will have an average elevation of about 31 feet above the natural surface, and 40 feet above the established grade, and will be 420 feet square. The estimated cost is -	295,340 00
The total cost of the reservoirs, - - - -	$605,840 00
The cost of the four divisions of the aqueduct, commencing at the Croton Reservoir, and ending at the Receiving Reservoir, including the crossing at the Harlem River, and the Manhattan Valley, by pipes, amounts to - - - - - - - - - - - -	6,189,000 00
And for the connecting pipes, between the receiving and distributing reservoirs, - - - - - - - - - - - -	499,110 00
Add for contingencies and superintendence, eight per cent, - - -	583,516 00
Total estimate for aqueduct, engineering, &c., - - - -	$7,877,466 00

To which must be added as follows:

Cash paid for land in fee, and estimated to be paid, - - - -	501,158 00
Cash paid for temporary use of land, and estimated to be paid, - -	12,175 00
Cash paid, and estimated to be paid, for salaries, postage, printing, travelling, stationery, Counsel, and Chancery expenses, &c., - - -	73,234 00
Total cost of completing the works, except the iron pipes for conducting the water through the streets of the city, - - - - -	$8,464,033 00

It therefore appears, that a sum of about $6,000,000 will be required for this object, in addition to the $2,500,000, authorised by the "Act to provide for supplying the city of New York with pure and wholesome water."

This high estimate, exceeding by *three millions of dollars* any former one, "can only be accounted for," says the report, "by the fact that the engineers, originally employed, did not possess the means of testing their calculations by the actual contract price, as we have been enabled to do."

The Commissioners conclude this important report, by reiterating their former suggestion in favor of a special department to take charge of the finances for the Aqueduct, and to adjust claims growing out of the work.

The Common Council, nothing daunted by the greatly increased cost of the contemplated Aqueduct, or perhaps being in too far to recede, complied with the call for additional means, by a memorial to the Legislature, asking authority to raise *three millions*, which was granted by the law of 29th March, 1838, the loan to bear an interest not exceeding six per cent. The Corporation, by another law of 24th March, were authorised to defray, out of the Water Fund, all expenses for procuring and laying down pipes for the distribution of the water. But the Common Council did not approve of the substitution of inverted syphons for a high bridge, to pass the water over the Harlem, and accordingly the Board of Assistants adopted this resolution:

RESOLVED, That it is inexpedient to adopt the plan proposed by the Water Commissioners, for crossing the Harlem river by means of a low bridge or syphon, and that the plan of the high bridge referred to in the Report of the Commissioners, should be adopted, as submitted to, and approved by, the electors of the City and County of New York.

Adopted by the Board of Assistants, July 9, 1838.

The progress made during this year was great. The whole remaining line in Westchester County, comprising the third division, and six sections of the fourth, were put under contract, at prices lower than those of the preceding year, and with great competition in the bids. The necessary maps of the land required on the island of New York, amounting to about 26 acres, were completed, and negotiations were entered into by the Commissioners, for the purchase.

Four blocks of the land required for the receiving reservoir, containing about $4\frac{3}{4}$ acres each, were obtained by purchase, and application was made to the Chancellor, for the appointment of appraisers, on whose award the remaining lands might be taken.

A circular was also addressed to the chief iron founders in the United States and Great Britain, inviting proposals for the iron pipes that would be required for syphons, and for connecting the receiving, with the distributing, reservoir. These pipes, for the most part, were to be 3 feet in diameter, and others 30 inches, varying in thickness, from one to one inch and a quarter each. The whole weight was estimated at from 4 to 5000 tons. This timely notification was given, to the end that it might be ascertained, whether it was best under all the circumstances of the case, to import these pipes, or obtain them at home.

In order to keep the progress of the work before the reader's eye, we copy from the Commissioner's Report of July, 1838, the statement of what had been accomplished since the previous report.

The work performed during the winter consisted, principally, of excavation of earth and rock, in tunnelling, and in quarrying stone, and preparing them for use in the construction of the culverts, bridges, and other erections connected with the aqueduct, which has greatly facilitated the spring operations. But, in order that some idea may be formed of the progress of the work, we beg leave to present the following statement, embracing the principal operations on the line; such as the length of aqueduct completed, the number and extent of tunnel excavation, the number and capacity of the culverts erected, &c.:

1st. Aqueduct. The whole length of aqueduct, arched and complete, was, on the 25th of June last, 10,280 feet, or about two miles in length.

2d. Side Wall. The length of the side wall of the aqueduct, ready to receive the arch, exclusive of that already arched, was 18,376 feet, or about three and a half miles in length.

3d. Culverts. There are twenty-two culverts completed and in use, discharging the water from the several creeks and runs, some of them of considerable magnitude; and their aggregate length is 1825 feet. The number partly finished was *seven*, and their length is 578 feet. Seven of these culverts measure from 100 to 148 feet in length; seven of them from 80 to 96 feet, and *thirteen* of them from 50 to 72 feet. Nine of them are large, measuring from six to ten feet span, eight of them from three to four feet span; and the remainder, from one and a half to two feet.

4th. Tunnels. Three of the tunnels have been perforated through the solid rock, from one end to the other, in the aggregate 670 feet in length. One on section twenty, 335 feet; one on section fifteen, 165 feet; and one on section thirty, 170 feet in length. There are also five tunnels, partly finished, measuring, in the aggregate, 610 feet, excavated. In a long tunnel on section fifteen, there have been excavated through the solid rock, 360 feet; and another on section sixteen, 200 feet; the other three, from 10 to 25 feet; making a total of tunnel excavation of 1280 feet in length.

5th. FOUNDATION AND PROTECTION WALL. The quantity of foundation wall laid, amounted to 28,000 cubic yards, and of protection wall, 13,160 cubic yards.

This is but a very brief sketch of the work which has been performed, and is confined altogether to the operations on the first and second divisions, exclusive of the large amount of excavation in rock and earth on a line of thirty-three miles in length, nearly the whole of which has been completed, together with a large amount of building materials prepared.

The contractors on the sections lately placed under contract, comprising the whole of the THIRD and a portion of the FOURTH divisions, have commenced their work with spirit, and appear unwilling to be outdone by their predecessors on the works. The number of mechanics and laborers employed on the whole line, on the 25th ultimo, was 3043; they will be very considerably increased during the summer, as the Commissioners have good reason to hope; which will enable them to show, in their next semi-annual report, an important addition to the work under their charge. The whole length of aqueduct now under contract, extending from the Croton to the Harlem River, is THIRTY-THREE MILES.

Owing to a turn-out for wages early in the season, the work on the line between the dam and Sing Sing, was somewhat retarded. The promptness of the magistrates of that town prevented the evil from spreading, and the contractors having taken back such of the laborers as they were still willing to receive, and refusing on any terms to employ the ringleaders of the rioters, order was restored and the work resumed.

But a more fruitful and formidable cause of disaster than casual dissatisfaction with the rate of wages, soon occasioned trouble on the line. The Commissioners, as has been already stated, bound all the contractors to prohibit the use of ardent spirits, and on the part of these contractors, entire good faith seems to have been observed on that head. But individual cupidity, and want of thought, or of a due appreciation of the consequences, on the part of the licensing magistrates, led to the opening of grog-shops in their worst form, in some of the neighboring farm houses, and in shanties erected for the purpose without the line where the contractors could exercise any authority. Here the poison was freely sold, and although the contractors and superintendents exerted all their vigilance to prevent its being introduced on the line, and repeatedly discharged laborers who were found intoxicated, the "enemy of man," as it is justly called in the report, prevailed so far, that in the month of April, during a drunken frolic, one of their ancient national feuds broke out among the Irish laborers, and under the respective denominations of *Corkites* and *Fermanaghs*, the two parties rushed into a desperate fight, in which one man, named Baxter, was killed, and very many were wounded and mangled in a shocking manner.

As, during the preceding year, no disturbance, misconduct, nor depredation had occurred among the laborers—no place for the sale of liquors having then been opened—and as it was all-important, alike for the progress of the work, and for restoring the confidence of the inhabitants along the route, that decisive measures should be taken to punish the rioters, indictments were found against several for *murder*. The swearing, however, was so contradictory, that the act of killing could not be fixed upon any individual, and the Court and Jury, foregoing the capital charge, were content to bind the most conspicuous, under recognizance, to keep the peace. Order was by these means restored, and every thing went on again in harmony.

The Commissioners, in this report, draw the attention of the Corporation to the fact, that the assessors of the towns in Westchester county, along the line, proposed to include not only the lands occupied by the aqueduct, but the unfinished work of the aqueduct itself, in the property of the town to be rated for taxation; and that instead of rating the lands only at the valuation of the neighboring farms from which they had been taken, they had in the town of *Greensburg* alone, valued the property of the aqueduct at $60,000

Believing such a measure, in regard to such a work, to be unprecedented, the Commissioners recommend to the Corporation, to invoke legislative protection.

They also renew a request, previously made, that the Corporation would take immediate measures for opening and establishing the grade of the avenues and streets through which the line of the aqueduct passed, and also those by which the receiving reservoir is bounded.

After bearing testimony anew to their constant satisfaction with the ability and devotedness of the engineer corps, and particularly of its able head, the Commissioners pay a merited tribute to the Common Council of 1835, "for the public spirit they displayed in the prompt approval of the plan for supplying the city with pure and wholesome water, as proposed by the Commissioners, and in their relying for authority to raise the means, upon the favorable voice of their fellow-citizens, through the ballot boxes, founded on their knowledge of the propriety of the measure, and the ability of the Corporation to carry it into effect. The same spirit has been uniformly evinced by subsequent Common Councils, in rendering their unremitting countenance and aid to the measure; and to these," the Commissioners add, "they are mainly indebted for their ability to progress thus far with the great and important work under their special charge."

During the whole of this year, operations were pushed with great vigor, so that nearly one million six hundred thousand dollars were expended, and from 3500 to 3800 men employed—denoting, on the part of the contractors, a determination to complete the work within the time specified in their respective contracts.

The whole amount disbursed, up to 31st December, 1838, was within a small fraction of *two millions* of dollars.

On 1st October, the Commissioners opened the bids from the various iron masters in England and the United States, to whom they had addressed notices respecting the iron pipes needed. There were three offers from England, and seven from the United States. That of the West Point Foundry Association being found a shade lower than the others, a contract was passed with them, with adequate personal security on their part for the due fulfilment of their undertaking.

The Commissioners also let out upon advantageous terms the difficult and important sections from 86 to 97, part of the fourth division. These included the bridge to support the syphons across the Harlem River, the work to support the pipes across Manhattan valley, the bridge over Clendining valley, the receiving reservoir at Eighty-sixth-street, and the distributing reservoir at Murray Hill.

This completed the contracts, from the dam at the Croton to the distributing reservoir, a distance of about 41 miles, and *all* the work was to be finished in 1841.

The opposition, however, to the syphon bridge over the Harlem, instead of a lofty aqueduct bridge on a continuous grade, was by no means abated. Notice was served on the Commissioners in behalf of land-owners not residents of the State, bordering on the line where it was to pass the Harlem, that application would be made to the Circuit Court of the United States, to restrain any such construction in or over that river, as "should impede or obstruct the navigation thereof, and particularly from filling up the channel of the said river." Moreover, notices were published in the papers in which the advertisements of the Commissioners appeared for contracts to build the syphon bridge, warning all persons against undertaking such a work, as every means the law would justify, would be used to prevent it. The Board of Assistant Aldermen, moreover, as has been seen, adopted a resolution in favor of the high bridge, but the Commissioners still persevered in their plan. The contracts were duly entered into, and the reasons of the Commissioners for going on with the syphon bridge are thus assigned:

1st, Because the plan submitted to the Common Council, and afterwards to the test of the ballot boxes, was in favor of the syphon.

2d, Because the Commissioners were of opinion, that the crossing in the manner proposed, is the easiest, the safest, and the most permanent and durable.

3d, Because this is the unanimous opinion of the Commissioners, and of the whole corps of engineers engaged on the works, and in this opinion they are joined by several engineers of eminence, not connected with the operations.

4th, Because the high arches will cost half a million of dollars more than the syphons, and will also require two or three years more time to erect them.

5th, Because the Commissioners are advised, by counsel learned in the law, that the Act of the Legislature authorises the passage of the water by the plan proposed by them.

6th, Because, notwithstanding these considerations, the question was submitted by the Commissioners to the Common Council, and their instructions requested, which they promised to follow, whether such instructions should be in favor of the high arches or of the syphon; but they have declined instructing them on the subject, or assuming the responsibility of changing the plan of the Commissioners; and now, believing it to be our duty to carry into effect that plan which shall require the least expenditure, and which may be completed in the shortest time, while it takes nothing from the permanence and usefulness of the object, we have adopted the plan by syphons. With these impressions, and in a firm belief in their correctness, it would be the height of impropriety in the Commissioners, under the circumstances of the case, to change or abandon the plan they have adopted; and they will therefore proceed in its execution, unless restrained by due course of law."

The summer of 1838 was one of unusual drought; which, while favorable to the work in hand, especially in the masonry, afforded an opportunity of comparing the flow of the Croton with that of ordinary seasons.

Accordingly, on the 16th August, Horatio Allen, Esq., principal assistant engineer, guaged the stream at two different stations—the one gave as the result 26,386,560 gallons, running in 24 hours, the second, 28,738,000, averaging 27,584,780 gallons, or nearly three times the supply requisite for the population of the city at that period.

On 5th September, 1833, Major Douglas guaged the river, and found 51,522,486 gallons running; and on 26th of the same month, Mr. Stein found 50,074,044 gallons. These were considered as fair averages of what may be depended on—though at times the Croton rolls to the Hudson several hundred million gallons daily. But over and above the running supply, the Croton lake created by the dam, is estimated to contain 100,000,000 gallons for each foot in depth from the surface, and this may be drawn down five or six feet, yielding as many hundred million gallons. The receiving reservoir will contain 158 millions of gallons, and the distributing reservoir 19 millions—altogether forming an aggregate surplus, in case of excessive and long continued drought, sufficient for any possible emergency.

The work performed during the last six months of the year is thus summarily stated:

"1st. *Aqueduct.* The whole length of aqueduct, arched and complete, is 59,169 feet or eleven and one fifth miles. That completed on the first of July last was about *two* miles. The increase, in this part of the work, since our last report, is nine and one fifth miles of aqueduct complete.

2d. *Side Wall.* The length of side wall, ready to receive the arch, exclusive of that already arched, is 1443 feet.

3d. *Culverts.* There are 79 culverts completed and in use. Their aggregate length is 5476 feet. The number completed at our last report was *twenty-two*, and their length 1825. *Increase*, 57 culverts. The number now partly finished is ten, and their length in feet 652. The number partly finished at our last report was *seven;* length 578. *Increase*, 3 culverts in progress.

Tunnels. The number of tunnels excavated throughout is three. Their aggregate length 667 feet. There are, besides, seven tunnels partly finished, measuring 1187 feet of excavation; making an aggregate of tunnelling of 1854 feet. The number complete at our last report was *three*, and the length 670 feet, together with *five* partly finished, measuring 610 feet in length, making a total of 1280 feet. Increase in this description of the work 574 feet of tunnelling.

Foundation and *Protection Wall.* The foundation wall laid is 58,439 cubic yards, and of protection wall 36,590 cubic yards; making a total of 95,029 cubic yards. The quantity of foundation wall, laid at our last report, was 28,000 cubic yards, and of protection wall 13,160; making a total of 41,160 cubic yards. Increase since our report in July last, 53,869 cubic yards.

This is a very limited sketch of the amount of work performed as a whole, and is only intended to convey some idea of the structure and its progress. The immense effort in penetrating high hills, and in crossing deep valleys, can only be judged of by a personal view of the vast amount of labor performed by the physical strength of man."

This Report of the Commissioners, especially in that part of it that commented on the Report made by the Board of Assistants in favor of a high bridge, and on the resolution given in a preceding page, which that Board, in conformity with the Report, passed—seems to have touched that body—and as the Commissioners had alway addressed their communications to the Board of Aldermen, the Assistants passed the following resolution :

Resolved, That the Water Commissioners be requested to communicate to this Board, as a constituent branch of the Common Council, a copy of their late semi-annual Report, to the end that this Board may take such action thereon as the nature thereof may require, and that the Clerk forthwith communicate a copy of this Resolution to the said Commissioners.

Adopted by the Board of Assistants, January 2, 1839.

Moreover, the landowners and others, who were contending for the uninterrupted navigation of the Harlem, abandoning their contemplated appeal to the U. S. Courts, addressed themselves to the Legislature. The efforts made were successful, and the following law was passed on 3d May, 1839.

AN ACT

Prescribing the manner in which the Croton Aqueduct shall pass the Harlem River.

The People of the State of New York, represented in Senate and Assembly, do enact as follows:

§ 1. The Water Commissioners shall construct an aqueduct over the Harlem river, with arches and piers; the arches in the channel of said river shall be at least eighty feet span, and not less than one hundred feet from the usual high water mark of the river to the under side of the arches at the crown; or they may carry the water across said river by a tunnel under the channel of the river, the top of which tunnel shall not be above the present bed of the said channel.

The Commissioners, who had in vain sought the instruction of the Common Council on this vexed question, of a high or low bridge, and who had at last, on their own responsibility, decided in favor of the low or syphon bridge, and had actually entered into contract for its construction, were naturally not a little annoyed at the change of plan thus authoritatively forced upon them. Nevertheless, they submitted with a good grace, and, having taken the precaution to insert in the contract a proviso, that if at any time the plan of the low bridge should be abandoned, the Commissioners might vacate the contract upon paying the contractors for work done, and materials delivered, or bespoken, they at once proceeded, on 6th May, when a certified copy of the act was handed to them, to declare that the contract was abandoned, and to direct their engineers to ascertain the value of the work done, and of the materials delivered under it.

They also directed the chief engineer, forthwith to examine and report fully upon the two modes of passing the Harlem, prescribed by the Legislature. This report, made on 1st June, seems of sufficient importance to be given at length.

REPORT

Of the Chief Engineer, on Plans for crossing Harlem River.

New York, June 1st, 1839.

To the Honorable the Water Commissioners of the City of New York:

Gentlemen:—The resolution of your Board, requiring the undersigned to prepare plans and estimates for crossing Harlem River, by a bridge, the arches of which shall be elevated 100 feet above common high water mark, and also for a tunnel under the channel of the river, has been under consideration.

The law passed at the recent session of the Legislature provides, in relation to a tunnel under Harlem river, that the top of the tunnel shall not be above the natural bed of the river, and that it shall extend across the channel of the same. This will require the abutments to be placed about 300 feet apart, and the top of the masonry of the tunnel about 18 feet below the high water level of the river. In relation to the bridge, the law prescribes that the arches in the channel shall be 100 feet at the under side of the crown, above common high water mark of the river, and not less than 80 feet span—conforming in these respects, we are at liberty to make the plans, in all others, without restriction from the law.

In the report of the undersigned, made to your Board on the 12th December, 1837, a plan for a bridge of sufficient height and stability to support the regular inclination of the aqueduct grade was presented. This plan provided for an aqueduct of masonry, to be rendered more impervious by a cast iron lining; but as it was supposed the Commissioners had power, and no objection having previously been made, on the ground of interference with the the navigation, a structure, conforming nearly to the shape of the valley, and rising to a moderate elevation above the surface of the river, on which iron pipes were to be laid and secured, was recommended, as best adapted for economy, permanence, and more ready execution, to carry the aqueduct across this heavy depression from the grade line. Although adopted by your Board, and put in progress of execution, the law before mentioned compels its abandonment. We are therefore with only the alternatives of the Act of the Legislature, as before mentioned.

The arches of the bridge, originally designed to maintain the grade of the aqueduct, were elevated 112 feet above the high water mark of the river, which is 12 feet higher than the Act requires. It is obvious, therefore, that 100 feet will not be sufficient to maintain an aqueduct of masonry, but will require iron pipes as conduits for the water. This I do not consider an objection, as I am fully satisfied, iron pipes will make the most suitable conduit for the water on such a bridge, and therefore have had a plan prepared, with a view to comply with the law, and avail of the economy and greater permanence from a less elevated structure. Owing to the less height required for the arches, and by adopting iron pipes for the conduit, the top of the parapets will be 114 feet above high water mark, which is 17 feet lower than the original plan. The superstructure being lighter than necessary for an aqueduct of masonry, a diminished thickness of arch stone may with equal safety be adopted.

The plan of piers and arches, also the hydraulic foundations, and manner of constructing coffer dams, and the character of the masonry in general, are proposed to be similar to that designed for the original plan. Some modifications in the construction and securing of the coffer dams, will be provided for in the estimates. For greater security, the expense of the coffer dams will be increased, by a more extensive excavation of the mud than was originally contemplated, and a course of plank to be put on the same before sinking. This plan, it will be perceived, has, in its general appearance, a great degree of similarity to what has, for distinction, been called the high bridge. It will, however, in consequence of its being of less height, and adapted to support a lighter superstructure, be less expensive. In the first instance, it is proposed to put down two three-feet pipes, which will probably be sufficient to supply the city for at least fifty years; but to adapt the work to receive two four-feet pipe, which will be sufficient when the full capacity of the aqueduct shall be required. As there will be only a head of about 15 feet, no difficulty will be experienced in the use of pipes of this dimension.

To guard more effectually against the influence of frost, the parapet walls are designed to be hollow. The same arrangement for influent and effluent gate houses, also for waste cocks, that was proposed for the low bridge, will be required in this.

The plans herewith submitted, though not, in all their details, entirely complete, it is believed, with the foregoing description, will explain fully to the Board the character of the plan under consideration.

Estimated Expense of the Aqueduct Bridge.

2,000 cubic yards of excavation of earth for foundations on shores, at 16 cents		$ 320	
200 cubic yards of excavation of rock for foundations on shore, at $3		600	
7 coffer dams, including pumping, excavation of pits, and earth filling, as per detailed estimate in report of December, 1837, at $13,000	$91,000		
Add for extra excavation of mud, and extra sheeting of frame	13,000		
		$104,000	
			$104,920
500 tracing piles, for foundations of land piers not on rock, at $5			2,500
1,700 cubic yards of concrete masonry, at $6			10,200
10,600 cubic yards of masonry in large piers, at $20		212,000	
3,800 cubic yards of masonry in small piers, at $15		57,000	
			269,000
490 cubic yards of water table and cornice on piers, at $30			14,700
3,020 cubic yards of large arches, at $30		90,600	
1,020 cubic yards of small arches, at $25		25,500	
			116,100
1,060 cubic yards of pilasters, at $15			15,900
3,150 cubic yards of exterior spandrils, at $13		40,950	
3,650 cubic yards of interior spandrils, and hance walls, at $6		21,900	
			62,850
250 cubic yards of flagging, to connect hance walls, at $8		2,000	
			64,850
1,300 cubic yards of parapet walls, at $12		15,600	
520 cubic yards of brick walls and wells, at $12		6,240	
250 cubic yards of coping on parapets, at $30		7,500	
			29,340
4,400 cubic yards of foundation walls at ends, at $2		8,800	
400 cubic yards of side wall on do. at $6		2,400	
			11,200

6,500 cubic yards of earth filling over pipes, at 40 cents - - -	2,600	
350 superficial yards turfing, at 30 cents - - - - -	105	
		2,705
1,000,000 ft. board measure, pine timber and plank for centering and scaffolding, at $35 - - - - - - - - - -	35,000	
300,000 ft. board measure, oak timber and plank for centering and scaffolding, at $45 - - - - - - - - - -	13,500	
		48,500
580 tons cast iron pipe, at $75 - - - - - - - -	43,500	
Lead, yarn, tallow, and laying down, estimated - - -	9,000	
2 pipe chambers, as per estimate detailed in report December, 1837, -	15,642	
Waste cocks, as per report December, 1837, - - - -	2,500	
		70,642
		$760,557
Add for contingencies 10 per cent.		76,056
		$836,613

Tunnel under the Channel of the River.

By the Act before mentioned, it is required that the top of the work put down for the tunnel, shall not be above the bed of the river in the channel; and it is understood as requiring the tunnel to extend entirely across the channel, which at the line of aqueduct is 300 feet wide. The bed of the river is about 18 feet below common high water mark. The channel is not this depth for its whole width, but slopes very flat on the sides. The outline of the plan, is to make a tunnel of masonry, of sufficient dimensions to allow four iron pipes, each three feet diameter to be laid within it. The tunnel to be made of two sections, or of two arched vaults, laid close to each other, and each sufficient for two pipes. The tunnel to terminate at each end, in abutments of masonry, having such slopes and curves as will afford the most favorable flow of water, that the situation will permit. A horizontal vault in each section will carry any water that may gather in the tunnel, to the vertical wells in the abutments, where it may be cleared by pumps. The tunnel at each end will open in the top of the abutments, and thence the iron pipe will pass from the tunnel, rising to a suitable level above the river, and enter the embankment by which it will be covered. To protect the pipes from frost and provide for convenient entrance into the tunnel, a house is to be erected over this opening.

It is proposed to make the tunnel, by first excavating the mud which forms the bed of the river, by means of a dredging machine, so as to allow a frame for a coffer dam to be sunk on the sand which underlies the mud. After the mud has been removed, a frame for a coffer dam is to be sunk, embracing the area of tunnel and abutments. The coffer dam being required to be about 400 feet long and 40 feet wide, it is obvious it would be extremely difficult, if not impracticable, to make this frame on land and launch it, as is proposed to be done for the comparatively small coffers required for single piers. It is therefore proposed to construct a float of timbers, and securely anchor it at the position for the coffer dam, and erect the frame in horizontal sections, until the work may itself be sufficiently strong to bear anchoring, when the float timbers may be loosened and removed from the same. The frame to be then completed in such sections as will be most convenient for the work. After the frame is sunk to its place and well secured, the driving of the sheet-piling, filling in with water-tight earth, and, in general, all other work, will be similar to that proposed for coffer dams for the piers; with such additional security as its larger dimensions demand. The coffer dam being completed, it is proposed to erect two fifty horse power steam engines, with suitable pumps, to clear the pit from water. The sand and rock within the coffer dam will then be excavated to the proper level of foundation of the masonry; in the progress of which the bottom of the coffer, below the frame, will require to be secured by suitable prop or stay timbers.

Masonry.—It is proposed to lay down a foundation course of concrete, formed to receive an inverted arch of brick, from which will rise curved walls to form abutments for the upper arches of the tunnel, all of which will be of brick masonry supported by concrete, and the exterior protected on the sides by well set stone, and the top by a covering of well jointed coping.

The iron pipes are proposed to be of metal, 1 3-8 inches in thickness, for the part that passes the tunnel, and 1¼ inches until they extend to a point 40 feet above the level of the river. Branch pipes and waste cocks will be required in the main pipe, above the high water mark of the river, as a means to force out the sediment that may be deposited in the bottom of the pipe. This means of clearing the pipes would probably be sufficient, if the waste pipes could be placed in, and discharge freely from the bottom of the bend; but as the cocks must be about 32 feet above the lowest part of the bend, and about 300 feet in line of pipe from the commencement of the lowest part, there is doubt whether the sediment would be raised by the current that could be given through the depression. On the first opening of the stop cock, with the pipe full, there would be a powerful rush of water; but it must be kept in view, that this force would only be of momentary, or of very short, duration; as the quantity discharged under this great head, would exhaust the head of the pipe much more rapidly than it could be supplied from the influent chamber, when the action in entering the pipe would be under comparatively a very small head. It is therefore obvious, the discharge at the cock would very shortly be reduced to the quantity that could enter the pipe from the pipe chamber. To provide, therefore, for removing sediment that may not be carried out by the force of current, discharging from the stop cocks, it is proposed to put in the pipes, at convenient distances, man hole plates, by which the pipes may be entered and cleared by manual labor.

When it is considered how difficult it is, under ordinary advantages, to construct masonry so as to be perfectly impervious to water, we cannot expect this tunnel, which must be constructed under circumstances peculiarly unfavorable, and exposed to a head of 18 feet, resting on the bare walls, will be sufficient to exclude all water; some will undoubtedly percolate through, and find its way into the tunnel. This water being salt, must be carefully kept from the pipes, or it would soon corrode and destroy them. It is therefore proposed to place the pipes on seats that will keep them clear from the walls of the tunnel, and protect the top by a roof that will turn off any water that might fall from the roofing arch, and thus allow the whole to settle in the bottom of the tunnel, and be drained by the vaults that connect with the pump wells, where suitable pumps must be erected to raise and discharge it from the same.

The duty of preparing an estimate for this tunnel is obviously a difficult one, and to a great extent must be viewed as mere conjecture. The comparatively small coffer dams required for the piers, are a work in which much embarrassment and difficulty must be expected in the execution, and uncertainty in regard to the estimated expense; and but few cases are known of equal difficulty. These, however, only enclose about one-tenth the area required for the coffer dam which is necessary for the tunnel. It is believed no experience exists in placing such a coffer, or one of one-quarter the size or difficulty, consequently we cannot have the light of experience to any very satisfactory extent. These remarks are made, not because I consider the work impracticable, but as one of great difficulty, the estimate for which must be considered as subject to much contingency and consequent uncertainty in amount. The estimate has been prepared with much care, all I believe that can be useful, and is submitted as my best judgment on a work, not capable of being reduced to ordinary accuracy in anticipating its cost.

Had we been permitted to restrict the channel of the river to 100 feet in width and 8 feet in depth at low water, which would probably have been an ample provision for all navigation that it is necessary to provide for, the plan of passing the aqueduct by means of a tunnel, would have been divested of a large portion of the difficulty and expense, and could have been entered upon with far greater certainty in relation to time, and expense of construction; but this we are not permitted to do.

In difficulty and expense of construction, the Thames Tunnel, at London, has more similarity than any other work of which I have any knowledge; though it is a work of greater difficulty, and in some respects decidedly so, than the proposed Harlem Tunnel.

The history of this work is, however, such as to admonish us of the uncertainty in estimating for work done under a heavy pressure of water. It was commenced in 1825, and then estimated to cost 160,000 pounds sterling. November 2, 1837, 12 years after its commencement, there had been expended 264,000 pounds, and it was then estimated to require an additional sum of 350,000 pounds to complete it, which, if correct, will make the final cost 614,000 pounds, or near four times the original estimate. As before observed, we are not to consider the two cases as parallel, though there is a degree of similarity, which very naturally excites attention when looking for some guide in the expense of other work.

Estimated Expense of Harlem Tunnel.

11,000 cubic yards earth excavation on shores, at 14 cents, - - - - -	$ 1,540
2,000 cubic yards rock excavation on shores, at $1 50, - - - - -	3,000
24,000 cubic yards excavation of mud in river, at 1, - - - - - - -	24,000
3,000 cubic yards excavation of sand in river, at 1, - - - - - -	3,000
4,000 cubic yards excavation of rock in river, at 5, - - - - - - -	20,000

Coffer Dam.

240,000 feet, board measure, white oak timber, at $35, - - - -	$ 8,400
700,000 feet board measure, white pine timber, at 20, - - - -	14,000
380,000 feet, board measure, yellow pine timber, at 30, - - - -	11,400
10,000 lineal feet round piling, at 20 cents, - - - - - -	2,000
	$35,800

20,000 pounds wrought iron bolts, straps and spikes, at 12 cents - -	$2,400	
Pin timber and treenails - - - - - - - - -	250	
Carpenter and other work, framing, sinking, and securing frame -	30,000	
Driving 2,000 feet lineal of sheet piling, at $2 - - - - -	4,000	
Driving 320 round piles at $3 - - - - - - - - -	960	
380,000 cubic yards earth filling and embanking coffer, at 40 cents -	15,200	
Estimated cost of pumps, steam engines, and working, (very uncertain)	30,000	
Removing frame, piling, earth of dam from the channel—estimated -	15,000	
		133,610
1,800 cubic yards brick masonry, at $18 - - - - - - -	32,400	
8,000 cubic yards stone masonry and concrete, in abutments and tunnel, at $10 - - - - - - - - - - - -	80,000	
460 cubic yards coping and side facing of tunnel, at $30 - - -	13,800	
2 entrance houses on abutments - - - - - - - -	2,000	
		128,200
6,500 cubic yards stone embankment in river, between abutments and shores, at $2 - - - - - - - - - - - -	13,000	
3,000 cubic yards foundation and protection wall, at $2 50 - -	7,500	
		20,500
700 tons iron pipes, delivered, at $75 - - - - - - -	52,500	
Lead, yarn, tallow, and work putting down 3,100 feet, at $4 - -	12,400	
13,000 cubic yards earth covering, at 20 cents - - - - - -	2,600	
2 pipe chambers, as per detailed estimate of December, 1837 - -	15,642	
Waste cocks and man hole plates - - - - - - - -	7,500	
		90,642
		$424,492
Add for contingencies, 50 per cent.		212,246
		$636,738

Aggregate estimate for bridge, - - - - - - -	$836,613 00
Aggregate estimate for tunnel, - - - - - -	636,738 00
Difference in favor of tunnel,	$199,875 00

The items of which the estimate for the bridge is made, are for the greatest part of a character that give confidence in its being a fair approximation to the actual cost. The hydraulic foundations are the principal exception. In relation to the tunnel, the greatest part is peculiarly uncertain; and it would not be surprising if unforseen difficulties should occur in its construction, that would materially reduce the difference that appears in the estimates.

In regard to the comparative maintenance of the work, the tunnel plan will require a pumping apparatus to be kept in constant operation, to clear the tunnel from water that may percolate through the masonry, The extent and expense of this will depend on the success that may be obtained in rendering the masonry impervious. The pipes will be exposed to deterioration from accidental contact with salt water, and from an atmosphere somewhat affected by its contact and contiguity with the same.

The pipes on the bridge will be enclosed in earth, be free from these contingencies, and consequently have greater durability. The work of repairs, or removal of the tunnel pipes, will be attended with greater difficulty and expense than those on the bridge. The waste cocks for the tunnel pipe, being 32 feet above the lower part of the bend, rendering it probable the sediment must be removed, to a great extent, by manual labor, through the man holes, will make the clearing of the pipes much more difficult and expensive than the bridge pipe. The supervision and care, necessary to keep the tunnel pipe in good condition and guard against sudden failure, will be much greater than required for the bridge pipe. In regard to the masonry, a defect or failure in either plan would be very difficult and expensive to remedy; and we should not anticipate any, or rather the work should be so well guarded as to leave no apprehension of such a result.

Well completed, the bridge, in the simplicity and economy of its operation, and its architectural appearance, would, no doubt, be the most satisfactory structure.

In the foregoing estimates and remarks, I have endeavored to call your attention to all the essential circumstances and considerations that have a bearing in deciding on the plan most appropriate to be adopted. The question is one of great importance, and surrounded with embarrassing difficulties, which in some respects are of a nature that do not admit of exact, or even hardly approximate, computation.

In relation to the time required for the completion, I think five years as little as should be calculated for the bridge; while the tunnel, if successful in putting down the coffer dam, may be completed in four years. It is not probable that either plan can be executed as early as other parts of the aqueduct; and it will be proper to lay down a temporary pipe, which may be sufficient for the introduction of the water; as for the want of suitable fixtures, some time will probably elapse, after its first introduction, before it will get into general use in the city. A twenty-two inch main may be laid down and protected for $30,000, and when the work is completed may be taken up and used to supply the city mains, by which the extra expense will not be much, if any, over $20,000.

In making up an opinion which of the two plans should be adopted, I have felt the question to be one involving great responsibility. The high bridge I have heretofore endeavored to avoid, as a work of great expense, and attended with much difficulty in its execution. From the considerations before detailed, I have however come to the conclusion, that under the modification now presented, it is better to adopt it, than the plan of carrying the aqueduct by a tunnel under the river. Could I have the same confidence in the estimate for the tunnel that I have in the bridge, I should have less in coming to this conclusion than I now feel; for although the tunnel estimate includes all that appears tangible, with an apparent liberality for all contingencies, still we know experience in similar work, much more limited in extent, proves how difficult it is to anticipate all the circumstances that will swell the cost of construction. If we have not calculated much more accurately for this work, than was originally done for the Thames Tunnel, we shall find our contingent allowance much too low. This, together with the consideration, that the supervision and maintenance of the pipe on the bridge, will be more simple and less expensive, and consequently more satisfactory than that in the tunnel, have induced me to give the preference to the bridge.

By a resolution of your Board, subsequent to the one before mentioned, my attention is called to a suggestion for a wooden bridge, resting on timber piers, sunk in the river, and filled with stone to high water, on which to erect wooden piers, to be connected by arches of the same material. To this has been added a verbal suggestion of your

Chairman, to carry up stone piers above the water, and then erect the wooden structure upon them.

Timber piers in the river could not be expected to last more than ten or twelve years, which would be quite temporary for such a work. The least that could reasonably be done, would be to raise the piers to such a height above the water as would be convenient to support the timber work. In my judgment, no calculation should be made, short of carrying the piers to the proper height for the spring arches of masonry, which they should be designed ultimately to support.

The estimate for masonry above the spring line of arches, is 224,540 dollars. A timber arch and trunk sufficient for two and a half feet pipes, which would be sufficient to supply the city with water for twenty years, could be erected and covered for about 75,000 dollars, which is about 150,000 dollars less than estimated to complete the work of masonry. Such a bridge would last, if the cover was kept in good repair, probably 30 years. It is quite practicable to raise timber work to support the superstructure from near the water's edge; but when it is considered that important bridges for travelled roads, are usually supported by piers of stone, and aqueducts for canals almost invariably so, we could not, I think, do less than give that degree of permanence and durability which would be obtained by carrying up the piers as above suggested.

In relation to the practicability and the diminished expense of erecting a timber arch, to support a trunk for the water pipes, there can be no question. At the same time there are objections to a timber structure, that should not be lost sight of. The decay that will be effected by the action of time on the timber, may not be sufficiently manifest in its external appearance, to give seasonable warning of its weakening influence on the structure, and (as is sometimes the case with wooden aqueducts on canals,) it will be liable to go down suddenly, and thus cause a breach in the aqueduct that will be difficult to repair in time to meet the wants of the city.

