Walter S. Church Jr.

ADVERTISEMENT

OF A

PROPOSITION

FOR

WARD COMPANIES,

TO SUPPLY THE CITY OF NEW-YORK

WITH

ROCK WATER, &c.

BY

LEVI DISBROW & J. L. SULLIVAN.

New-York:

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No. 49 William-street.

1832.

PROPOSITION.

THE Corporation, it is well known, has been anxious to supply the City with pure and wholesome water. It is therefore proper to premise, on this occasion, that the inventors of the mechanical means of deriving water from the primitive rock, and of distributing it in aqueducts of cheap construction, and well adapted to the cleansing of the streets, or of more immediate application to the exigencies of the summer time; having by law the privilege for a period, of rendering this service, feel it incumbent to offer this method to consideration; but are, at the same time, bound by respect towards the members of the Corporation to do so conditionally, that it do not interfere with the views of the municipal authorities in regard to bringing in the waters of the Bronx, should the right have been acquired of the institution that holds it. (See Appendix.)

But as the solicitude to undertake that work was manifested at a period earlier than the date of the latest experience in perforations, it is possible those views may have changed; or may be, after the facts contained in this publication may have been understood. In this event only can the countenance of the Corporation be expected to be given to the plan proposed of instituting *ward companies*.

The whole subject is therefore submitted for public opinion, requisite to sustain whatever is to be done in this improvement; and if the suggested plan should be acceptable, it will probably be expressed in petitions for leave to execute these works, in convenient divisions of the city.

JOHN L. SULLIVAN,
LEVI DISBROW.

NEW-YORK, July, 1832.

From
A Memoir on the Croton Aqueduct
By Chas King 1843 page 98

Minutes of the Common
Council

" 15th Apl 1799.

A Letter from S Ludlow, Esq Pres
of A Co Lately istablished by
Law called "the Manhattan
Co," for the purpose of supply-
ing this City with water, to-
gether with a copy of their
Charter, were respectively
read, & the consideration of
the steps to be taken by this
Board thereon were postponed

ADDRESS

TO THE INHABITANTS AND PROPRIETORS OF THE CITY OF NEW-YORK.

By J. L. Sullivan, Civil Engineer

THIS Island is a part of that range of primitive rock, which extends along the coast of New-England, and from hence south-westward, marking the line of distinction, through the middle and southern states, between the upper and lower country. It is the rock over which all the rivers fall, in their course from the mountains to the Atlantic.

Between this dividing line or ridge of gneiss rock, and the Alleghany mountain of granite, the country is occupied by strata of secondary formation, and ridges and hills and vales of *diluvial origin*. This underground ridge of *gneiss*, thus extending nearly parallel to those high mountains, was the antediluvian coast of this continent. It has, like other ridges, its depressions and its elevations. Where this city stands, it is depressed, and the hollow is occupied by a *bed of sand*, not more than 100 feet deep, of loose texture, and incapable of preventing the percolation of foul water into the wells sunk in it. Such is the decided opinion of a committee of scientific men, appointed by the New-York Lyceum, last year, to answer an inquiry on this subject, made by one of the aldermen. They were very explicit, and expressed the opinion, that disorders were prevented from cure, and *dyspepsia*, that comprehensive name of all gastric derangements, *caused* by bad water.

It is true, that this respectable committee expressed an opinion *against relying on perforations for water*: but they were not informed of the main facts: had they been, perhaps they would have had very different impressions. This is the more to be regretted, as the subject is one in which the Lyceum might well have taken an influential lead. They appear not to have had an opportunity of investigation—not even of the perforations at the city hall, which they suppose to be in *rock*, when they are *only in earth*, and were ruined by excessive economy in substituting thin Philadelphia pipes for the substantial castings of *Mr. Allaire*, thus defeating the purpose of the *protective tube*, one of Mr. Disbrow's inventions.

The prejudice disseminated widely by the published letter of that respectable committee of the Lyceum, we meet, by simply showing, that if they

had examined the subject extensively, it would have been encouraging to the corporation, and they might have hailed this *new art of drawing water from the rock*, as propitious to the health and prosperity of the city, and as the only immediate means of supply. Perhaps, too, they would have found the geological circumstances in favour of confidence, even before experience had led the way. The error was, in thinking the strata of the primitive rock of this island *vertical*, when in fact they are inclined, and dip in the opposite direction to the primitive rock of the Alleghany mountain. It is said in Professor Silliman's lectures: "Geology is erected upon *facts*, and not upon mere speculation; and facts must never be contradicted by it." Let us then see what they warrant us to hope.

The evils which threaten this community, not only in the prevalence of the present epidemic, but accumulating with numbers, are too serious not to call forth generous efforts of philanthropy and enterprise commensurate to the occasion. The causes of predisposition to disease will cease, when foul water and bad air shall be got rid of.

The committee's analysis of the well water shows, that in bathing therein, it does not cleanse. Give the people pure water to drink, and they will not desire to mix spirits therewith. Spiritous liquors, all know, are unhealthy, because alchohol is composed of 12 parts carbon, 8 oxygen, 3 hydrogen, and is not digested, but absorbed.

It is found that the blood of a cholera patient is overcharged with carbon: and the heart and lungs consequently impeded.

Carbonic acid gas is generated in all the spontaneous changes to which dead animal and vegetable matters are subject: hence, the great imimportance of city cleanliness.

The proposition here contained, is addressed to those who have a deep interest, moral and social, in the consequences, whether of attention or of neglect of the means which a beneficent Providence has brought within their reach. To those who are the possessors of this commercial centre of the Union: the fairest of her cities: by nature the most healthy; the place of their birth or choice: the position of their industry and skill: to the men of business, of every denomination, this plan of permanent and early relief is respectfully submitted, as the most practical and economical.

My design is, 1st. Briefly to mention the instances of Mr. Disbrow's invariable success in deriving pure water from deep subterranean veins,

2d. Describe the geological characteristics of this locality, which justify the expectation of always finding it, at the depth of from 100 to 500 feet.

3d. The patented inventions that constitute our system of operation, possessed by no others, and therefore our duty to offer.

4th. To suggest a plan of carrying our improvements into operation, so as to make it profitable as well as effectual.

Machinery.

In the year 1824, Mr. Levi Disbrow, then residing in New-Brunswick, invented a powerful machine, for the purpose of perforating rock in search of water. It is perfectly accurate in its operation; and expeditious when a small steam engine is employed. This machine is the subject of his first patent, in 1825. The implements for enlargement, and overcoming every exigency, were the subjects of the second patent, in 1830, including the protecting tube, to defend the bore in operation in earth, and to bring up the pure water, unmingled with the surface or upper waters.

When the boring is in earth alone, the tube in successive joints is gradually forced down. When rock is perforated, a joint is made therewith.

Instances.

The 1st perforation was at New-Brunswick, for John H. Bostwick, Esq., on a high rocky hill, 250 feet, through slate and red sand stone; the water rose seven feet above the surface, one and half gallons a minute.

2d—at New-Brunswick, for Judge Simpson, 150 feet; overflowing.

3d—same vicinity, for Mrs. Griffith, 300 feet deep; overflowing moderately.

4th was at Somerville, for Governor Vroom, rising above the surface.

5th—at Princeton, on high ground, for Mr. Potter, from the bottom of a dry rock well, 100 feet, sand stone; rising five or six feet in the well.

6th—near Philadelphia, for Matthew Carey, Esq., from the bottom of a dry rock well, 40 feet deep, perforation 50 feet in gneiss; the water standing seven or eight feet deep.

7th—in Philadelphia, Northern Liberties, previous excavation in earth 40 feet, boring in *gneiss* rock 160 feet; the water rising and remaining 20 feet from the surface.

8th—near Baltimore, for Joseph Bosley, Esq., 200 feet in *gneiss*; the water rising nearly to the surface.

9th—at Harper's Ferry, for the United States, 200 feet, lower part *gneiss*; the water rising to near overflowing.

At *Alexandria*, 400 feet, without finding rock, and abandoned; showing how abrupt the primitive formation must be, as Potomac falls are only a few miles west of this city.

10th and 11th were at Perth Amboy, (in search of coal,) through clay, trap, red slate, 140 feet; both overflowing copiously.

12th—on Newark marsh, for Anthony Dey, Esq., two perforations, 100 feet deep, through sand, gravel, hard pan, clay and red sandstone; the water rising to near surface.

13th—on the marsh, for Samuel Swartwout, Esq., 80 feet deep.

14th " " Israel Foot, Esq., 80 feet deep, in sandstone; both overflowing.

15th—at Paulus Hook, for Messrs. J. & C. L. Strong, through *gneiss*, (principally,) 250 feet; water rising nearly to the surface.

16th—at Albany, for Boyd & M'Cauley, 300 feet, through black slate; mineral water.

17th—at Troy, through slate; good water.