The work may be destroyed by fire, as was the case with one of the Schuylkill bridges at Philadelphia. Its great elevation will expose it to severe storms of wind, which, as it grows weak from age, may at a time not expected, force it from the piers, or so derange its joints as to render it incapable of supporting the aqueduct. All other work constructing on the line has been designed with a view to the greatest durability, and to guard as much as possible against the necessity for repairs, and especially such as would materially jeopardise the regular flow of water in the aqueduct. To adopt a wooden structure at the most important point, in regard to its magnitude and expense, would certainly be a great departure from all other work on the line of aqueduct; and to the undersigned it does not appear expedient, for the difference that may be saved in the first instance, to change the character of the work by adopting a wooden structure at this place.

Should the Board be of opinion, that either the tunnel plan, or the wooden arch bridge, would be the most suitable for them to adopt, I shall feel no hesitation in going forward, with every effort in my power, to produce a successful accomplishment. It is, however, my opinion, as before expressed, that under all the circumstances, the aqueduct bridge of masonry with iron pipes for the conduit, is the most suitable structure to be adopted; and should the Board coincide with this opinion, I have no doubt, that when completed, it will be viewed as the most satisfactory work.

Respectfully submitted.

JOHN B. JERVIS,

Chief Engineer, N. Y. W. W.

The Commissioners, for all sufficient reasons, preferred the high bridge to the tunnel, and without having in any degree changed their own views, as to the superiority of the syphon bridge to either, they issued a notice on 15th June for building a bridge of masonry, in conformity with the specifications exhibited.

Meantime the general work on the line went forward "with full as much speed," say the Commissioners, "as is desirable under present circumstances;" they add, "had the Commissioners, however, been left to pursue the original plan of the work, there can scarcely be a doubt that the Croton water would have been flowing through our streets, and regaling both the taste and sight of our citizens, on, if not before, the 4th July, 1842."

The summary of the work for the first six months of 1839, is thus given:

1st. THE AQUEDUCT.—The whole length of aqueduct, arched complete, is 77,587 feet, running measure, or about 14 miles and two-thirds. That completed on the first of January last, as per our semi-annual report of that date, was 59,169 feet, or 11 miles and one-fifth. The increase in this part of the work, since our last report, is 18,418 feet, or about three and a half miles in length.

2d. SIDE WALL.—The length of side wall ready to receive the brick facing and arches, was, at our last report, 1,443 feet. It now amounts to 17,535 feet, making an increase in this description of the work, of 16,092 feet, in six months.

3d. CULVERTS.—There are 92 culverts now complete and in use, leading off the water of the several streams at which they are the conduits. Their length in the aggregate is 6,240 feet. The number completed at our last report was *seventy-nine*, and their length 5,476 feet. There is, therefore, an increase of 13 in the number of culverts built since our last report.

4th. TUNNELS.—The number of tunnels excavated through their whole length, is *five*, and in the aggregate, are 1,197 feet long. Only *three* were completed at our last report, of 667 feet in length, which shows an increase of *two* tunnels completed, 530 feet in length. There are in progress of completion, besides the above, *six* tunnels, which have been excavated in the aggregate, 1,809 feet, making the aggregate of tunnelling, up to the 25th of June last, 3,006 feet, and of masonry in the tunnels, of 1,707 feet, being an increase since our last report, of 1,152 feet.

5th. FOUNDATION AND PROTECTION WALLS.—The foundation wall laid, is 91,980 cubic yards, and protection wall, 74,270, making a total of 166,250 cubic yards. The quantity of this description of work performed at our last report was 95,027 cubic yards, which shows an increase, for the last six months, of 71,221 cubic yards of foundation and protection wall.

6th. VENTILATORS AND WASTE WEIRS.—These necessary and ornamental structures, will be placed at equal distances along the whole line. *Six* of them are now complete, and *seven* in progress. They are built of marble, or a light colored stone, from 14 to 20 feet in height, rising up in the form of a pyramid, and may answer to point out to strangers, the line of the aqueduct, as well as vents, through which the collected air may discharge itself.

There is, in addition to the above, a vast amount of labor which cannot be well described, except by extending this report to an inconvenient length — such as the rock and earth excavation, the stone quarried and dressed, the vast embankments thrown up in the numerous valleys and ravines, over which the aqueduct has to pass, with the necessary machinery and tools prepared for carrying on the operations.

Some important and expensive structures, however, which are not included in the sketch given above, ought not to be omitted, although the description must be very brief and imperfect. Take for example the following:

1st. An archway over a street, in the village of Sing Sing, of 20 feet span, and 14 feet in height.

2d. The aqueduct bridge over the Sing Sing Kill a considerable run of water, possessing several mill privileges. The arch of this bridge is 88 feet span, and about 70 feet in height from the bed of the creek. The centres for turning this large arch, have been up for some time past, and thirty courses of the arch stone laid. The aqueduct proceeds from the Sing Sing tunnel, crossing both the aforesaid street and creek, from north to south.

3d. An archway over the Highland turnpike, now highway, about eleven miles below the Croton dam, of 20 feet span, and 14 feet in height.

4th. The large culvert on Mill River, requiring an arch of 25 feet span, and 170 feet in length, situated about thirteen miles below the Croton dam. The depression of the valley through which this stream passes, is 72 feet below grade, and the height of the foundation wall, including the aqueduct, reaches to 87 feet above the bed of the river.

5th. A very expensive archway, forming a carriage way under the aqueduct, at Jewell's Brook, about seventeen miles from the Croton dam, of 14 feet span, and 125 feet in length. The foundation wall at this place is 50 feet in height to grade, and 62 feet to the top filling of the aqueduct.

6th. An aqueduct bridge over the railroad at Harvey's marble quarry, of 16 feet span, and 10 feet in height.

7th. An archway over the road at Saw Mill River, of 16 feet span, and 14 feet in height.

8th. The large double culvert on Saw Mill River, with arches of 25 feet span each and 82 feet in length. The river is 42 feet below grade, and to the top of the aqueduct, 56 feet. The two last structures are connected, the aqueduct passing over both of them, in its course to the city

These important pieces of workmanship, are composed of the first quality of building stone, hammer dressed, and well bedded together. They are a credit to the skill of the mechanic, as well as to the architect, and are now nearly complete, the arches of all of them being closed, except at Sing Sing Kill, and Saw Mill River, both of which will be closed before the termination of the present working season.

The Corporation, on their part, continued preparations for the distribution of the water. The following resolution, adopted by both Boards, was approved by the Mayor on the 17th of April:

Resolved, That a line of water pipes be laid through Christopher-street, from Hudson-street to Sixth avenue; also, through Clarkson-street, from Hudson to Varick-street, through Varick to Hammersley, through Hammersley to intersect with pipes already laid in Houston-street, also through Houston-street from Hudson-street to Greenwich-lane, and through Greenwich-lane to the Sixth avenue, and that the Water Purveyor be authorised, under the direction of the Joint Committee on Fire and Water, to advertise for estimates for the necessary pipes and fixtures, to lay the same agreeably to the Water Commissioners' map.

In order, moreover, to comfirm confidence in stocks issued for the Water Stock, they adopted this resolution in June:

EXTRACT OF A LAW OF THE CORPORATION, ENTITLED "A LAW PROVIDING FOR THE REDEMPTION OF THE CITY STOCK."

§ 2. All revenue to be received for water, to be procured by the works for supplying the city of New York with pure and wholesome water, and furnished to the inhabitants of said city, is especially pledged and appropriated as a Sinking Fund towards the redemption of "The Water Stock of the City of New York."

Approved by the Mayor, June 19, 1839.

During the next six months, until 31st December, the contractors seem to have pressed forward their work with undiminished zeal, having in their employment, on an average, from 3000 to 4000 men. The expenditures during the year, reached the great amount of $2,300,438, and at the close of it the following results appeared:

1st. *The Aqueduct.*—The whole length of aqueduct, arched complete, is 137,630 feet, running measure, or about 26 miles. That complete on the 1st of July last, as per our semi-annual report of that date, was 77,587 feet, or about 14 and two-thirds miles. The increase in this part of the work, since our last report, is 60,043 feet, or about *eleven and one-third miles.*

2d. *Culverts.*.—There are now 114 culverts complete and in use, for discharging the water of the several streams on which they are erected. Their length, in the aggregate, is 7542 feet. The number completed at our last report was 92, and their length 6240 feet. There is therefore an increase of *twenty-two culverts*, since the first of July last.

3d. *Tunnels.*—The number of tunnels excavated through their whole length, is *seven*, and they are, in the aggregate, 2068 feet in length. There were five completed at our last report, of 1195 feet in length, which shows an increase of *two* tunnels completed, of 873 feet in length. There are besides the above, *nine* tunnels in the progress of completion, that have been excavated in the aggregate, 2133 feet, making the total of tunnelling up to the 25th of December, 4201 feet, and of masonry on the aqueduct, within the tunnels, 2476 feet, being an increase, during the last six months, of 1964 feet in length.

4th. *Foundation and Protection Wall.*—The foundation wall now laid, amounts to 115,210 cubic yards, and the protection wall to 114,384, making a total of 229,594 cubic yards of dry wall, which shows an increase, during the last six months, of 63,344 cubic yards of wall.

5th. *Ventilators and Waste Weirs.*—There are 24 of these necessary structures now finished complete. A large portion of them are intended as ventilators to discharge the superabundant air collected in the aqueduct, and a few of them are fitted for waste weirs, for discharging the water from the aqueduct, if at any time repairs should be required, or any other cause make it necessary. There were *six* complete on the first of July last, making an increase of *eighteen* in this description of the work. Besides the foregoing, there has been a great deal of work performed, which cannot be described with the necessary degree of accuracy and plainness to make it understood, such as earth and rock excavation, which has been performed before the grade of the aqueduct could be reached; embankment and backfilling, performed after the aqueduct is in form, &c.

There is still about *six and a half miles* of aqueduct to complete, in the county of Westchester, and about *seven and a half miles* of aqueduct and pipe work, on the island of New York, making the length of the unfinished work, about *fourteen miles.*

This was a very trying year for financial arrangements; nevertheless, the city continued to face all its engagements with punctuality, and to meet the great expenditure on account of the aqueduct; and the Commissioners, although not charged with any agency in raising the money needed for the work, nevertheless express their clear conviction that it would be better to pay higher interest, if necessary, for the amount required for the next year, than to incur the loss of interest, the claims of damages from contractors, and the unavoidable injury to the unfinished works, that would result from a suspension.

The Commissioners at the same time estimate the wants of the year 1840, at $2,100,000.

The high bridge was contracted for in August, 1839, at $737,755, conditioned that it should be completed in August, 1843. Meantime, it will have been perceived in the report of Mr. Jervis, that he suggested as a temporary expedient, the laying down pipes along the coffer dam in the river, through which the Croton water might be conducted to the New York shore. The Commissioners repeat this suggestion without expressing an opinion concerning it, but in referring to the rapid execution of the general work they say "there is hardly a doubt that the whole line from the Croton to the Harlem, will be finished, some years, before the expensive and difficult work over the latter river can be."

Much, however, and of very difficult and expensive construction, remained to be done on the island of New York. Independently of the stupendous works at the Harlem river, scarcely yet commenced, there were the expensive crossings at Manhattanville, and at the Clendening valley, besides the two reservoirs, on all of which, as yet, but little progress had been made. Indeed, so heavy and so costly was the work on the island, that it alone, extending through only seven miles, was estimated to cost more than three millions of dollars, about two thirds of the original estimates by Major Douglas and Mr. Martineau, for the whole work.

These two engineers, without consultation or co-operation, made separate estimates in 1835. That of Major Douglas, was for $4,786,637 00, that of Mr. Martineau, for $4,225,814 00. The difference arose from the mode of passing the Harlem, which, by Mr. Douglas's plan was on a high bridge, and Mr. Martineau's by inverted syphons, on a low bridge.

With such apparent agreement, the Commissioners were well foun ded in assuming that *five millions* would certainly accomplish the work, yet the result has proved the estimates in question, to be entirely delusive. This may be explained, without impeaching the sagacity or accuracy of those engineer, by the facts, that they had no actual experience derived from the price at which contracts would be taken—that the difference in the cost of land from that which it bore in 1835, and that afterwards placed on it by speculators and interested persons, was beyond calculation—and that the prices of work and materials were largely enhanced between 1835 and 1837. "The whole project, in fact," say the Commissioners, " was entirely new, and perhaps without precedent as to cost, and therefore it ought not to be considered as a want of talent, that mistakes were made in estimating the expense."

In confirmation of these views, and of the great liability to error in estimates for undertakings of such a nature and extent, the reader will recall the fact stated in the Preliminary Essay, that almost all the estimates for the various water works of London, fell vastly short of the actual cost.

On the 27th of December, 1837, after he had placed thirteen sections of the first division under contract, and therefore with some practical experience of the value of such work, Mr. Jervis made an estimate of the cost, so far as the engineering was concerned,

of the whole line, which amounted to - - - - - - -	$7,877,346 00
This was exclusive of the cost of land, salaries, and other expenses, which the Commissioners themselves estimated at - - - -	586,567 00
	$8,464,033 00
For the additional cost of the high bridge, - - - - -	443,432 00
	$8,907,465 00

Nine millions therefore, may be assumed as the cost of the aqueduct, over and above the loss of interest on the capital, until the work be finished and productive.

This report closes with a general recapitulation of the work done, of the difficulties overcome, and of the nature, form, and materials of the aqueduct, all which we propose to present in a connected form, after the narrative of the progress of the work is completed.

On the 30th March, 1840, the Commissioners, who, from the commencement of this great enterprise, had directed and superintended its progress, having been superseded, made a final report to the Board of Aldermen. This sets forth the precise condition of the funds which they had received, of which the details, with accompanying vouchers, were communicated to the Comptroller, and the balance in hand paid over to their successors; it gives information of the exact condition of the work, and of what had been done since January, and finally adds the satisfactory statement that the whole line of aqueduct had then recently been examined by the chief engineer, who reported very slight injury from a very inclement winter.

Having surmounted many and great difficulties in the execution of their trust, having disbursed nearly *four and a half million dollars*, without the error of a cent in account with the Comptroller, with the whole of the land required for the aqueduct in peaceable possession, with the contracts for the entire works made, and a large portion of them completed—the Commissioners handed over the trust to their successors, whose path was so comparatively plain and easy.

Their report thus concludes:

The late Commissioners are free to confess, that they feel a deep interest in the success of the work, and would have been pleased, had circumstances permitted, to have continued their superintendence until its completion. They hope, however, that it will be prosecuted by their successors, in a manner creditable to themselves and beneficial to the public. We leave with them our efficient and highly esteemed chief engineer, John B. Jervis, Esquire, for whose services in the successful prosecution of the work, the public are greatly indebted. The industry and ability with which he has conducted this great enterprise, will carry his name to future time, let who will be charged with its completion. We cannot forbear expressing the hope, therefore, that our successors will avail themselves of the talents and acquired knowledge of Mr. Jervis, for the further prosecution of a work of so much importance to this city. The advantages in retaining his services, and also of his present assistants, must be obvious; as the information they possess, relative to the manner in which the contracts are to be fulfilled and executed, of the materials to be used, of the plans and specifications in explanation of the several parts of the work to be performed, and of numerous other matters connected with it, will be, in our opinion, of the first importance to those who are to have the supervision of its progress, and an efficient aid in the substantial construction of the work. This information cannot be possessed by any, be their abilities what they may, without the practical knowledge which is only acquired by years of attention and familiarity with the subject.

The Commissioners claim no further merit for themselves, in conducting this important concern thus far, than what is fairly due for a devotion to the duties enjoined on them by the tenor of their office, and for the faithful disbursement of the large sums placed in their hands by the Corporation officer charged with that duty.

Respectfully submitted,

STEPHEN ALLEN,
WILLIAM W. FOX,
CHARLES DUSENBERRY,
SAUL ALLEY,
THOMAS T. WOODRUFF, } *Late Water Commissioners.*

New York, March 25, 1840.

It would be eminently unjust, in parting with these Commissioners, to withhold from them the praise of having faithfully, intelligently, and assiduously fulfilled the trust which they had held for so many years. The Chairman of the Board in particular, *Stephen Allen*, has left upon the work, from its commencement to the advanced stage in which he relinquished it to his successor, the stamp of his energetic character and strong and inquiring mind.

The new Commissioners, Messrs. Samuel Stevens, Benj. Birdsall, John D. Ward and Samuel B. Childs, immediately entered upon their duty, and with great fitness, Mr. Stevens, who from so early, and through so long a period had labored for the introduction of pure and wholesome water into the city, was named the Chairman. Their first want was money, which, upon application to the Legislature by the Common Council, that body was, by law of 27th April, authorised to raise to the extent of three million dollars, at an interest not exceeding six per cent., and for a period not exceeding thirty years. The following provisions of the law restrict the use of the funds thus to be raised, and looked well to the security of the lender.

§ 4. All the provisions of the laws heretofore passed on the subject of the Croton Water Works, pledging the faith of the city of New York, providing a sinking fund for the redemption of the stock issued by virtue thereof, are hereby made applicable to the stock issued in pursuance of this act.

§ 5. No part of the fund created by this act, or any other fund raised for the purpose of constructing or completing the Croton Aqueduct, and the works connected therewith, and distributing the water throughout the city, shall be diverted from such object; and no item of expenditure hereafter to be made by the Corporation of the city of New York, and not approved by the Water Commissioners and Comptroller of said city, shall be charged by the Corporation of the said city to the debit of the said fund; but this provision shall not apply to the refunding of advances heretofore made by the said Corporation, for or on account of the said aqueduct, or the water pipes connected therewith.

At the same session the Legislature remedied the injustice which had been attempted in some of the towns of Westchester, through which the aqueduct passed, of taxing it as personal property. The law of 7th May, restricted the assessors to taxing the lands in Westchester county occupied or used for the aqueduct, only upon their value, *exclusive* of the works.

The Common Council lost no time in passing an ordinance authorising the Comptroller to issue stock for this new loan, and on 21st May they constituted, by resolution, a *Committee on the Croton Aqueduct*, to be composed of a joint special committee of both Boards. To this Committee were to be referred all matters relating to the aqueduct, except the sale and disposal of stock and other duties ordinarily belonging to the Finance Committee.

The new Commissioners retained the corps of engineers as they found it, with the very capable chief at its head, and the work made rapid progress during the year.

The first report in January, 1841, and embracing the period from 20th March, to December 31st, gives this summary of what was done.

Present state of the Work.

It will be recollected that the whole work is divided into four great divisions, and which collectively, are divided into one hundred and one sections, generally one half of a mile in length.

The *First Division*, which embraces the Croton Dam, Croton River, and first 10 177-1000 miles adjoining the same, may be said to be completed. The dam requires an expenditure of about one thousand dollars to complete the contract. The bridge across the Croton River, which was made in lieu of the one overflown by the water of the river, and the portion of the turnpike also required to be made, are both done, as well as the private road adjacent to the river, and it is expected the Commissioners appointed by the State to judge of this matter, will receive the bridge and roads, as a full substitute for those which our works rendered useless. There is an iron railing and gatekeeper's house, with some other small contingencies, which are estimated at four thousand dollars, to complete all the work at and near the dam.

The dam across the Croton River was commenced in January, 1838, and is now all but completed. It is believed to be durable in its character, and possessed of sufficient strength to resist the Croton, which is, however, a stream occasionally rendered by freshets, very powerful and turbulent.

The dam is formed of hydraulic stone masonry, connected with an earthen embankment. The embankment is about 250 feet long, 65 feet high at its extreme height, 250 feet wide at base, and 55 wide at top. This embankment is supported and protected on its lower side by a heavy protection wall 20 feet wide at base.

The portion of the dam over which the water flows, together with the abutment and bulkhead adjacent, is of hydraulic stone masonry; their united length is 105 feet. The width of the sheet of water flowing over the dam is 90 feet, and it is supposed in times of a freshet will be from four to six feet deep; it has already in the last autumn been equal to three feet. The area of the Croton Lake is about 400 acres, the available capacity of the lake taken at seven feet deep, (the depth to which the water can be drawn down,) and of an average area of more than 300 acres, may be stated at 600 millions of gallons.

The total capacity of delivery of the aqueduct is about 50 millions of gallons for 24 hours, but in case the lake is being reduced seven feet, by a discharge through the aqueduct, not more than 35 millions can be calculated on as the average delivery during *that* time.

The flow of the Croton in ordinary low water exceeds 50 millions for 24 hours, and the minimum flow after long continued drought has been ascertained to exceed 25 millions, consequently, assuming the Croton at its *lowest rate* of flow, there would elapse 60 days before the lake would be reduced seven feet, and 60 days before the delivery of the aqueduct would fall below 35 millions of gallons in 24 hours.

In addition to this abundant supply, the water of the river at various parts for the distance of 15 or 20 miles could be dammed up, at a small expense, and large ponds made to discharge into the Croton, which would always furnish a supply far beyond the capacity of the aqueduct to discharge; and the singular fact also exists, that a stream called the Ten Mile River, of very considerable supply of water, which now discharges into Long Island Sound, might be diverted or made to pass into the Croton. This fact is mentioned for its singularity, rather than from its being of any importance to the work. The lake, formed by the dam, flows already over some lands not embraced by the deeds or rights obtained by our predecessors; and when it is considered that it is liable to rise three feet higher than it has yet been, it will be perceived that the extent of our water line must be considerably increased; but as the surface of the lands subject to be overflown beyond the Corporation title, is mainly of inconsiderable value, the damages will be small.

The beautiful sheet of water now formed by the dam, the Board have called the Croton River Lake, as readily distinguishing it from the entirely artificial reservoirs. The highest point of land on the eastern side of it, in a late visit with the Corporation to the Croton River Lake, was named "Mount Varian," in honor of our worthy Chief Magistrate, during whose mayoralty the works at the Croton River have been commenced and completed.

Second Division, commencing at the southern termination of the first division (about three miles south of Sing Sing) and running 10 732-1000 miles to the village of Hastings, is also entirely completed, if we except about 140 yards in length at the Mill River Valley, which is a high stone wall and embankment designed to support the aqueduct, and to complete which requires about 20,000 dollars.

Third Division, which commences at the southern termination of the second division, near Hastings, and runs in a southerly direction 9 669-1000 miles, to within about two miles of the Harlem River. This division is all completed, and the final payments on the contracts are liquidated.

Fourth Division, commencing at section 80, terminating the third division, and running to the Battery in the First Ward of the City of New York, distance in all fourteen miles. Of this division, sections 80, 81, 82, 83, 84 to 85, in length about two miles, are in Westchester County, and are entirely completed.

The whole distance in Westchester County, all of which is nearly completed, is 32 miles and two-thirds of aqueduct, the arch bridge of 88 feet span at Sing Sing, 12 tunnels (or under ground excavations for the aqueduct,) whose aggregate length amounts to

4406 feet, 32 ventilators for the escape of the air from the tunnel, and four waste weirs, for the discharge of the surplus water from the aqueduct.

The Harlem River Bridge.

After leaving the sections of the fourth division in Westchester County, we arrive at section 86, which includes the crossing of the Harlem River, and here we have been engaged with the *high bridge.* We should be happy to be enabled to state, that this structure could proceed as rapidly as the remaining part of the work, and would be as soon completed.

This bridge, it will be recollected, is, by the plan, to be supported by seven *land arches*, each of 50 feet span, on the valley between the river and the adjacent hills, and over the river by eight arches of 80 feet span each, the crown of the *intrados* of the arches is 100 feet above the surface of the water, and the height of the superstructure near 120 feet. We have sunk four coffer dams in the river for the river piers, and built the foundations of two piers to above high water mark, and another is about four feet above the foundation. The amount of money spent on the Harlem Bridge, for the work and materials not yet used, amounts to $91,100.

Leaving the Harlem River, as you approach the city, we have section 87 of the aque duct, which includes a small tunnel through rock, completed or nearly so; 88, 89 and 90 are in a great state of forwardness; when you arrive at section 91, which includes the crossing of Manhattan Valley. This section is a mile in length, and one of the heaviest on the line; it consists of 800 feet of tunnel cut through rock, and about three-fourths of a mile of grading for two lines of iron pipes of 36 inches diameter. This last section is about one half completed, and will easily be completed the next fall. We then arrive at section 92, which is nearly completed, with the exception of the tunnel, which is 420 feet long, through rock, 120 feet of which is excavated. The next section, No. 93, is completed, and the account settled. Section No. 94 crosses the Clendening Valley, and embraces a very heavy stone foundation wall and three arches, or aqueduct bridges, for contemplated streets. This section is about three eighths of a mile long, is about two-thirds finished, and the contract for completion expires next fall. Section 95 is also about two-thirds completed. No. 96 embraces the receiving reservoir, which covers a surface of thirty-two acres, at Eighty-sixth-street, and is about one-half completed; the contract expires next fall. Sections 97 and 98, together two miles in length, are to be constructed by laying down two lines of iron pipes of thirty-six inches interior diameter, which are to form the connexion between the two reservoirs; about one-fourth of this work is done. We then come to section 99, which is composed of the distributing reservoir, which work is about one-half completed. In reference to this work it is greatly to be regretted that Forty-second-street should have been reduced to so low a grade, which has increased very greatly the cost of the walls, without adding in any respect to the utility or beauty of the work. This location being higher than any of the adjoining lands, it is not obvious why your predecessors required it to be cut down at so great an expense to the city, and disadvantage to the reservoir, as it required the walls on Forty-second-street to be sunk nearly twelve feet lower, and on the sides, fronting the Fifth avenue and Fortieth-street, an average of eight feet lower than would otherwise have been required.

The remaining work, south of the distributing reservoir, consists in laying down the large mains to supply the lower parts of the city with water, and the small pipes to distribute it through the streets, the progress of which is known to your honorable bodies.

During the last fall, the water was introduced, several times, from the Croton Lake into the aqueduct. For greater security it is made to pass through two chambers, each having nine small gates, of 16 inches by 40 inches, by which any unusual velocity, growing out of the variations in the head of the water in the lake, may be controlled or equalised.

In the instances we have referred to, the water passed through the first eight miles of the aqueduct, to a waste weir at Sing Sing, where it was discharged in six hours. This strengthens the opinion, that it will certainly pass through the whole line, as fast as at the rate of one mile per hour, which is the rate calculated on.

The frequent use of the thermometer has shown that the temperature of the aqueduct was fifty degrees, in our coldest days previous to the 1st of January. This proves that neither the water nor the masonry of the arch will be exposed to frost. The variation of temperature between summer and winter is found to be only five degrees.

We have only excavated the rock and earth between the two reservoirs of a width sufficient for two, instead of three lines of large pipes, which will furnish a sufficient supply for at least half a century. The saving in this particular amounts to 10,000 dollars.

We were not able to make any arrangement with the contractors for the receiving reservoir at Yorkville, by which we could abandon, for the present, the construction of the northern division of this work, as proposed by us, with any advantage to the public; so much work having been already executed, and so much of the earth being required for the embankments of the streets surrounding the reservoir and the southern division, that we were obliged to let this reservoir proceed, as contemplated by our predecessors; except, that we do not excavate the rock, as was previously intended, by which there is a saving, as estimated, of 75,000 dollars.

We have added to the expense of the distributing reservoir about $9,000, in consequence of having adopted a different finish from that contemplated by our predecessors. With the exceptions above stated, and the abandonment of the three arched bridges at Clendening Valley, the work has in all other respects been progressing agreeably to the plans of our predecessors in office.

The project of dispensing with some of the arches over Clendening Valley, was approved by the Common Council, but vetoed by the Mayor, Mr. Varian, on the ground that it would close streets, which, according to the map of the city, were at some future period to be opened in the direction of the arches to be dispensed with. The Commissioners, in the report under consideration, examine at length and in detail, the objections of the Mayor, which they thought might all be obviated—even admitting, which they do not, that the lines traced on the map of the city as future streets, thereby became in law and fact streets, by running a street parallel with the aqueduct, at which these future streets would terminate, and along which the travel might pass a short distance till the occurrence of an arch, of which three were still to remain.

Neither Board of the Common Council took into consideration this *veto* of the Mayor, and the Commissioners, deeming that the responsibility for the work and its construction, was legally with themselves, persisted in their plan of dispensing with the three arches, thereby saving an expenditure of $52,000, subject to the deduction of $4500 only, for damages paid to the contractors for the change of plan.

The high bridge over the Harlem River, reappears in this report, as a difficult, costly, and not necessary work—and inasmuch as the plan agreed upon by the former Commissioners, was not to continue the grade line of the aqueduct, but to descend on the Westchester side some 14 feet with the water in iron pipes, and after passing it over the river in a horizontal line, to raise it on the New York side within 2½ feet of the elevation from which it was taken on the north shore, this report recurs to the low bridge, as safer, much cheaper, and with its centre arch of 50 feet height from the water, offering no obstacle to any probable navigation of the Harlem. The saving in time, by this plan, would be nearly two years; the saving in money, nearly $200,000. This recommendation, however, found no favor, and as a positive law of the Legislature enjoined the construction of the high bridge, if any, the work on that plan was steadily prosecuted.

During the month of April, some of the laborers on the upper part of the line struck for wages, and not content with abandoning work themselves, associated in large numbers, and marching along the line, compelled those who were willing to work on at present rates, to break off. The efforts of the civil authorities to restrain the violence of these lawless men, proved unavailing; and the Commissioners having communicated to the Mayor their apprehension of damage to the work, a military detachment was ordered on the line, at whose appearance order was speedily restored and work resumed.

In the course of this year a difference of opinion arose between the Commissioners and the Common Council, in relation to their respective duties in laying the distributing pipes.

On the 4th May, the Commissioners made a communication to the Board of Aldermen, calling their attention to the subject of laying down distributing pipes through the city, and expressing their doubts whether committees of the Corporation, necessarily changing from year to year, could execute the work as properly, economically, and seasonably, as a fixed department.

By the law of 28th April, authorising the additional loan of three millions, the fifth section of which is quoted in a preceding page, it is expressly enacted "that no item of expenditure should be charged against the water stock fund, except the same is approved by the Water Commissioners *and* the Comptroller." Under this provision, the Commissioners stated to the Board of Aldermen, that they felt constrained to call the attention of their engineers to the subject of supplying the city with pipes, and laying them down.

"The extent of the subject," say the Commissioners, "and its importance, will be readily perceived, when it has been stated by our predecessors, that lines of pipes, to the extent of 165 miles, will be required, and as early as the spring of 1842, according to the opinions of our predecessors, from which we see no reason to dissent. The lines of pipes now laid down, are in extent about 35 miles, which are to be mainly abstracted from the length of line believed to be required. Now by the progress made the last year, and understood to be making for the present year, it would require 14 or 15 years to complete the laying down of the distributing pipes, supposing the city to remain stationary."

Another objection to the work being done by committees of the Corporation, seems to have been, that it was by day's work, and not by contract, and therefore less economical. All the other work on the aqueduct had been done by contract, and it is reasonably urged that the same practice should be observed in laying down the distributing pipes.

The former Commissioners had so construed the then existing laws, as to terminate their duties and responsibilities at the distributing reservoir; and they had so reported to the Common Council. But this was antecedent to the law of 28th April.

The Commissioners, after elucidating the grounds on which they differ as to this point from their predecessors, urgently pressed upon the Board of Aldermen for a decision, before the new Board came in, as the incumbents were familiar with the subject, and it would necessarily require some time for their successors to become so.

No decision, however, was made. In August an ordinance was adopted, organising the *Croton Aqueduct Department*, to be composed —

1. Of the *Croton Aqueduct Committee*, being a joint committee of three members from each Board, whose duties are thus defined:

§ 2. All bills for expenditures incurred in relation to the said department, shall be carefully examined by the Croton Aqueduct Committee, and, if approved, shall be signed by the respective Chairman thereof, and paid.

§ 3. The Croton Aqueduct Committee are hereby vested with the powers necessary for making all contracts in relation to the said department, and for conducting the water-works, purchasing materials, and distributing the water; provided always, that the powers of the said Committee shall not be construed to interfere with those now vested in the Water Commissioners, and that the contracts of such Committee shall not exceed the amount of the moneys which may, from time to time, be appropriated for the several objects aforesaid; and the said Committee is hereby required to make reports monthly to the Common Council of their proceedings.

2. Of an Aqueduct Commissioner, at a salary of $1000 per annum, to give bond in $5000, and take an oath faithfully to perform his duties—which are to superintend and direct the aqueduct department, to take charge of all contracts, books, papers, and vouchers of the department, to file copies of all contracts immediately upon their execution, in the Comptroller's office, to keep a complete record of every transaction apper-

taining to the water pipes, and the distribution of the water in the city, showing the cost of the pipes, whence obtained, &c., with a complete description, map, and plan of all the different sizes of pipes now laid down, and to be laid, with the exact dimensions of their offsets in each street, and the distances they are laid from the sidewalks, in order that the size of the pipes, and their offsets, with their exact location may be known thereby.

He is also, under the direction of the Committee, to advertise for, and make contracts, examine and certify bills for work, and generally to perform such duty as may be required of him by the Croton Aqueduct Committee. He is also to make a quarterly report to the Common Council, of the detail of every expenditure in the department, with the number of the different sizes of water pipes and their connections, on hand and under contract.

3. Of a Water Purveyor, to be subject to the direction of the Committee and the Commissioner.

Next month, viz: on the 24th September, the Common Council passed an ordinance, which summarily determined, so far as they had the power, the points at issue between them and the Water Commissioners.

The first section directs the Comptroller to charge to the Water Works, all the requisitions of the *Water Commissioners*, for or on account of the Croton Water Works, *north of, and including, the distributing reservoir*, and the requisitions of the *Croton Aqueduct Commissioners*, for or on account of the procuring and laying down water pipes in the city of New York, *south of the said distributing reservoir.*

The concluding sections are in these emphatic words:

§ 3. No contract that may hereafter be entered into by the Water Commissioners, shall be binding upon the Common Council until ratified by the Common Council.

§ 4. The powers of the Water Commissioners shall not extend to the making of any contracts for materials or labor, to be used or employed in the city of New York, or in procuring and laying down water pipes in said city, south of the distributing reservoir; and they are hereby instructed not to enter into any contract for the procuring or laying down mains and water pipes in said city south of said line — this duty having already been invested in the Croton Aqueduct Commissioner and Croton Aqueduct Committees of the Corporation.

Approved by the Mayor, September 24, 1840.

A long and somewhat angry controversy was the result of this ordinance. It will not be either useful or agreeable to renew the details of it in these pages. We content ourselves, therefore, with a single statement of the points on which it turned.

The Water Commissioners maintained that the laws of this State direct that all the moneys raised from the sale of the Water Stock, issued for supplying the inhabitants of this city with water, shall be expended " by and under the direction of the said Commissioners."

That the work thus entrusted to them embraces the full and entire completion of the original plan for supplying water to this city for the use of its inhabitants, and that "*the plan*" adopted by the Commissioners, ratified by the Common Council, and approved of by the people, comprehended as well the necessary work for bringing the water to the city, as the furnishing, laying down, and fitting for use, the distributing pipes throughout the city.

The Water Commissioners also claimed, that since the passage of the Act of April 27, 1840, no item of expenditure made by the Common Council, can be charged to the debit of the Water Fund, without their approval.

The Committee of the Common Council, the Comptroller, and the Counsel to the Corporation, contended that the original plan adopted, ratified, and approved of, for supplying the city of New York with water for the use of its inhabitants, terminated at Murray's Hill, and that the Water Commissioners cannot therefore, legally, construct or superintend, any part of the work south of that point.

And, consequently, the Common Council had the exclusive right and power to construct and complete all the necessary works south of Murray's Hill, including the procuring and laying the distributing pipes; and for this purpose can use such portions of the Water Fund as may be requisite, and that the same can be paid for out of that fund, by the Comptroller, without the approval of the Water Commissioners.

After reports and counter reports, opinions of counsel and various discussions, the Corporation made good their ground, and exercised the exclusive right of distributing the water from the reservoir at 40th street.

A very serious loss, the first that deserves the name, occurred to the work on the night of the 7th January, 1841, by a great and sudden rise in the water of the Croton, and consequently of the Croton Lake, which carried away the dam for a distance of near 200 feet. It was the part described as an earthen embankment, with a base of 250 feet, and protected on the lower side by a dry stone wall of 20 feet thickness at the base. The mason work was but slightly injured. The storm and its effects are thus described by the Commissioners :

" This unprecedented rain storm commenced on Tuesday evening, the 5th instant, and continued without cessation until Thursday night, the 7th instant, at 12 o'clock. The commencement of the rain storm found the ground covered with snow eighteen inches deep. The rain was heavy and the temperature of the weather very warm. On the evening previous to the disaster, it was perceived that the water was rising on the bank above the overfall of the dam, very fast. The rise continued through the night to be equal to about 14 inches per hour. At half past 4 o'clock, the water having risen 15 feet above the overfall or apron of the dam, and two or three above the earthen embankment, (which was 12 feet above the overfall,) the embankment part of the dam gave way. It was obvious from the beginning, that if the water passed over the earthen embankment, it would carry away this part of the dam; and the result to be expected immediately followed. The earth being washed away, the protection wall gave no resistance, and the earth and the heavy protection wall were all swept down the river, so as not to have left a single stone now remaining, on the section of the dam referred to.

"We have stated above, that the calculation was, that the water might rise from four to six feet above the overfall of the dam, but instead of this, it rose to about fifteen, and for this rise the dam was not calculated; the earthen embankment gave no protection against such a height of water; and the overfall was not of a capacity, although 90 feet in length, to discharge the water which the flood brought down. There is a small waste gate in the dam of five by six feet, but hardly intended to relieve the river when in flood. The water in part escaped through the aqueduct passing over the gates, and discharging itself, at a waste weir, near Mill River, a distance of nearly 15 miles, without any injury to the aqueduct. It is obvious, that greater provision must be made to allow this stream to pass in its natural channel in time of freshets.

"In addition to the above injury to our works, the freshet has left remaining no bridge over the Croton River on its whole length, either above or below the dam.

"There were three bridges below, one called Tompkins' Bridge, valued at 1400 dollars, the bridge at the Wire Mill, cost 1200 dollars, and the Quaker Bridge over which the New York and Albany stages pass, valued at 1500 dollars. Tompkins' Bridge was carried away before the dam went, as were also it is believed, the other two bridges.

"Mr. Albert Brayton, the son of one of the dam contractors, perceiving about one o'clock, the danger to the people below the dam on the opposite side, by the continued rise of the water at the dam, and believing that it must give way, with praiseworthy attention and foresight, hurried down to give the alarm, and when he arrived at Tompkins' Bridge, a distance of a mile, he found the bridge gone, and was not able to get across. He then went to a house for a horn, which he blew, and which was heard by the persons intended to be alarmed and who lived on the opposite side; but not understanding it, they took no measures for their safety, until still later, when the water began to come down in torrents. Two people at Baileys' Mills occupied themselves so long in removing their property, that they could not get with safety to the main land, and repaired to a small clump of trees in the channel; which, lamentable to say, were afterwards swept away, and no doubt these two persons were drowned. One of the laborers, lately on the works was also drowned. No dwelling house above the dam was carried away. John Tompkins, below the dam, lost his dwelling house, which was of small value, say five or six hundred dollars, and his son, John Tompkins, lost a grist mill and dam, value fifteen hundred or two thousand dollars. Two small dwelling houses at Bailey's Factory were also lost. The Wire Mill of the Messrs. Bailey's, supposed to be worth, with the two small houses above, from fifteen to twenty thousand dollars, was also swept away. An old grist mill, called Hallman's Mill, which had been abandoned, and not worked for many years, of little value, was also swept away. These are all the losses which have come to our knowledge on the Croton River, and all the losses to everybody above and below the dam, including the dam, are considerably inside of $75,000."

No other parts of the aqueduct were injured by the storm, and the Commissioners conclude this their first report with expressions of satisfaction, that thus far "the aqueduct on the line stood remarkably well, the culverts had been sufficient to discharge the waters from the valleys and streams, and the embankments had been but little washed or damaged by the unprecedented storm."

The prevalence of heavy rains in the spring of 1841, retarded the reconstruction of the Croton dam, which was contracted for anew, at an increased price indeed, but of larger dimensions and more durable materials; and delayed operations on the yet unfinished portion of the line.

The work had been found to withstand, with very little injury, the severe cold and the unusual floods and rains of the past season. The beautiful bridge at Sing Sing exhibited not the least settlement or defect; and, with the exception of some spots where, in order to maintain the grade line across low grounds, the aqueduct rests on dry foundation walls, in which slight settlement had occurred, the whole work stood admirably.

In their semi-annual report of 12th July, 1841, the Commissioners thus briefly report the doings of the six months:

The works on this island, including the reservoirs, the mains, Clendening Valley bridges, and the tunnels, have been progressing during the summer, although retarded from the want of punctual payments.

The foundation for the bridge over the Harlem River, so far as piers Nos. 7, 8 and 9 are concerned, has been laid in the bed of the river, and the sinking of the coffer dams has been attended with less difficulty than was apprehended. In fact, the bed of the river, when cleared by the removal of the sand and mud, and the immense boulders found therein, has proved admirably calculated for the support of the lofty and imposing structure intended to rest upon it.

Commissioners, contractors, and engineers, all complained, during this period, of the inequality and delay in the payments stipulated, occasioned partly, perhaps, by the former misunderstanding between the Commissioners and the Common Council, as to their relative rights and duties, but mainly by the financial difficulties of the times, and the exhaustion of the funds appropriated.

To put an end to all difficulties as to contested rights, as well as to provide the additional means needed for the completion of the work, the Legislature, on the application of the Common Council, passed a law on the 26th July, by a two-third vote, authorising the Corporation to raise three and a half millions more. We annex portions of that law, which is a very important one, as settling several material points: 1st. That of laying a tax on the citizens to pay the interest of the water loan. 2d. To limit the power of the Water Commissioners over the aqueduct to its termination at Murray's Hill. 3d. To authorise the Commissioners, with the assent of the Common Council, to change the plan of crossing the Harlem on a high bridge, to inverted syphons and iron pipes. 4th. To postpone the construction of a reservoir at Yorkville; and 5th, to authorize the Common Council to execute all the work south of Murray's Hill.

We annex these sections:

§ 4. The moneys to be raised by virtue of this act shall be applied and expended to and for the purpose of supplying the city with pure and wholesome water, according to the provisions of the act hereby amended; and no part of the funds created by this act, or any other fund raised for the purpose of constructing or completing the Croton Aqueduct, and the works connected therewith, and distributing the water through the city, shall be diverted from such object.

§ 5. All the provisions of law heretofore passed on this subject, pledging the faith of the city of New York, and providing a sinking fund for the redemption of the stock issued by virtue thereof, are hereby made applicable to the stock issued in pursuance of this act.

§ 6. It shall be lawful for the Mayor, Recorder, and Aldermen of the city of New York, as the supervisors of the city and county of New York, of whom the Mayor or Recorder shall be one, from time to time, and as often as they may deem it necessary, to order and cause to be raised by tax on the estates real and personal of the freeholders and inhabitants of, and situated within, the said city, and to be collected, such amount of money as shall be requisite to defray the interest upon the Water Stock of the city of New York.

§ 7. The said money shall be assessed and collected in the same manner as now provided by law for the assessment and collection of taxes in the city of New York.

§ 8. It shall be the duty of the Water Commissioners of the city of New York, to finish and complete the aqueduct for supplying the said city with water, down to and including the distributing reservoir at Murray's hill, according to the plan adopted by the said Commissioners, and ratified by the Common Council of the said city, with such immaterial alterations as may be necessary, and as may be agreed upon by the said Water Commissioners and the said Common Council.

§ 9. The said Commisoioners, by and with the consent of the said Common Council, shall have full power and authority to change the plan of crossing the Harlem river with arches and piers, and instead thereof to carry the water across the said river by means of inverted syphons of iron pipes, until otherwise directed by the Legislature, so as not unnecessarily to interrupt the navigation of the said river. And the said Commissioners are further authorised by and with the consent of the said Common Council, to alter the plan of constructing the reservoir at or near to Yorkville, and to complete so much of such reservoir as shall be deemed sufficient for the present purposes of such aqueduct.

§ 10. It shall be the duty of the Mayor, Aldermen and Commonalty of the city of New York, to execute all the work necessary for supplying the said city with water, and for distributing the same for the use of the inhabitants thereof, below the said distributing reservoir at Murray's hill; and the said Mayor, Aldermen, and Commonalty shall assume the execution and performance of the following contracts, made by the said Water Commissioners for work and materials to be supplied for the construction of the said aqueduct, below the said reservoir at Murray's hill; that is to say, their contract with Henry V. B. Barker, dated twentieth of October, one thousand eight hundred and forty, for work to be done on the Fifth Avenue, between Fortieth and Twenty-first streets; their contract with John B. Chollar and Ebenezer Jones, made the twenty-third of October, one thousand eight hundred and forty, for iron pipe; their contract with S. V. Merrick and John Town, for seven hundred tons of thirty-inch iron pipe; and also their contract with T. H. Wintersteen and David I. Myers, for five hundred tons of iron pipe; all which said contracts are deposited in the office of the Comptroller of the city of New York.

The relative rights and duties of the parties being thus authoritatively settled, each proceeded, in his own sphere, to accomplish the matter in hand.

It being strenuously desired that the city should, in the summer of 1842, be in the possession and enjoyment of the water, every effort was made to ensure such a result. Obstacles, however, arising from the great difficulty of the principal operations yet unfinished, disappointed partially, the hopes of the engineers and Commissioners. The contractors for the new dam in the Croton, for instance, were bound to have it in such an advanced stage by 1st November of this year, as to throw *two feet* water from the lake into the aqueduct. The next disappointment was in the bridge over the Harlem, arising from not finding, as the soundings had indicated, a rocky bottom on which to rest the foundation of some of the piers of the bridge. Nevertheless, the Commissioners and the engineers still adhered to the opinion that the 4th of July, 1842, would witness the introduction of the Croton into the houses and fountains of the city.

The Report of the Commissioners on 17th of January, 1842, thus exhibits the state of the work:

Of the first division, the aqueduct part is finished, and was nearly so on the 1st of January 1841. The only part of this division remaining unfinished, is the dam. After the carrying away of the earthen embankment, comprising a major part of the dam, the undersigned concurred with the engineers in the advantage of constructing the new dam on an entirely different plan from the one previously constructed; and instead of the extended earthen embankment, a continuous stone dam, laid in hydraulic cement, was decided on; to be constructed entirely across the river, so that the overfall, or apron of the dam, will be of the same extent as the natural breadth of the river. The length of the new part of the dam (the mason work of the old dam not having been carried away) is 180 feet; so that with the mason work of the first erected dam, which still remains, it will make a dam of an overfall of 260 feet. The dam, when completed, will be about 50 feet high, having a base of masonry 65 feet wide; and banked in, on the up stream side, with an embankment 250 feet wide at base. The profile of the face of the dam corresponds with the curved form which the water will assume in pouring over it, and is coped with cut stone, in the most substantial manner.

At the toe of the dam, a heavy apron of crib work, 8 to 12 feet deep, and 53 feet wide, filled in with stone and planked, gives great security to that part of the work. With the view of keeping 4 feet of water on the apron at the toe of the dam, and thereby breaking the force of the fall, by its action on a body of water, there has been constructed, at a point 300 feet below the main dam, a secondary dam of timber and stone, which is 200 feet long and 9 feet high. The abutments of this secondary dam, with two piers of crib work, filled in with stone, have been used for the purpose of a bridge across the river, and will remain a bridge to accommodate the public and for the use of the keeper of the gate house.

The construction of the new dam was vigorously commenced by Messrs. McCullough, Black & Co., early in the spring, under contract, to raise the same so high by the 1st of November following, as to throw at least two feet of water into the tunnel of the aqueduct.

This requirement of their contract they have not fulfilled; which is to be regretted, mainly on the ground that the work could not be left in as secure a condition against the spring floods, as it would have been left, had this condition of the contract been complied with. The contractors urged in excuse, the great difficulty in procuring sufficient quantities of large stone, and of a suitable quality, and the consequent failure, by their sub-contractors, in the delivery of such stone; which difficulty was enhanced by the rejection of every stone not deemed of the most durable quality.

The work, on the whole, has been prosecuted, with the exception referred to, with commendable perseverance and energy, and the dam can be made to throw into the aqueduct the water required, early in the ensuing summer, and can be conveniently completed during the summer months.

It is presumed that the mason work of the dam, will derive additional strength from the extension of the time of its construction.

The remaining part of the aqueduct proper, in Westchester, being the second, third, and part of the fourth divisions, is completed to the contemplated gate house at the Harlem River.

Harlem Aqueduct Bridge. This work has not been progressing as fast as was expected by the Commissioners and Engineers. To some extent the embarrassment has arisen by not finding a rock foundation in the bed of the river for pier No. 10; and after removing the mud and boulders in the river to the depth of thirty-five feet below the surface of the water, without finding rock, it was determined to place this pier on piles, and this work is now in progress. Although disappointed in not finding a stone foundation, we find the earth in the bed of the river of a compact character, and well suited to give security to the pier, by piling.

The foundations for piers Nos. 7, 8 and 9 are, all of them, with their mason work, carried up above high water. Piers Nos. 3 and 4 have, also, been piled for masonry; and on piers Nos. 5 and 6, the masonry has been raised to eleven feet in height.

We have supposed that the details of expenditure for Harlem Bridge, would be interesting to your honorable bodies, and have therefore to state, that the amount paid, from the beginning, and due to the first of January inst., is $210,000. The continuation of the work, sinking the remaining piers and driving the piles, mainly necessary for the proposed temporary bringing of the water across the river, and the expense of laying the pipes for that purpose, will amount to $116,558.

The estimated cost of carrying the bridge up to its contemplated height, from the point or position in which it will be, on the 1st of July next, will amount to $596,779.

After the water is introduced, by these temporary means, there will be no pressing necessity for the high bridge being erected faster than is convenient for the resources of the Corporation, and the economy of its construction, provided no objection should be urged against a reasonable interruption of the river navigation, by the persons interested therein, the value of which navigation is, at present, too small to be estimated.

Entertaining this view of this important subject, the Board of Water Commissioners have determined, and so instructed the contractors, that without further instructions from them, the Board of Commissioners, they, the contractors, are to do no work on the bridge, excepting such parts as may be necessary and directed by our engineers, to carry the water on the temporary plan across the river, and the erection of the piers of the bridge up to high water mark; and to accomplish this, will keep them busily employed until the 1st of January next. In giving these instructions, we considered we should best meet the views of our fellow-citizens and the Common Council. If we are mistaken in the wishes of the Common Council, we shall be glad to be informed of the same. Under this arrangement of the work, the whole amount required by this department to bring the water to Murray's Hill, will not differ materially from $650,000, which includes the settling up the demands for work already done on the several contracts not yet completed.

Clendening Valley. The Common Council will recollect that we informed them, through their Committee, in July, 1840, that we proposed dispensing with the arched bridges contemplated to be made by the original plan, over 96th, 97th, and 101st streets. The two Boards, by resolution, in 1840, approved the contemplated change. His Honor, the late Mayor, fearing enormous damages would be exacted by the contractors, doubted the expediency of the measure, and deemed it his duty to veto the resolution of the two Boards. Neither of the Boards of the Common Council took into consideration the veto message of the late Mayor, that we are aware of, and as the responsibility of the work, and its mode of construction, was legally with this Board, we deemed it our duty to dispense with the bridges in question, and the work at the Clendening Valley is now completed without them.

The saving, by this alteration, has been $52,000, and a more substantial and durable work made to supply the place of arches. We have also arranged with the contractors, to settle all their claims for this departure from the original plan, and for the material which they had provided for the arches, for the sum of $4,500.

The excavation of about 50,000 cubic yards of rock has been dispensed with in the receiving reservoir, of which about 45,000 lie in the northern division. This constitutes a saving of $50,000, one dollar per cubic yard being the price for excavating.

The unfinished work on this island, is on sections Nos. 88, 89, 90, 91, 94, 96, including the receiving reservoir, 97, 98, and the distributing reservoir, all of which can be completed early in the ensuing season.

Engineer Department.—Under the direction of the Board, the chief engineer has reduced the corps to one chief, one principal assistant, and two resident engineers, with the assistants and inspectors mentioned in his report.

The total expenditures up to 31st December, 1841, for all objects connected with the aqueduct, were $7,107,463 03.

The early part of the working season of 1842 was rainy, and occasioned some solicitude lest the contractors, especially those for the dam, should not be able sufficiently to advance their work, to realise the expectations of the citizens to behold the Croton flowing in their streets on the 4th of July; but after the state of the weather permitted operations to be resumed, the work on the dam was carried on with such diligence and energy, that the water in the Croton lake was raised sufficiently high to flow into the aqueduct with a depth of 18 inches, on the morning of the 22d June.

The report made by the Commissioners on 8th August, announces the gratifying fact that the Croton had reached New York, and was flowing in her streets.

We give the language of the report itself, in describing this most important and interesting event. It also keeps up the record of the progress and condition of the works at the period of its date:

Croton Dam. The work on this dam is now so nearly completed, that whenever it is considered safe and proper to do so, the quantity of water sent into the aqueduct may be increased to its full capacity.

This massive structure, of which the dimensions and a description were given in the last report, is supposed to be one of the most beautiful and substantial of its kind in the world. The cut stone masonry of the overfall being now completed, with the exception of 15 or 20 feet at the southern end adjoining the waste culvert, a perfect idea can be formed of its finished appearance; and this is well calculated to impress a spectator with the belief that it is almost, if not entirely, indestructible by the elements, or time.

Between the Croton Dam and the influent gate-house at Harlem River, the line of aqueduct was finished last season, and during the present season this gate-house has been nearly completed.

The embankment in the Harlem River, which serves the double purpose of securing the coffer dams for the piers of the bridge, and forming a foundation for the temporary water pipes, has been finished, and the pipes were laid upon it, and a connection formed between the two sides of the river early in June.

To the lowest part of the large connecting pipe, a branch pipe was attached, and to this were fitted jets of various sizes and forms. This was done for the purpose of ascertaining by experiment, what form and size will be best suited for fountains, which may be erected in the public squares or other parts of the city, for convenience or ornament. The jet is generally allowed to play a few hours in the afternoon of every day, and the large volume which it throws to the height of 110 feet, is an object of much interest to those who visit this, at present, most interesting spot.

Harlem River Bridge.—The progress of this work, since our last report, has, owing to several causes, been slower than we expected. In that report it was mentioned that after carrying the excavation for pier No. 10, thirty-four feet below the surface of the water, without finding rock, it was determined to place it upon piles. In carrying out this determination, 240 bearing piles have been driven, varying in length from 30 to 36 feet. Cross timbers were laid upon the heads of these, and the spaces between these timbers filled with concrete. Upon the timbers, the cut stone masonry was commenced, and several courses of this are now laid. All the difficulty and danger inseparably connected with the use of coffer dams, of the great size and depth required for this pier, have been successfully overcome, and the masonry will, in a few weeks, be raised above the high water of the river. The coffer dams for piers Nos. 11, 12, and 13, are in their places, and embanked, but none of them have yet been cleared of water, or the character of the foundations ascertained. It is expected, however, that 11 and 12, and perhaps 13, will require the same operations of piling and timbering, previous to laying down any part of the masonry.

The present condition of the work is as follows: The foundations of piers Nos. 2, 3, 4, 5, 6, 7, 8, 9, and 10, are laid and secured, and the masonry of all, except No. 10, is carried above high-water mark from 4 to 15 feet. The foundations of Nos. 11, 12, and 13, which are river piers, remain to be put down, and Nos. 1 and 14 at the two ends of the bridge. These last will be built upon rock, and at a considerable height above the water. A very large quantity of cut stone, for various parts of the work, is prepared, and much of it brought upon the ground. All, or nearly all, the timber for the centres of the arches is delivered, and the amount of machinery and arrangements of the contractors for carrying on the work is such, that if the commissioners should feel authorised to urge it forward, there is no doubt but it could be carried up as fast as a due regard to its stability would warrant.

Receiving Reservoir at Yorkville.—The excavation at this place was carried on at a moderate rate during the whole winter, and on the opening of the spring, such additions were made to the force employed there, that the work was fitted for the reception of water on 27th June.

It is not yet, however, entirely finished; but the contractors are making such progress as will probably enable them to complete the whole in the course of the ensuing month.

The work in the 5th Avenue, in which are laid the iron pipes, connecting the receiving and distributing reservoirs, is nearly completed. Something remains to be done at one or two culverts, and perhaps something more ought to be done in the way of regulating the Avenue.

Distributing Reservoir at Murray's Hill.—This work is now nearly complete; about one-half the length of the enclosing wall is finished, and the remaining half requires little to complete it but the cornice. So far as it has been tried by the pressure of water 20 feet in depth, it has proved perfectly tight, and its performance in all respects is entirely satisfactory.

When this is completed, and the streets and grounds about it are regulated, it will be one of the most interesting objects of utility and curiosity to citizens and strangers, which our country affords.

Ever since the completion of the masonry of the aqueduct, it has been frequently and carefully examined, with a view to detect defects, if any existed, or failure, if any should take place; and it has been found, with slight exceptions, to continue as perfect as on the day it was finished.

In the few cases where imperfections have been found in the interior, they have been repaired, and the work improved in such manner as is supposed will secure its future permanency; the exterior covering of earth has, in several places, been enlarged and secured, sometimes by covering with turf, and sometimes by a layer of broken stones.

Having described the progress and proximate completion of the work under our charge, we have the satisfaction further, formally, to communicate to the Common Council, that the dam, the aqueduct, and the reservoirs are now all in operation and successfully performing the work for which they were designed. On the 8th June, the Commissioners, accompanied by the engineers, commenced a journey through the aqueduct, on foot, which was completed in the two succeeding days, to Harlem river, a distance of 33 miles. The whole line having been found in good condition, orders were given to close the openings which had been left in the bottom, for the escape of water which flowed into the work in tunnels and deep cuttings. This having been done, and the dam raised sufficiently to cause the water to flow into the aqueduct, it was admitted to the depth of 18 inches, at 5 o'clock in the morning of the 22d June. A boat capable of carrying four persons, which had been prepared for the purpose, called the "Croton Maid," was then placed in the aqueduct to be carried down by the current. She was navigated sometimes by one portion of the party, sometimes by another, during her singular voyage, and arrived at Harlem river almost simultaneously with the first arrival of the water. The velocity with which the current flowed in the aqueduct was a matter of great interest, and therefore carefully observed; and we were much pleased to find that it was at a quicker rate than the calculations of the engineers had led us to expect. The velocity observed at that time was a mile in 40 minutes; but subsequent observations, with the depth of water increased to 2 feet, have shown that it flows a mile in 36 minutes, and with a depth of 4 feet, the velocity will probably not fall far short of 2 miles per hour. On the arrival of the water at Harlem river on Thursday, the 23d June, formal notice of the event was given by the Commissioners to the Mayor and Common Council, who were also informed, at the same time, that it was our intention to admit it into the receiving reservoir at Yorkville on the succeeding Monday.

This intention was completely carried out; the water having been admitted into the northern division of the reservoir on that day at half past 4 o'clock, P. M., in the presence of a large assemblage, which included the Mayor and several members of the Common Council, the Governor of the State, the Lieut. Governor and the other members of the Court for the Correction of Errors, and many other distinguished persons. A salute of 38 guns was fired upon the occasion by a detachment of artillery, detailed for that service by Gen. Sanford. The "Croton Maid," which arrived soon afterwards at the reservoir, was hailed by the assembled citizens with much enthusiasm, as she afforded indubitable evidence that a *navigable* river was flowing into the city, for the use of its inhabitants. The President of the Board then presented the boat to the Fire Department of the city, (through their chief engineer, C. V. Anderson, Esq.,) with some remarks upon the magnitude of the aqueduct through which she had been navigated, and the important results, pecuniary and moral, which may be expected to flow from the abundance and excellence of the water, with which our citizens are hereafter to be supplied. These remarks were replied to by the Hon. Morris Franklin.

The water was retained in that reservoir until the 2d July, when it was allowed to flow into the iron pipes which conduct it to the distributing reservoir. Public notice had been given sometime previous, that it would be admitted into that reservoir on the 4th of July; invitations were sent to the Mayor and Common Council, and several others, to attend at sunrise in the morning of that day, for the purpose of observing the first entrance of the water. At half past 4 o'clock the order was given to the chief engineer to open the stop-cocks of the influent pipes; and at a quarter before 5 o'clock, the Croton river was in full flow. Owing to the early hour at which the water first appeared in the reservoir, few persons were present to witness the important event; but shortly afterwards, the Mayor, several members of the Common Council, and a number of the most respectable inhabitants of the city, visited the work, and all expressed themselves highly gratified at the sight of the long-wished-for Croton water, its abundance and purity, and at the almost unexampled perfection of all parts of the work, as indicated by its performance.

A jet which threw the water from forty to fifty feet high had been prepared at 47th street, and was playing at an early hour. This, from its great beauty, attracted much attention; but on opening the pipes to the reservoir, its height was so much diminished that it was stopped a few hours; after which it was again allowed to play, and during the remainder of the day, formed one of the principal objects of attraction.

At the particular request of the Mayor, who stated that the tanks at 13th street were dry, and the city much exposed if a fire should occur, the water was permitted to flow into the distributing pipes, which have been laid down under the direction of the Common Council. But owing to the unskilful manner in which that work was designed and executed, nearly the whole day passed before the pipes could be sufficiently cleared of air, to allow the water to flow regularly into the lower part of the city.

The water has since continued to flow with a depth in the aqueduct of about two feet, and delivering into the receiving reservoir about 12,000,000 imperial gallons per day. No accident has occurred to interrupt its regular performance, and no failure or defect, or indication of either, has been observed in any part of the work after the most careful inspection.

In a tone of natural exultation, this report concludes with warm congratulations to the city, on the practical accomplishment of the great and costly work undertaken by it, and looking back to the small beginnings from which this magnificent undertaking sprang, thus recalls the past:

Your predecessors in office on the 16th of March, 1829, called up and discussed the report of a committee for abolishing the system of public cisterns, and laying down two lines of 12 inch iron pipes, one through Broadway and one through the Bowery; and placing a tank or reservoir in 13th street, on the pinnacle of a rock there situated. James Palmer was the chairman of the committee, and brought good practical sense as well as an honest reputation to the support of the measure. The plan was fully discussed—was pronounced by some to be visionary, and it was declared by a member then in the city councils, that water enough could not be procured to fill a tea-kettle, much less the tanks and pipes!! The reply to that argument was, "Give us the tank and pipes, and we engage to fill them, if we have to carry the water in quart bottles."

The report was adopted, the tank constructed, the pipes laid down, and the hydrants erected. No public cisterns were ever afterwards made. Every subsequent year added length to the line of pipes, until we now have 130 miles, and the Croton River flows into that tank, and through those pipes and hydrants, erected by the appropriation of that night.

Fortuitous circumstances reserved for the gentleman, who in 1829, in his place in the Common Council, gave the pledge, "that in case the well to be dug on the point of the rock on 13th street would not fill the tank and pipes in Broadway and the Bowery with water, that they should be filled, if need be, with quart bottles," 13 years afterwards, on the 4th of July, 1842, to open the gates of the reservoir and fill these very pipes and this very tank, not from "quart bottles," but from the Croton River, passing through the whole line of the Croton Aqueduct!

The gentleman here referred to, was *Samuel Stevens, Esq.*, the presiding officer of the Board of Commissioners, whose name and services will be recorded with those of Stephen Allen, and Douglas and Jervis, for the enduring gratitude of the distant generations, whose health, comfort, and safety will, while "grass grows and water runs," continue to be promoted by the great work, to which these gentlemen devoted such faithful and intelligent care.

On the 20th January, 1843, the then Commissioners made their final report, which, announced the completion of the Croton Dam, and that it had undergone, without damage, the test of a full ordinary freshet caused by the warm rains, and the breaking up of the ice in the early part of January. The utmost rise of the water above the dam was 25 inches; although, according to estimate, a million gallons per minute passed over it, exclusive of that which escaped through the waste culvert of the dam, and through the aqueduct. This quantity of waste water, was one hundred and twenty times more than that brought to the city by the aqueduct.

The Harlem bridge was reported to be in satisfactory progress. "The foundations of all the land piers, on both sides of the river," says the Report, "are completed, and the masonry of several of them is carried to a considerable height, presenting an appearance of great solidity and beauty. The foundations of five of the river-piers, Nos. 7, 8, 9, 10 and 11, are also completed, and the stone work of the first four has been carried to the height of forty feet or more, and the last, No. 11, is nearly ready to receive the masonry. The work upon the two remaining foundations, Nos. 12 and 13, is in progress. The excavation for No. 12 is completed, and a large part of the bearing piles are driven. The contractors have recently erected another steam engine for the purpose of pumping and hoisting out the earth excavated in No. 13. The precise character of the foundation for this pier has not yet been very satisfactorily ascertained. The indications at present are, that it will be found similar to that of Nos. 10, 11 and 12, and require piling in the same manner. The coffer dams, used for putting down these foundations, have been found to answer their intended purpose very perfectly. No accident has thus far attended their use, and they have been kept free of water with less difficulty than could reasonably have been expected."

The whole amount expended on the works up to 20 January, is stated by the Commissioners at *seven millions nine hundred and ten thousand four hundred and seventy-six dollars*, to which a further amount of $662,540, required for work unfinished and contracts unsettled, would be added. Both these sums, however, are exclusive of the pipes laid from the distributing reservoir, that head of expenditure being under the charge of the Corporation.

The certainty of an adequate supply of water from the reservoirs, even when the aqueduct is under repair, is thus strongly stated in this Report.

"The capacity of the reservoirs (perhaps beyond the wants of the city) is making good the opinions of the present Board when they first entered on their duties; this was manifested on the late occasion of examining the interior of the aqueduct; the water was shut off and not permitted to enter the reservoirs for ten days; in these ten days, all the water used in the city for fires and culinary purposes and waste (though the jets d'eau were not playing) reduced the quantity of water in the reservoirs only *one-tenth*. The water held back in the receiving reservoir would, at this rate, have been sufficient to supply the city for 100 days. The capacity, too, of the receiving reservoir was considerably diminished by not excavating to the depth contemplated by the original plans.

The aqueduct had now been several months in operation, through summer heats and winter cold—and of course it became a subject of deep interest to ascertain how the work had stood. We copy from the report of Mr. Jervis to the Commissioners on 16th January, this interesting detail on the subject:

No interruption to the supply of water to the city has occurred, since its first introduction. The water continued to flow uninterruptedly through the aqueduct, from the 22d of June, when it was first let in, to the 8th of November, when it was shut off for the purpose of more effectually inspecting its condition, and the effect that had been produced by the action of the water or other cause.

Previous to the time of shutting off the water, several examinations, similar to that mentioned in my report of July last, had been made by myself and the resident engineers, Messrs. French & Hastie, by means of a boat floating through the aqueduct, between the Croton Dam and Harlem River. Some unimportant defects were discovered inside the aqueduct, a short time before the water was shut off, and two small leaks appeared on the outside. The next day after the water was shut off, I commenced an examination inside the aqueduct, in company with one of your Board, Mr. Ward, and the resident engineers, Messrs. French & Hastie, on their respective districts, and continued it through the entire aqueduct.

For that part on this island, our party was increased by the addition of Messrs. Ring & Birdsall, and Mr. Allen, the principal assistant engineer.

On the examination we were accompanied by men prepared to attend to any work that might appear necessary; and as soon as we passed over a district, they received their directions, and immediately proceeded with such work as it was considered expedient to do. Some defects were discovered, the greater part of which appeared to have been overlooked in previous examinations, which now were discovered, most probably from the clean state of the masonry, after a washing of near five months; there was, however, evidence that a small additional settlement had taken place in a few instances. The work required was vigorously prosecuted to completion, and on the 16th, eight days after the water was shut off, it was again let into the aqueduct. In the main, the aqueduct appeared substantially well, and the defects not such as to give serious apprehension that its successful action would have been impaired by them for a long time. Enough, however, was discovered to show the propriety of the examination. The two leaks that had appeared on the outside were successfully stopped by the work done inside, and nothing has since appeared to indicate any defect in the work.

The reservoirs, during the time the water was shut off from the aqueduct, proved amply sufficient for the supply of the city, and indeed much beyond a supply, as a large quantity of water had to be wasted from the receiving reservoir before the lower end of the aqueduct could be examined.

By a proper watchfulness, any material defect in the aqueduct may be timely discovered, by appearances on the outside, or examinations by means of a boat floating through the inside. The latter should be done generally once in each month, and more frequently on parts most liable to prove defective. In addition to this, it should be established as a rule, that the water is to be shut off twice in a year, for a thorough inside examination, when all repairs that may appear necessary should be made. With suitable preparations, the examination and work required could ordinarily be accomplished in about ten days, during this time, the reservoirs would amply supply the city with water. With proper regulations, they would give a sufficient supply to 500,000 people for double the time proposed. The most suitable time for such examinations would be early in the months of April and November, when the temperature of the water in the reservoirs would not be materially affected.

The water has usually flowed at the depth of two and a quarter feet in the aqueduct, but has been as high as three and a half feet, and between the Croton Dam and Sing Sing waste wier (nearly 8 miles) was for several weeks from five to six feet deep.

The water in the receiving reservoir has been gradually raised to its present height of eighteen feet in the northern division, and twenty-six feet in the southern division. When full, the northern division will have twenty feet, and the southern thirty feet. It will be proper, for the winter, to keep the water at its present level in the northern, and to raise it gradually to twenty-seven feet in the southern division. I recently made a careful examination, in company with Mr. Hastie, the resident engineer, of the vaults of this reservoir. We found some leakage through the walls, but not sufficient to give any apprehension for the security of the work. The same day we examined the vaults of the distributing reservoir. At four places we found the earth between the walls to be quite soft, indicating that some water had percolated from the bottom of the reservoir, passed under the inner wall, and made its appearance in the vault between the exterior and interior walls. The quantity of water was extremely small, in some cases not sufficient to make a perceptible stream in the channel designed to carry any leakage that might occur to the sewers on the outside, but the earth was fully saturated, and in other cases a very small trickling stream passed off in the channel. The extent of this leakage is small, the main part of the bottom appearing well. The leakage through the interior walls is very small; they are as impervious as could have been anticipated, in view of the great pressure to which they are exposed. Their greatest leakage is at the junction of the division walls with the influent and effluent cock vaults. In each direction from them, the leakage decreases, and in about half of the western division the walls (and channel to carry off leakage water) are entirely dry. There is conclusive evidence that the leakage through the walls has to some extent subsided, although the pressure, by gradually raising the water, has been increasing. The water now stands in the reservoir at about thirty-three feet above the sills of the gate frames, or thirty-five feet above the bottom, and within three feet of the designed top water level.

Some small leakages have occurred in the joints of the iron pipes, that have been laid down in connexion with the aqueduct work; the most troublesome has occurred in the temporary pipe at Harlem River, and is mainly to be attributed to the manner in which it was necessary to lay down this pipe, not allowing all the freedom of action that is necessary to provide for the expansion and contraction occurring in the different temperatures to which they are exposed.

The aqueduct and its appurtenances have been subjected to the trial of near seven months, and I have endeavored to detail fully the effect the water has produced, and the prospect of its capacity to fulfil, with regularity and permanence, the object of its construction. It has been the subject of intense solicitude and care, and although there is good ground to believe that in the main, the work will prove to have the stability and permanence that is necessary, it will still, for sometime to come, require a vigilant watchfulness. The deep interest I feel in the success of the work, as also its great importance to the city, induces me to urge, that the persons to whose care it may be committed, be selected with reference to their acquaintance with the work, and their known ability and faithfulness, for the supervision required. After the work before mentioned shall have been completed, the ordinary work of supervision and repairs, if well directed, will probably be obtained at a moderate expense. At the same time it should be distinctly urged that economy or efficiency, can only be expected, from the supervision and care of men, who are intimately familiar with the method of construction and the character of the work, and who will deeply feel the high responsibility confided to their industry and fidelity. The main burden of this duty will consist, in an unwavering perseverance; watching with scrutinizing care every part of the work, and seasonably providing for, and making such repairs as may be necessary. The extent of the work, the variety of its structures, the severe pressure to which many of its parts are necessarily exposed, and the *great* importance to the city, in maintaining it in a condition that will ensure a regular and full supply of water, must give to every reflecting mind, a strong sense of the high responsibility that will rest on those to whose care it is confided. Not expecting to be much longer engaged in the general charge of the work, I have felt it to be a duty that I owed, not more to my own reputation, than to the interest of the city in this great work, to urge the above remarks in relation to its future management."

No one will fail to be struck with the tone of natural solicitude evinced by the chief engineer in the close of this extract, for the due care and perservation of a noble work, on which he had expended so much time, talent, and anxiety, and by his connection with which he could not but feel, if more modest than the Roman poet, he did not say,

> Exegi monumentum ære perennius
> * * * * *
> Quod non imber edax, non Aquilo impotens
> Possit diruere, aut innumerabilis,
> Annorum series et fuga temporum.*

With regard to the permanency of the work and the probability on any great expenditures for repairs or additional securities, Mr. Jervis holds this language:

> What now appears sufficient, may on further trial, develope the necessity of additional security. I am not aware of any indication, further than has been mentioned in the former part of this report, of the probable necessity of further security. Should, however, the appearance of water passing from the bottom of the distributing reservoir, as mentioned in a former page, show any material increase, or if it should not subside in the course of a few mouths, an additional course of concrete should be put over the bottom. I hope this may not be necessary, though it is proper for me to remark that I feel some apprehension that it may be expedient, as a prudential measure, to incur a further expense of twelve to fifteen thousand dollars for this purpose.

Early in this year, 1843, another change of political parties in the government of the State having occurred, the former Commissioners were reinstated, and now have charge of the work—without any change occurring in the engineer department, other than by the reduction consequent upon the finishing of operations.

Having thus brought our narrative of the progress of the work to its conclusion, it remains to present, as promised, a connected view of the aqueduct, its chief and most striking constructions, its general plan, and such other details as are likely to interest our readers.

We are permitted by Mr. Jervis to avail ourselves, for this purpose, of the description published by him on occasion of the civic celebration of the 14th of October, to which he enables us to add some further particulars of the state of the work, up to the instant of passing these sheets through the press:

* ——————————I've raised
A monument more durable than brass,
Which, not the wasting storm nor blast all impotent
Shall e'er o'erthrow, nor yet innumerable
Successive years, nor flight of time.

DESCRIPTION OF THE CROTON AQUEDUCT BY J. B. JERVIS.

GENERAL DESCRIPTION OF THE LINE.

The Croton Aqueduct was designed to supply the city of New York with an abundance of pure and wholesome water. It commences about six miles above the mouth of the Croton river, where a dam has been constructed to elevate the water of the river 40 feet, to the level of the head of the aqueduct, or 166 feet above mean tide. The course of the aqueduct passes along the valley of the Croton to near its mouth, and thence passes into the valley of the Hudson. At 8 miles from the Croton dam, it reaches the village of Sing Sing, and continues south through the villages of Tarrytown, Dobbs' Ferry, Hastings, and Yonkers.