18th—at Ballston, for Mr. Lummis, 100 feet, through black slate; overflow of mineral water.

19th—at same, for a company, 150 feet; same result.

20th—at Watertown, on Black River, for Mr. Bebe; producing a copious overflow.

21st—at Springfield, Massachusetts, for Thomas Blanchard, through red sandstone and slate; a copious overflow.

At Boston, about 30 perforations,
Providence, 8 or 10 do. } in earth and rock.

22d—on York Island, at Greenwich, for Guy Richards, Esq.

In earth, 68 ft.
gneiss, 134

202 feet; water rising to within 20 feet of the surface of the ground, discharging 17 gallons a minute.

23d—at Greenwich, for Joshua Underwood,

20 feet in earth,

100 feet in gneiss rock, water rising to within 18 feet of the surface.

24th—at Greenwich, for John Hunt, { 4 feet excavation, 65 " in gneiss.

25th—on the western summit, about 170 feet above tide, near the Deaf and Dumb Asylum, known as the Botanic Garden of William Shaw. Here the rock rises above ground, and shows its range and dip distinctly. Excavation of a well 20 feet; perforation from its bottom 92 feet; the water rising freely to within 18 feet of surface, or standing permanently two feet deep in the well, soft and pure. The bottom of the perforation is as high as the ground at the city tank.

26th—in Bleecker-street, near Broadway. Excavation first in earth down to the rock, 48 feet; perforation through strata of rock, 400 feet; producing a copious flow of soft pure water, rising to within 29 feet of the surface.

These are all the instances in rock attempted—all were successful; giving invariably very soft pure water.

With a knowledge of these facts, the Committee of the Lyceum could not have told the Common Council, "that perforations are *utterly useless*: that they may be carried to any imaginable depth in this rock, and when completed, will be merely reservoirs to receive the drainage from above."

Their mistake appears to me to have been in the supposition that the *primitive gneiss* of this island is in *vertical* strata. They say "The gneiss

of this island is nearly vertical or upright, and these are so closely united as to be barely visible to the eye. It is not then from these crevices or partings that we are to expect a supply of water."

It may be said, in reply to this, that it is surely not from these *superficial partings* that we are to expect water, but from much enlarged partings or spaces, deep in the earth. The strata are seen to be inclined, at about 60 degrees, when by quarrying they are laid open. The line of dip is between west and north-west.

Now what are the reasons for thinking that the dip of the strata are less and less steep as they descend into the earth, and the "partings" more open?

This is probable, because as the committee say, (page 3,) the rock is softened by being in contact with water for a long time. And this is proved by the progress of the drill, which proceeds faster as it approaches a parting, as three to one, and slower as it recedes; and if thus softened, and the water is *flowing*, it must *wear the spaces wider*. That it must flow, is evident, because no *parting* can be so close as to prevent its flow and escape, if the source is high. We often see water issuing from the seams of rock *That they have been worn away, is evident, from the fact that the drill often drops or falls perceptibly between strata.*

The lowest strata in the Bleecker-street perforation, were found to be 9 f. 8 f. 13 f. 9 f. 14 f. 16 f. 11 f. thick obliquely.

Water was found at 362 feet, and at each successive space or parting; but not enough till that at 442 feet was reached. The drill went five feet farther without reaching another.

Here, then, we have evidence of the existence of regular strata rising one over the other, and extending farther and farther *eastward* under each other, forming the eastern slope of the ridge; and this is the cause of the good water found on the east side the town, by boring down *to* this sloping rock, water issuing from between the strata.

At the Dry Dock, the perforation was 100 feet. At Mr. Fickett's, 102 feet. And several others, also in earth, on the eastern side of the town. On the west, several also with like result, the water being better than that of the wells. At Washington Market, 72 feet. At Wooster and Grand, 50 feet. At Cram's Distillery, 72 feet. But in such a soil, it may not be reasonable to expect, that, even at this depth, with a dense population, the water will long remain uncontaminated, especially with open pavements, permitting foul water to soak in. Cemented streets are better.