At the latter place, it leaves the bank of the Hudson, crosses the valleys of Sawmill river and Tibbits' brook, thence along the side of the ridge that bounds the southerly side of Tibbits' brook valley, to within 3½ miles of the Harlem river, where the high grounds of the Hudson fall away so much as to require the aqueduct to occupy the summit of the country lying between the Hudson and East rivers.

This formation of country continues to, and is terminated by, the Harlem river, at the point where the aqueduct intersects it, which is one mile northwesterly from Macombs' dam.

The length of the aqueduct from the Croton dam to Harlem river, is 32.88 miles, for which distance it is an uninterrupted conduit of hydraulic stone and brick masonry. The high ground that bounds the northerly side of the Harlem river valley, is very near the level of the aqueduct at that place; and the width of the valley at the aqueduct level is about 1450 feet, or a little over one quarter of a mile; over which a bridge is designed to be constructed (and is now in progress) at an elevation of 114 feet above the level of high tide in the Harlem river, on which iron pipes are to be laid to convey the water across the valley.

The shore on the southerly side of the river is a bold, precipitous rock, rising at an angle of about 30 degrees, to a height of 220 feet, or about 100 feet above the level of the bottom of the aqueduct.

After crossing this valley, the aqueduct of masonry is resumed, and continued 2.015 miles, to the termination of the high ground on the north side of Manhattan valley.

This valley is 0.792 mile wide at the level of the aqueduct; below which it descends 102 feet. The conduit of masonry here gives place to iron pipes, which descend into the bottom of the valley, and rise again to the proper level on the opposite side; from which point the masonry conduit is again resumed, and crossing the Asylum ridge, and Clendening valley, is continued 2.173 miles, to the receiving reservoir at Yorkville.

This reservoir is bounded by 86th street on the north, 79th street on the south, 7th Avenue on the west, and 6th Avenue on the east. It is 1826 feet long and 836 feet wide on the outside angle of the embankment; containing an area of 35 acres, divided into two divisions, and is (a little over) 5 miles from the City Hall. From the receiving reservoir, a double line of iron pipes three feet in diameter, are laid down in 80th street and 5th Avenue, to convey the water 2.176 miles to the distributing reservoir at Murray Hill. The location of this reservoir is on the 5th Avenue, between 40th and 42d streets, and is three miles from the City Hall; it is 420 feet square on the cornice of the exterior wall, and contains an area of 4.05 acres, divided into two equal divisions, and has an average elevation of 44.5 feet above the level of the streets around it.

The length of aqueduct from the Croton dam to the distributing reservoir is 40.562 miles—to wit:

Masonry conduit in Westchester county - - - - - -	32.880
Do. do. on New York Island - - - - - -	4.187
Total length	37.067
Receiving reservoir from end of aqueduct to south-eastern effluent gate house - - - - - - - - - - - -	0.172
Distributing reservoir - - - - - - - - - -	0.080
Iron pipes on bridge over Harlem valley - - - - - -	0.275
Do. do. across Manhattan valley - - - - - - - -	0.792
Do. do. between reservoirs - - - - - - - -	2.176
	40.562

It is proper to add to the above, the length of the Croton reservoir, which has been formed by the erection of the Croton dam and other work necessary to obtain the water, at a suitable level on the Croton river, as without this dam and reservoir, the aqueduct would have required an extension of five miles to reach the proper level on the river; which is now attained by means of the dam. The entire length, therefore, from the point on the Croton, which has the requisite elevation, to the distrbuting reservoir, is 45.562 miles. The large mains running from the distributing reservoir, through the central part of the city, would add about four miles, making the total length of the main conduit nearly fifty miles.

DESCRIPTION OF THE COUNTRY THROUGH WHICH THE AQUEDUCT IS LOCATED.

The soil, earth, and rock, of the country from the banks of the Croton to the city of New York, is of one general character. The line cuts a small section of marble of inferior quality, about two miles below the Croton dam. In running through the State farm at Sing Sing, it passes a few hundred feet (mostly by a tunnel) in a marble of pretty fair quality for building; and again at Dobbs' Ferry and at Hastings it lightly cuts a similar rock; at the latter place marble has been got out to some extent for market. No more marble was discovered by constructing the aqueduct until it reached Harlem river, where in excavating two of the coffer dams to obtain foundation for the piers, marble rock was found in the bed of the river. This is supposed to be a continuation of the stratum that appears in Harlem valley at the Kingsbridge road, near the Hudson river. With these limited exceptions, the prevailing rock of this district is gneiss, of great variety in quality. In many places it affords excellent building stone for ordinary purposes, and to some extent good blocks of hewn stone have been obtained. A very large proportion, however, of this rock is totally unfit for building purposes.

The surface soil is generally a sandy loam, containing a very small proportion of argillaceous earth. Below the surface soil, gravel, sand, boulders, or detached rock, have in most cases been found, and also hard pan to a considerable extent.

A large proportion of the open cutting, and nearly the whole tunnel cutting, has been through rock. More than 400,000 cubic yards of rock have been excavated.

The general formation of the country is extremely irregular, and unfavorable for the economical construction of such a work.

Commencing at the Croton dam, on a level 40 feet above the river, which descends from this point to tide-water, at the average rate of 25 feet to the mile, the grade of the aqueduct was compelled to encounter great irregularities of surface. Very little regular table-land could could be found for its location. While the main ridge of high land, that lay on the left of the line in Westchester county, controlled the general location, numerous spurs of ridges, of various forms and extent, bounded by deep ravines, rendered it impossible to avoid deep cutting and frequent tunnelling, through ridges, and heavy filling in the valleys; leaving a very limited proportion of the line in favorable cutting. On the island of New York, with the exception of about one mile from Harlem river, there was no leading ridge to control or guide the location; which rendered it more difficult to decide on the conflicting claims of different routes.

There are on the line sixteen tunnels, varying in length from 160 to 1263 feet, making an aggregate length of 6841 feet. The height of the ridges above the grade level at the tunnels ranges from 25 to 75 feet.

There are in Westchester county twenty-five streams crossing the line of aqueduct, that are from 12 to 70 feet below the grade line, and from 25 to 83 feet below the top covering of the aqueduct. The most prominent of the valleys, are Lounsberry's, Indian brook, Sing Sing kill, Mill river, Jewel's brook, and Saw Mill river; the foundations of which are in no case less than 40 feet below the grade line, or 53 feet below the top covering of the aqueduct. Besides those above mentioned, there are numerous brooks and valleys of less depth, requiring culverts, and artificial foundations to support the aqueduct. The level of mean tide at Harlem river is 120.66 feet below the grade line of the aqueduct, of which a more particular description will be given hereafter.

On New York Island there are several deep and abrupt valleys, along the precipitous rocky hill that bounds the southerly shore of Harlem river. But the most important valleys on the island are Manhattan valley, Clendening valley, and Bowne's valley. A more particular notice of Manhattan and Clendening valleys will be given when describing the plan of work, the manner of construction for the others being similar to that for the valleys of Westchester county.

DESCRIPTION OF THE PLAN OF WORK FOR THE AQUEDUCT AND ITS APPURTENANCES.

Aqueduct. The form and dimensions of the interior of the aqueduct are as follows: The bottom is an inverted arch; the chord or span line is 6 feet and 9 inches, and the versed sine 9 inches. The masonry of the side walls rises four feet above the springing line of the inverted arch, with a bevel of one inch to a foot rise, or four inches on each side, which brings the width at the top of the side walls, 7 feet and 5 inches; forming the abutments of the roofing arch, which is a semicircle, having a radius of 3 feet 8½ inches, or a chord line of 7 feet 5 inches. It will therefore be perceived, the greatest interior width is 7 feet 5 inches, and greatest height 8 feet 5½ inches. The area of the interior is 53.34 square. In rock tunnels the roofing arch is generally dispensed with, but the bottom and sides are formed with masonry similar to that above described. There is an exception to this form in the first 4.949 miles of the upper end of the aqueduct, where the side walls have an extra height, on account of the bottom being depressed, to draw the water at a lower level from the Croton reservoir.

The plan, dimensions, and character of masonry are as follows: In excavation, a bed of concrete masonry is laid down as a foundation. It is laid level across the bottom, three inches thick at the centre of the inverted arch, and curved on its upper surface, to form a bed for the arch, which brings it 12 inches thick at the spring line, and is carried three inches thick under the side walls or abutments. The abutments are 2 feet 8 inches thick at the spring line of the inverted arch, and 2 feet at the top, or spring line of the roofing arch. The inverted arch is of brick, 4 inches thick. The roofing arch is also 8 inches thick. The abutments, or side walls, are of rubble stone, with a brick facing 4 inches thick. Spandrels of stone are carried up solid from the exterior angle of side wall, on a line that is tangent to the arch. When the bed of concrete is formed for the inverted arch, a heavy course of plastering is laid over it, on which the arch is laid. When the stone work of the side walls was up, the face that received the brick lining had its irregularities filled with successive courses of plastering, and finally a uniform course of a quarter of an inch in thickness over the whole, in front of which the brick facing was laid up. A course of plastering was also put over the roofing arch. The concrete masonry was formed by mixing one part hydraulic cement, three parts clean sand, and three parts fine broken stone; in some cases fine pebbles were in part substituted for broken stone. The masonry was all laid up in hydraulic cement, obtained mostly from the hydraulic lime of Ulster Co. The mortar for the stone work was composed of one measure of cement to three of clean sharp sand, and for the brick masonry and plastering, one of cement to two of sand. It may be proper to remark, that every cargo of cement was tested by actual experiment, after it was brought on the ground, before any was allowed to be used. This precaution has had a very salutary influence on the character of the work; the cement in all cases where it is exposed to view, in its exterior, or broken up for examination, or otherwise, has appeared highly satisfactory. In the commencement of the work, there was much difficulty in getting the workmen to lay their stone and brick in a thorough, full bed of mortar, which is obviously very important in hydraulic masonry. But a rigid system of inspection, requiring all imperfect work to be taken down and relaid, was successful in obtaining work of great compactness and solidity.

The area of a cross-section of masonry in the aqueduct is:

Concrete masonry, - - - - - - - -	4.605	}	
Stone in side walls, - - - - - - -	21.572	}	
Do. in spandrils, - - - - - - -	2.690	}	28.867,
Brick in arches and side facing, - - - - - - -			13.658,
Total, - - - - -			42,525 sqr. feet

A limited departure from the above area has been made where peculiar circumstances seemed to justify or require it; the most important in extent is, where the aqueduct passes over low grounds or valleys, and a dry wall of stone is raised to the proper level to support the conduit masonry, and generally for the depressed bottom on the 4.949 miles at the upper end of the aqueduct, and in a few other cases in the first contracts, where the bottom arch and brick facing is 8 inches thick. On the foundation walls, the concrete masonry is laid one foot extra thickness, and three feet extra width; the base of the side walls is also increased, and the proportion of cement to sand in concrete and mortar for stone work is one to two and a half. In other respects the masonry in conduit, is similar on foundation walls to that in excavation. The proportion of lime of aqueduct masonry on foundation walls over valleys, to that in excavation, is about as one to eight. The masonry of the aqueduct is covered with earth to a sufficient depth to protect it from frost.

Culverts. To pass the streams that intersect the line, and the land floods, there has been constructed under the aqueduct 114 culverts, whose aggregate length is 7959 feet. The span varies from one and a half foot to twenty-five feet. Those of one and a half foot span are of a square form, and are constructed by laying down a foundation of concrete masonry, on which a course of well jointed stone, not less than nine inches thick is laid, forming a stone platform on which well dressed stone is laid, one or two courses high, for the abutments or side walls, and finished by a second course of well dressed flagging, not less than nine inches thick; all the work laid in hydraulic mortar. The culverts over one and a half foot span, with the exception of three of twenty-five feet span, are constructed as follows:

A foundation of concrete masonry is formed, and in a few instances some timber and plank is used with it; on this an inverted arch of well dressed stone is laid in regular courses, to form the bottom channel of the culvert; side walls or abutments are thence raised to such height as required, the face being well dressed stone, laid up in courses, and backed with rough dressed work. An arch is then turned from the abutments, with well dressed stone in regular courses. Wing walls at the ends are constructed in different forms as circumstances required.

The character of masonry in the large 25 feet culverts is similar to that above described, except they have no inverted arch.

There are five road culverts of from 14 to 20 feet span, constructed of masonry of the same character. All the culverts are of stone laid in hydraulic cement.

Ventilators. There are 33 ventilators constructed to give free circulation of air through the aqueduct. Eleven of them are constructed with doors that admit an easy entrance into the aqueduct. They rise 14 feet above the surface of the ground over the aqueduct, and are constructed with well dressed stone, circular in their form, slightly beveling or tapering towards the top, where the opening is 15 inches in diameter. They are placed at a uniform distance of one mile, except where they are rendered unnecessary by a waste weir, which serves all the purposes of a ventilator. At this distance apart, they are found to afford a free and sufficient ventilation.

Waste Weirs. There are six waste weirs constructed on the line of aqueduct, so arranged as to allow the water to pass off when it rises to the proper height; with gates to draw the water from the aqueduct when necessary. They are constructed with well dressed stone; the gates and gate frames are of cast iron, fitted to stone jambs and lintels; the frames are faced with brass for the gates to work against, and the gates are operated by a wrought iron screw rod and brass nut, working in a cast iron socket. The water from the weir or gates, falls into a well, and is then carried off through a culvert to the outside channel. A stone building with a brick arched roof is erected, so as to inclose the waste weir and its appurtenances.

Croton Dam. The southern shore of the Croton river at the point where the dam is located, is a gneiss rock; moderately sloping up the hill from the water's edge, but not appearing to extend far into the river. The dam required to be raised 40 feet above low water in the river; and it was an important object to arrange the plan so as to obtain a rock foundation for the masonry.

To effect this, the northern abutment was located as far in the river as the rock was supposed to extend, and from this to build up the dam to the level where the top line intersected the natural slope of the hill, and then to cut the hill away; making an opening sufficient for the waste weir of the dam.

In prosecuting the work, it was found the rock descended more rapidly into the river than was supposed, which induced the moving of the abutment further towards the hill than at first located; and finally, an artificial foundation had to be made for a small portion of it. It was intended to make the waste of the dam 100 feet, with abutments of eight feet high; but in consequence of the disappointment in regard to the extent of the rock in the river, it was found difficult to obtain the desired length of the water way, and it was concluded to raise the abutment to 12 feet at the lower end, and 15 feet at the upper end, and allow the water way to remain an average length of 90 feet for this height. The natural rock formed the southern abutment, and the aqueduct being on this side, the water was conducted to the gateway at its head, by a tunnel, cut 180 feet through the rock; this allowed the gateway to be located on solid rock, in a situation not exposed to the floods of the river. The water enters the gate chamber by an archway through the second bulk-head. The gate chamber is provided with a double set of gates; one set of guard gates, of cast iron set in cast iron, frames, and one set of regulating gates, made of gun metal, set in frames of the same material; the gates are all 18 by 40 inches, and there are nine gates in each set. They are all operated by means of wrought iron screw rods.

The gate chamber and bulk-heads are constructed of well dressed masonry, laid up in hydraulic cement.

In the north abutment a waste culvert has been constructed, with suitable gates of cast iron, to draw the water down in the reservoir at such times as it may be necessary, to facilitate the making of any repairs that may be required, and to discharge the river at ordinary times during the construction of the work. From this abutment the old channel of the river was filled by an embankment, with a heavy protection wall on the lower side, which was raised 15 feet above the waste weir of the dam, and designed to be 50 feet wide on the top, but was not completed the full width, when the unprecedented flood of January, 1841, carried it away. The embankment stood well, and gave no indications of failure, until the water rose to near the surface, and passed through between the frozen and unfrozen earth about 20 inches below the top. After the breach was made in the embankment, large masses of heavy ice came down from the reservoir, which soon broke down the unfinished protection wall, and carried off nearly the whole embankment. The masonry of the dam and abutment sustained but little injury. Such a flood had not been anticipated, and the water way proved insufficient to pass it off. Had the embankment been completed the full width, and the protection wall carried up to the full height it was intended to carry it, the work might have proved adequate to the emergency. It was determined to fill the gap made by this breach, (about 200 feet long,) by a structure of hydraulic stone masonry, adapting 180 feet as waste weir. This work presented all the difficulties it was originally intended to avoid, by carrying the work partially into the hill. It was necessary to form an artificial foundation, and carry up a heavy body of masonry, in the channel of the river, which in some parts had 15 feet in depth below its ordinary level; subject in ordinary seasons to frequent and sudden floods, and affording no means to form another channel for it to pass, until the work could be accomplished.

Had it been admissible to construct the dam with timber, the difficulties would have been far less. But the importance of the object it was designed to secure, and its great height, demanded the most permanent and durable structure that could be made.

The greatest height of the weir of the dam is 40 feet above the low-water level, and 55 feet above the bed of the river. The width of masonry, at low-water line of river, is 61 feet.

The form on the lower face commences on a curve, described by a radius of 55 feet, and continues to within about 10 feet of the top, when a reversed curve, on a radius of 10 feet, carries the face over and meets the back line of the wall. The back line is carried up vertically, with occasional offsets. The main body of the work is laid up of rough stone; the curved face of large and closely cut stone, with four heavy courses at the bottom dovetailed together, the joints cut to the line of radius of curve.

Above the masonry an embankment of earth is filled in, and extends to 275 feet in width on the bottom, with a slope of one to five on the up-stream face. The north end of the new weir is terminated by an abutment that rises 12 feet above it. From the toe of the masonry an apron is extended 35 feet, composed of hewn timber secured by ties, bolts, and treenails, in a very substantial manner, and filled for 16 feet from the stone work, with concrete masonry, and the remainder with loose stone, and covered with a course of 6 inch white elm plank. A second apron is partly made which is to extend 30 feet further.

At 300 feet below the main dam, a second dam is in progress, which is to be 9 feet high, constructed of timber, stone and gravel, which will set the water back over the apron of the main dam, and form a pool to check the water as it falls on it.

A coffer dam was constructed in the river to inclose about 120 feet of the work, from which the water was pumped by a steam engine, and a concrete foundation laid down on a very firm hard pan. The remainder of the foundation was made by sinking timber piers at suitable distances, running parallel with the dam, and filling the spaces between them with concrete masonry. In preparing the specifications for this work, the method and order of prosecuting it was particularly designed, and from which no material departure has been found necessary; the structure is now nearly completed.

The contractors, Messrs. McCullough, Black, McManus, and Hepburn, have evinced a highly commendable energy and ability in its prosecution.

This dam sets the water of the river back five miles, and forms a reservoir of about four hundred acres, and has rendered it necessary to construct several new roads and bridges as a substitute for those covered by the flow, the principal of which is the Somerstown turnpike. The grounds lightly flowed on the margin, have been excavated so as to give 4½ feet for the least depth of water. From this reservoir the water flows into the bulk-head, at the upper end of the tunnel, from a level averaging 10 feet below the surface.

Aqueduct Bridge at Sing Sing. The Sing Sing kill, where it crosses the line of aqueduct, runs in a deep and narrow gulf, the bottom of which is 63 feet below the grade line, or 76 feet below the top covering of the masonry. Over this gulf an aqueduct bridge has been constructed. Near the north end of the valley that spreads out from this gulf, a road culvert, or arched viaduct has been constructed under the conduit. The principal work here is the large arch directly over the gulf. It is 88 feet span, and 33 feet rise; the form is an oval drawn from five centres; the abutments are commenced on the solid rock, near the bottom of the gulf. The work is constructed of well dressed stone masonry, laid in hydraulic cement. Open hance walls are carried up over the interior and above the solid spandrels, and united at the top by brick arches. The spaces between the hance walls are carried entirely across the crown of the arch, to afford as much facility as possible for any water that might leak from the conduit to pass off. The depth of arch stone at the spring line is four feet, and at the crown three feet. The parapets and walls of the conduit are carried up with an opening of six inches between them, more effectually to guard against the effects of frost, and to carry off any water that might leak from the conduit, and prevent its being absorbed by the outer or parapet wall. The conduit over this bridge is constructed of stone and brick masonry, so arranged as to receive a lining of cast iron; the iron being set back so as to receive a facing of brick over the bottom and sides, which is further secured by three courses of hydraulic cement plastering.

It is not probable that any considerable quantity of water would have escaped, if there had been no other security than the stone and brick masonry; but it is hardly possible to make masonry so perfectly impervious, that it will not show wet, or a sweating appearance on the exterior wall, and the action of frost in this climate, will produce in such cases a deterioration, that may be slow, but will eventually destroy the work; hence the importance of using every precaution to guard against the smallest leakage. This bridge was erected under the contract of Young and Scott of Philadelphia, and the work conducted by Andrew Young (of the firm), who was the first contractor to commence work on the aqueduct. It is due to Mr. Young to say, this work was thoroughly executed; the arch proved this, when on striking the centres, it did not settle over $\frac{3}{4}$ of an inch, and has not changed since. This I consider a very small settlement for so large an arch.

HARLEM RIVER BRIDGE.

The width of the river at the place where the aqueduct line crosses it, is 620 feet at ordinary high water mark; as has been before stated, the shore on the southern side is a bold rock rising from the water's edge, at an angle of about 30 degrees, to a height of 220 feet; on the northern side, a strip of table land forms the shore, and extends back from the river 400 feet to the foot of a rocky hill, which rises at an angle of about 20 degrees to a few feet above the level of the aqueduct; the table-land is elevated about 30 feet above the river; the channel of the river to which the water is reduced at very low ebb tides, is 300 feet wide, and the greatest depth 16 feet; each side of the channel the bed is a deep mud, covered from three to four feet at ordinary flood tide; next below the mud there is a thin stratum of sand, and this is followed by a stratum of sand and large boulders intermixed; below the stratum of boulders, or detached rock, there has been found in the coffer dams for two piers, Nos. 8 and 9, a compact marble rock, and in the coffers for Nos. 7 and 10, a stratum of clay and sand, that is quite impervious to water, and affords a good medium for piling.

The general plan of the bridge now in progress of construction, is as follows: Across the river there are 8 arches, each of 80 feet span, resting on piers that are at each extremity and in the centre 20 feet wide at the spring line of the arches, with intermediate piers that are 14 feet wide at the spring line; on the south of this range of large arches there is one arch, and on the north 6 arches, each of 50 feet span, resting on piers 7 feet wide at the spring line, and two abutments that terminate the arch work of the bridge. From the abutments a continuous foundation wall of dry stone work is extended to the gate chambers on each side.

The whole length of the bridge is 1450 feet; the height of the river piers above high water line is 60 feet to the spring of the arches, and 95 feet above the lowest foundation that has been put down; the arches are semicircular, and the height 100 feet to the soffit, or under side, at crown—to the top of the parapets 114 feet above the ordinary high water line of the river, and 149 feet above the lowest foundation of the piers that have been commenced. The width across, on the top of the parapets, is 21 feet; the exterior of piers, spandrels and parapets has a bevel of 1 to 48, and have openings in the interior walls.

The space between the parapets is arranged to receive and protect from frost two cast iron pipes, each four feet in diameter, which are to lie 12 feet below the grade line of the aqueduct, to which they will descend from the gate chambers at the ends of the bridge. The object of using pipes in this case, is, more effectually to secure the conduit from leakage, that might eventually injure the masonry of the bridge, and it incidentally allows the bridge to be constructed of less height.

To make the capacity of the pipes for conveying water equal to that of the aqueduct, an extra fall of two feet has been given across the bridge, and the aqueduct on the southern side of the river is constructed two feet lower than the regular grade, to accommodate this arrangement. It is intended in the first place to put down pipes 3 feet in diameter, and to increase the size as the wants of the city may require.

The foundations of all the land piers but two have been put down, with bearing piles to support them; they are placed below high water line; and 5 to 6 of the base courses of masonry have been laid on each; the remaining land pier and both abutments will have a rock foundation. There are seven piers in the river, the foundations of four of which have been laid; for two of them solid rock has been obtained at a depth below high water line of 17 feet for one, and 35 feet for the other. The pier next the northern shore has a piled foundation; to prepare it, an excavation of 16 feet was made, passing through the strata of mud, sand and detached rock, whence the piles could be properly driven.

The piles were of oak, from 16 to 35 feet long, and driven at 2½ feet apart from centre to centre. The other pier, (called No. 10 in the general series,) for which a piled foundation has been prepared, is near the centre of the river channel. The stratum of boulders lies much lower at this place, and required an excavation to be carried 30 feet below common high water line, before a suitable stratum for driving piles could be reached. When the excavation was carried to this depth, boring was made to ascertain if rock could be found for the foundation; but after going down without success to a depth of 70 feet below high water, the effort was abandoned, and the driving of piles commenced, as the only means of securing the foundation. The piles were driven at three feet apart from centre to centre, to the depth of 30 to 35 feet.

It may be remarked, that all the piling for the bridge has "come home" with great regularity and firmness, and gives great confidence that it will afford an unyielding support to the structure. The foundations for the water piers are yet to be put down; two of them will probably require bearing piles to support them, and rock is expected to be found for the other. The coffer dams are all put down and embanked, and the work of emptying them is soon to commence.

A temporary pipe 3 feet in diameter is laid down, (partly on the embankment of the coffer dams,) which now conveys the water across this valley.

Gate chambers are arranged at each end of the bridge, with gates to regulate the water, and the one on the north end has a waste weir to discharge the surplus water that at any time the pipes might not be able to carry.

The bridge is to be constructed of well dressed granite.

It may very properly be inquired, if the water can be carried temporarily across this valley by iron pipes, why construct this expensive bridge? The reply is, that a plan was prepared, and the work put under contract, to construct a low bridge with one arch for water way; but a supposed value which was attached to the future navigation of the river, was so pressed upon the Legislature, as to induce them to pass a law, requiring that the under side of the arches should be 100 feet above ordinary high tide in the river. The law, therefore, and not the otherwise necessity of the case, has controlled the plan for crossing this valley.

MANHATTAN VALLEY.

The water is conveyed across this valley by means of iron pipes. A gate chamber is placed on each side, by which a connection is formed between the conduit of masonry and the iron pipes, and gates prepared for regulating the flow of water in the same manner as before described for Harlem River. The width of the valley is 0.7917 miles from gate chamber to gate chamber, and the depth at which the pipes are laid in the centre is 102 feet. Two cast iron pipes, each three feet in diameter, are laid down, and provision made for two more, to be laid when they shall be required for the wants of the city. In order to give the pipes sufficient capacity to discharge the quantity of water required, an extra head of three feet is given in crossing the valley.

CLENDENING BRIDGE.

This bridge is constructed over a valley of the same name, that is situated about equally distant between Manhattan valley and the receiving reservoir. The greatest depression is 50 feet, below top of aqueduct, and the valley is 1900 feet across.

The line of aqueduct runs 100 feet westerly of, and parallel to, the 9th Avenue.

In the plan of the city, streets are laid out, but not yet opened, that cross the aqueduct at right angles. For three of the streets archways are constructed under the aqueduct for their accommodation when they may be opened for use. The archways for each street are, one for carriage-way of 30 feet span, and an arch on each side for side walks of 10½ feet span. The style of masonry is similar to that before described for the Sing Sing bridge, and the same method of open walls and cast iron lining is also adopted. That part of the bridge which has no provision for street arches, is composed of a continuous wall of masonry, carried up on a bevel of one-twelfth its rise to the grade line of the aqueduct, where it is 30 feet wide; the outside or face of this wall for one foot in breadth, is laid in hydraulic mortar, and the remainder is laid dry. The method of laying up this dry masonry was to lay a course of large stone in such a manner as to give them the greatest solidity, and within a few inches of each other; after the course was laid over the work, the interstices were thoroughly filled with small broken stone, well pounded in, and levelled up to receive the succeeding course. (The same plan was adopted in all the dry foundations which were laid up to support the conduit over low grounds.) After the foundation was carried up to the proper height for the conduit masonry, parapets of hydraulic masonry were carried up to the level of the roofing arch of conduit, between which the conduit masonry of the usual form (excepting the side walls, which were 12 inches extra thickness) has been constructed, and covered with earth to protect the sides and top from frost; the earth covering being secured by turfing carried over from parapet to parapet. The work presents a very substantial and finished appearance.

Receiving Reservoir.—This reservoir is 1826 feet long and 836 feet wide, and including its embankments contains 35.05 acres, and its area at top water line, 31 acres, divided into two divisions; the northern division is designed to contain 20 feet depth of water, and the southern 30 feet depth. But they are not fully excavated in some parts, where rock occurs, it not being deemed sufficiently important to incur the expense of excavation in rock for the increased capacity that would be obtained. The reservoir has a capacity of 150,000,000 imperial gallons, as it now stands. The reservoir is formed with earth banks, the interior having regular puddled walls to render them impervious to water; the outside protected by a stone wall, laid up on a slope of one horizontal to three vertical, the face laid in cement mortar, and the inside dry; the inside is protected by a dry slope wall, laid on the face of the embankment, which slopes 1½ horizontal to one vertical. The embankments are raised four feet above the top of water line, and are 18 feet wide on the top, excepting the high banks on the sourthern division and the western bank on the northern division, which are 21 feet wide. The greater part of the embankments for the northern division are of moderate height; but a portion of the eastern and western banks of the southern division are 38 feet high above their base. Vaults or brick archways are constructed, in which iron pipes are laid, so arranged that the pipes from the northern division connect with those from the southern division, and thence pass off to the distributing reservoir, and to supply the adjacent districts. The main vault is on the eastern side; it is 540 feet long and is 16 feet span; that on the western side is 400 feet in length, and 8 feet span; designed for supplying at a future day the district on the north river side above 42d street. The pipes are all provided with stop cocks, and so arranged that they can receive the water from either division; except one pipe from each division, that leads to the distributing reservoir. It is intended to carry three lines of pipes, each three feet diameter to the distributing reservoir, (at present only two lines are put down,) and the arrangement will allow two pipes to be drawn from either division, so that in the event of emptying one division for repairs, the other would supply two pipes for the distributing reservoir, and all other pipes having a connection with each division would be in full supply, notwithstanding the suspension of one division. A pipe is put through the division bank, with a stop cock, to allow the water or not, as may be desired, to pass from one division to the other.

The aqueduct intersects the reservoir at right angles with its westerly line, and 252 feet south of the north-westerly corner.

At this point a gate chamber is constructed, with one set of gates to pass the water into the northern division, and another set to pass it into a continued conduit of masonry, constructed within the embankment of the reservoir, to the angle of the southern division, where it enters by a brick sluice into this division. This arrangement gives the power of directing the water into either division, or both, at the same time, as may be desired.

In the division bank, a waste weir is constructed to carry off the surplus water from either division, when it rises to the proper height.

Distributing Reservoir. This reservoir occupies the highest ground in the vicinity, and higher than any part of the city south of it; the site is generally known as Murray Hill.

In order to mair tain the elevation of the water, it was necessary to raise the walls of the reservoir to an avarege height of 45½ feet above the grade of the streets that bounded it on three sides, the greatest height being 49 feet, and the least 39 feet; the foundations were sunk five feet below the grade of the streets. The walls are of hydraulic stone masonry, constructed with openings, to reduce the quantity of masonry and give a more enlarged base.

The openings are made by an exterior and interior wall, connected at every ten feet by cross walls, which are carried up to within 17 feet of the top, and there connected by a brick arch thrown from one to the other, and the spandrels between them levelled up solid, and a course of concrete put over the whole, 6 inches thick, which reaches a level 10 feet below the top, whence the exterior wall is carried up *single* to the top.

The exterior wall has a bevel of one to six, and is uniformly four feet thick from the bottom to the top of the connecting arches; the inner wall is carried up plumb, with offsets, the lower section six feet thick, the middle section five feet, and the upper section four feet thick. The space between the exterior and interior walls, at 41 feet below the top, is 14 feet, or 24 feet from the outside of exterior to inside of interior walls; and the space between them at the spring of connecting arches, in consequence of the bevel of the exterior wall, is reduced to 9 feet and 9 inches, and from outside of exterior to inside of interior walls 17.75 feet.

The cross walls are four feet thick at bottom, and have one offset of six inches on each side at 8 feet below the spring line of connecting arches; they have an opening 6 feet high, and 1½ feet wide, at a suitable level near the bottom, to allow a drain to be formed, to collect any water that may leak through the work, and carry it off in sewers provided for that purpose, and also to allow persons to go in and examine the work.

Some modifications in the cross walls are made to accommodate the gate chambers, and connect the corners of the work. On each corner of the reservoir, pilasters 40 feet in width are raised, projecting four feet from the main wall, and in the centre, on the streets and 5th Avenue, there are pilasters 60 feet wide and projecting 6 feet from the wall. The pilaster in the centre, on the 5th Avenue, rises 7 feet above the main wall, and all the others 4 feet above. Doors are placed in the central pilasters on 40th and 42d streets, which give access to the pipe chambers, to work the influent and effluent stop-cocks, from which chambers, an entrance is made to the openings in the walls.

In the central pilaster on the 5th Avenue, an entrance is made by a door to a stairway that leads up to the top of the walls. On the outside walls, an Egyptian cornice is laid, which accords with the general style of the work. The pilasters are laid in courses, and well dressed ashlar face, and the main wall with coursed rubble work, rough hammer-dressed. Inside of the walls of masonry, a thorough puddled embankment of suitable earth is formed, fifty-eight and one-third feet wide at the line of reservoir bottom, and sloping on the inside face one and a half to one for 24 feet high, and one to one for the remaining 16 feet high, and making with the walls on top a width of 17 feet; the faces of the banks are lined with a course of rubble hydraulic masonry 15 inches thick, and coped with dressed stone. The bottom is a very impervious hard-pan, on which two feet of puddled earth is laid, and this covered by 12 inches of hydraulic concrete. The reservoir is divided into two divisions by a wall of hydraulic masonry, at the toe of which a sloping bank of puddled earth is raised 18 feet high and covered with rubble masonry; this wall is 19 feet thick at the bottom, six and two-third feet thick at top water line, and four feet at top. In this wall a waste weir is placed, with a well of two falls, together 52 feet, from which the waste water enters a sewer in 42d street, and passes off about one mile to the Hudson river. In each division there is a waste cock to draw the water from the bottom.

The reservoir is designed for 36 feet of water, and, when full, will stand 115 feet above mean tide. The walls rise 4 feet above the water line. An iron railing is to be placed around the walls on top of the cornice. The capacity of this reservoir is 20,000,000 imperial gallons.

Grade Line of Aqueduct. The general declivity of the aqueduct in Westchester county is 0.021 foot per hundred, or a fraction over 13¼ inches per mile.*

The top of the conduit pursuing this grade, corresponds with the top of the dam on the Croton; but in order to adapt the aqueduct to draw at a lower level from the Croton reservoir, the bottom grade was depressed at the head 2.93 feet, and a declivity of 0.0113 foot per 100 feet, or 0.59664 foot per mile for 4.949 miles, where it intersects the regular grade. The top of the aqueduct was depressed only 0.583 foot, and carried level 2276 feet, where it intersected the regular grade line of the top. This gave an extra height of side walls, enlarging the capacity of the aqueduct, more than equivalent to the diminution of declivity, and provides for drawing from the reservoir to a depth of 6 feet, and still leave the capacity of the conduit 35,000,000 of imperial gallons.

The grade of the aqueduct from Harlem river to Manhattan valley, is the same as the general declivity in Westchester county; but that from Manhattan valley to the receiving reservoir 2.1727 miles, is 9 inches per mile. It has been stated, the extra fall given for the pipes at Harlem river, is 2 feet, and at Manhattan valley 3 feet; between the reservoirs there is a fall of 4 feet, when both are full; but it is expected something more than this will be required at times, to furnish the full quantity that will be wanted. The pipes are provided with waste cocks at the depressions, and air cocks at the summit bends.

The first contracts for work on the aqueduct, were made in April, 1837, at which time about ten miles of the upper end was advertised, but in consequence of the proposals being considered too high, only about half of it was contracted for. About the middle of May, the contractors generally entered on the work contracted for. In September following, about 16 miles more was put under contract; in May, 1838, the balance of the line to Harlem river was put under contract; and the work on the island, except the grading of the 5th Avenue for pipes, in October following. In consequence of legislative interposition, the Harlem river work was re-let in August, 1839.

The work was so far completed, as to permit the water to be let in from the Croton dam on the 22d day of June, 1842; and it was admitted into the distributing reservoir on the 4th of July following. There is yet considerable work to be done at the Croton dam, the receiving and distributing reservoirs, which will probably all be completed in September or early in October. The Harlem river bridge will require at least two years to complete it. At the latter place, a temporary pipe conveys the water across the valley.

The following extract is taken from my report of the 12th inst. to the Board of Water Commissioners:—

"Since the water was introduced into the aqueduct, the velocity has several times been ascertained, though not in so perfect a manner as I intend to have it done, as soon as other duties will allow the time necessary. Sufficient data, however, have been ob-

* As an illustration of the extreme sensibility of water to the smallest declivity, it may be stated that on a long reach of the Erie canal from Lockport, for a distance of sixty miles, the fall is only of half an inch in a mile The Romam aqueducts had an average declivity of one foot in six hundred.—[Ed

tained to show, that the capacity of the aqueduct for delivering water will be at least 15 per cent. greater than the calculated flow. I have not been much disappointed in finding the flow of water in the aqueduct, to exceed the calculation, as all my observations on the currents in canal feeders, have led me to believe the formulas laid down give rather less than the actual result. The flow of water through the pipes across Manhattan valley, and also the temporary pipe across Harlem river, being attended with circumstances somewhat different, has led some very intelligent persons to predict, that our expectations would not be realised in these cases; it therefore may be proper to observe that trial has proved such predictions to have been not well founded, as the flow through the pipes has in a very exact manner corroborated the anticipated capacity, as compared with that in the aqueduct.

The Croton reservoir, (which has received the name of Croton lake,) covers about 400 acres of land, and is available as a reservoir for 500,000,000 imperial gallons of water, above the level that would allow the aqueduct to discharge 35,000,000 gallons per day. The flow of the Croton is about 27,000,000 gallons in twenty-four hours at the lowest stages, which continues, with moderate rises by occasional rains, from two to three months in the year. This may be considered the minimum capacity of the river. When the wants of the city shall require a daily supply of 35,000,000 gallons, it will be necessary, during the season of lowest water, to draw daily from this reservoir 8,000,000 gallons, to make up the deficiency in the natural flow of the river. This amount the reservoir would supply for 62 days, without any aid from occasional rains; which may safely be relied upon, to keep up the required supply from the reservoir, beyond any drought we have ground to apprehend. The supply of the Croton, from its daily flow, aided by this reservoir, may therefore be taken with great confidence at 35,000,000 gallons, which will be very ample for the wants of the city for a long time to come; and when the day arrives that it will require a larger quantity, it may be obtained by constructing other reservoirs further up the stream, where there are abundant facilities for such purposes."

The total cost of the aqueduct, from the Croton dam to the distributing reservoir inclusive, will be nearly 9,000,000 of dollars.

New-York, 27th July, 1842.

The unfinished portions of the work, chiefly on the Harlem bridge, have been steadily advancing during the period since the introduction of the Croton into the city; and by a letter of recent date from the chief engineer, we are informed that "the foundations for the two last water piers at Harlem bridge are now in progress; the piles are driven for one of them, and they are nearly ready to receive the cap timbers and flooring on which the masonry is to be constructed. For the other the piling is in progress. On the last foundation put down, the masonry is proceeding, and is nearly up to high water line. All the other piers are raised above high water, and the masonry is actively progressing on several of them. It is probable the unfinished foundations will be completed, and the masonry raised above high water by the month of September, and several of the piers be carried up by the close of the season to their full height, ready to receive the arches."

While these sheets are passing through the press, an examination of the whole line of aqueduct has been made with most satisfactory results; the water was stopped off between the Croton and the receiving reservoirs, and a minute personal inspection was made by the chief engineer and his assistants, who passed through the whole conduit, and only, upon very close examination, were enabled to detect some slight defects, which a few days would suffice for repairing. The exterior of the work had suffered as little injury as could be expected from the frosts of winter, and the heavy rains of this spring—and neither outside nor inside had anything occurred to interfere with the regular action, which the various structures were designed to accommodate and promote.

Among the enumerated causes of injury to the Roman aqueducts, it may be remembered, was the formation on the bottom and sides of the channel way, of a stony concretion, produced by matter deposited by the water. It is therefore satisfactory to know, what indeed might *a priori* have been anticipated from the purity of the sources whence the Croton is fed, and the granitic region through which it passes, that no such deposit is made by its waters.

"A fine sediment," says Mr. Jervis, in a letter to the author of 22d April, "has been deposited on the bottom and sides of the aqueduct, but as yet its depth or thickness is too small to be measured with much accuracy. As near as I can estimate, it might reach one inch in thickness in thirty or forty years, if left so long undisturbed. It is, however, so easily removed, that in a few days the whole conduit could be washed clean, and the sediment be discharged by floating it out at the waste weirs. It appears to be a fine alluvial matter, which is readily washed from the masonry, and I do not anticipate that it can ever be a serious inconvenience to the usefulness of the aqueduct."

The temperature of the water in the conduit has been found to vary but few degrees between winter and summer. After the water had been in the aqueduct about two months, it was ascertained, by sending down the current a self-registering thermometer on a float, that its temperature, as compared with that of the water at its head, had fallen some four or five degrees. This was in warm weather; the opposite result would occur in cold weather. The utmost range of the thermometer, between summer and winter, in the conduit, before the water was let in, was from 45° to 55° of Fahrenheit. That range would be changed by the temperature of the water at different seasons, and brought nearer to its own variations. As yet, however, no sufficient experiments have been made on this point. Enough is known, nevertheless, to prove that the conduits are beyond the influence of frost — and, constructed as they are, with fidelity and of the best materials, a duration may be anticipated for the Croton aqueduct equal to that of the *Aqua Alsietina* of Rome, of which it is related that, *one thousand years* after the Goths had cut off its supply, Cardinal *Orsini*, in the year 1693, re-introduced water into it, and that it flowed on for 20 miles to Rome, without loss or interruption, and as freely as in its ancient day.

The average flow of water since its introduction into the Croton aqueduct, has been about fourteen million gallons daily, which gives a height in the conduits of two feet four inches. Its capacity for delivery is more than quadruple this quantity, and the supply is equal to the utmost capacity.

And now, having concluded the narrative and descriptive parts of the Memoir, it will not be deemed an unreasonable indulgence of patriotism civic or pride, to present a brief and flattering comparison between this New York Aqueduct, and the most magnificent of those constructed in ancient or in modern times, the relative population and wealth of the respective countries or communities by which such undertakings have been accomplished, the cost so far as it is ascertainable, and the sort of labor employed.

Rome claims the first place, both of ancient and modern days, for the abundance of her supplies of water through aqueducts. The grandest of her gigantic works was executed by an imperial master and servile hands; but even under her consuls, the people had no share either in the labor or the burden, of the two grandest aqueducts ever constructed.

The *Anio Vetus*, in the year of Rome 480, was paid for from the spoils taken from Pyrrhus, overthrown by the Consul, M. Curius Dentatus, in the preceding year—and the *Aqua Marcia*, a yet more magnificent work, was commenced in the year of Rome, 608, the same year in which the great rival of Rome, Carthage, surrrendered, and in which the Consul *Mummius* destroyed Corinth, carrying off a prodigious plunder. From means thus acquired, was this aqueduct probably provided for.

These were the two great works of republican Rome, but they were cemented by the blood of slavery, and defrayed by the spoils robbed from the conquered and the oppressed.

Imperial Rome constructed the *Claudian*, and the *Anio Novus*, each a river of itself. But both these were commenced by that monster, *Caligula*, who expressed the wish that the Roman people had but one head that he might strike it off at a blow, and who installed his horse, Consul and High Priest. His extortions, oppression, avarice and cruelty, were feebly compensated to the people of Rome, and cannot be pardoned by posterity, although he did undertake those two magnificent structures. It was reserved for the Emperor Claudius to finish them—a successor scarcely less atrocious in character or conduct than Caligula—the dupe of favorites—the slave of lust—stupid, bloody and rapacious.

We have said these aqueducts were cemented with the blood of slavery, and such undoubtedly was the fact, although we have no direct testimony to offer in its support. But we know that slavery was coeval with the foundation of Rome; for although Romulus, as it is related by Livy, at the commencement, and in order to increase its population, made his new city an asylum for runaway slaves, it is also recorded, that before his reign ceased, captives made in war, were reduced to slavery. "From that time," says a modern and learned writer, "the number and importance of the slaves of the Ro mans, are abundantly attested by authorities of all descriptions, and of every period down to the fall of the Western Empire."*

Hume, Wallace, and others, who have scrutinized the accuracy of the numbers of slaves said to have existed at Rome, leave no room for doubt, that vast multitudes were kept in that degraded condition. They were the only servants, and according to Dionysius of Halicarnassus, the only "operatives" or workmen in the city, and so great was the increase in numbers of this sort of population, that in the age of the *Gracchi*, the labor of agriculture, too, was performed by them, and the class of free husbandmen disappeared from Italy. It was from indignation at this state of things, consequent upon the possession of immense landed estates and many slaves, by a few proprietors, that Tiberius Gracchus was stimulated to propose the Agrarian law.†

It may be assumed with confidence, that the slave population of Rome, was from an early period, at least equal to that of the freemen; and as wealth and luxury increased, and it became a mark of rank and condition to have a numerous retinue of slaves, this class much preponderated.

Hence we state, without hesitation, that the Roman aqueducts were built by slaves.

Concerning the manner of applying this labor, it may be conjectured that it was through contractors, for Frontinus, in a passage which refers to the vigilance he was obliged to exercise, in order that the works should be always in order, says he insisted with the contractors—as we translate *redemtoribus*—upon the necessity of always having a number of slave-artificers, (servorum opificum,) near the fountains, both within and without the city.‡

In a modern English Compend of the History of Rome, published anonymously, but purporting to be derived from Niebuhr, Wachsmuth, Heeren, and especially Professor Schlosser, of Heidelberg, we find the distinct statement, without reference, however, to any authorities, both that public works were built by contract, and that the laborers were slaves.

"The Romans," says this writer, "undertook no buildings on account of the State, but had them performed by contract with private speculators, in the same way as they farmed out the collection, or rather the proceeds of the public revenues. These contracts

* Inquiry into the State of Slavery among the Romans, by Wm. Blair, Esq., p. 2.

† Plutarch's Life of the Gracchi.

‡ Frontinus, chap. ii.

were drawn up in writing, of which Cato has preserved to us a specimen in his book on agriculture."

In reference to the *Aqua Appia*, the same writer makes this statement: " The pride of a princely patrician, Appius, who looked indeed upon his family as his country, but who looked upon his country as his family—a man who may be called the express image of the ancient patriciate—of the sternness, vigor, simplicity and constancy of the old Roman nobility—for the first time since the kingly era, employed the revenues of the State, greatly augmented as these were by the possession of Campania and the plunder of Samnium, in a gigantic undertaking, in the building of an enormous aqueduct, and the planning of the most remarkable highway of the Roman empire.

At this time the Romans as well as the Latins continued to pay war-taxes, land-taxes, property-taxes; the tithe of the demesne lands brought large sums in, and the tolls had become more productive since the domain had received aggrandizement; the number of slaves, owing to the wars, had greatly increased. Appius therefore could not better oblige the mass of the citizens, than by undertaking an enormous public work, which should occupy them, and give them an opportunity to enrich themselves through the labor of their slaves. At the same time he announced by these means the greatness of Rome to the whole world, and secured immortal glory to himself."*

In regard to the receipts from the water of the aqueducts, collected from the gardens and buildings to which they were distributed, we find upon a more careful examination of Frontinus, an incidental statement, that this revenue, " amounting to sestertium C. C. L. millium, equal to *one million of dollars*, which had been diverted to the private purse of Domitian, was by the justice of the godlike Nerva restored to the people."†

The Roman aqueducts in Gaul, in Spain, and other conquered provinces, were the works of proconsuls, virtually irresponsible for the exercise of their power; and the labor by which they were built was that of the legions. Magnificent as were these structures, and fraught with benefit to all within their sphere, they were nevertheless the badge of servitude, the boon of a conqueror to subject peoples.

Of modern works, the *Canal de L'Ourcq*, in France, by its extent and the copiousness of its supply, is among the most remarkable. But that too, was a government undertaking, feebly prosecuted through a period of some thirty years, and completed at last at a great expense, in incurring which, or in the means for its repayment, the people had no voice. The canal cost 24,326,278 francs, or near five millions of dollars, and the distribution of

* History of Rome, pp. 126, 7, Carey, Lee & Blanchard's edition, 1837.

† Frontinus, chap. ii.

the water about four million dollars more. Its revenue as a navigable canal, is about 60,000 francs, and from its waters consumed in Paris. 1,460,000 francs, altogether a little more than $300,000.*

For its bold and lofty arcades, the solidity of its masonry, and the imposing grandeur of the whole structure as it bestrides the beautiful valley of Alcantara, the aqueduct of Lisbon may claim the first place. It is, however, short in its course, and its supply of water is comparatively small. This is wholly a royal work.

In Great Britain, all the water-works seem to have been private speculations, in which the hope of gain was the alluring cause—except, indeed, the original undertaking of *Hugh Myddleton*, to introduce the New river into London. He certainly appears to have acted for the general good, and to have made great personal sacrifices for its promotion. In other instances, the commercial spirit, which looks to a reward for its investments, was at the bottom of the enterprise.

The city of New York presents, it is believed, the only instance of a comparatively small community, not exceeding at the time 280,000 inhabitants, deliberately voting that an enterprise should be undertaken, in a style and on a scale greatly beyond their actual or any near future wants, but which, designed to endure for ages, would bear record to those ages, however distant, of a race of men who were content to incur present burdens, for the benefit of a posterity they could never know.

Having resolved on the work, they carried it forward with a degree of constancy and energy alike remarkable, so that in the space of five years, an aqueduct was completed, which, for the natural difficulties overcome, the substantial character of its structures, the very remarkable verification, in the results, of the previous calculations of the engineers as to the flow of the waters, and the quantity that could be delivered, for the extent of its course, and the abundance of its supply, may be ranked among the foremost of like undertakings throughout the world.

Nor were the extraordinary financial difficulties which affected the whole country, almost the whole world, during the greater portion of the period this enterprise was in progress, permitted to check its steady advance. The city resolved that the means should be found, and they were found.

Yet, with all this energy and perseverance, there was no rashness. The calculations of the cost, were carefully made, and it is a circumstance unparalleled probably in the history of like undertakings, and one which reflects great credit on the exactness of the knowledge of the chief engineer, Mr. Jervis, and on his professional skill and fidelity, that

* Duten's Histoire de la navigation interieure de la France, p. 566, 7, vol. i. Paris 1829.

the very first estimate he gave, after he had made himself master of the details of the proposed work, and had the experience of some few contracts, has turned out to be *within*, and not much differing from, the actual cost. In Great Britain, it had grown into an article of faith, that the estimates of engineers for like works, were in no wise to be relied on, and certainly the experience of London justified such incredulity.

The whole work was executed by contractors, employing free labor, was paid for by a single city, where slavery is unknown, and is designed and calculated to supply the wants of any population which that city can sustain.

Its copiousness of waters is so great, that two of its fountains daily throw away more water, than suffices for the supply of other large cities.

Indeed, there is scarcely any feature of the work more imposing and magnificent than the volume of water which its fountains pour out in perennial flow, and the height to which they are projected.

There are, to be sure, higher jets in Europe—the highest perhaps in the world is that of Cassel, in Westphalia, which, according to modern travellers, rises from a pipe of 12 inches in diameter, to the extraordinary height of two hundred feet—but it never plays much more than half an hour! Its reservoir is on a hill behind the town, at an elevation of 300 feet.

The "Grandes Eaux," or famous water works of Versailles, are in like manner mere holiday play-things, which on the first *Sunday* of every month are exhibited for the admiration of the crowds which then throng the avenues of that beautiful and sumptuous palace; but at all other times, the sea-gods and the sea-horses, and the Neptunes and the Naiads, sculptured in marble or cast in bronze, and constituting groups in and about the various basins of these fountains, are dry as the gravel walks that lead to them.

The cost* of the Croton Aqueduct was very great—but once made, it is final, and its waters being distributed by its own head, there is not, as in Paris and in London, in Phila-

* TOTAL COST OF THE CROTON AQUEDUCT.

Paid for work done by contractors up to 1st April, 1843, - - - - - -	$7,138,486 34
Incidental expenses up to same date, including salaries of engineers and Commissioners -	436,860 11
Cost and rent of land for line of aqueduct - - - - - - - -	408,155 67
Actual money cost of the aqueduct to the distributing reservoir at Murray's Hill - -	$7,983,502 12
Add, for procuring and laying water pipes - - - - - - - -	1,878,839 51
Interest on water stock to 1st August, inclusive - - - - - - - -	1,577,459 43
Sundry water loan, and other expenses - - - - - - - - -	12,818 55
Total expenditure - - - - - - - - -	$11,452,619 61

The whole amount of stock authorised to be issued, is twelve millions of dollars. The balance unexpended will suffice to complete the high bridge over the Harlem, and henceforth the interest on the debt is to be paid from taxes.

delphia, Richmond, and Cincinnati, a large annual expenditure for forcing-pumps and steam engines.

The solidity of the general structure forbids the idea, for centuries, of other than slight occasional repairs; the abundance of the source relieves from all solicitude as to adequate supplies for the multitudinous population of hereafter. It is for the future even more than for the present, and will attest to other lands and to other times, that, magnificent as may be the works of conquerors and kings, they have not equalled in forecast of design, and beneficence of result, the noble aqueduct, constructed at their own cost, by the freemen of the single city of New York.

THE CELEBRATION

OF THE

FOURTEENTH OCTOBER, 1842.

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It was natural that so great an event as the completion of the Croton Aqueduct, should be deemed by the citizens, at whose cost and through whose constancy it had been constructed, worthy of some public celebration.

We have seen how the Lord Mayor and citizens of London honored the introduction into that city, of the New River; and the memory of the imposing ceremonial in our own city, upon the marriage of the Lakes with the Ocean by the completion of the Erie Canal, was a precedent too recent and too agreeable, to be departed from.

Accordingly on the 5th July, in the Board of Aldermen, Alderman Lee presented the following preamble and resolutions, viz:

Whereas, The important work of introducing the waters of the Croton River in the city of New York is now completed, and in such a manner that it cannot be viewed without a feeling of pride at its execution; a work upon which posterity will look back to those who transmitted the blessing with veneration, and that will be for ever remembered as an evidence of the liberality of the citizens of New York, the importance of which is equalled only by the legacy handed down to us by the sires of the Revolution, for, while the one ensures to us prosperity, together with freedom and religious liberty, the other secures to us and our posterity that health, without which all other blessings dwindle into insignificance:

Therefore Resolved, That, if the Board of Assistants concur, a Joint Committee of five members from each Board be appointed to make arrangements for commemorating this event in a manner corresponding with its vast importance, and that they be authorised to invite our fellow-citizens to unite with the Common Council in celebrating, with all suitable demonstrations of joy, the completion of this great and stupendous work.

These were, on motion of Alderman Davies, referred to the Joint Committee on the Croton Aqueduct, from which Committee the following report was received on 19th September:

The Joint Committee on the Croton Aqueduct, to whom was referred the preamble and resolution presented by Alderman Lee, July 5, 1842, in relation to celebrating the event of the introduction of the Croton Water into the city, presented the following report, recommending the adoption of the preamble and resolution referred to them, together with the resolution annexed to this report—*Respectfully Report:*

That they have had the same under consideration, and that they do cheerfully respond to the sentiments therein contained:—the introduction of the healthful streams of the Croton to our homes, forms an era in our municipal history, which must always be among the brightest on the page that records our civil glories.

This great work, equal to any on this continent for magnitude, and for a display of scientific skill, has been successfully completed in the space of five years, by the unaided credit of our city, and enterprise of our citizens. The hopes of half a century are now turned from dreamy longings, with but a faint chance of fulfilment, into the enjoyment of a substantial blessing, whose benefits will not only delight us in our day, but will serve as a broad foundation for the unchanging gratitude of remote posterity. The Committee have sought among their fellow-citizens for an indication of their opinion upon a public celebration, and are pleased to find all are anxious to unite, as brethren owning a common property in this good structure, in celebrating its glorious completion.

The Fire Department have already made extensive preparations for such an occasion, and the Committee hope that the Common Council will meet the wishes of so valuable a portion of our citizens, and sanction by their authority, a day to be dedicated to universal public rejoicing.

Since the passage of the ordinance making an appropriation for the erection of a fountain in the Park, the engineers and officers of the Croton Department have turned their attention towards its construction, by an early day, so far as to enable us to display the beauty and capacity of the water.

The lateness of the season renders it improper to do more than lay the foundation, and prepare the basin for the celebration. The laying of the coping, and the finishing of the whole, must be deferred until after the frosts of the coming winter have entirely ceased.

The Committee think that the introduction of the water cannot be properly celebrated, until the fountain is so far completed as to admit of an exhibition of its powers, and believing the same will be completed by the 14th day of October next, the Committee now designate that day as the proper one for the celebration.

The Committee recommend the adoption of the annexed preamble and resolution, and also submit herewith a resolution for the consideration of the Common Council:

Resolved, That the sum of two thousand dollars be, and the same is hereby appropriated for the purpose of celebrating the introduction of the Croton water into this city, and that the same be applied under the direction of the Committee on the Celebration;

and that said Committee be requested to report a programme of the ceremonies of the day to the Common Council, at least three days before the day fixed for such celebration.

HENRY E. DAVIES,
EDWARD D. WEST,
CHARLES W. SMITH,
GEORGE F. NESBITT,
WILLIAM DODGE,
DANIEL WARD.

The preamble and resolution were adopted, and the blank in the latter was filled with $2000.

The President then appointed Aldermen Davies, West, Smith, Lee, and Crolius, such Committee on the part of this Board.

The Board of Assistants concurred in these proceedings, and on their part appointed Assistant Aldermen Nesbitt, William Dodge, Daniel Ward, H. C. Atwell, and C. F. Dodge, as members of the Joint Committee.

On the 10th October, the Joint Committee made this report:

The Committee appointed to make arrangements for celebrating the introduction of the Croton water into the city of New York on the 14th instant—*Respectfully Report:*

That, having taken into consideration the great importance of this stupendous monument of the enterprise of the citizens of New York — a work which cannot but create in the breast of every citizen, a feeling of pride at its completion, and which will vie in magnitude with any in the world, and will be handed down to posterity as an evidence of the liberality of the free and enlightened citizens of the greatest commercial emporium in the United States, in the nineteenth century; for while tyrants and despots may have caused monuments to be erected, in order to commemorate their reign, your Committee believe there is not an instance on record in which the citizens of any country have, of their own free will and accord, authorised the construction of a work of the same magnitude, the beneficial effects of which will be experienced by ages yet unborn.

Your Committee, feeling desirous that the completion of this proud monument of liberality and enterprise, should be celebrated with such public demonstrations of joy as a work so beneficial to our city deservedly demands, invited the co-operation of their fellow citizens connected with the various trades, societies and associations, either literary, beneficial or benevolent, and most cheerfully has it been responded to; all, to appearance, feeling anxious to commemorate the accomplishment of this interesting object, which has cost so much profound study and application on the part of some of our most estimable citizens, before this important project was matured, and all the springs of action necessary to bring it to perfection, were fully arranged and systematized. Nor is it confined to *our* citizens alone; various associations from our sister cities and the neighboring villages, anxious to rejoice with us, have signified their intention of uniting in the procession.

Invitations have been sent to the Corporations of Brooklyn, Albany, Troy, Jersey City, Newark, Elizabethtown, Rahway, New Brunswick, Trenton, and Philadelphia, and

Trustees of Williamsburgh, all of which have been accepted, except that to Philadelphia, who have been obliged to decline on account of its being the day on which the new Board is sworn into office — a circumstance much to be regretted, from the fact, that from the authorities of that city the most valuable information has been received in reference to the work ; and the kind manner in which it has invariably been imparted, places this city under obligations to them which scarcely can be repaid.

The Committee, desirous of adding every thing in their power to the splendor of the day, were induced to apply to George P. Morris, Esq., for an original ode to be sung on the occasion. General Morris, with his usual kindness, has responded to your Committee in the production of an ode replete with beauty and feeling.

The New York Sacred Music Society, through their President, Luther B. Wyman, Esq., have in the kindest manner volunteered to sing the ode, from a stage to be erected for that purpose in the Park, in front of the City Hall. The number of vocal performers are rising two hundred, male and female; an adequate number of instrumental performers are engaged, and, on the whole, it is presumed that this will form one of the most interesting points in the day's festivity.

The splendid banner, painted by Mr. Smith, and intended as a present to the Fire Department by the city authorities, will be presented by His Honor the Mayor to the Board of Trustees of the Fire Department Fund, who are delegated by the Department to receive it, at nine o'clock in the morning, in front of the City Hall.

General Gilbert Hopkins has been selected as the Grand Marshal of the day, who has selected twenty-six gentlemen as aids.

The day will be ushered in by the firing of a national salute by the veteran corps, under the command of Capt. Chapman, who has kindly consented to perform that duty.

The bells of the different churches in the city are directed to be rung one hour at sun-rise, at noon, and at sun-down.

The line will be formed under the direction of the Grand Marshal and aids, in Broadway — the right on Battery Place — at nine o'clock, and will move precisely at ten o'clock. The whole line will countermarch up Broadway to Union Place — down the Bowery to Grand-street — up Grand street to East Broadway — down East Broadway to Chatham-street — down Chatham-street to the Park.

The Committee are desirous that the Inspectors of the streets through which the procession will pass, should be particularly instructed to have the streets cleaned, and that no vehicles or fruit-carts be allowed in them.

HENRY E. DAVIES,
GEORGE F. NESBITT,
FREDERICK R. LEE,
EDWARD D. WEST,
CHARLES W. SMITH,
CLARKSON CROLIUS, Jun.,
R. H. ATWELL,
DANIEL WARD,
WILLIAM DODGE,
CHARLES J. DODGE,

Joint Celebration Committee.

New York, October 10, 1842.

Invitations were addressed by the Sub-Committee of Arrangements designated for that purpose, consisting of Aldermen Crolius, West, and Assistant-Alderman Wm. Dodge, to many distinguished citizens and strangers. From among numerous replies, we select for publication those which follow, beginning with that of the President of the United States:

From the President of the United States.

Washington, Oct. 11, 1842.

GENTLEMEN:—

I should be most truly happy to be present at an event so interesting to your city as the celebration proposed for the 14th, and to which you have invited me. Circumstances, however, deny to me the pleasure of such a visit. I heartily rejoice with the citizens of New York, in the completion of a work so vastly important to the health, and comfort of its inhabitants. It is justly to be classed among the first works of the age, and is honorable to the enterprise of the great centre of American trade and commerce.

I tender to you, gentlemen, assurances of my high respect,

JOHN TYLER.

From Ex-President John Quincy Adams.

C. CROLIUS, Jun'r., Ald'n. 6th Ward,
E. D. WEST, Ald'n. 16th Ward,
WILLIAM DODGE, Ass't. Ald'n. 3d Ward,
} *Committee of the Common Council of the City of New York.*

Quincy, 11th October, 1842.

GENTLEMEN:—

I pray you to accept my grateful acknowledgments for the honor done me, by the invitation to join with the Common Council of your great and illustrious city, on the 14th inst., in celebrating the introduction of the Croton water into the city.

Detained by indispensable engagements at home, I regret that I shall be deprived of the pleasure of participating with you, in the festive enjoyment of an event so interesting to the health and comfort of your immense, and still multiplying, population. For whatever may contribute to their welfare and happiness, my best wishes, are but the dictates of duty, no less than the impulses of a patriotic heart.

I am, with great respect, gentlemen,

Your obliged and very obedient servant,

JOHN QUINCY ADAMS.

From Ex-President Van Buren.

Kinderhook, October 8, 1842.

GENTLEMEN:—

I regret, exceedingly, that it will not be in my power to avail myself of your polite invitation, to join the Common Council of New York, in celebrating the introduction of the Croton water into the city.

Participating, very fully, in the gratification which is derived from the successful completion of that great work, and sincerely thankful for this mark of respect on the part of the Common Council,

I am, gentlemen,

Very respectfully,

Your obedient servant,

M. VAN BUREN.

To

CLARKSON CROLIUS, Jun'r.,
E. D. WEST, and
WM. DODGE, Esq'rs., } *Committee.*

Those from different functionaries in the State Government next claim notice:

From Governor Seward.

Albany, October 12, 1842.

Gentlemen:—

Your kind letter, bearing date the 30th September, inviting me to attend the celebration of the completion of the Croton Water Works, was found by me on my return to this city on Friday last. But a severe indisposition, from which I am just recovering, has prevented my acknowledgment of that invitation, or your subsequent note, in which it was so kindly renewed.

Sympathizing sincerely with my fellow-citizens in the accomplishment of that great work, I with great pleasure, accept the invitation. I shall leave this city to-morrow evening, and take up my lodgings with the Honorable Samuel B. Ruggles, Union Square.

With very high respect,

Your obedient servant,

WM. H. SEWARD.

To

CLARKSON CROLIUS, Jr.,
EDWARD D. WEST, and
WILLIAM DODGE, Esqrs. } *Committee, &c New York.*

From Lt. Governor Bradish.

Albany, November 1, 1842.

Gentlemen:—

I am just favored with your invitation, in behalf of the Common Council of the city of New York, "to join with them on the 14th day of October, in celebrating the introduction of the Croton water into the city of New York."

Your letter was missent, and went first to Moriah, in Essex County; was forwarded thence to Moira, in Franklin County; was thence returned to Albany; thence forwarded to New York; thence sent back, and has just reached me here. I regret, exceedingly, this long delay in the receipt of your letter, as it has prevented its earlier and due acknowledgment. Had it, however, reached me in season, my indispensable public duties here would not have permitted me the great pleasure it offered me. It would otherwise have afforded me the highest gratification, to unite with the Common Council and citizens of

New York, in the celebration of an event, as important to the interests, as it is honorable to the character, of your city. The completion of the Croton Aqueduct, and the supplying of a great city with pure and wholesome water, would have illustrated any age of any country. Their achievement is a fit subject of the high congratulation and just pride of ours.

I beg you will, although late, be pleased to receive for yourselves, and communicate to those you represent, my due acknowledgments for the courtesy extended to me on this occasion.

And believe me to be, Gentlemen,

With sentiments of great respect,

Your obedient servant,

L. BRADISH.

To

C. CROLIUS, Jr.,
E. D. WEST,
WILLIAM DODGE, Esquires. } *Committee.*

From the Secretary of State.

Albany, 6th October, 1842.

GENTLEMEN:—

After an absence of several days from the city, in consequence of sickness in my family, I have received, through you, the polite invitation of the Common Council, to attend the celebration of the introduction of the Croton Water in the city of New York, on the 14th instant. I have some doubts whether I shall be able to avail myself of the invitation; I will, however, be with you if I can.

Very respectfully

Your obedient servant,

S. YOUNG.

To

CLARKSON CROLIUS, Jr.,
EDWARD D. WEST,
WILLIAM DODGE, Esqrs., } *Committee of Invitation, &c., &c., New York.*

From the Comptroller of the State of New York.

Comptroller's Office,
Albany, October 12, 1842.

GENTLEMEN :—

I have received your kind invitation in behalf of the Common Council of the city of New York, requesting me to join with them on the 14th instant, in celebrating the introduction of the Croton water into the city of New York. My engagements will deprive me of the pleasure of being present on the interesting occasion to which you allude.

I am, gentlemen, with great respect,

Your obedient servant,

A. C. FLAGG.

Messrs.
CLARKSON CROLIUS, Jr.,
EDWARD D. WEST,
WM. DODGE,
New York.

From the Attorney General of the State of New York.

October 3d, 1842.

GENTLEMEN :—

I have the honor to be in the receipt of your favor of the 1st inst., inviting me, on behalf of the Common Council of the city of New York, to join with them, on the 14th inst., in celebrating the introduction of the Croton water into the city of New York.

I need not assure you that it would give me great pleasure to be present on an occasion so interesting, but I regret that professional duties will compel me to decline an invitation, the acceptance of which would give me great pleasure.

With the highest personal consideration for you, gentlemen, and those you represent, I have the honor to be, your obedient, humble servant.

GEORGE P. BARKER.

To
J. CLARKSON CROLIUS, Jr. Esq., Ald. 6th Ward,
EDWARD D. WEST, Esq., Ald. 16th Ward,
WM. DODGE, Esq., Ass't Ald. 3d Ward,
Committee.

From the Surveyor General.

Surveyor General's Office,
Albany, October 21st, 1842.

GENTLEMEN :—

Absence from this place, on official business, prevented me, until the 16th instant, from receiving your polite invitation to join the Common Council of New York, in celebrating the introduction of the Croton water into your great city.

The object of this note is to assure you, gentlemen—though at a late period—that I gratefully appreciate your invitation, and to express to you and the Common Council my regrets, that I could not have participated in the felicitations of an event that will mark an epoch, glorious in the history of New York.

With great consideration,

Your obedient servant,

NATHANIEL JONES.

CLARKSON CROLIUS, Esq.,
EDWARD D. WEST, Esq.,
WM. DODGE, Esq.,
Committee, &c.

The replies of the foreign Consuls follow :

From the British Consul.

Her Britannic Majesty's Consulate,
3d Oct., 1842.

GENTLEMEN :—

I have the honor to acknowledge, and with feelings of no ordinary kind, accept the invitation of the Common Council, to join with them on the 14th instant, in celebrating the introduction of the Croton water into the city—a work, which stands among the greatest enterprises of any nation on earth, governed by, and voluntarily paid for, by the people. Tyrants have left monuments which call forth admiration, but no work of a free people, for magnitude and utility, equals this great enterprise. That such an event should call forth an expression of admiration, and that the Common Council should afford an opportunity for so doing, will ever redound to the honor of the city. Most happy shall I be, to assemble and participate in the general joyful event.

I have the honor to remain, gentlemen,

Your humble servant,

J. BUCHANAN.

To

C. CROLIUS, Esq.,
E. D. WEST, Esq., } *Committee.*
WILLIAM DODGE, Esq.,

Consulat-General
De France
Aux Etats Unis.

From the Consul of France.

New York, October 3d, 1842.

The Consul General of France, presents his compliments to the Common Council of the City of New-York, and will be very happy to join with them on the 14th inst., to celebrate the introduction of the Croton Water into the city of New-York.

To

Messrs. C. CROLIUS, Jr., Alderman 6th Ward,
" E. D. WEST, Alderman 16th Ward,
" WM. DODGE, Asst. Alderman 3d Ward.

Gentlemen of the Committee of the Common Council of the City of New York.

From the Consul of Prussia.

Mr. Schmidt has much pleasure in accepting the invitation with which the Corporation of the city have honored him, to join with them on the 14th inst., in the celebration of the day.

5th October, 1842.

From the Consul of the Netherlands.

The Consul of the Netherlands will have the honor of joining with the Hon. Common Council of the City, on the 14th inst., in celebrating the introduction of the Croton water in the City of New York, according to their polite invitation, dated 26th September last.

New York, 4th October, 1842.

From the Consul of Portugal.

GENTLEMEN :—

The undersigned will with much pleasure accept the polite invitation of the Honorable the Common Council of the City of New York, to join with them on the 14th day of October in celebrating the introduction of the Croton water into the city of New York.

Respectfully, your obed't. serv't.,

PHILIP N. SEARLE.

New York, 3d October, 1842.

C. CROLIUS, Jr.,
E. D. WEST,
WM. DODGE. } *Committee.*

From the Swiss Consul.

Mr. De Rham, Swiss Consul, accepts the honor of the invitation of the Common Council for the Celebration of the 14th inst.

New York, October 6th, 1842.

From the Consul of Sweden and Norway.

Consulate of Sweden and Norway, in New York, October 6th, 1842.

As Mr. Zachrisson will not be in town on the 14th instant, he regrets that he cannot accept of the invitation from the Common Council of the city of New York, to join with them in the Celebration of the introduction of the Croton Water into the city of New York.

To the Common Council of the City of New-York.

From the Consul for Greece.

Mr. Dutilh, Consul for Greece, regrets that it is out of his power to accept the very flattering invitation of the Honorable the Common Council of the city of New-York, for the 14th instant.

New York, October 6th, 1842.

From the Meklenburg Consul.

Meklenburg Consulate, New York, October 1st, 1842.

Consul Heckscher regrets that absence from town, will deprive him of the honor, kindly tendered him by the Honorable Common Council, of joining with them on the 14th day of October, in celebrating the introduction of the Croton Water into this city.

From the Consul of the Two Sicilies.

New-York, October 6th, 1842.

To the Committee of the Croton Water.

Sirs:

The Consul General of the Two Sicilies, in acknowledging the receipt of the polite invitation of the Common Council of the city of New York, has the honor to inform the Committee, that he will be most happy to join them on the appointed day.

Respectfully your obedient servant,

R. MARTRYCELL.

To

C. CROLIUS,
E. D. WEST,
WM. DODGE, } *Committee.*

Consulate of the Grand Duchy of Hesse.

New-York, 8th October, 1842.

Gentlemen:—

Your favor of 26th ultimo, has been received only a few days ago.
The honor of your invitation is accepted by your obedient servant,

A. BOLLERMANN, *Consul.*

Messrs.

C. CROLIUS, Jr., Ald'n.,
E. D. WEST, Ald'n.,
WM. DODGE, Ass't Ald'n., } *Committee.*

From the Consul of Frankfort.

The undersigned, Consul of Frankfort on the Main, feels honored by the invitation of the Honorable Common Council of the city of New York, of the 26th September, and will with pleasure join with them on the 14th inst., in celebrating the introduction of the Croton water into the city of New York, if not prevented by circumstances out of his control.

Respectfully,

Your obedient servant,

FRED. WISSMANN.

New-York, 6th September, 1842.

To Messrs.
C. CROLIUS, Jr., Ald'n. 6th Ward,
E. D. WEST, Ald'n. 16th Ward,
WM. DODGE, Ass't Ald'n. 3d Ward,
} *Committee.*

From the Consul of Mexico.

New York, October 6th, 1842.

GENTLEMEN :—

I have the honor to acknowledge the receipt of your invitation to join with you in celebrating the introduction of the Croton water into the City of New York, to which absence from the city alone prevented my answering before, and I now do it, regretting exceedingly the necessity which compels me to a further absence, and consequently deprives me of the pleasure of participating with you in the celebration of so auspicious an event.

Very respectfully,

Your obd't. servant,

JOHN GRANJA.

To Hon. Messrs.
C. CROLIUS, JR.
E. D. WEST.
WM. DODGE,
} *Committee.*

From the Consul of Venezuela.

Consulate of Venezuela in the City of New York.

GENTLEMEN :—

The undersigned cheerfully accepts the polite invitation of the Common Council of the City of New York, to join in the celebration of the introduction of the Croton Water into this city.

October 7th, 1842.

Very respectfully, your obd't servant,

J. B. PURROY,

Consul of Venezuela.

To

C. CROLIUS, JR.
E. D, WEST, and
WM. DODGE, Esqr's. } *Committee, etc.*

From the Consul of Texas.

Consulate of Texas, New York, October 11, 1842.

GENTLEMEN :—

I duly received your kind invitation of 26th September, to join the Honorable, the Common Council of this city, on the 14th instant, in celebrating the introduction of the Croton Water into the City of New York.

I have delayed until now to acknowledge the honor of your invitation, in the hope that I should be enabled to be present on that interesting occasion. But fearing that my engagements for that day will deprive me of the pleasure, I pray you will accept my regret and excuse my absence.