Such being the circumstances, we turn with some confidence to facts which the science of geology offers, to sustain the *rationality of always expecting to find water in the spaces of the strata of gneiss.*

This variety of the primitive rock, coeval with granite, the earliest product of crystallization from the primordal ocean, according to geolo-

gists, evidently, like the others, took a stratified form from the beginning. Whether or not stratified was a disputed point for a long time. Saussure changed his opinion, on seeing *les Aiguilles* from the summit of Mont Blanc. Playfair and Humboldt were convinced of their *universality*. And Hutton accounts for them, by supposing the partings caused by shrinkage of the mass. They were, however, once horizontal, and for a long time so, as the rocks of *secondary formation*, soft slate, transition rock, limestone and sandstone, alternate, and stand leaning against the vertical strata of the granite Needles of the Alps, just mentioned, which rise perpendicularly several thousand feet, appearing to have been *upraised* by some mighty agency, forcing their way through the secondary strata.

Professor Silliman says, that "secondary rocks are usually horizontal, or not many degrees from that position; but when they *touch primitive mountains*, they *generally slope down their flanks*, always lying above them, but declining gradually towards the plain countries, and terminating commonly beneath them."

They *appear* to terminate beneath them, because the plains and the diluvial hills, like the Catskill, and most others in our country, are the deposits or accumulations of rock and earth, thrown together by the violence of the waters of the general deluge.

There is, indeed, no place where water is not found on digging, because rain falling on all, soaks in, more especially into high lands, where the clouds are most attracted and condensed. These small superficial waters, which break out in springs, and form brooks and streams, explain those deeper operations of nature, on which we must *here rely*.

If the primitive rock is in strata, those of the Alleghany mountain must connect with the gneiss ridge of the *original coast*, and the pure waters of the clouds entering their spaces, must act, press and move, with a force proportioned to that of gravity, the universal law, and flow in these deep channels in proportion strong and rapid, if vented at considerably lower points than their source.

The same author remarks, that strata of primitive rock in a given situation, many miles below the surface, may, and necessarily must, come into view at some place or another; and if the soil or diluvium were completely removed, they would appear probably for many leagues; it might be even for hundreds of miles beneath the surface, (or to this effect.)

Therefore, when a primitive rock comes in view, or *crops out*, its line of dip is considered as indicating, with perfect certainty, its course, *at least until it meets with primitive rock dipping in the opposite direction.* And the same learned author intimates, that there is such a connexion between the granite of the Alleghany and the *Rocky Mountains*, as the intermediate space is all of secondary formation, exhibiting the largest surface of derivative rock on the globe.

From observation, I believe the Alleghany strata slope also eastward, covered by secondary, and these by diluvial deposits, and must, at some depth, meet the gneiss strata; and blend being nearly the same.

And if we may imagine all the earth removed from between this *gneiss range* and the granite range of Alleghany, it would exhibit a basin of rock, layer on layer, with the western side about 2000 feet the highest.

Bakewell says, "In the formation of North America, it is much more common to find primitive rocks at low levels, and at moderate angles of elevation, than in Europe."

We have now before us intelligibly the explanation of these subterraneous rock waters, intercepted in their flow to the ocean by this *gneiss barrier*, which appears at the lower falls of all our principal rivers, having their sources in the Alleghany mountains, and flowing eastward. I call it a barrier, because the water rises above tide in the partings, after passing under the Hudson.

Without pretending to the minutiæ of geology, it is sufficient for my purpose, to show *that there exists no inconsistency* with that science in this supposition, but rather that the facts tend strongly to prove it; and to distinguish these waters from those of the secondary rock, and the tertiary, and the diluvial hills.

The waters in the perforations on these have a different source. It is sufficient to account for them, to recollect the high and well watered country which lies between the Hudson and the Delaware—at Passaic Falls, 112 feet, and at Brookland pond, on the dividing ridge, 800 feet above tide.

If, then, *philosophy sustains experience*, may we not yet hope that the Lyceum will, on a review of the facts, sustain and encourage confidence in this system?

Indeed, the excavation of the great well for the city tank, is a *further* testimonial. It is carried down 100 feet, 16 feet diameter, and has two horizontal shafts of 50 feet, 4 feet square; (out of which shafts alone, rock enough was taken to equal a boring of 3,700 feet.) At this moderate depth it yields 8.000 gallons a day, as I compute it. But the Bleecker-street perforation of 442 feet, yields 44,000 gallons a day, and is capable of yielding much more, (or such are,) with our improvements.

The Mechanical Means.

The inventions of Mr. Disbrow, for perforating the rock, and bringing up the water pure, as high as it will rise, was the subject of his two first patents. The third comprehends a principle of which we are joint inventors. An improvement, relating to the means of obtaining the greatest quantity of water that can be derived from any one perforation. The *quantity* that will flow through the lower orifice will, if no impediment to its approach exists, be found to be that due to the hydrostatic pressure, or head of water existing, known by the height at which it stands

the district of Three Rivers; whereas about the Rice Lake, north of Lake Ontario, and on the St. Maurice river, it is more or less sterile, as it is also in the unsettled parts of Lower Canada, below Quebec.