I have the honor to be, gentlemen,

very respectfully,

your obliged servant,

J. H. BROWER.

To

CLARKSON CROLIUS, JR., Esq. Alderman 6th Ward,
E. D. WEST. Esq. Alderman 16th Ward,
WILLIAM DODGE. Esq., Asst. Alderman 3d Ward. } *Committee.*

The Officers of the Army and Navy on the station, and other Naval Officers casually here, being invited, made these replies:

From the Officers of the U. S. A.

Head Quarters, Fort Columbus, October 11, 1842.

Col. Bankhead, and the Officers of the Army on this station, accept with pleasure, the invitation of the Common Council of New York, to join with them, on the 14th inst., in celebrating the introduction of the Croton Water into the City.

JAS. BANKHEAD,
Colonel 2d Artillery.

Messrs.
C. CROLIUS,
E. D. WEST,
WM. DODGE. } *Committee*

From the Officers of the U. S. N.

Navy Yard, New York, October 7th, 1842.

GENTLEMEN:—

I have had the honor of receiving through you an invitation from the Common Council of the city of New York, inviting myself and the officers of the Navy Yard, "to join with them, on the 14th day of October next, in celebrating the introduction of the Croton water into the city of New York;" and I beg to assure the Committee, that the Officers and myself will have the greatest pleasure in participating in an event so memorable.

With great respect,
I have the honor,
Your most ob't serv't,
M. C. PERRY,
Com. Navy Yard, N. Y.

To
Alderman C. CROLIUS, Jr.
" E. D. WEST,
" WM. DODGE, } *Committee.*

From W. C. Wetmore, Commander of the North Carolina.

U. S. Ship North Carolina, October 13th, 1842.

GENTLEMEN :—

The Officers of the North Carolina have had the honor to receive the polite invitation from the Common Council of the city of New York to join with them on the 14th day of October, in celebrating the introduction of the Croton water. The Boys of the Naval School will be in attendance if the weather should be favorable, if not, the want of winter clothing, which has not been received on board, will prevent their appearance.

Will the Committee please state the time and place of meeting for them on that occasion.

Very Respectfully,

Your Obedient Servant,

W. C. WETMORE.

Commander.

To Messrs.

CLARKSON CROLIUS,
E. D. WEST,
WM. DODGE.
} *Aldermen and Committee of Arrangements*

From the Naval Court Martial.

The President and Members of the Naval General Court Martial, now sitting on board this ship, regret that it is not in their power to accept the polite invitation of the Common Council of the city of New York, to join with them on the 14th instant, in celebrating the introduction of the Croton Water into the city of New-York.

United States Ship North Carolina.

October 5th, 1842.

From the Judge of the Southern District of New York, and from the United States District Attorney, who accepted the invitation.

From the United States District Judge.

City Hall, October 13, 1842.

Judge Betts accepts with pleasure the invitation of the Honorable Common Council to unite with them in the Croton celebration to-morrow.

From the United States District Attorney.

Mr. Ogden Hoffman accepts, with great pleasure, the invitation of the Common Council to join with them in celebrating the introduction of the Croton water into the city of New York.

October 13, 1842.

The first Water Commissioners, and the resident and assistant engineers, employed on the work, respectively answered as follows:

From William W. Fox.

To C. Crolius, E. D. West, Wm. Dodge, Esqr's,—

Yours of the 26th Sept., inviting me to join with the Common Council in celebrating the introduction of the Croton water into the City of New York, was this day received. Circumstances will prevent my accompanying the procession. Accept my thanks for your attention in giving the invitation.

Respectfully,

New York, October 10th, 1842. WILLIAM W. FOX.

From Benjamin M. Brown.

Nelson's Hill, Mamaroneck, 8th October, 1842.

To C. Crolius, Jr., E. D. West, Wm. Dodge, Esqr's. Committee, etc.

Gentlemen :—

Your polite invitation to join in the interesting ceremonies of celebrating the introduction of the Croton water into the city of New York, I received this day, and it will afford me much pleasure to attend the same.

The subject of introducing *pure* and *wholesome* water in the city, was one that early engaged my attention when entering public life, and it does afford me much satisfaction to see its successful accomplishment.

Respectfully, your ob't. serv't.,

BENJAMIN M. BROWN.

From the Chief Engineer.

New York, 10th October, 1842.

To CLARKSON CROLIUS, Esq., *Chairman Committee of Invitation for Croton Aqueduct celebration.*

Sir :—

I received the invitation of Committee to attend the celebration of the introduction of the Croton water into the city, and hope my health will be so far restored by that day, as to allow me the pleasure of participating in the celebration of this event, to which I have looked with no ordinary care and responsibility for near six years. The work, I trust, will fulfil the highest expectations of usefulness, which induced the city to enter upon the great enterprise.

Very respectfully, your obedient servant,

JOHN B. JERVIS.

From E. French, Esq., Resident Engineer.

Engineer's Office, 1st division Croton Aqueduct,
Sing Sing, October 11, 1842.

GENTLEMEN :—

I have the honor to acknowledge the receipt, and to signify my acceptance, of the invitation to join with the Common Council of the city of New York in celebrating the introduction of the Croton water, which you have so kindly favored me with.

With much respect,
Your obedient servant,
E. FRENCH,
Resident engineer,
1st division Croton Aqueduct.

To Messrs.

C. CROLIUS, Jr., Alderman 6th ward,
E. D. WEST, do. 16th do.
WM DODGE, do. 3d do.
Committee.

From Mr. Hastings, late Resident Engineer.

New York, October 7th, 1842.

GENTLEMEN :—

I have the honor to acknowledge the receipt of your circular letter of the 26th ult., inviting me to join with the Honorable Corporation of the city of New York, in celebrating the introduction, &c., of the Croton water on the 14th inst.

I thank you, gentlemen, and the honorable body you represent, for your polite invitation, and shall be most happy to join them in the celebration of an event so honorable to them and useful to the people of this great city.

With great respect,
I have the honor to be, Messrs.,
Your most obedient servant,
H. P. HASTINGS.

Hon. C. CROLIUS, Jr.,
E. D. WEST, and
WM. DODGE,
Committee.

From the Assistant Engineer.

Sing Sing, October 11th, 1842.

Gentlemen :—

The undersigned acknowledges the honor of an invitation of the Common Council of the city of New York, to join with them in celebrating the "introduction of the Croton water into the city of New York," and accepts the same with great pleasure.

Very respectfully,

Your obedient servant,

M. CHURCHILL,

Ass't. Eng'r.

To Messrs.

C. CROLIUS,
E. D. WEST, *Committee.*
W. M. DODGE,

From the Assistant Engineer.

Gentlemen :—

I have the honor to accept the invitation of the Common Council, to join with them in celebrating the introduction of the Croton water.

Respectfully, your obedient servant,

JAMES RENWICK, Jr.,

Ass't. Eng'r.

Aldermen

CROLIUS, WEST, and DODGE,

Committee.

Invitations were also extended to the municipal authorities of contiguous cities and States.

The Governor of New Jersey, prevented by public business from being present, apologised as follows:

From the Governor of New Jersey.

Trenton, N. J., October 13th, 1842.

GENTLEMEN:—

Your letter reached me at this place this moment. I regret very much that my public duties here will prevent my being with you to-morrow, at the celebration of one of the most beneficial works in our country, and which cannot fail to promote in a large degree the health and comfort of your city.

With my thanks to the Common Council, for their polite invitation,

I remain,

Your very obedient servant,

WILLIAM PENNINGTON.

To

C. CROLIUS,
E. D. WEST,
WM. DODGE, Esqrs. } *Committee, &c.*

From the Mayor of Trenton.

To Messrs.

CLARKSON CROLIUS,
E. D. WEST, and
WM. DODGE.

Trenton, October 12th, 1842.

GENTLEMEN:—

Yours of the 10th instant, was received by this morning's mail. I have the honor on the part of the Common Council of the city of Trenton, of informing you that the invitation is accepted. The Council have determined to come on in the Thursday evening train of cars.

Very Respectfully,

Your Obedient Servant,

CHARLES BURROUGHS, *Mayor.*

From the Mayor of Princeton.

Princeton, 12th Oct., 1842.

GENTLEMEN :—

The Common Council of the Borough of Princeton, accept with great pleasure the invitation of the Common Council of the City of New York, to join with them on the 14th inst., in celebrating the introduction of the Croton water into the city.

Very respectfully,

Your ob't serv't,

ALEX. M. CUMMING, *Mayor*.

To

CLARKSON CROLIUS, Jun'r.,
E. D. WEST, and
WM. DODGE, Esq'rs., } *Committee.*

From the Mayor of New Brunswick.

New Brunswick, Oct. 11th, 1842.

GENTLEMEN :—

The Common Council of this city have authorised me to acknowledge the receipt of your invitation, to join with the Honorable the Common Council of the city of New York in their celebration on the 14th inst., and to accept of the same, which I do with great pleasure.

I am very respectfully,

Your ob't. serv't.

FITZ RANDOLPH SMITH, *Mayor*.

To

Hon. Ald. CROLIUS,
" " WEST,
" Asst. Ald. DODGE, } *Committee.*

From the Mayor of Elizabethtown.

To the Hon. C. CROLIUS, JR.,

SIR :—

The polite invitation from the committee of the Corporation of New York to the Corporation of Elizabethtown, to join with them in celebrating the introduction of the Croton water into their city is acknowledged. This corporation connot but be suitably impressed with the value of such an invitation, and they have instructed me to return for answer their acceptance of it, and their congratulation at the completion of a work so magnificent in design and so successful in execution. They propose to reach the Battery Hotel by the 8 o'clock boat, on Friday morning, which will probably reach the city by half past nine in the morning. With the sincere wish that your great city may realize all its anticipations from this stupendous work, I am, with great respect,

Your ob't. serv't.,

WM. CHETWOOD,

Mayor of the Borough.

From the Common Council of Newark, N. J.

City of Newark, October 11th, 1842.

GENTLEMEN :—

Your letter of invitation to "the Mayor and Common Council of the city of Newark," has been duly received.

I am instructed, in communicating the acceptance of the invitation, to say, that the Mayor and Common Council of Newark, regard the great work referred to in your communication, as an enduring monument of the enterprise of the citizens of New York, and also of the ability and vigor of those Councils which have conferred so many practical benefits and advantages on the Commercial Metropolis of our country.

I have the honor to be,

very respectfully,

your ob't. serv't.,

JOSEPH N. TUTTLE,

Clerk of the Common Council.

Messrs. C. CROLIUS, JR.,
" E. D. WEST,
" WM. DODGE,
} *Committee, etc.*

From the Mayor and Common Council of Jersey City.

Jersey City, 4th October, 1842.

GENTLEMEN:—

The Mayor and Common Council of Jersey City accept your polite invitation to be present at the "celebration, on the 14th instant, of the introduction of the Croton water into the city of New York," and have instructed me to notify you thereof.

Assuring you that this evidence of your neighborly consideration shall be greatfully remembered and reciprocated,

I have the honor to be,

Your obedient servant,

THOMAS A. ALEXANDER.

To

C. CROLIUS, Jr.,
E. D. WEST,
WILLIAM DODGE, Esquires. } *Committee.*

From the Mayor of Philadelphia.

Mayor's Office, Philadelphia,
October 7, 1842.

GENTLEMEN:—

I have the honor to acknowledge the receipt of your note of the 24th September, inviting the Select and Common Councils and the Mayor of this city to participate in the ceremonies of the 14th instant, intended to celebrate the introduction of the Croton water into your noble city.

I am instructed by the Councils to express their regret, that as the 14th falls on the day on which the new Councils are annually organized, and sworn into office, the members of these bodies will then necessarily be restrained by their official duties from leaving this city.

As the oath of office is usually administered by the Mayor, the same cause will interfere to prohibit his departure, and deprive him of a great enjoyment.

While the authorities of this city are thus obliged to give up the pleasure you tender to their acceptance, they avail themselves of the opportunity, to offer their warm congratulations to their sister city upon her successful accomplishment of this magnificent enterprise.

I have the honor to be,

Gentlemen,

Your obedient servant,

J. M. SCOTT,

Mayor of Philadelphia.

To

GEORGE F. NESBITT,	HENRY E. DAVIES,
WILLIAM DODGE,	CHAS. W. SMITH,
DANIEL WARD,	EDWARD D. WEST,
CHAS. J. DODGE,	FREDERICK R. LEE,
RICHARD H. ATWOOD,	CLARKSON CROLIUS,
Board of Assistant Aldermen.	*Board of Aldermen,*

Committee of Arrangements.

From the Mayor of Brooklyn.

Mayor's Office,
Brooklyn, October 5, 1842.

GENTLEMEN :—

In answer to your very friendly invitation to the members of this Corporation to join with your Common Council in celebrating the introduction of the Croton water into the city of New York, on the 14th instant, I am requested to say that the invitation has been accepted, and a Committee, consisting of Aldermen Thomas G. Talmage, Thos. J. Gerald, and James Hazlit, has been appointed on behalf of the Common Council, to attend to any necessary arrangements. Any communications may be made to that Committee.

Yours, &c.

HENRY C. MURPHY.

To

C. CROLIUS,
E. D. WEST,
WM. DODGE, Esqrs.

From the President of Williamsburgh Trustees.

Williamsburgh, October 13th, 1842.

Gentlemen :—

Your polite invitation in behalf of the Common Council of the city of New York, bearing date the 26th day of September, and post marked, New York, October 2d, did not come to hand till this morning.

I shall call a special meeting of the Board this afternoon, and shall lay your com nication before them.

I regret that it had not come to hand in due course, as it has been the source of much surprise that our little village should have been so *far overlooked*, as there is none *who feel more interest* in participating in celebrating the completion of a work that has not its equal in this or any other country.

I am, very respectfully,

Your obedient servant,

JNO. C. MINTURN,

President of the Village, Williamsburgh

Messrs.
C. CROLIUS, Ald'n. 6th Ward,
E. D. WEST, Ald'n. 16th Ward,
WILLIAM DODGE, Ass't. Ald'n. 3d Ward.

From the Common Council of Albany.

Albany, 4th October, 1842.

Gentlemen :—

In behalf of the Common Council of the city of Albany, we have the honor to acknowledge the receipt of an invitation from the Corporation of New York to attend the celebration of the introduction of the Croton water into your city.

By a resolution of the Common Council, unanimously adopted last evening, the invitation was accepted, and the undersigned appointed a Committee to make the necessary arrangements for carrying the same into effect. It is most probable that the number of persons who will attend will be about twenty-five.

We will leave here in the evening boat of the 13th instant.

We have the honor to be,

Respectfully, your obedient servants,

COR. TEN BROECK,
CHAUNCEY WHITNEY,
JOHN McKNIGHT,
Committee on the part of the Common Council of Albany.

To

CLARKSON CROLIUS, Jr.,
EDWARD D. WEST, and
WILLIAM DODGE, Esqrs.,
Committee.

From the Mayor of Troy.

Troy, October 4th, 1842.

Gentlemen :—

I have the honor to acknowledge the receipt of your letter of the 1st inst., inviting the Mayor and Common Council of Troy to join the Corporation of New York on the 14th of the present month, in celebrating the introduction of the Croton water into your city. I take the earliest opportunity to convey to you, gentlemen, and through you, to your Common Council, the thanks of our Board and my own, for the invitation, and our acceptance of it.

The period fixed for the celebration is one when our citizens are usually much occupied with business, which, with previous engagements, will prevent a full attendance from our Board. Our intercourse with New York is so frequent and intimate, that we are always "at home" in your good city; and while we sensibly appreciate your hospitable intimation, that arrangements will be made for our accommodation, we are well aware that the duties of the Committee will be various and most arduous permit; those of us, therefore, who are able to avail ourselves of your invitation, to report ourselves on the morning of the celebration, and to give you no further trouble than to assign us such place in your order of arrangements as you may wish us to occupy.

Very respectfully,

Your obedient servant,

JONAS C. HEARTT,

Mayor of Troy.

To

C. CROLIUS, Jr.,
E. D. WEST, and
WM. DODGE, Esqrs., } *Committee, &c.*

An invitation to the Officers and Cadets of the U. S. Military Academy, was acknowledged, and declined thus:

From Capt. Swift, U. S. Corps of Engineers.

West Point, October 13th, 1842.

Gentlemen:—

Your invitation to the Superintendent of the Military Academy, and the Corps of Cadets, to attend the Croton water celebration to-morrow, has just been received.

The permanent Superintendent of the Academy, is at present absent, and during his absence I do not feel myself authorised to accept for the Cadets, your flattering invitation. I must express, however, for the Corps, my high appreciation of the honor conferred upon them by the invitation.

Very respectfully, gentlemen,

your obedient servant,

ALEX. I. SWIFT,

Captain U. S. Corps of Engineers,

Acting Superintendent

Military Academy.

Messrs.

CROLIUS, WEST, & DODGE,

Committee of Arrangements,

of the Common Council of New York.

From among many received, the organs of deputations, and from private guests, the following are selected:

From John Anthon, Chairman of Meeting of the Bar.

At a meeting of the members of the Bar of the city of New York, held at the room of the Law Institute, in the City Hall, on Tuesday, October 4, 1842, on motion of Mr. David Graham, Mr. John Anthon was called to the Chair, and John W. Edmonds appointed Secretary.

On motion of Mr. Daniel Lord, Jr., it was

Resolved, That the members of the Bar will co-operate with the Common Council, and their fellow-citizens, in celebrating the completion of the Croton Water Works.

Resolved, That Messrs. John W. Edmonds, James W. Gerard, Daniel Lord, Jr., Robert J. Dillon, and George Griffen, be a committee to act in behalf of the Bar on that occasion.

JNO. ANTHON,
Chairman.

J. W. Edmonds, *Secretary*.

To HENRY E. DAVIES, Esq., *Alderman, &c.*

Sir:—

Herewith I have the pleasure of forwarding to you, in obedience to the directions of the members of the Bar, an account of their proceedings at a meeting held this day in the room of the Law Institute, and beg to inform you, that the committee appointed on that occasion, are ready to co-operate with your committee at once.

Very respectfully,
Your obedient servant,
J. W. EDMONDS.

October 4, 1842.

From the Chairman of the New York Pilots.

New York, October 13th, 1842.

To Messrs. DAVIES, SMITH, WEST, &c.,

Committee of Arrangements Croton Celebration, &c

GENTLEMEN :—

In answer to your communication, dated September, 22d, 1842, the New York and Sandy Hook Pilots would be gratified to have a situation in line assigned them at the celebration of the great work of bringing pure and wholesome water into our city.

They will number some thirty or more, with a banner, &c.

Yours, very truly,

JOHN HYER,

Chairman Committee of Arrangements.

GREGORY THOMAS, *Secretary.*

From the Counsel of the Corporation.

Mr. D. Graham, Jr., accepts with pleasure, the invitation with which the Committee on the Croton Celebration have honored him, for the 14th instant.

84 Warren-street, Oct. 13, 1842.

From the Public Administrator.

New York, October 13, 1842.

To

C. CROLIUS, JR., Esq., Ald. 6th Ward,
E. D. WEST, Esq., Ald. 16th Ward, and
WM. DODGE, Esq. Ass't. Ald, 3d Ward,
} *Committee.*

GENTLEMEN :—

I have received to-day the invitation of the Common Council through your committee, to join them on the 14th day of October, in celebrating the introduction of the Croton water into the city of New York.

I thank you for the invitation, and shall be happy in accepting it.

I have the honor to be,

Your obed't. serv't.,

EDGAR KETCHUM.

From Pierre Van Cortlandt.

Peekskill, October 8th, 1842.

To C. Crolius, Jr., E. D. West, Wm. Dodge, Esq'rs.

Gentlemen :—

I have this day received your polite invitation from the Common Council of the city of New York, to join with them on the 14th instant, to celebrate the introduction of the Croton water into the City of New York. With pleasure I accept your invitation, and will be in New York at the time appointed.

I have the honor to be, gentlemen,

Your ob't. serv't.,

PIERRE VAN CORTLANDT.

From the Justices of the Marine Court.

To the Honorable
CLARKSON CROLIUS,
E. D. WEST,
WM. DODGE.

The Justices of the Marine Court, Hammond, Sherman, and Randall, have the honor to acknowledge the receipt of the invitation, which they accept with pleasure, to join with the Common Council of the city of New York, on the 14th instant, in celebrating the introduction of the Croton water into said city.

October 13th, 1842.

The following characteristic letter, from a former, and much respected citizen of New York, well deserves a place in this record :

Burlington, New Jersey, October 10th, 1842.

Esteemed Friends :—

Accept my very grateful acknowledgments for your kindness in extending to me an invitation to attend the celebration of the introduction of the Croton water into the city, on the 14th instant.

Several engagements interfere to prevent my acceptance of the favor, and it might not comport very well with one of my age and habits to join in the parade, and mingle in the festivities of the celebration ; but I do not the less rejoice, and that most heartily, that we have lived to witness the accomplishment of a work, which must confer an immeasurable amount of comfort and safety on the city at large.

Since my first acquaintance with New-York as a citizen, it has increased about five fold in numbers, and probably as much in wealth. It was my privilege, during a 25 years, residence, to unite with my very truly esteemed fellow-citizens, in the establishment and promotion of several of the beneficent institutions which now add dignity to the character of the city. Among the enterprises (in prospect,) was one for providing an ample supply of pure water. For this purpose, I once went on a mission to Albany. That project, doubtless, happily for the city, proved abortive.

That the present great undertaking should have succeeded in so reasonable a time from its commencement, in the midst of financial difficulties, redound most highly to the credit of the authorities, the committee, the engineers, the artificers, and the public.

That the city has enjoyed the blessings of peace and prosperity, during the execution of this noble enterprise, though not unmingled with severe privations, is cause of devout gratitude to our Heavenly Benefactor.

May this virtue flow as freely through the hearts of the cizens, to the banishment of intemperance, and the promotion of health and morals, as the waters of the Croton will hereafter flow through the arteries and veins of its two great reservoirs.

I am, with sentiments of great regard,

Very truly your Friend,

JOHN GRISCOM.

C. CROLIUS, Jr.
E. D. WEST,
WM. DODGE
} *Committee.*

The next note is from a London banker, of celebrity, then happening to be in this city:

Mr. H. Palmer will have great pleasure in accepting the invitation of the Common Council of the city of New York, to join them on the 14th inst., in celebrating the introduction of the Croton water into the city.

Globe Hotel, 7th October, 1842.

The Engineer and Superintendent, we believe, of the Fairmount Water Works, was prevented by indispensable engagements, from his being present, and thus sent his good wishes:

Philadelphia, October 4, 1842.

GENTLEMEN :—

Your kind invitation of Sept. 26, inviting me to join in the celebration of the introduction of the Croton water, has been received.

To meet your Honorable Councils and the gentlemen who have brought your great works to so happy a termination, would be a high source of gratification to me ; but it so happens that the day named is the one on which the inauguration of our Councils takes place, which circumstance will prevent them, as well as myself, from participating in the enjoyment of seeing a flow of wholesome water passing through your streets—equal in magnitude, and more effective in the arrangements and stability of the work, than any other extant.

May the citizens of your great city appreciate and enjoy the health and blessings produced by your spirit of enterprise.

With great respect,

Your obedient servant,

FREDERICK GRAFF.

To Messrs.
CLARKSON CROLIUS, Jun.,
E. D. WEST,
WILLIAM DODGE,
Committee of Invitation.

The fourteenth of October arrived, and a more beautiful day never broke upon the earth. A brilliant sun, a sky veiled but not clouded, and a breezy atmosphere were in harmony with the occasion, and with the joyousness of the multitudinous population crowded into the city from all surrounding regions, to witness and share in the grand jubilee.

At sun-rise one hundred guns were fired, the bells of all the churches and public places were rung, and in less than an hour the streets were alive with moving masses.

The first ceremony of the morning, was the presentation at the Mayor's office, at 9 o'clock, in accordance with the recommendation of the Committee, of a Banner to the Fire Department. This ceremony passed off as follows:

PRESENTATION OF THE BANNER TO THE NEW-YORK FIRE DEPARTMENT.

Mayor's Office, New York City, $9\frac{1}{2}$ *o'clock A. M.*,
14th October, 1842.

Present—His Honor, Robert H. Morris, Mayor; Adam Pentz, Esq., President of the Fire Department; the Trustees of the Fire Department Fund; several of the Grand Marshals of the day, with their Aids; Members of the Common Council; and the gentlemen composing the late Joint Committee on Fire and Water.

Cor. B. Timpson, Chairman of late Joint Committee on Fire and Water, said,—

Mr. Mayor—Want of time compels me to be brief, and to exclude some remarks I had intended to make on this occasion. I hold in my hand a resolution which was presented to the Common Council by Thomas R. Lee, Esq. late Assistant Alderman of the 8th Ward, and unanimously adopted by both branches of the City Government, and approved by His Honor, the Mayor. It is as follows:

" *Resolved*, That a suitable banner be provided at the expense of the City, under the direction of the present members of the Joint Committee of Fire and Water, and that the same be presented to the Fire Department, by his Honor, the Mayor, on the occasion of the celebration of the introduction of the Croton Water into this city."

Adopted by the Board of Assistant Aldermen,		May 2, 1842.
" " " Aldermen,		" 9, "
Approved by the Mayor,		" 14, "

Samuel J. Willis, *Clerk of the Common Council.*

At the time this resolution was offered, it was supposed that the celebration of the introduction of the water of the Croton into this city would take place on the approaching 4th of July, the day we celebrate as that on which our glorious national independence was declared, and the committee to whom it was intrusted, consisting of Abraham Hatfield, Morris Franklin, Daniel Ward, Daniel D. Briggs, Wm. Adams, and myself, were prepared on that day to comply with its requirements, but unavoidable circumstances caused delay until the present time; and now, sir, in relinquishing our trust, permit me to say that this splendid banner was designed and executed by Allan Smith Junr., Esq., of this city. The front represents the Fire Department as having achieved a victory over the devouring element, receiving the blessings and thanks of the widow and her orphans for the protection and benefits derived from it—beautiful emblems of power and beneficence—helplessness and gratitude. They are attended by a hero of the flames. Erect, above all, stands old father Neptune, evidently delighted with the victory he has accomplished over his ancient enemy, the Demon of Fire, by the aid of his skillful and intrepid allies—the Firemen of New York. On the other side of the banner the Queen of Cities, represented by a female wearing a crown, is calling attention to a picture, a view of the dam on the Croton River—the origin of the aqueduct. On the lower part of the border surrounding the picture, are emblazoned the arms of the city of New-York in basso relievo. The silk on which the design is portrayed, measures nine and a half feet by seven and a half feet. Its color is a rich mazarine blue—the fringe, tassels, and cord, are amber and crimson. The banner is surmounted and greatly adorned by three separate groups of carving—the centre consisting of a fireman's cap as a base, with a trumpet affixed to the top, on which stands a large eagle with extended wings, measuring three and a half feet from tip to tip. At each end are trophies, composed of Hook and Ladder, Torch, Trumpet, Pipe and Axes.

His Honor, the Mayor, then rose and made the following speech :

Mr. President and Trustees of the Fire Department,—

"I have been deputed, by a resolution which has just been read to you, to present on the part of the Common Council, to the Department of which you are officers, this Banner, as a testimonial of their high approbation of the services rendered by the Fire Department, and as evidence of their esteem and regard for the members composing that department. The Fire Department was organised on the 20th day of March, 1798, from which period, to the present time, by its constant vigilance and unceasing and disinterested efforts, the property of our citizens has been protected. Blended with the important services you have thus rendered, you have also performed the important functions of a charitable institution, having for its object the relief of the widows and orphans of your deceased associates ; the benefits thus conferred by the department have been as extensive, as their intentions were praiseworthy. This occasion, the celebration of the arrival of the Croton water in our city, is happily selected for the presentation of this banner, as it is to be hoped that among the many important benefits to result from that work, not the least will be to relieve your department of a great proportion of its dangerous and arduous duties. The emblems upon this standard are indicative of the foresight and energy of our citizens, and of the services and humanity of the Fire Department. On one side stands the Queen of Cities, representing the scientific enterprise of our citizens, and pointing to the Croton Dam and Aqueduct, which leads the waters of a distant river to our city, for our protection and comfort. On the other side is Neptune, the god of the ocean, showing that these waters have arrived among us. Their effect is exhibited by the figure of Victory, which stands upon the prostrate Demon of Fire, while the widow and the orphan children, with their friend, the fireman, show the consummation of the work, and that the charity of your department is all that will now be required of you. Acccept, sir, this Banner, and present it to your associates as a token of our regard, and an emblem of the services they have rendered."

The Mayor was replied to by Adam Pentz, President of the Fire Department, as follows:

"In behalf of the Fire Department, I thank you cordially for the presentation of this elegant token of the approbation and kind feeling of the Common Council, and for the handsome and complimentary terms in which you have been pleased to convey it. I am sensible that no language of mine, could give any thing like an adequate expression of the gratification experienced by the Department upon this occasion. That gratification is not diminished, but enhanced, by the reflection, that no extensive conflagration, recently subdued by the energy and activity of the Department, has awakened in a generous community a disposition to thus express its approbation; but that those into whose hands the people have entrusted the guardianship of these interests, regarding our institution as a most efficient agent of public good, and not unmindful of the services and sacrifices to which its members are subjected, have in this public manner marked their appreciation of the past, while at the same time they have held out a stimulus to the future. The occasion upon which we are assembled, commemorating the completion of one of the most stupendous public works of the Union or of the age, furnishing so rational a cause for rejoicing, is welcomed by no portion of your fellow citizens with more sincere pleasure, than by that portion which I have the honor to represent. While some have looked merely to the introduction of pure and wholesome water into the city as being an indispensible requisite of public health, and others, regarding the distance from which it has been brought, and the obstacles overcome, as constituting an enduring monument of the enterprise and public spirit of our citizens, the firemen of the city, while participating in the feelings of both these classes, yet with that devotion to their duties by which they have ever been distinguished, rejoice chiefly, because this great work, in giving increased efficacy to their exertions, affords additional security to the property of their fellow citizens. It is perhaps not too much to say, that nearly all the great fires by which large portions of our city have been devastated, might have been early arrested, had the department possessed the same facilities for obtaining an abundant supply of water, as that which they will now enjoy from the introduction of the Croton. In view of these facilities, and animated by this expression on the part of the city government, the members of the department will continue to discharge their duties with increased zeal, and cherish the recollection of this day, as among the brightest in the history of their institution."

The various Military Corps assembling at their respective parade grounds, were by eight o'clock, in march for the Battery, which scarcely furnished space for them all. After undergoing inspection, at 10 o'clock precisely, the procession moved in the order and route indicated by the annexed programme, previously published.

PROGRAMME OF ARRANGEMENTS.

The Line will be formed at 9 o'clock A. M. precisely, 6 abreast, the right resting on the Battery. The column will move at 10 o'clock, in the following order, viz:

Escort of Cavalry from General Storms' Brigade.

THE GRAND MARSHAL,

General Gilbert Hopkins, accompanied by his Special Aids,

General Prosper M. Wetmore, General Nathan B. Graham,
Colonel Florence Mahoney, Colonel Henry P. Robertson,
Colonel William W. Tompkins, Captain James Wardell.

Military Guard of honor to the Grand Marshall—comprising—
The Independence Guards,
The Sing Sing Guards, and
The Washington Riflemen.

FIRST DIVISION,

Comprising the Artillery and other Military bodies, commanded by Major General Charles W. Sanford.

SECOND DIVISION,

Under the direction of Major General Stryker, Assisted by Mr. O. W. F. Randolph, Aid to the Grand Marshal—comprising

Commissioners of Croton Aqueduct Board.

1. Water Commissioners and Ex-water Commissioners.
2. Members of the Society of Cincinnati.
3. Mayors of New York, Brooklyn, Albany, Troy, Jersey City, and Newark. in carriages.

Second Regiment N. Y. State Artillery, as an escort to the Common Council.

4. Committee of Arrangements of the Common Council, with staves of office.
5. Members of the Common Council, with staves of office.
6. Ex-Members of the Common Council.
7. Governor and Lieutenant Governor and Suite—(mounted.)
8. Members of Congress and State Legislature.
9. Common Council of Brooklyn.
10. Trustees of Williamsburg.
11. Common Council of Albany.

12. Common Council of Troy.

13. do do Jersey City, Newark, Elizabethtown, New Brunswick, Princeton, and Trenton.

14. Officers of the Corporation.
15. County Officers.
16. Engineers and Officers of the Water Works.
17. Foreign Consuls.

THIRD DIVISION,

Under the direction of Gen. Wm. L. Morris, assisted by Mr. Andrew H. Mickle, aid to the Grand Marshal.

1. Officers of the Army and Navy.
2. Militia Officers off duty.
3. Naval School.
4. Reverend the Clergy.
5. Judges and Officers of the Courts.
6. Members of the Bar.
7. Professors and Students of the University.
8. New York Lyceum.
9. Society of Letters.
10. Chamber of Commerce.
11. Board of Trade.
12. Historical, Philosophical, Philological, and other Scientific Societies.
13. Members of the various Societies for the Promotion of the Fine Arts.

FOURTH DIVISION,

Under the direction of Brig. Gen. Pentz, assisted by Mr. John T. Dodge, and Mr. George C. Ring, aids to the Grand Marshal, comprising

The Officers and Members of the Fire Department.

FIFTH DIVISION,

Under the direction of Colonel Philbrick, assisted by Mr. James Nesbitt, aids to the Grand Marshal. Comprising

1. Masonic Fraternity.
2. Contractors and Workmen of the Water Works.
3. Typographical Society and Printers.
4. North River Navy: a car drawn by 4 horses, representing the Miller and his men.

A car drawn by 4 horses, with model of steamboat North America.

Phenix Foundry.

North River steamboat Captains, in 2 barouches.

SIXTH DIVISION,

Under the direction of Capt. Wm. H. Cornell, assisted by Mr. George G. Hopkins, aids to the Grand Marshal. Comprising

The Butchers of the cities of New York and Brooklyn.

SEVENTH DIVISION,

Under the direction of Mr. John Ridley, assisted by Mr. Silas S. Howell, aids to the Grand Marshal. Comprising

1. Gold and Silver Artisans.
2. Mercantile Library Association.
3. Marine Society.
4. Pilots' Society.
5. General Society of Mechanics and Tradesmen.
6. Mechanics' Society School.
7. Delegates of the United States Home League.
8. American Institute.
9. Mechanics' Institute.
10. School of the Mechanics' Institute.
11. Officers of the United States Government.
12. Pupils of the Deaf and Dumb Institution.

EIGHTH DIVISION,

Under the direction of Surgeon Gen. Pennell, assisted by Col. Robt. C. Morris, aids to the Grand Marshal.

1. St. Nicholas Society.
2. St. George's Society.
3. Friendly Sons of St. Patrick.
4. Officers of the Irish Emigrant Society.
5. Hibernian Universal Benevolent Society.
6. Hibernian Benevolent Burial Society.
7. Shamrock Benevolent Society.
8. Sons of Herman.
9. German Washington Benevolent Society.

10. Socrates Union Society.
11. Italian Universal Benevolent Society.
12. St. David's Society.

NINTH DIVISION.

Under the direction of Col. A. G. Crasto, assisted by Col. Benj. W. Benson and Mr. Graham, aids to the Grand Marshal, comprising the Temperance Societies en masse.

TENTH DIVISION.

Under the direction of Major G. H. Striker, assisted by Capt. Mason Thompson, aids to the Grand Marshal, comprising

1. Rockland Lake Association.
2. Citizens.
3. Strangers.

The several public bodies and Associations are requested to assemble in season to carry out the following

PROGRAMME.

The following are the places designated by the Committee of the Common Council for the reception of the various invited guests :

1. Sacred Music Society, Vice Chancellor's Court Room.
2. Common Council and Mayors of New York, Brooklyn, Albany, Troy, Jersey City, Newark, Elizabethtown, New Brunswick, Princeton, Trenton, and Trustees of Williamsburg, No. 8 City Hall.
3. Governor and Staff, Heads of Departments, members of Congress and State Legislature, and State Society of the Order of Cincinnati, No. 4 City Hall.
4. Ex-Mayors and members of the Common Council of New York and Brooklyn, Chamber of the Judges of the Court of Common Pleas.
5. Foreign Ministers and Consuls, officers of Army and Navy, Mayor's Office.
6. Judges of the Courts and Members of the Bar, Court Common Pleas Room.
7. Militia Officers off duty, Circuit Court Room.

The Divisions enumerated in the programme will assemble as follows :

1st Division	on the	Battery.
2d	do	City Hall.
3d	do	City Hall and Park rear City Hall.
4th	do	Broadway, right on Battery place.
5th	do	Chambers street, right on Broadway, west.
6th	do	Broome street, right on Broadway, west.

7th	Division on	Warren street, right on Broadway.
8th	do	Greenwich, right on Warren street.
9th	do	West Broadway, right on Canal street.
10th	do	Park Place.

The line of march will be taken up precisely at 10 o'clock, A. M., and will be as follows:—The right of the procession will move from the Battery, thence up State street, around the Bowling Green and up Broadway to Union Park, around the Park and down the Bowery to Grand street, through Grand street to East Broadway, down East Broadway and Chatham street to the Park.

Should the weather not prove propitious on the 14th instant, the celebration will be postponed, on which a white flag will be displayed at City Hall, Niblo's, and Bowery Theatres, at 7 o'clock, A.M.

On the arrival of the head of the column at the Park, and also upon circling the public ground at Union Place, the beautiful Fountains recently constructed will be opened with the display of the Croton water.

On reaching the Park at the close of the march, the several bodies will pass the front of the City Hall in the following order:—

The Military and the Sixth Division will pass into Broadway, and be under the direction of their respective Commandants. The Fourth Division will form on the sidewalks outside of the Park. The Ninth Division will pass for dismissal to the rear of the City Hall. The remaining Divisions will be dismissed in the Park front of the City Hall.

The several societies and guests previous to dismissal will witness the ceremonies in front of the City Hall, as follows:

An address by Samuel Stevens, Esq., President of the Board of State Water Commissioners, upon delivering the custody of the Croton Water Works to the Water Commissioners of the Corporation. A reply from John L. Lawrence, Esq., President of the Croton Aqueduct Board.

An Ode, written by Gen. George P. Morris, Esq., will be sung by the New York Sacred Music Society.

The ceremonies will be closed by nine cheers from the citizens and others upon a signal from the Grand Marshal, and the whole be dismissed.

All Societies and Military Corps who have not reported to the Committee of Arrangements, will report to the Grand Marshall at the Mayor's Office, on or before 9 o'clock,

A. M., on the day of the procession. The Aids to the Grand Marshal will assemble at the Mayor's Office, this day, at 4 o'clock, P. M., when they will receive their badges.

By order of the Joint Committee of Arrangements of the Common Council.

HENRY E. DAVIES,
EDWARD D. WEST,
CHARLES W. SMITH,
FREDERICK R. LEE,
CLARKSON CROLIUS, Jr.
Committee of Board of Aldermen.

GEORGE F. NESBITT,
WILLIAM DODGE,
DANIEL WARD,
CHARLES J. DODGE,
RICHARD H. ATWELL,
Committee of Board of Assistants.

October 13th, 1842.

GILBERT HOPKINS, *Grand Marshal.*

The details of this most numerous and imposing procession ever seen in any American city, cannot be given without more space than we have at command. The grand Canal celebration in its aquatic display, exhibited a feature wanting in this—but in respect of numbers present in the procession, and in the thronged streets as spectators, this exceded that, as indeed it could hardly fail to do, taking into consideration the vast increase in the population of the city since 1825, the period of the Canal *fete.*

" There was, says the New York Express, a multitude present whom no man could number, and the devices presented an almost endless variety. We could neither number the one nor the other. The procession was two hours and ten minutes in passing the Express Office on Broadway. The ranks were from two to ten deep. Every rank, every age, and every profession were represented. We saw all of the seventy ways of living, and at least six of the seven ages of man ; and the first, the infant in its mother's arms, at least in the crowd and lookers on. Every nation, too, that holds communion or commerce with our own, was there. There was the man of war and the man of peace —the soldier and the sailor—the master and the apprentice—the father and the son—the man of words and the man of deeds—the mace and the axe—the plough and the sword—the cannon and the bible—the music of the harp of ten strings, and the hoarse notes of the martial band. The church bells mingled their merriest peals, the cannon spoke at morning, noon, and night, in their most vociferous tones of power. There were flying artillery and artillery on foot, infantry and calvary, riflemen and marines, and soldiers of every rank and every service. The Scotch Highlanders, with the tartan and the plume, presented a beautiful and soldierlike appearance. So did the heavy compact band of Germans, who are capable of doing good service, we warrant, whenever they are summoned to the field. The city companies never appeared better, and the troops from the neighboring towns, added not a little to the splendid military pageant.

The Firemen presented an immense concourse of persons. The fifty companies of the city were all in the ranks, with guests from Philadelphia, New Jersey, Connecticut, Long Island, and from other quarters we believe.

The Butchers were as numerous and respectable a body of men as could be picked from the city or any where else, and they were numeous enough now to slay a million of hecatombs of cattle, or to provide flesh for ten legions of the most carniverous of the human family.

The Temperance men, boys and women, for women were present, and many of them there were, presented a grand appearance, and added many a rood to the miles which made up the length of the whole procession. But we can hardly particularize any one class where all appeared so well."

With every effort to obtain an accurate account of the different corps, associations, and crafts, in the procession, of their numbers, banners, and devices, we have been unable to procure all. We present however, the general result as follows, first taking occasion to express our special acknowledgments to Mr. C. V. Anderson, Chief Engineer of the Fire Department, for the detailed statement furnished by him of the magnificent display made on the occasion, by the Firemen, both of other cities and our own. The procession was thus constituted :—

Escort of Cavalry from General Storms' Brigade.
The Grand Marshal,
General Gilbert Hopkins, accompanied by his Aids,

General Prosper W. Wetmore,	Colonel Henry P. Robertson,
General Nathan B. Graham,	Colonel William W. Tompkins,
Colonel Florence Mahoney,	Colonel John D. Van Buren.

Military Guard of Honor to the Grand Marshal, comprising:
The Independence Guards,
The Sing Sing Guards, and
The Washington Rifle Company.

FIRST DIVISION.

Commanded by Major General C. W. Sandford.
General Sandford and Staff, mounted.
First troop National Gaards.
Troop of Washington Guards.
Staff Officers, mounted.
First Brigade of New York State Horse Artillery.
Under command of Colonel Storms.
Brigadier General Morris and Staff.
Brass Band.
The 11th Regiment of N. Y. State Artillery, with their ordnance.
Company of Light Artillery.
Montgomery Light Guard.
Benson Cadets.
Band of Music.
The Highland Guard, under command of Captain Greig.
Brass Band.
National Grays.
Flank Company of the 222d Regiment.
Battalion President's Guards.
Brass Band.
The Light Guard.
Band of Music.
The German Battalion, consisting of the Jefferson Grenadiers, Jefferson Guard, and Jefferson Rifle Corps.
Colonel Hall's command. Troop of Horse Artillery.
Third Regiment Washington Greys, preceded by a band.
The Ninth Regiment National Cadets, preceded by a band.

SECOND DIVISION.

Under the direction of Major General Stryker, assisted by Mr. O. W. F. Randolph. Aids to the Grand Marshal, comprising:

Commissioners of the Croton Aqueduct Board, Water Commissioners, and ex-Water Commissioners, in barouches.
Members of the Society of Cincinnati, in barouches.

Mayors of New York, Brooklyn, Albany, Troy, Jersey City, Newark Elizabethtown, New Brunswick, Princeton, and Trenton, in carriages—band of music.

Second Regiment New York State Artillery, as an escort to the Common Council, consisting of the Governor's Guard, State Fencibles, and New York Cadets.

Band.

Committee of Arrangements of the Common Council, with staves of office.

Member of the Common Council with staves of office.

Ex-Members of the Common Council.

Governor and Lieutenant-Governor and Suite, in barouches.

Members of Congress and State Legislature.

Common Council of Brooklyn, with staves of office.

Trustees of Williamsburgh.

Common Council of Albany.

Common Council of Troy.

Common Council of Jersey City, Newark Elizabethtown, New Brunswick, Princeton, and Trenton.

Officers of the Corporation.

County Officers.

Engineers and Officers of the Water Works.

Foreign Consuls, in barouches.

The second division embraced a body of our most aged and distinguished civilians. Some were on foot, some on horseback, and some in carriages. The authorities were on foot, and with their staves of office but seldom seen, and seemed to embody in their persons the authority and trust which the people have committed to their hands.

THIRD DIVISION.

Under the direction of Gen. Wm. L. Morris, assisted by Capt. Andrew H. Mickle, Aids to the Grand Marshal.

Officers of the Army and Navy.

Militia Officers off duty.

Naval School.

Reverend the Clergy.

Judges and Officers of the Courts.

Members of the Bar.

Professors and Students of Columbia College, and the University.

New York Lyceum.

Society of Letters.

Chamber of Commerce.

Board of Trade.

Historical, Philosophical, Philological and other Scientific Societies.

Members of the various Societies for the Promotion of the Fine Arts.

A Life Boat, built by C. S. Ingersoll.

Band of Music.

Company of City Guards.

Battalion of Washington Guards, Montgomery Guards, and Franklin Blues, preceded by Music.

Pilots' Society, with banner and band of music.

FOURTH DIVISION,

Under the direction of Brigadier General Pentz, assisted by Mr. John T. Dodge and Mr. George C. Ring, Aids to the Grand Marshal, comprising the Officers and Members of the Fire Department.

Order of the Fire Department Procession, on the occasion of the Croton Celebration, October 14th, 1842.

At the head of the procession was a Band of Music, brought from Philadelphia, by the Neptune Hose Company of that city. Immediately after the Music, came the

Fairmount Engine Company, of Philadelphia, numbering 37 men, dressed in the uniform of the Philadelphia Firemen, viz: glazed hats, with the name of the Company painted upon them, drab fire coats and pants, and oil cloth capes over the shoulders, also bearing the name of the Company. The Engine drawn by the Company was splendidly painted and mounted. This Company was followed by

Neptune Hose Company, of Philadelphia, numbering 56 men, in black fire dress, also, with glazed hats and capes, drawing a splendid four-wheeled hose carriage, silver mounted, and with appropaiate painting and designs. These two Companies arrived by rail road from Philadelphia on the day previous, and were received at the landing in Jersey City, by a Committee appointed by the New York Fire Department. On their arrival in the city, they were received by Engine Company No. 14, and Hose Company No. 12, in full fire dress, and escorted to the Arsenal Yard, where a place had been provided for their apparatus. The Companies then proceeded to Monroe Hall, where they partook of a collation, provided by the Committee of reception, and were introduced to the members of the Common Council, and were afterwards escorted to their quarters. On leaving the city, on the day after the celebration, they were attended to the rail road, by Engine Company No. 14, and Hose Company No. 12.

They were followed in the procession by

Engine Company No. 3, *of Hudson*, with their Engine drawn by 32 men, and also some members of Engine Company No. 8, of Albany. This Company had been received and escorted by Engine Company No. 20, of this city. They were followed by

Engine Company No. 1, *of Poughkeepsie*—Engine painted black and gilt, drawn by 35 men ; uniform fire caps, red shirts, and dark pants. This Company was received and escorted by Engine Company No. 34, of this city.

Next in order came the *Fire Department of Newark, New Jersey*, which had been invited by the New York Fire Department. They arrived on the morning of the procession, and were escorted by Engine Company No. 21, and Hose Company No. 21. They consisted of the following:

Engineers, Foremen, and Assistants, bearing the Banner of the Newark Fire Department.

Representations from the Hook and Ladder and Engine Companies, dressed in full fire dress, but without apparatus. The whole number from Newark, was about 150 men.

Immediately after them came the *Fire Department of Jersey City*, which had also been invited, and were also escorted by the same Companies. It consisted of

Fire Engines No. 1 *and* 2, each drawn by about 40 men in fire dress. They were followed by

The Fire Department of Williamsburg, represented by the Chief and Assistant Engineers, and Engines No. 1 and 2, each with about 75 men.

After them came the *Fire Department from Brooklyn*, also invited. This Department arrived on the morning of the procession, and were received at the Ferry and escorted to the line, by a delegation of the New York Fire Department, in the following order: Hose Company No. 8, Engine Company No. 5, Hose Company No. 9, Engine Company No. 40, Hose Company No. 10, Engine Company No. 8. The Department consisted of the following:

Banner, inscribed with name, "Brooklyn Fire Department."
Engineers and Exempt Firemen.
Fire Wardens.

Washington Engine Company No. 1—Engine drawn by 80 men, dressed in dark pants, red shirts, and fatigue caps—the Foreman, Assistant, Pioneer, and men at the

Tongue, in full fire dress—the Pioneer bearing a Banner, repersenting a portrait of Washington. Another Banner was a full length figure of a Fireman. Next came

Neptune Engine Company No. 2—Engine painted black and gold, drawn by 74 men in the same dress as above.

Eagle Engine Company No. 4, painted red, with blue and gold, drawn by 60 men—same uniform.

Constitution Engine Company No. 7—painted white and blue—drawn by 125 men—same dress as above. Motto, "Ready and Willing."

American Engine Company No. 9—painted black and gilt. The back carved with two Angels, with their wings forming an arch, completely gilded—the design on the back, a full length figure of Red Jacket, by Weir—drawn by 39 men—dressed in fire caps, red shirts, and dark pants.

Atlantic Hose and Relief Company—Four-wheeled hose carriage, bearing 1000 feet of hose, and 25 buckets, drawn by 30 men in citizen's dress.

Clinton Hook and Ladder Company No. 2—Truck, with full set of implements, drawn by 56 men, in citizen's dress, and oil cloth caps.

Most of the Engines were highly ornamented with flowers, ribbons, &c.

General outlines of the New York Fire Department Procession, on the occasion of the Croton Water Celebration.—October 14*th*, 1842.

Grand Marshal—CORNELIUS V. ANDERSON.

Assistant Marshals,

W. Wells Wilson,	Dewitt C. Mott,
John B. Miller,	Samuel L. Liscomb,
George Kerr,	Samuel Waddell,
Alfred Carson,	George H. Ramppen,
Charles Forrester,	Zophar Mills,
Philip B. White,	Joseph W. Long,
Owen W. Brennan,	John T. Rollins,

John Rese.

The Grand and Assistant Marshals were dressed in the uniform of the Engineers of the Fire Department, viz:—white fire cap, blue coat and pantaloons. The line was formed in Hudson street, and extended from Christopher to Reed streets. The Procession moved at 9 A. M., down Hudson to Chambers street, to Broadway and to the Battery, in the following order:

BAND OF MUSIC.

Banner of the New York Fire Department, borne on a stage, richly carpeted and festooned, and drawn by four white horses, elegantly caparisoned, and each horse led by a black groom in Turkish dress. The Banner was supported by the Trustees of the Fire Department. It was designed and executed by Allan Smith, Jun., of this city. The front represents the Fire Department as having achieved a victory over the devouring element, receiving the blessings and thanks of the widow and her orphans, for the protection and benefits derived from it—beautiful emblems of power and beneficence, helplessness and gratitude. They are attended by a "Hero of the Flames." Erect above all stands Neptune, evidently delighted with the victory he has accomplished over his ancient enemy, the Demon of Fire, by the aid of his skilful and intrepid allies—the firemen of New York. On the other side is the Queen of Cities, calling attention to a picture, representing the Dam at the Croton River, the origin of the aqueduct. On the lower part of the border, surrounding the picture, are emblazoned the arms of the city of New York, in basso relievo. The silk on which the design is portrayed, measures 9½ feet by 7½ feet; its color is a rich mazarine blue. The fringe, tassels, and cord, are crimson and amber. The banner is surmounted and greatly adorned by three separate groups of carving, the centre consisting of a fireman's cap, with a trumpet affixed to the top, on which stands a large eagle, with extended wings, measuring three and a half feet from tip to tip—at each end are trophies composed of hook and ladders, torch, trumpet, pipe and axes.

The banner was presented to the Fire Department on the morning of the procession, by his Honor the Mayor, Robert H. Morris, with an appropriate address, and was received by A. P. Pentz, Esq., President of the Fire Department.

Next to the Banner came the Grand Marshal and two aids, followed by the officers of the Fire Department Fund.

The Exempt Firemen followed, and were succeeded by

Hudson Fire Engine Company, No. 1, drawn by 129 members. Uniform, fire caps, red flannel shirts, and dark pantaloons. Engine painted black, striped with gold; painting on the back, represents a death struggle between a Greek and Turk, both overhanging a precipice. Engine decorated with roses, ribands, &c. A small engine was borne by 4 boys. The banner of the Company represented a steamboat on fire, the engine leaving the engine house, surmounted by a portrait of C. V. Anderson, Chief Engineer; on the other side, a tomb scene, with a view of the reservoir. Next came

Eagle Hose Company, No. 1, drawn by 40 men. Uniform same as above; four wheeled hose carriage, painted black and gold. Banner—on one side, an eagle with a fire in the back ground, on the other, the burning of the National Theatre. Next came,

Mutual Hook and Ladder Company, No. 1. Truck drawn by 40 men, in citizen's dress, dark throughout; truck painted green, with black stripes. Banner represents the name and number of the Company, surmounted by a gilt hook and ladder; on each side are torches and axes; above is a Phœnix rising from the flames, beneath is the motto of the Company, "Mutual." Next came,

Chatham Fire Engine Company No. 2. Engine painted red and gold, with bronze pannels; the painting on the back is a portrait of James Wallack, as Rolla. Engine drawn by 38 men; uniform, fire caps, red flannel shirts, and dark pantaloons. Banner, representing the burning of the Bowery Theatre; on the right is a fireman, carrying an orphan child in his arms, and leading another by the hand; on the left is a representation of the engine with their hose attached to a hydrant; two brass torches and brass signal lanterns, were borne by boys. Next in order was,

Niagara Hose Company No. 2. Two wheeled hose carriage, painted red, drawn by 10 men, dress as above. Next came,

Forrest Engine Company No. 3. Engine painted black and gold; the painting on the back represents the last scene in the tragedy of Metamora. Drawn by 32 men, dress same as above; the Banner borne by 6 lads in uniform; the front represents the Goddess of Liberty, fostering Commerce and Trade, in the distance buildings on fire, and engines at work. On the back is a view of the burning of the Bowery Theatre, the whole surmounted by the American Eagle, bearing the motto, "Liberty, Commerce, and Trade." Next came

Independence Hose Company No. 3. Two wheeled hose carriage, painted black and gold, drawn by 40 men, in the same uniform as above. Followed by,

La Fayette Hose Company No. 4. Two wheeled hose carriage, drawn by 15 men, in the same uniform as above. Next was,

Protection Fire Engine Company No. 5. Engine painted black, with gilt stripes, carriage work, cream with red stripes, ornamented with flowers, drawn by 46 men, uniform as above. The Company was preceded by a miniature engine, a fac-simile of the large one, and borne by 8 boys. Followed by,

New York Hose Company No. 5. Four wheeled hose carriage, painted green, polished brass scrolls and mountings; a gilded arch sprung, from the top of the reel, surmounted by an eagle, from whose talons garlands of natural flowers were carried to the four extremities of the carriage. Drawn by 40 men, uniform as above. Banner, borne by a member and supported by two boys in fire dress, was of crimson silk, yellow fringe and tassels — represents a golden figure five, surrounded by a length of hose — upon a scroll above, is the name of the company, and beneath is the motto, "From our vigilance you derive safety." On the other side is a garland of flowers — staff surmounted by a gilt fire cap, displaying the number of the company.

Neptune Fire Engine Company, No. 6. Engine painted red, striped with gold — drawn by 40 men in same uniform as above. Banner represents Neptune drawn by sea horses.

Croton Hose Company, No. 6. Four wheeled hose carriage, painted pearl color, with gilt; on the front box a view of Genesee Falls, on the back box Neptune and Amphitrite; drawn by 25 men; same uniform. Large banner, representing the Croton aqueduct, and young Croton presenting a goblet of the water to the Queen of Cities, who is crowning a fireman with a wreath. The Fire King lies prostrate and chained. Neptune stands quietly looking on, and Manhattan is about retiring, as his services are no longer required. The whole surmounted by a spread eagle. Small banner, with the name and number of the company.

Wave Hose Company, No. 7. Two wheeled Hose Carriage, painted drab, drawn by 20 men. Same uniform as before, preceded by a banner and two American flags.

Manhattan Engine Company No. 8. Engine painted drab, drawn by 58 men same uniform as before. Engine dressed with flowers.

BAND OF MUSIC.

First Ward Hose Company, No. 8. Four wheeled Hose Carriage, painted black and gold; carriage work, green, with black stripe; front box representing the Bay of New York, and the Wave Club Boat in a race; back box representing the "first ship;" polished brass scrolls and mountings; carriage ornamented with dahlias and evergreens, drawn by 35 men, same uniform as before. Banner of blue silk; on the front, a representation of the burning of Dr. Eastburn's church in Canal-street, the hose carriage in the fore ground; on the reverse, a portrait of the hose carriage, and a fountain in the distance; motto, "Duty, though in Peril." Staff, surmounted by a gilt fire cap, with the number of the Company; banner, borne by a member and supported by two youths in fire dress.

Columbian Hose Company, No. 9. Four wheeled Hose Carriage, painted salmon color and gilt, decorated with flowers; painting on front box; a female bearing a child in her arms, fleeing from a burning building; back box, a view of Niagara Falls; drawn by 40 men; dress as above.

Water Witch Engine Company, No. 10. Engine decorated with flowers, drawn by 50 men, dress as above. Banner represents a fire in Elizabeth-street, and a fireman rescuing two females from the flames. Two brass torches, beautiful signal lanterns, and two splendid guide flags.

East River Hose Company, No. 10. Two wheeled Hose Carriage, painted blue, red and gilt; trimmed with dahlias and other flowers, drawn by 25 men; uniform as above.

Oceanus Engine Company, No. 11. Painted dark blue, black and gold, the back represents the burning of Troy and death of Achilles. Drawn by 37 men in same uniform as before.

Gulick Hose Company, No. 11. Two wheeled Hose Carriage, red and gold. Drawn by 18 men in same uniform.

Knickerbocker Engine Company No. 12. Engine painted green and yellow, striped with gold, trimmed with roses, design on the back, Diedrich Knickerbocker. Drawn by 26 men in same uniform as above.

BAND OF MUSIC.

Washington Hose Company No. 12. Four wheeled Hose Carriage, painted cream color and gilt—on front pannel a representation of Washington crossing the Delaware—on back pannel, the surrender of Cornwallis at Yorktown. Drawn by 50 men in same uniform.

Eagle Fire Engine Company, No. 13. Engine painted black, striped with gold—silver plated mountings. Design on back, a mother rescuing her child from an eagle's nest. Decorated with wreaths and boquets of dahlias. Motto, Nunquam non paratus." Drawn by 40 men—same uniform.

Express Hose Company, No. 13. Two wheeled Hose Carriage—red, striped with blue, drawn by 20 men in same uniform. Banner borne by 3 men, representing the Park, City Hall and Park Row, the company stretching their hose. Motto on banner, "We come to conquer and to save."

Columbian Engine Company, No. 14. Engine painted red and maroon, with gilt. Design on the back represents an Indian maid parting from her lover. In the distance are seen several canoes approaching, in one of which is the chief to whom she has been bethrothed by her father. Engine drawn by 53 men—uniform as above.

Atlantic Hose Company, No. 14. 12 men in citizens dress, with badges and without their carriage.

Eagle Hook and Ladder Company, No. 4. Truck, blue ground with yellow and red stripes. Full complement of implements. The whole decorated with numerous flags. A centre pole with a model of the apparatus. Drawn by55 men, with fire caps, red shirts and dark pants, preceded by 5 boys bearing torches, and a carved figure of a fireman. Banner, on front an eagle and hooks and ladders; on back, burning of the Merchants' Exchange, the truck in the foreground.

Victory Hose Company, No. 15. Two wheeled hose carriage, dark green, striped with gold. Painting on box, the tomb of a member of the company. Drawn by 29 men in same uniform as above. Banner represents the tomb of a member of the company who was killed by a falling wall. Two boys bearing brass torches. Carriage ornamented with dahlias and surmounted by an American Flag.

Chelsea Fire Engine Company, No. 16. Engine red and gold, drawn by 55men, with velvet caps, red shirts, and dark pants.

Naiad Hose Company, No. 16. Two wheeled hose carriage, black with gold stripes. Drawn by 25 men, fire caps, red shirts and dark pants. Banner, blue silk, gilt letters, inscribed, "Naiad Hose Co. No. 16, organised Dec., 1837." Trimmed with white fringe.

Clinton Hose Company, No. 17. Two wheeled Hose Carriage, black and gold. Drawn by 22 men, same uniform as above.

Union Fire Engine Company, No. 18. Engine painted white and red; drawn by 62 men; uniform as above. Banner, representing a fire.

Franklin Hose Company, No. 18. Two wheeled Hose Carriage; scarlet, blue and gold; decorated with flowers. Drawn by 20 men—uniform as above.

La Fayette Engine Company, No. 19. Engine red with gilt pannels. Drawn by 26 men; same uniform as above.

American Hose Company, No. 19. Two wheeled Hose Carriage; red and gold. Painting on Leader Jacket—the Goddess of Liberty, in a car, drawn by sea-horses. Drawn by 32 men; same uniform as above. Banner, burning of the Exchange, surmounted by an eagle and fire cap.

Washington Fire Engine Company, No. 20. Engine drawn by 43 men in same uniform as above. Large banner representing in front, a figure of Washington; on back, a figure of La Fayette. Small banner, the following motto:

> "To him ye nations yield eternal fame,
> First on the heroic list enrol his name,
> High on the ensculptured marble let him stand
> The undaunted Hero of his native land."

Fulton Fire Engine Company, No. 21. Engine painted white with red stripes, ornamented with ribbons and flowers. Drawn by 37 men, same uniform.

Protection Hose Company, No. 21. Two wheeled carriage, dark maroon, striped with gold, entire iron work plated with brass. Design on the back, representing the Goddess of Liberty. On the leader jacket, painting of a statue spouting water. Drawn by 35 men. Same uniform as before. Banner inscribed with the name and number of the Company and decorated with flowers.

Protector Fire Engine Company, No. 22. Painted red and blue; decorated with dahlias, artificial flowers, etc. Brass torches and guide flags, with the name and number of the Engine. Drawn by 50 men in the same uniform as above.

United States Fire Engine Company No. 23. Painted blue; design on the back, the dying Greek. Drawn by 42 men; uniform as above. Engine trimmed with flowers.

Triton Hose Company, No. 23. Two wheeled Hose Carriage, painted red and gold. Drawn by 16 men; uniform as above.

Jackson Fire Engine Company, No. 24. Black and gilt. Design on the back, a painting of Gen. Jackson. Drawn by 35 men; uniform same as above.

Eighth Ward Hose Company, No. 24. Two wheeled Hose Carriage, trimmed with flags and dahlias. Drawn by 18 men, two boys bearing torches. Uniform as above.

Cataract Engine Company No. 25. Engine painted black and gilt, brass torches, signal lantern, and 4 small guide flags, all carried by boys. Engine drawn by 53 men, same uniform as above.

Jefferson Engine Company No. 26. Engine painted blue, with gilt stripes, design on the back—Thos. Jefferson delivering the Declaration of Independence. Drawn by 35 men; uniform as above. Two boys bearing torches.

Van Buren Hose Company No. 26. Two wheeled hose carriage, painted vermillion and gold; design on the back, a portrait of President Van Buren; drawn by 26 men, dressed in fire cap, dark coats and pantaloons.

North River Engine Company No. 27. Engine painted blue, with gold stripes; design on the back, Othello's Courtship; on the side panels, Laurence's Monument, with motto, "Dont give up the Ship," drawn by 60 men; uniform fire caps, red shirts, and dark pantaloons.

Third Ward Hose Company No. 27. Two wheeled hose carriage, blue ground with gilt, brass mountings; banner of blue silk, with name and number of the Company: Carriage drawn by 23 men; uniform, fire caps, blue shirts, and dark pants.

Union Hook and Ladder Company No. 5. Truck painted red with gold stripes, Ladders painted white and blue; a boy standing on the Truck, bearing the motto, "We are pledged to abstain from all intoxicating drinks; Banner representing a fire, and the men in the act of pushing in a front wall; drawn by 28 men; uniform fire caps, red shirts, and dark pantaloons.

Guardian Engine Company No. 29. Engine painted blue, striped with scarlet and black, dressed with ribbons and wreaths, drawn by 44 men, same uniform as above.

Eleventh Ward Hose Company No. 29. Two wheeled Hose Carriage, painted black and gilt; in the centre of the carriage was placed a banner, bearing the name and number of the Company, an American flag on each side, a half circle erected on the front of the scrolls, bearing a live eagle, having suspended from his neck, a heart, bearing the number of the Company; carriage decorated with ribbons; drawn by 16 men, same uniform as above.

Hope Engine Company No. 31. Engine painted white, ornamented with gold, carved back, representing the Coat of Arms of the State; painting on back, representing Faith and Hope; iron work plated with brass; painting on each side of leader jacket, Hebe giving drink to an eagle; Banner of blue silk, representing Hope, and a female figure with the motto of the Company, "We hope to conquer and to save," on the opposite side the motto, "And the waters prevail;" two boys bearing brass torches, dressed with ribbons, on each side of the Engine, and in the centre of the rope, a boy bearing a wreath of dahlias; Engine drawn by 52 men, dressed with fire caps, red shirts, dark pants, and white patent leather belts.

Putnam Hose Company No. 31. Two wheeled Hose Carriage, painted blue and gilt; on each side of the carriage an American flag; in the centre a blue flag, with the word "Liberty," in gold letters; drawn by 20 men, same uniform.

Bunker Hill Engine Company No. 32. Engine painted red, striped with gold, the number 32 on the back, preceded by a banner, with a representation of the Battle of Bunker Hill, and the death of Warren, on one side—on the other, two figures, representing Hope and Liberty, resting against a monument, bearing the inscription, "Brief, brave, and glorious was his young career;" banner borne by a Fireman, with two boys; by the side of the Engine, two boys, bearing torches and guide flags, Engine drawn by 50 men, in same uniform as above.

Richard M. Johnson Hose Company No. 32. Two wheeled Hose Carriage, painted black, striped with red and gold, drawn by 21 men, same uniform.

Black Joke Engine Company No. 33. Engine painted black, with gold stripes, drawn on a stage, richly carpeted and festooned, by 4 horses, men surrounding the Engine in full fire dress, Engine highly ornamented with ribbons and flowers, preceded by 58 men, in same uniform as above.

City Hose Company, No. 33. Two wheeled hose carriage, painted black and gold, preceded by a banner presented by the Liberty fire company of Baltimore; the carriage drawn by 25 men, attended by a delegation of 13 members of the Liberty fire company of Baltimore, in the appropriate dress of Baltimore firemen. Uniform of the company, same as above.

Howard Engine Company, No. 34. Engine painted red and gilt. Design on back represents Howard giving aid to the sick. Banner of blue silk, with the following: "Howard Fire Engine Company, No. 34, founded A. D. 1807." Engine drawn by 85 men in same uniform as above.

Fifteenth Ward Hose Company, No. 35. Two wheeled hose carriage, painted light blue; drawn by 19 men; same uniform.

Equitable Engine Company, No. 36. Engine black and claret, striped with gilt. Design on back representing sailors rescuing a mother and child from the sea. Engine decorated with long pipe, eagle, and two American flags; also dressed with ribbons and flowers — four boys bearing guide flags and torches — drawn by 54 men; same uniform.

Glendoveer Hose Company, No. 36. Two wheeled hose carriage, painted cream color with gilt stripes — decorated with wreaths of dahlias — drawn by 16 men; same uniform as above.

Tradesmen's Engine Company, No. 37. Engine painted green and black, striped with gilt. Design on the back, a female figure representing industry, with spinning-wheel, bee hive, &c. — a fire in the distance. Motto, "Industry and perseverance overcome every obstacle." Engine drawn by 53 men: same uniform.

Southwark Engine Company, No. 38. Large engine built in Philadelphia, on the plan of engines used in that city. Engine painted green, with bronze mouldings — mountings of Prince's metal, with side lamps of same. On the front slide board of condenser case, is a painting of an eagle perched on a rock in the sea, bearing in his talons the motto of the company, "Semper paratus"— on the back slide a painting of the New York city Coat of Arms. Banner was borne on the engine — tassels supported by two boys. Banner represents Amphitrite, the queen of the sea, drawn by tritons in her coral car; hovering over her is Cupid, with his torch of fire — in the distance a city in flames. Engine was drawn by 94 men, four abreast, dressed in fire caps, red shirts, dark pants, and black leather belts.

Lady Washington Engine Company, No. 40. Engine painted white, with blue and gilt stripes. Leader jacket painted white, with a fireman's certificate painted on one side, and a discharge certificate on the other — painting on back, a female sitting, holding in her right hand a torch, and on her right an eagle with a portrait of Washington suspended from its neck. On the top of the condenser case a spread eagle, bearing the motto of the company, "Combined to do good, and not to injure." Three boys bearing brass signal lantern and torches. Engine drawn by 60 men; uniform as above.

Clinton Engine Company, No. 41. Engine painted yellow, with red and gilt stripes. Painting on back, a pedestal, on which is a bust of De Witt Clinton, with the genius of Agriculture, crowning him with a wreath of flowers. At the base of the pedestal is an American eagle. On the right, a view of the city of Albany — on the left a distant view of the Erie canal — on the front slide, a view of the Erie Canal Aqueduct at Rochester. On the top of the condenser case, a liberty cap with an American flag. Two boys bearing brass torches. Engine drawn by 55 men; uniform as above.

Northern Liberty Engine Company, No. 42. Large engine on the same plan as engine No. 38 — painted black, with gilt stripes — polished brass mountings. Engine drawn by six white horses, preceded by the company, numbering 37 men. Dress fire caps, white shirt, and red shirt *over all*, open at the breast, and dark pants — the banner of white silk, embroidered with a wreath, and the name of the company. The engine was followed by the hose tender, and also by Engine Company No. 3, of New Haven, as invited guests, attended by a band of music. The Engine Company No. 3, of New Haven, consisted of 38 men, in red shirts, fire caps, and dark pants, drawing their engine, painted blue and cream color.

Mechanic Hook and Ladder Company, No. 7. Truck elegantly dressed with a profusion of dahlias and other flowers, extending from a small ladder raised in the centre, to each end. Banner, representing Neptune delivering the keys to Charity, to relieve the Widow and Orphan. Truck drawn by 35 men, same uniform as before.

Engine Company, No. 43.

Live Oak Engine Company, No. 44. Engine painted color of live oak, with gilt stripes; front stanchions, two carved figures of Turks. Design on the back, representing Juliet, in a scene from the play of Romeo and Juliet; 4 boys bearing guide flags and torches; drawn by 90 men; fire caps, red shirts, and dark pants.

Yorkville Engine Company, No. 45. Engine painted cream color and gilt. Design on the back, "Aurora," drawn by 31 men; same uniform.

Relief Engine Company, No. 46. Red and salmon color, with gilt stripes; drawn by 41 men; same uniform.

Mazeppa Engine Company, No. 48. Black and gilt. Design on back, Mazeppa bound to a wild horse; drawn by 30 men, same uniform.

Mohican Company, No. 50. Red and gilt. Design on the back, the city Coat of Arms; drawn by 40 men, uniform as before.

The Committee of Arrangements, consisted of the following:

HENRY B. HINSDALE, *Foreman of Hose Company, No.* 3., *Chairman.*
CORNELIUS V. ANDERSON, *Chief Engineer.*
ELIJAH C. KING, *Foreman of Engine Company, No.* 26.
WILLIAM WILLIAMSON, *Foreman of Engine Company, No.* 13.
STEPHEN KANE, *Foreman of Hose Company, No.* 12.
HENRY SNYDER, *Foreman of Engine Company, No.* 42.
WILLIAM TAPPER, *Foreman of Engine Company, No.* 46.

Delegates to confer with Common Council.

HENRY B. HINSDALE,
CORNELIUS V. ANDERSON.

The number of Firemen from neighboring cities, was - -	1,072
The number in the New York Department - - - -	3,003
Total,	4,075

The Procession was so long that it was impossible for all to meet at the Battery, or even within two miles of it. While one branch, therefore, were moving into the line on Broadway, by marching towards the Battery, another in the procession were marching up. In this double line the different Fire Companies passed and re-passed for three-quarters of an hour. The citizen firemen paid marked respect to their guests, and one another as they passed, either by moving on with their heads uncovered or by raising their hats. Surely, we thought, with Croton water to extinguish a fire, and such a body of men to use it, New York will never suffer again from a conflagration.

FIFTH DIVISION.

Under the direction of Colonel Philbrick, assisted by Mr. James Nesbitt, Aids to the Grand Marshal.

Programme of the Procession of the Masonic Fraternity, as part of the General Procession on the 14th of October, 1842.

The Grand Marshal.

Band.

Naval Lodge, No. 69, following their banner, of blue silk, on which is painted the U. S. Ship of the line, Pennsylvania.

Montgomery Lodge, *No.* 68. A green banner, with a full length portrait of General Montgomery.

Mariner's Lodge, *No.* 67. Banner a ship laying to, near a wreck. Motto from *Cowper*, "Sweet Charity, thou tutelary friend of helpless Man."

La Fayette Lodge, *No.* 64. Their banner is a full length portrait of La Fayette, standing on a hand, emblematic of the career of the General through life, *supported by the hand of Providence.*

Mechanic's Lodge, *No.* 31. Banner representing the emblems of the Craft.

Mount Moriah Lodge, *No.* 27. A scarlet banner with the three primitive Grand Masters assembled at the East of Jerusalem. Hiram Abiff exhibiting the design for the interior of the *Sanctum Sanctorum.*

Adelphi Lodge, *No.* 23. A crimson banner representing three Brethren—an American Indian, an Asiatic, and a European in union.

Washington Lodge, *No.* 21. A blue banner with a copy of Stuart's head of Washington.

Abram's Lodge, *No.* 20. A blue banner with a vignette painting of Abram, the father of the faithful.

Fortitude Lodge No. 19. Banner with vignette appropriate to the name.

Trinity Lodge, *No.* 12. Banner of dark blue, with angels adoring the sacred Word.

Independent Royal Arch Lodge, *No.* 2. Banner of light blue, with the Arch of Titus, in vignette.

Ancient Chapter, *No.* 1 (of Royal Arch Masons), with a large scarlet banner with the name of the body in gold letters.

Knights Templars in the costume of the Order.

Representatives of the Grand Lodges of New Jersey, Connecticut, Georgia, South Carolina, District of Columbia, and Hamburg, with small banners of arms.

The Officers of the Grand Lodge.

Grand Tiler, with drawn sword.

Four Grand Stewards with white rods.

Grand Standard of the Order, with four supporters. This banner is in the form of a Masonic apron, of white silk, and purple satin flap. On the centre is the arms of the Ancient Freemasons; on the flap the name of "The Grand Lodge of the State of New York;" the whole surrounded by a broad border of ornamental gilding.

Grand Sword Bearer, with Sword of State.