A deep rich black loamy soil, containing abundance of vegetable matter, predominates in the southern parts of the New Castle, Home and Midland districts; in the peninsula of Prince Edward, and about Kingston the soil is more clayey;* partial alluvial tracts are met with in some parts of the course of most rivers; and on the north shore of Lake St. Peter's (formed by the widening of the St. Lawrence) is to be found one of great extent and inexhaustible fertility;† on the whole, the quantity of land incapable of tillage in Canada, is exceedingly small, particularly in the upper province, and most of it at the present day, preserves its aboriginal character, unimproved by expensive manuring, unimpaired by excessive cropping.

The American farmers judge of the quality of the soil by the timber trees found upon it. Cæteris paribus, well grown trees indicate richness, more especially if they are of hard wood; stunted pine being the certain indicators of a barren soil. Again, a predominance of maple, black birch, beech, &c. indicate the richest deep black loam; fir, spruce, &c. intermixed with the hard woods, indicate fertile clay. Pines, &c. alone indicate a sandy soil; if the trees be large, *fertile;* if small, *sterile*. Oaks also delight in soils in which sand predominates. These fertile sandy soils are seldom found many leagues from the lakes and large rivers; the back country generally consisting of the rich black loam already mentioned. On the former, however, wheat seems to thrive better than on any other, though no attempt, that I am aware of, has been made to improve and adapt them to other purposes, by means of lime or gypsum, the former of which is always—the latter generally, at hand; indeed, to the total neglect of manures, both vegetable and mineral, I shall frequently have occasion to advert.

I cannot dismiss this part of the subject without mentioning a part of the country of which I do not speak from personal inspection, but which all agree in designating as the paradise of Upper Canada. I allude to the HURON TRACT: a triangular block of

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* The soil of Lower Canada is principally clay.

† An extensive proprietor in that neighbourhood, informed me that he is now cropping land that has been cropped for forty years in succession, without manure. The soil is certainly twenty feet deep in some parts; so that deep ploughing is all that is wanted to get at a new virgin soil.

land, based on the east side of the southern end of Lake Huron. It's middle latitude is about 43° 15' north, and it's longitude from 80° 40', to 82° west; it is estimated to contain 1,100,000 acres; the whole, excepting the small quantity they have sold, belongs to the Upper Canada Land Company. Notwithstanding it's thinly settled state, "the climate of the Huron tract (a friend reports) is milder than any other part of Canada, and they will here find every natural advantage a settler can desire. I think the soil is generally sandy loam, and tobacco seems to thrive here wonderfully, though I do not know much about it's culture. I have seen some book accounts mention clay, but as yet, I have seen but little of it, though the quantity of vegetable soil fully warrants what you told me of Canada generally. The trees too are majestic; indeed, I think I could hardly find it in my heart to treat them as enemies: ONE I am now looking at, and on which I incessantly hear the axe of a raw-boned woodsman, (I give up my argument about the cross-cut saws,) I would certainly preserve. The underbrush, as it is called, is surprisingly thin; and I like the place so much, I think I shall fix on it."† * * * * * * *

We have now seen that the soil and climate of both the Canadas are highly favourable to the production of wheat, and indeed of every thing else. I shall now devote a short space to the subject of internal communications.

In Mr. Jacob's second report, is an interesting calculation of the cost of conveying wheat to market in Mecklenburg. A table is constructed thereon,‡ showing that the whole value of the produce would be expended in carrying it 240 miles, (50 German miles.) If Canada depended on it's summer roads, such or worse would be the result. The excellence and extent of her natural water communication, however, renders the cost of conveying wheat, even from a great distance, very trifling. In the Appendix E will be found an interesting table, drawn up by Mr. Samuel Revans, of Montreal, (a gentleman known for the extent and accuracy of his knowledge of mercantile statistics,) exhibiting the cost§ of carrying produce to Montreal, from different distances; it forms a striking contrast to Mr. Jacob's table. The more distant parts of the province of Upper Canada,

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† I have a great deal of interesting correspondence on Canada, chiefly from new settlers, and persons about to take lands in Upper Canada, from which, when it accumulates a little more, I shall make a selection for publication.

‡ 8vo. edit. page 9. The whole statement, page 7 to 10, is worth looking at.