The Holy Bible on a purple velvet cushion, borne by a Past Master. On this Bible is inscribed the following legend:

"On this Sacred Volume,
On the 30th day of April, A. L., 5789,
In the City of New York,
Was administered to
GEORGE WASHINGTON,
The first President of the United States of
America,
THE OATH
To support the Constitution of the United States.
This important ceremony was
Performed by The Most Worshipful Grand Master
Of the State of New York,
The Honorable
ROBERT R. LIVINGSTON,
Chancellor of the State."

Two Grand Chaplains.
Grand Secretary and Grand Treasurer.
Senior and Junior Grand Wardens.

The Rt. W. Deputy Grand Master, and The Most Worshipful Grand Master, the venerable MORGAN LEWIS, in a barouche, supported by four Grand Deacons with blue staves.

Contractors and Workmen of the Water Works.
A large main Pipe drawn by four horses.

A truck surmounted by a banner with the inscription "Croton Aqueduct Department," bearing several pipes, and workmen, with red caps, on which was inscribed "pipe layers," at work. Banner with portrait of De Witt Clinton, and a view of the locks of a canal.

Xylographic Society and Printers.
North River Navy. A car drawn by two horses, representing the Miller and his Men.
A car drawn by four horses, with model of steamboat North America.
North River Steamboat Captains in two Barouches.

The Fraternity wore all the varied badges and insignia of the craft, and the division was one of the most novel and interesting of the group. The Croton Water Pipe was hauled along to show what had been done by men, and by what means it had been accomplished. Pipe of every weight and dimension, the implements of the workmen, their carts, machinery, &c., all made a part of the *tout ensemble* of this division.

The Printing Press was the same that Benjamin Franklin had worked upon in London, and on the same car was one of the *new fashioned* ones of our day, occupied in striking off an ode written for the occasion.

The North River Navy was represented in a long boat well filled and manned, and hailing as "The People's Line."

The Miller and his Men were up to their eyes in meal. The corn was ground, bags of meal laid by, and everything betokened the thrift and enterprise of the laborer, and of the business.

The Phenix Foundry in this division was a model piece of work. It was a live foundry, with live coals of fire, and smoke enough almost to have driven those out of doors within, as it certainly would have driven those in doors out. Various emblems and inscriptions adorned this live house, one of which was "Strike while the iron is hot," "Practice makes perfect," &c.

SIXTH DIVISION,

Under the direction of Capt. Wm. H. Cornell, assisted by Mr. George G. Hopkins, Aids to the Grand Marshal,—comprising the

Butchers of the cities of New York and Brooklyn.

The Butchers had a banner with the inscription "Agriculture is our National wealth."

Here was another and one of the grandest of the exhibitions of the day. Every butcher was in costume, with his clean white apron, and both arms covered with a checked sleeve, slipped on to make all neat and tidy. A large part of the number were on white horses. Many amusing badges, banners and appropriate devices were scattered through the procession. A large ox and a lamb were upon one platform ; upon another enclosed as in a yard, was a cow, calf, and a score of sheep, all alive, bleating and kicking, and seeming amused and delighted at being the lions of the day, not bearing a load, but being borne and well fed by the corn and hay which had been abundantly provided. Next came the

SEVENTH DIVISION,

Under the direction of Mr. John Ridley, assisted by Mr. Silas J. Howell, Aids to the Grand Marshal,—comprising

Gold and Silver Artizans.

Mercantile Library Association.

Marine Society.

The General Society of Mechanics and Tradesmen of the city of New York.

With the Apprentices' Library and Male Department of the Mechanics' Society School belonging to the Society.

Band of Music.

Banner of the Society. Of blue silk, edged with white silk fringe and tassels.

Description: crimson draperies on a blue ground, in the centre a Medallion, representing a pelican feeding her young, surmounted by the American Eagle, bearing the Arm and Hammer, the well known emblem of the Society:

Under the Medallion, "General Society of Mechanics and Tradesmen, instituted," MDCCLXXXV.

Marshal, Richard E. Mount, Ex-President of the Society.

Aids, Edwin B. Clayton, Samuel Roome, Ex-Presidents of the Society.

President of the Society, Linus W. Stephens.

First Vice President, James Van Norden.

Second Vice President, Shivers Parker.

Treasurer, Adoniram Chandler, Ex-President of the Society.

Secretary, Isaac Fryer.

Ex-Presidents.

John McComb, Brigham Howe,

Cornelius C. Jacobus, Eleutheros D. Comstock.

Members of the Society.

Apprentices' Library.

Banner of blue silk. Medallion. The Arm and Hammer. Readers of the Apprentices' Library.

Chairman of the Library Committee, James B. Bensal.

Members of the Library Committee.

Readers of the Apprentices' Library.

Banner of blue silk. Medallion. The Arm and Hammer. Knowledge is Power.

Male Department of the Mechanics' Society School.

Banner of blue silk. Medallion. The Arm and Hammer. Mechanics' Society School. Instituted 1820.

Chairman of the School Committee, James Phyfe.

Members of the School Committee.

Principal of the School, Isaac F. Bragg.

Pupils of the Male Department of the School six abreast, in charge of Assistant Teachers.

Banner of blue silk, same as last mentioned.

Whole number in procession, 367.
American Institute.
Mechanics' Institute, with a miniature steam engine in full operation.
School of Mechanics' Institute.

The banner borne by the *Gold and Silver Artizans* was of blue silk, about two yards square, surrounded by a rich gold colored fringe. On the front was painted a shield, in the quarters of which was represented in gold and silver the different articles of their manufacture; under the shield on a ribbon was the motto "Union and Perseverance ensures success." On the reverse a shield, on which was represented a mechanic's arm and hammer, and around it, in letters of gold, the name and date of the association, "Gold and Silver Artizans, 1841." They also bore in procession on a platform with raised centre, covered with black velvet, a splendid display of Silver ware and Jewelry, and specimens of pure Gold and Silver in bars. This display was of several thousand dollars value, and attracted from the admirers of these articles the attention they richly merited.

The number in procession was supposed to be about three hundred.

The various societies which followed bore each their appropriate badges and banners, and young and old presented a pleasing view.

EIGHTH DIVISION.

Under the direction of Surgeon General Pennell, assisted by Col. Robt. C. Morris, aids to the Grand Marshal.

Friendly Sons of St. Patrick.
Officers of Irish Emigrant Society.
Hibernian Benevolent Burial Society.
Hibernian Universal Benevolent Society.
Shamrock Benevolent Society.
Sons of Herman.
German Washington Benevolent Society.
Italian Universal Benevolent Society, with an elegant banner of the landing of Columbus on the discovery of America.
St. David's Society, preceded by a stage on which were seated three bards with long beards, playing on their Cambrian harps.
Welsh Temperance Society, with a banner.

These Societies turned out strongly and with all their emblems. There were Harps and Harpists, and instruments and men did honor to each of the several societies and countries represented. One at a glance could see in this division men born in almost a dozen Kingdoms, all good citizens here, but like all good citizens, though adopted, never forgetting the land of their fathers, or the mothers that nursed them.

NINTH DIVISION.

Under the direction of Colonel A. G. Crasto, assisted by Col. Benj. W. Benson and Major Minthorn Tompkins, Aids to the Grand Marshal.

Comprising

The Temperance Societies, *en masse.*

Barouch, containing the officers of the Liberty Hose Company of Baltimore.

Washington Temperance Guards, commanded by Capt. Wm. Lee.

Union Riflemen.

Sandy Welch, mounted on a charger.

Washington Temperance Benevolent Society.

Marine Temperance Society.

Manhattan Temperance Society.

Junior Washington Temperance Society.

Franklin Temperance Society, preceded by a band composed of members of the Institute for the Blind, seated on a car.

Junior Franklin Temperance Society.

Broadway Washington Temperance Society.

Rockland Lake Association, with two ice carts.

Mount Pitt Temperance Society.

Washington Total Abstinence Society.

Neptune Temperance Society, accompanied by a detachment of U. S. Marines and Soldiers, in uniform.

Chelsea Temperance Benevolent Society.

Bloomingdale Temperance Society.

Howard Temperance Society.

Eagle Junior Temperance Society.

Cold Spring Temperance Society.

Young Men's Cold Spring Temperance Society.

Hamilton Temperance Society.

Lafayette Temperance Society.

Fifth Ward Temperance Society.

Washington Temperance Society.

Good Samaritan Temperance Society.

Washington Temperance Benevolent Society of Brooklyn.

Junior Hand in Hand Temperance Society.

Washington Prospect Temperance Beneficial Society.

Printing Press on a stage, in operation, printing Temperance odes.

Bakers' Temperance Society.

Washington Temperance Benevolent Society of Jersey City.

Marshal Temperance Society.

Lady Marshal Temperance Society. The members, ladies, being drawn in six barouehes.

What a revolution was here. Gray hairs and beardless boys, mothers and daughters, both sexes, all ages and ranks were here. Reformed drunkards made good and sober citizens, and these not seen in one or a score but in a thousand faces. The heart beats lighter at such a spectacle as this, and words in praise of it is but gilding refined gold or adding a perfume to the violet.

We have obtained the following notice of some of the banners borne by the Temperance Societies:

Cold Spring Temperance Benevolent Society. Henry K. Cushing, President; P. J. Bagwell, V. R. Terry, Vice Presidents; M. Dougherty, Recording Secretary; Thomas Edgerly, Corresponding Secretary; John C. West, Financial Secretary; Ezra Beach, Treasurer; Dr. M. L. Osborn, Marshal. Banner, of blue silk, (presented to this Society by John Stewart Esq., Alderman of the 14th Ward,) representing a gentleman tendering the pledge of total abstinence to a poor ragged inebriate. Inscription, "Turn; drink of the pure fountain of life, come with us and be free. A small banner, Cold Spring Temperance Benevolent Society. Organised Nov. 19, 1841.

Large Banner of the Baker's Temperance Benevolent Society. America, the Genius of Temperance, offering the Staff of Life and the Cup of Health, and pleading the cause of Temperance. The Temple of Science and Wisdom divides the picture, showing the opposing principles; on the left the sun rises in all his glory; Peace, Commerce, Mechanics, and Agriculture flourish. On the right how different the picture! The sun sets in blood, the earth wrapped in all the horrors of Intemperance; the lightning destroying the false light that has already enticed the ship of the Inebriate to his destruction. The moderate drinker is coming on under easy sail, just entering the sea of trouble, and the first glass making its appearance on the horizon. One figure represents beastly intoxication, the other one has just thrown off the shackles of Intemperance, and is supplicating for protection and relief. The Anchor of Hope firmly planted in the Rock of Safety with the pledge of Total Abstinence for its cable, extending across the abyss of destruction and winding through the land. On the reverse side, the American eagle, descending with the Olive Branch of Peace and the Shield of Protection emblazoned with the likeness of the Father of his Country, and the GOD-FATHER OF TEMPERANCE. The motto, "Conquer we Must, for our cause it is just." Both banners designed and painted by A. D. O. Brouerel, of

Brooklyn. The small banner, front side, represents the interior of a Bake House, and the Temperate Bakers cheerfully performing their work. All is Peace, Harmony, and Cleanliness, and an appropriate motto, "Praise God for all." On the reverse side, encircled in scroll work, is a landscape, brightened with the Sun of Peace, and the Sheaf of Plenty is standing in a field where the grain is already stacked; motto the same as above.

The Good Samaritan Temperance Benevolent Society, was headed by a splendid large banner, representing the Good Samaritan in his act of Mercy upon an unfortunate man, who had fallen among thieves, and lain by the road side, in accordance with the name they bear. On the reverse, the Woman of Samaria, at Jacob's Well, in the act of giving a draught of water to the Saviour of men. This Society numbers rising 500 members, and turned out about 200, owing to so many belonging to other Societies. The Officers of the Society are, Nathan Cropsey, President; Lorenzo B. Porter, Vice President; John Vincent, Secretary. Seaman H. Wright, Marshal of the day; William Moger, James H. Green, Mott Owen, W. H. Pennington, and James Frasier, Aids.

The Manhattan Temperance Benevolent Society of the city of New York. Mr. Abraham Van Disberk, the Grand Marshal of the day, on horse back; next was the banner of the Society, carried by Mr. Henry Van Benscoton, Mr. Sillick Roberts, and Mr. Price. The banner green and purple silk, surmounted with a cherry colored liberty cap, and drapery of the same; color the design on the front side is an Indian, representing the last of the Manhattoes; in his left hand, a bow, with which he is pointing to a grave, or Indian mound, that contains the last of his race, that has been destroyed by alchohol; at his right hand is a beautiful female, representing the Genius of Temperance, with one hand on his shoulder, and with the other hand holding out the pledge, and with a kind look, begs him to sign, but with a look of sorrow, he declines, as he is the last of his race; at their feet runs a clear stream of water; in the distance is seen the city, with her tall spires and masts pointing to the clouds—the whole surrounded with the inscription, Manhattan Temperance Benevolent Society, organised February 23d, 1841; on the other side of the banner represents a Ship Yard, with a ship in frame, and the carpenters to work at it; in one side of the yard is a well of water, and one of the men drinking out of the bucket; at a distance we see a ship under full sail in a storm, representing the storm of intemperance; above, you discerne the clouds breaking away, and the rainbow of promise, assuring us that the storm is passing over, and there is yet hope for the poor drunkard; it is surrounded with the inscription, "Auxiliary to the Washington Temperance Benevolent Society of New York."

Next followed the officers of the Society, viz: George Hull, President, John R. Ames, Vice President, Wm. Bennet, Secretary, David L. Young, Treasurer. In the centre of the line was a small banner, carried by three boys ; on it was the representation of a decanter of brandy, upside down, with the brandy running out, with the inscription over the top, "Right Side Up;" in the rear, was a white banner, with the inscription of Manhattan Temperance Benevolent Society of New York. The Staff Marshal was Silas Pearsall.

The Festivities in the Park on the return of the Procession.

At two o'clock, a part of the advanced guard of the procession, consisting of a detachment of the Washington Grays, gallopped up to the front of the City Hall, and announced to the officers in attendance there, that the cavalcade had reached the Chatham Square on its return. Measures were immediately taken to clear the space in front of the City Hall, as also the scaffolding which had been erected for the accommodation of the Sacred Music Society and the orators of the day. At this time the rear of the left wing of the vast procession was still filing past the west side of the Park, so that at the most moderate computation it could not be less than seven miles in length.

At 20 minutes past two, his Honor the Mayor and the members of the Common Council, foreign Consuls, and invited guests, took their stations on the front of the Hall, which then presented a most animated spectacle, every nook and niche being crowded with spectators. The troops then passed in review order before the assembly, and were followed by the other portions of the procession, with the exception of some few detachments which filed off, and entered the Park by the southeastern gate.

By half past four o'clock, the immense cavalcade had filed off and been stationed at convenient distances in the Park, whereupon the Grand Marshal, Gilbert Hopkins, announced to the orator of the day that the Mayor was ready to hear him. Samuel Stevens, Esq., President of the Board of Water Commissioners, then advanced to the front of the platform and delivered the following address. which was listened to with the most patient attention.

Mr. Mayor and Gentlemen of the Common Council:

In delivering over the Croton water, and the works on this island, I have been requested by your Committee to make such remarks as the occasion may suggest.

From the earliest period of the history of our city, the attainment of pure and wholesome water has been a subject of the highest interest.

The *Tea Water Pump*, situated near the corner of Pearl and Chatham streets, was, for a long period of time, the grand source of all drinkable water for the lower part of the city.

Mr. Stevens then gave a rapid sketch of the various schemes, propositions, and devices, for supplying the city—all which having been presented more at large in the memoir, are omitted here.

Mr. Stevens then continued—

We of New York have therefore now got the great desideratum, an abundant supply of pure and wholesome water, to be sure at a great cost—nine millions of dollars, exclusive of the main and distributing pipes throughout the city, (now laid to the extent of 130 miles,) exclusive of the interest accumulating on the cost, being in all twelve millions of dollars.

Well, what of that! does it not belong to the system which Eternal Wisdom has inflicted on the world?—that the greatest blessings can only be procured at the greatest cost and sacrifices?

What is this water to do for us? It is to protect our city from the awful conflagrations to which it was subject. We now pay in premiums one million of dollars annually to insure about half the value of our buildings, goods, and chattels, for we are our own underwriters to the extent of one million more of premiums—here are two millions in premiums paid, or risks incurred. If the Croton works give but half security, you save more than will pay the whole interest of the cost. Reflect, gentlemen, on the amount of property consumed in the city, and then consider if we cannot afford to give twelve millions for security. In two days of December, 1835, our citizens had consumed by fire twenty millions of dollars, principally in warehouses and merchandise.

If the twenty millions of property destroyed had consisted of dwelling houses, it would have turned 100,000 of our citizens into the streets.

I do not state an impossible case. I state an event highly probable to have happened; for London—a city built of less wooden materials—had at one fire, in 1666, 13,000 houses burnt, which occupied 436 acres, and embraced 400 streets, 86 churches, and a variety of magnificent buildings. The destruction amounted in value to fifty millions of dollars. The extensive fire at Hamburg during the past year, and the constant occurrence of fires throughout our country, show the danger we were in.

Does any individual still say that we cannot afford to pay so much as this great work has cost? I assert that security against such awful calamities cannot be too dearly bought, if it is bought at the lowest possible rate.

It must be had if possible in every community, and the man who grudges money to save the city from destruction, can be only one who wants no security but for stocks, and dividends, and bonds, and mortgages; and into whose thoughts the welfare and happiness of his fellow beings never enter.

But does water cost so much? London, in 1834, was supplied with 34,000,000 gallons, and paid for it annually $1,380,000. Paris is supplied with two quarts per day to each individual, at an expense of $750,000 per annum. The Croton will furnish three hogsheads a day to each of our population, at but $600,000 per annum.

After all, we have followed but at a respectable distance ancient Rome, with her nine aqueducts, some of which were longer than the Croton Aqueduct, and together were capable of supplying 250,000,000 of gallons per day. But history does not enable us to say, if all of them were in operation at one time; nor do we know all the purposes to which it was applied. The irrigation of the land was no doubt among its most extensive uses. Nor do we learn whether these aqueducts supplied one million or four millions of inhabitants, so widely do the accounts of the population of ancient Rome differ.

The works of Rome were built by soldiers and by slaves. Ours was voted for by freemen, was constructed by freemen—and we make the aspiration that in all ages to come it may bless freemen, and freemen only!

Mr. Stevens then went on to speak of the value and healthfulness of the water for domestic purposes, of which the quantity used daily, he computed to weigh 250,000 tons; paid a merited compliment to the Firemen of New York, and adverted to the fact that in all expenditures on this great work it is not known that a single dollar of the people's money has been lost or dishonestly applied, and he hoped that while the Corporation would adopt measures in reference to the water to meet the interest on the debt, they would be just to the rich, and liberal to the poor.

In conclusion, Mr. Stevens said, it was a source of great pride and satisfaction to him, as a native of this great city, to say, that he had watched with care and some anxiety, every person who had formed a part of this great and noble celebration, and that he could not discover neither a drunkard nor a fool from the first to the last.

As soon as the cheer had subsided, the following reply was made by J. L. Lawrence, Esq., President of the Croton Aqueduct Board:

Mr. President, and Gentlemen of the Board of Water Commissioners:—

In receiving, with my associates of the Croton Aqueduct Board, the custody of the work committed to us, I take the occasion to convey to you, the thanks of your fellow-citizens, for the zeal, perseverance and fidelity with which your duty has been performed, and to congratulate you on the virtual completion of the work entrusted to you, and your predecessors in office. Of the manner in which both have discharged their respective tasks, the results we this day celebrate, speak in most emphatic praise. The science and skill of your able engineers, have excluded all errors of combination and construction, and met the highest expectations of the public. In mechanical execution, the work appears to defy the test of scrutiny, as completely as we trust it is destined to resist the assaults of time. Contrary to predictions, ventured on the subject, its efficiency in delivering the water, not only equals but largely exceeds the mathematical estimate.

The island on which New York is built, is peculiarly fitted for the site of a great city. Blessed with a salubrious climate—surrounded by waters forming a noble harbor, and constituting links of natural or practicable inland communication with adjacent sister States, with the rich territory of our own State, and with the boundless and fertile regions of the West—connected by a short and uninterrupted passage with the ocean, the pathway from foreign climes, and from the extensive sea-board of our confederate States, and possessing, within easy reach, almost every necessary for construction and supply, our position combines natural advantages for a large community, devoted to the prosecution of commerce and the arts, unsurpassed by those of any other spot on the globe. In the list of these endowments, one essential, only, appeared to be absent. Pure and wholesome water, an element indispensable to the wants, comforts, and business of a crowded population, was found within our limits in inadequate quantity; and at each onward stride of our city, even this stinted allowance decreased in purity, as well as in measure, until it had become our reproach. A sufficient and permanent supply was to be found only at a great distance, as if to test whether the gifts so bountifully bestowed on us, could incite us to repair the single deficiency. To accomplish the object, it was necessary that formidable physical obstacles should be overcome; that capacious and enduring channels of covered masonry should be constructed, rivaling in extent and magnitude, the boasted aqueducts of antiquity, and casting into shade any kindred works of modern times; and that, for these purposes, an expenditure should be incurred, exceeding that which was encountered by our State, when she united the Hudson with the Lakes. And such momentous results were to be obtained, not from the resources and co-operation of an entire people, but through the credit and enterprise of a single city, which, though destined, as we cannot doubt, eventually to equal in population and wealth the proudest capitals of the civilized world, was to be impelled to the vast effort while yet in the infancy only of her growth and strength!

It is with feelings of pride and joy, we this day realize that the work is achieved. The obstacles have disappeared. The hill has been levelled or pierced, the stream and the valley have been overleaped, the rock has been smitten! Nature, yielding to human industry, perseverance and skill, no longer withholds the boon she had before denied us. A river, whose pure waters are gathered from the lakes of the mountain-range, arrested and diverted in its course, after pouring its tribute through a permanent and spacious archway, for more than forty miles, at length reaches our magnificent reservoirs, from whence it is conducted by subterranean conduits, extending one hundred and thirty additional miles, throughout the greatest portion of our city. The necessary additions, comparatively not large, are now in rapid progress, which will diffuse the salutary current through every remaining artery and vein of our metropolis, exciting new and healthful pulsations in her system, and spreading comfort, activity, and vigor throughout her entire frame.

Of the valuable consequences which will be derived from this work, some may not be developed until after successive years. The little experience already had, points to many useful results that were not foreseen. Among its immediate and palpable benefits, are its influences on domestic convenience and comfort—the promotion of sobriety and personal cleanliness—the purification of our streets—the consequent increase of public health—the facilities it will extend to mechanical and manufacturing industry—the vast increase of steam-power among us, to be employed in the arts—the supply to our mariners of a necessary element, which will remain comparatively unaffected by change of climate, and pre-eminently, the security it will afford against the dangers of conflagration. Each neighborhood, uniting its inhabitants for purposes of mutual safety, may promptly arrest the ravages of fire in its early stages; and if such associations be numerously formed, extensive fires need but rarely occur. Large as we may deem the expense of this vast structure, we cannot but consider it as cheaply purchased, when we reflect that the calamity of a night, occurring when we were without the protection now afforded, involved a destruction of property of twice this cost.

The history, Mr. President, which you have this day given, of the rise and progress of this undertaking, forms a just tribute to numerous citizens, who assisted in its origin and consummation. It is a characteristic of this work, that the credit attached to it, belongs pre-eminently to no individual, but is diffused, though in unequal degree, throughout an extensive circle. Fortunately, the field of commendation is so large, that each may reap his deserved harvest, without infringing the rights of his neighbor. Our thanks and remembrances are due to ALL, whose exertions in the Legislature of the State—in our municipal councils—in the various commissions of exploration, of survey, of estimate. superintendence and construction, contributed to the great achievement. Nor can I pass over the munificence and public spirit which have been displayed by the whole body of our fellow-citizens. An overpowering popular vote sanctioned the undertaking, approved of the ways and means, and ordered its commencement. Although some few believed that caution, and even prudence, demanded a postponement of the effort, yet once resolved upon, all cheerfully yielded their acquiescence and co-operation. Amid the unparalleled difficulties and discouragements which have marked the times, since it was begun, no hesitation has impeded its progress; but its march has been onward, steadily, perseveringly, successfully, to its completion.

Sensible of the honor conferred by the constituted authorities of the city, in committing to us the trust confided to our hands, it will be the effort of myself and colleagues to employ every power given to us, for the protection and advancement of the great work now in our charge. Long may that work endure to illustrate the wisdom of its founders —a monument of the enterprise and perseverance of our people—and the source of health, safety, and happiness for successive ages

The ladies and gentlemen of the Sacred Music Society then took their stations on the platform, and sang the following ode, printed copies of which had been liberally distributed at the expense of the Corporation during the day:

THE CROTON ODE.

Written at the request of the Corporation of the City of New York, by George P. Morris, *and sung in front of the Park Fountain, by the Members of the New York Sacred Music Society, on the completion of the Croton Aqueduct.*

CELEBRATED OCTOBER XIV, MDCCCXLII.

Gushing from this living fountain,
  Music pours a falling strain,
As the Goddess of the Mountain
  Comes with all her sparkling train.
From her grotto-springs advancing,
  Glittering in her feathery spray,
Woodland fays beside her dancing,
  She pursues her winding way.

Gently o'er the ripling water,
  In her coral-shallop bright,
Glides the rock-king's dove-eyed daughter,
  Deck'd in robes of virgin white.
Nymphs and Naiads, sweetly smiling,
  Urge her back with pearly hand,
Merrily the sylph beguiling
  From the nooks of fairy land.

Swimming on the snow-curled billow,
  See the river spirits fair,
Lay their cheeks, as on a pillow,
  With the foam beads in their hair.
Thus attended, hither wending,
  Floats the lovely Oread now,
Eden's arch of promise bending
  Over her translucent brow.

Hail the wanderer from a far-land!
  Bind her flowing tresses up!
Crown her with a fadeless garland,
  And with crystal brim the cup.
From her haunts of deep seclusion,
  Let Intemp'rance greet her too,
And the heat of his delusion
  Sprinkle with this mountain-dew.

Water leaps as if delighted,
  While her conquered foes retire!
Pale Contagion flies affrighted
  With the baffled demon, Fire!
Safety dwells in her dominions,
  Health and Beauty with her move,
And entwine their circling pinions
  In a sisterhood of love.

Water shouts a glad hosanna!
  Bubbles up the Earth to bless!
Cheers it like the precious manna,
  In the barren Wilderness,
Here we wondering gaze, assembled
  Like the grateful Hebrew band,
When the hidden fountain trembled,
  And obeyed the Prophet's wand.

Round the Aqueducts of story,
  As the mists of Lethe throng,
Croton's waves, in all their glory,
  Troop in melody along.
Ever sparkling, bright and single,
  Will this rock-ribbed stream appear,
When Posterity shall mingle
  Like the gathered Waters here.

Gilbert Hopkins, Esq., the Grand Marshal of the day, now announced that the ceremonies were at an end, and he proposed that the assemblage join him in nine hearty cheers for the City of New York and perpetuity to the Croton water.

The cheers were given with a heartiness that made the welkin ring again.

Not a single accident happened in the Park or its immediate vicinity, and great praise is due to the parties appointed to keep the ground, for the good dispositions they made.

COLLATION IN CITY HALL.

After the ceremonies of the day were closed, three large tables were spread in the City Hall, where the Mayor, the Governor, the members of the Corporation, officers and several hundred citizens partook of a cold collation, and Croton water and lemonade, but no wine or spirituous liquors. All was conducted with order and propriety, but with no ceremony; no chairs were provided, but a sufficient number of knives and forks for each to help himself. It was a well arranged republican repast—one of which the many could partake.

Mayor Morris offered a toast, which he prefaced with some apppropriate remarks—returning in behalf of the citizens their thanks to the Executive of the State, and to the vast number of persons from various places who had come among us to celebrate a joyous event, which was made more joyous by their countenance and participation. He closed by offering a toast, which was drunk by all, accompanied by cheers—it was as follows:

"The Executive of the State of New York."

When the applause consequent upon this toast had subsided, the Governor addressed the company as follows:

Mr. Mayor and Fellow-Citizens:—

Accept my thanks for this flattering, this generous welcome. To be thus remembered at a moment like this, amidst the heartfelt rejoicings not only of the thousands who dwell in this proud city, but of the multitudes who have poured in from the surrounding communities, demands and receives my warmest gratitude.

You have well observed, sir, that these multitudes have joined in this glorious pageant, not as curious spectators, but rather as joint owners of the great work whose completion we this day celebrate. It is indeed the triumph not only of the city but of the country at large. Its results reach far beyond the narrow confines of the metropolis. An achievement like this, which casts a mantle of protection over the commercial store-house of the continent, may indeed be a subject of felicitation for the whole American people.

We have this day enjoyed the spectacle alike, rare and sublime, of a vast community uniting in one common emotion, called forth by the performance of a great act in the mighty drama of a nation's history. If the immortal bard spoke truly of individual man when he said,

"All the world's a stage,
And all the men and women merely players;
They have their exits and their entrances,
And each man in his turn plays many parts."

how much more august the spectacle to him who meditates on social man playing his various parts upon "the broad and universal theatre of nations," and amid the shifting scenes of human society. And such a spectacle is this day presented. We celebrate a work, commenced and completed indeed within our day and generation, but extending its results far into the lengthening vista of succeeding ages. I will not attempt, sir, to embody the emotions excited by the event, nor even to depict the feelings of pleasure awakened by the physical change which has stolen over the city of our pride and affection. A new feature has been stamped upon the face of our metropolis. But yesterday it was the dusty trading mart, unattractive and unadorned—to-day the pure mountain stream gushes through its streets and sparkles in its squares. To the noble rivers with which it was encircled by Nature, is now added the limpid stream brought hither by Art, until in the words of the Roman poet, alike descriptive and prophetic, her citizens exult,

> " inter flumina nota
> Et fontes sacros."

But it is not for the purpose of dwelling on the grandeur of this noble work, or even its manifold and beneficial influences upon the health and happiness of a vast population, that I have risen, but rather to draw from the occasion whatever of instruction it suggests.

I would then venture to remark that this stupendous aqueduct, and these splendid fountains, so worthy of being enjoyed, are equally worthy of being paid for. They owe their very existence to that mighty engine of modern civilization—public credit. With borrowed money they have been built. Is there one among us " with soul so dead," as to doubt that this debt will be paid to the utmost farthing? Is there one among this assembled multitude who would enjoy the benefit, yet basely shrink from the burthen? The glorious work yet remains, manfully to meet, and punctually to pay, the debt which has been so wisely, so beneficently incurred. Who will venture to predict that this sacred duty will not be fully performed? Who can believe that the foul blot of repudiation will ever spread itself over the pure, untarnished credit of this high-spirited community? Were this possible, the massive walls and lofty arches of this noble structure, now the city's pride, would stand as monuments only of her degradation and shame. It is not, sir, that I believe it possible that under any circumstances or under any temptation, our city or our state could fail for a moment to maintain its unsullied public faith, but rather that it seems peculiarly proper on this occasion of rejoicing, to declare our firm belief that the debt incurred for the public works, not only of this city and this state, but of all the American communities will be, as it ought to be, paid to the utmost farthing. It is true, sir, that in some misguided portions of our country, breaches of public faith have occurred, injurious to the national character and dangerous to public morals; but I cannot doubt that each and every of the defaulting communities which shall steadily and manfully persevere to the final completion of its works, will find in the resulting benefits, ample means for redeeming the faith plighted to the public creditor. It is in this point of view that the completion of the costly structure we this day commemorate, is replete with encouragement and instruction. Sir, let us for a moment suppose that the Municipal Legislature after incurring a heavy debt, had, in a moment of prejudice, passion, or fear, before the completion of the aqueduct, suspended its further construction. Could we imagine a spectacle more degrading than the dismembered work lying in fragments throughout its length of forty miles, from the Croton Lake to the confines of the city? Who could then be found "so poor to do it reverence," and who so sternly virtuous, as to submit without complaint, to the taxation which such folly would render necessary? Let us then adopt as a cardinal maxim in the conduct of these great enterprises, that benefits must be made to keep pace with burthens; in a word, that works once commenced, must be steadily and perseveringly prosecuted, and we afford the surest guarantee for the preservation of public faith.

The Croton aqueduct is but one of many works of physical improvement, constituting portions of an extensive system, commenced in a season of great prosperity, and all like this tending to develope the resources and promote the honor and welfare of the country. Why is it, that while public confidence has forsaken all others, it has crowned the consummation of this? Can the cause be mistaken? Is it not that enlightened forecast, and steady, unflinching perseverance have carried this work to its destined end? The mingled emotions of pride and joy which have filled the bosoms of the vast multitudes this day assembled, afford but a foretaste of the feeling which will be kindled when our whole system of public works shall be brought into beneficial operation. With this bright example to encourage and lead us onward, shall we be told that we have not the ability to proceed further? Away, then, with unmanly despondency! Our State possesses resources and revenues, sure and unfailing, equal to the support of her government and the payment of all her existing debts—and I here proclaim, that without embarrassment, or cause for embarrassment, she could with the expenditure of a sum but little exceeding that which the city of New York has expended on this aqueduct, complete to the utmost mile, all her unfinished canals and railroads. If the city, with three hundred and twelve thousand inhabitants, can expend on a single undertaking twelve millions of dollars, cannot the State of New York, with two and a half millions of people, and comprehending within its limits this very city, sustain the further burthen of seventeen millions, required to finish works now in progress? The proposition demonstrates itself. We want only time, and not much of that. Let us dispel, then, the clouds which obscure our vision, look at the brightening sky and put forth every energy and submit to every burthen, even to each citizen's taking the spade in his own hands to complete the New York and Erie, and the

New York and Albany Rail Roads, the two unfinished lateral Canals, and the enlargement of the Erie Canal.

One more reflection and I shall have done. This aqueduct, like all our other public works, was undertaken not only for the present but for the future. Its capacity is graduated not to supply the wants of the present population of the city, but to meet the exigencies of the million, who, within half a century may be congregated upon Manhattan Island. Shall that million be allowed to plant here their hopes and their homes? That result depends on the completion of the public works of this State, and those of the communities with which we are connected. There are other Atlantic ports besides New York, other Rivers besides the Hudson, other Canals and Rail Roads besides our own, other governments besides the City Councils I address, and the Legislature of our State; and although the trade of the continent now flows in our channels, it has not worn them so deeply that it may not yet be diverted.

Believe me, fellow-citizens, that I speak for no temporary effect and with no personal motive. I have reason to love the State of New York, not merely like all her sons, but I owe her a debt that few are ever permitted to incur. If, short of Heaven, I have an object paramount to her welfare and honor, I know it not; and if I have a thought, feeling, or emotion inconsistent with her best and highest interests, may this right arm drop off and may this tongue forget its cunning.

With pride which none but a Citizen of the State of New York can know, I offer to this vast asssembly this sentiment:—

The City of NewYork—*One* American Community, which through a trying crisis and amidst discouraging embarrassments, has prosecuted the system of physical improvement, at the same time maintaining its credit and completing its works.

The company soon after separated; and in conclusion, the evening throughout the city, says the New World, was as quiet and orderly as though it had followed but an ordinary day.

All the places of public amusement were thronged in the evening. A large and respectable congregation were present at the Tabernacle, to listen to the singing of the Sacred Music Society, and the address of Rev. Dr. Samuel H. Cox, on music.

The fair at Niblo's was crowded to suffocation. Many were doubtless attracted thither by the splendid display of fire-works which took place in the garden at half-past eight. Castle Garden was also visited by a large number of spectators to see the Balloon ascension and the fire-works exhibited there also. The Museums, the Astor House, and Howard's Hotel were brilliantly illuminated in the evening.

The most beautiful spectacle of the evening was the illumination of the Astor House, by Messrs. Coleman & Stetson. They had so arranged their preparations, that all the lamps were hung at the seven hundred window lights, with a servant at each window ready at the sound of the gong to apply the tapers. The whole were thus illuminated in a twinkling. We were standing in front at the moment, and the effect was beautiful.

Throughout the day and evening the magnificent fountains in the Park and Union Square were kept in full play, and formed the most novel, as well as the most pleasing feature of the day.

There was much, says the Commercial Advertiser, very much—indeed we may say every thing—in this celebration, to excite strongly the most grateful feelings and reflections. The favorable condition of the weather, the immense magnitude and vast utility of the achievement whose completion it was designed to honor, the perfect succcss that has attended the great work, in the quality of the water and its overflowing abundance, the facility with which it is distributed, and the happy effects it is already visibly producing—the universal satisfaction with which the celebration and its objects were regarded—the beauty of the fountains, and the proud consciousness which every citizen of New York felt that his or her own cherished and honored city had, in this mighty undertaking, accomplished a work with no superior, either for extent or for excellence of object—all these were elements of gratification such as it is not often the pleasant lot of a municipal peopte to enjoy; and they were enjoyed, temperately, yet with an exquisite satisfaction.

And apart from these, there was the sense of grandeur always called into being by the sight of the presence of a great multitude, animated by one impulse, and moving or acting in the attainment of a common object. Nor was the proud reflection absent, that under the benign influence of political institutions which give and secure to every man his equal share in the general rights, powers and duties of citizenship—amid this great convulsion, as it may be called—this mighty upheaving and commingling of society—where half a million of people were brought together into one mass as it were, there was not a guard, a patrol, a sentry, not even a solitary policeman, stationed any where to hold in check the ebullition of social or political excitement—that there was need of none—and that the peace, order, and quiet of the city were as completely undisturbed as they could have been in London, Paris, Vienna, St. Petersburg, or any other great city of monarchical Europe, by legions of bayonets and an army of peace-officers.

As a record of this celebration, and of the great event it commemorated, the Committee of the Common Council caused a silver medal to be struck, of the engraving on which, a *fac simile* is presented on the following page; they also voted that a memoir of the work should be prepared, which has been accomplished imperfectly, indeed, but it is hoped with tolerable minuteness and accuracy, in the pages that are here brought to a close.

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