§ All the prices and rates in the text, notes and tables, are in Halifax currency, except when otherwise mentioned; this currency is fully explained in Appendix D.

their power to secure and defend them. There must be *union of purpose* and great perseverance to command success. It is in these respects only that Philadelphia excels New-York.

The protection of the mechanic interest ought ever to be a primary object in a commercial place: and it is to be hoped that when the present dispensation shall have passed over, the recollection of it will be a powerful inducement to guard as much as possible against its recurrence, and against the severe distresses of suspended business—the consequence as much of the predisposing condition of the city as of the epidemic.

The wealthy are not unwilling to pay whatever is requisite. It is thirty-three years since pure water was promised. Is it not time for the people to resume, and to assert their right of providing for themselves this article of prime necessity? Is it not false economy to postpone what ought to have been already done?

It has been proved that New-York might, at less cost, be a much better supplied city than Philadelphia, with her boasted Schuylkill.

Modes of carrying this plan of supply into effect.

There are two modes by which the rock water may be distributed. 1st. By means of a main pipe, laid two feet under the pavement, with branches to the edge of the side walks rising in hydrant posts, as at Philadelphia. The nearness and elevation of the reservoir will here be such as to permit of a less diameter of pipe than where all the water comes through one or two. and the aqueduct be less costly than usual.

The other mode is an elevated aqueduct. The columns, high enough to cross the streets above the travel. may be substitutes for the awning posts. The pipes being covered in, the whole will present the aspect of an architectural colonnade.

In winter. the only defence necessary, will be to empty them at night into the fire cisterns, if such should be made: or to stop supplying after six o'clock, each family previously filling a water cask for the evening's use.

The *elevated aqueduct* is recommended by the circumstance of its not disturbing the pavement for repairs. always accessible, and capable of being ornamental. A colonnade, surmounted with a cornice, containing the pipe, may have vines trained up the posts, and along it, mingling their foliage with the trees. and be a pleasing relief to the eye from the windows of houses. Plainer colonnades might occupy the interior of squares.

In the more busy parts of the city, where the streets are narrow, the *underground pipes* will be preferable. From either, the water may be carried into the kitchen and bathing rooms, as well as be delivered at the door for purposes of public cleanliness. In some places, three hydrants on the front of a square will be sufficient.

An estimate requires accurate data; but for the present, it will suffice, for example, to say, that a ward of the extent of the third, contains about 24,000 feet of street, and if all charges were three dollars a foot, including the cross pipes, it would not exceed 100,000 dollars. We may say, then, that the amount of capital for each ward, will be between one hundred and two hundred thousand dollars, if, as we suppose, there are fifteen hundred houses in each ward that will take the water at ten dollars a year, this would pay the charges, and an ample revenue. Each owner of an estate being a party interested in the good operation of the work, and each being of a moderate extent, it will be a very manageable property.

The steam engines properly constructed, will not throw out any smoke, nor make any noise. The persons in charge of them may always be mechanics, having some occasion for a little moving power, when not all required, and this privilege be equivalent to the care.

No doubt very cheap elevated aqueducts might be temporarily made in wood; but we are speaking of a permanent work and property.

Some misconception of the expense of perforation having prevailed, it is proper to state here the terms which the *experience* of Mr. Disbrow enables him to offer.

Beginning at the surface of the ground. The perforation in earth only, placing therein an 8 inch tube, the first 100 feet, $7 a foot.

10 " " 10 "

12 " " 15 "

Rock boring, 2 1-2 inch perforation, for the 1st 100 ft. $7 a foot, $700

do.	do.	2d "	10 "	1000
do.	do.	3d "	15 "	1500
do.	do.	4th "	20 "	2000
				$5200

To enlarge a 2 1-2 inch bore, and make it 8 inches in diameter:

The 1st	100 feet,	$700
2d	"	1000
3d	"	1500
4th	"	2000
		5200
		$10,400

10,400 dollars for a perforation, 8 inches in diameter, 400 feet in the rock.

This is, no doubt, less than the boring and well at Bleecker-street cost. Before Mr. Disbrow's services were engaged here, some artisan was employed, who used the common instruments. These broke in the hole, and could not be extricated, and it was necessary to begin anew.

His first contract (as he informs me) was to bore

200 feet, for	- -	$1000	2 1-2 inch perforation.
100 " more for	-	1000	
100 " more for	-	1500	
		3500	
to enlarge it to 7 inches, 200 ft.		2000	
to enlarge 200 feet more.		4250	
		9750	
Contract for a new curb to the well,		600	
		$10,350	

The engine employed to raise 11,000 gallons of water in twenty-four hours, is six horse power, and uses about three quarters of a ton of coal in that time, and may have cost two thousand dollars.

TO THE INHABITANTS OF PHILADELPHIA AND OTHER CITIES.

Although a precedence is given to this essential work in New-York, this publication may also interest you; as it contains an explanation of the *geological circumstances*, that show the probability of *always* finding soft pure water in the primitive rock, as in some few instances more south, already mentioned.

Although the Northern and Southern Liberties of Philadelphia do partake in the Schuylkill works, it may be desirable to them, as indeed it may be to other parts of the city, to have rock water to drink. At Baltimore, the long descending streets would be favourable to aqueducts: at Washington, the *Pennsylvania avenue* might be easily supplied. At Richmond, one perforation in the primitive rock would supply all the town. At Charleston, they have long desired a supply from the country; New-Orleans uses the river water—it is soft and pure, but turbid. A few deep perforations might give that city an excellent supply: and the dust, often very annoying there, might be kept down by the general distribution of water in elevated aqueducts.

113 BLEECKER-STREET.

New-York, July, 1832.

APPENDIX.

THE language used in the act of incorporation of the Manhattan Company, is here given, to show that no interference with their exclusive right is possible:

"SEC. 5th. *Be it further enacted*, That it shall be lawful for the said company to enter into and upon, and freely to make use of any land which they shall deem necessary, for the purpose of *conducting* a plentiful supply of pure and wholesome water *to* the said city; and to erect any dam or other works across or upon any stream or streams of water, river or rivers, or any other place or places where they shall judge proper, for the purpose of raising such *stream or streams*, or turning the course thereof, or of making use of such *streams, rivers*, or places for constructing or working any necessary engines; and to construct, dig, or cause to be opened, any canals or branches whatsoever, *for the conducting of such stream or streams*, or any other quantity of water, from any source or sources, that they may see fit; and to raise and construct such dikes, mounds, or reservoirs, as they may judge proper, for securing and conveying such supply of water *as aforesaid* to the said city; and to survey and lay out all such lands and *streams* as they may think proper, in order to ascertain the best mode of furnishing such supply, and the best and most productive *streams* and sources or fountains of water, for that purpose; and to lay and conduct any number of pipes, conduits, or aqueducts, through or over any of the said lands, or any rivers or streams, of water, as they may see fit, *to or towards the said city*, and in any and every part of the said city; and to agree with the owner or owners of any mills, lands, tenements, or hereditaments, that may be damaged or affected by any of the said operations, for and about a reasonable compensation, to be made to him, her, or them, for such mills, lands, tenements, or hereditaments, or the use thereof, as may be used or occupied for the purposes aforesaid, or any of them, or for any damage which he, she, or they, or any of them, may sustain by the employing, diverting, or obstructing any *such stream or streams*, or using any such lands, or the cutting, laying, raising, or making any such reservoirs, aqueducts, canals, trenches, pipes, conduits, dikes, or mounds aforesaid; and in case of disagreement," &c.

The sixth section relates, in usual manner, to right of entry and use.

The seventh section gives the President and Directors power to make by-laws. And they "may also agree with the corporation of the city of New-York, the inhabitants of the said city, and others, choosing to take or use the said water, regarding the rates at which the same shall be paid for; *Provided* that the said company shall, *within ten years from the passing of this act, furnish and continue a supply of pure and wholesome water*, sufficient for the use of all such citizens dwelling in the said city, as shall agree to take it on at the terms to be demanded by the said company; in default whereof the said company shall be dissolved.

It is a remarkable proof of the purity of the rock water, and freedom from all acids, like those mentioned in the analysis of the well water, that when iron pumps are used, the water is not corroded or oxydized, but continues limpid and soft.

From Guy Richards, Esq.

I certify that Mr. Disbrow sunk a shaft, during the last summer, at my establishment at Greenwich, called the Eagle Mills, to the depth of about 204 feet —sixty-eight feet of it through sand and gravel, and the remainder in the rock, 2½ inch bore. The pump has been in constant operation more than three months, (Sundays excepted,) and has delivered about 22,000 gallons per day. Yesterday, the stroke of the pump was lengthened, and after fifteen hours trial, the quantity pumped for an hour was measured, and found to be at the rate of 26,000 gallons in twenty-four hours. It is nearly as soft as rain water, and leaves no scale on the boilers; but, on the contrary, has taken off that which had been formed from the water previously used, and left them entirely clear.

The pump and water can be examined at the Mills, corner of Greenwich-lane and Perry-street.

GUY RICHARDS.

New-York, April 10, 1832.

MANHATTAN ISLAND, *New-York, April* 9, 1832.

We certify, that we have obtained water, for our domestic purposes, from a well at the corner of Avenue D. and Fifth-street, bored and sunk by Mr. L. Disbrow, and that we approve of the water, as being pure, both good for drink and washing, and, as we believe, the best and cheapest that can be had by any other means, on the Meadows.

(Signed)

SAMUEL FICKETT,
GARDNER FICKETT,
CHARLES CURTISS,
FRANCIS FICKETT,
JOHN THOMES.

A similar certificate was also obtained from Jeremiah Dodge and others, near the corner of Columbia and Rivington streets.

New-York, April, 1832.

We, the undersigned, living in the vicinity of Washington market, certify, that we had experienced great inconvenience on account of the qualities of the water, drawn either from wells or the Manhattan Water Works, till Mr. L. Disbrow sunk the well in said market, and that we now obtain ample supplies of good water from that pump.

(Signed)

VAN ORDEN & VAN BRUNT,
ISAAC F. CONCKLIN & Co.
H. I. SWAIN,
THOS. BARTINE,
WILLIAM ALLISON,
GREEN & WETMORE,
HENRY D. D. WALD,
JAMES ANNETT,
LEONARD BAUM,
R. BUNN,
WILLIAM HARRISON,
JOHN B. EBBETS.

I certify, that, carrying on an extensive business in washing clothing for the inhabitants of the city, I found great difficulty in procuring water for washing. I employed Mr. L. Disbrow to bore for water, and have obtained a large supply of good soft water, from which I supply a large manufacturing establishment, besides selling large quantities through the city for drink and other purposes, in addition to what I want for washing.

(Signed) JOSHUA UNDERWOOD.

Practical Suggestions from the preceding pages.

As the Asiatic epidemic is now ascertained to occur wherever uncleanliness and intemperance combine to poison the air, the water and the blood, winter and summer, the remedy, for the present and the future, is in our power, and obvious.

If the Manhattan Company has not been able to effect what it was instituted by law to do, it has done a valuable service to the city, in demonstrating, by a deep perforation on Broadway, near Bleecker-street, the practicability of drawing water from the subterraneous rock, in sufficient quantities for cooking, drinking, and washing.

What this company cannot, perhaps, according to the letter of its charter, do, they may allow the Corporation to do, had it funds; or, an association of the benevolent and public spirited. They may be willing to sell this property, as being in readiness, and to them useless.

Let a company be formed, to comprehend the 4th, 6th, 8th, 9th and 14th wards, as these comprehend the most populous and lowest ground of the city. Let the Corporation only consent, and it will be done. Let a *temporary aqueduct* be made throughout this whole extent from this source of supply, which may yield, at least, 144,000 gallons in twenty-four hours, now yielding, with an engine much below the proportion suitable to the perforation, a third as much.

Let the system thus commenced, be carried on till completed; and as many perforations made as may be necessary. Let it not depend on the purchase of the Manhattan Company, however desirable in point of time. Theirs will not alone be sufficient; perforations should be made on Chatham-square, and on the Park, and on or near St. John's-square.

Let other wards also form companies; let meetings to appoint committees to open books be held, and purchase (if they will sell) whatever would be available of the Manhattan works, that may not be reserved for use, when ready at some future time, to bring in the rivers and streams of Chester.

Let the perforations already made be more availed of to supply their neighbourhood. Let manufacturing establishments requiring much good water, supply their surplus to the squares in which they are situate, if so agreed.

Let there be a law to inspect and condemn old houses, unfit for habitation. Let the *Five Points* be converted to a square, as no nuisance can be safely permitted in future that public vigilance and regulations can prevent.

Walter S. Church.

No. 2.

TO THE

MECHANICS OF NEW-YORK,

ON THE SUBJECT OF SUPPLYING THE CITY WITH PURE WATER.

The reason for my addressing to you especially this account of the means of supplying New-York with good water, is, that the right of doing it, in the manner I shall describe, is the privilege of Mr. Levi Disbrow and myself, jointly.

He is well known to you as a mechanic. By superadding to his mechanical improvements certain others, which as an engineer I have devised, our interest has become united, and our system complete, of deriving pure water from the primitive rock which underlays this city, by borings, reamings, hydrostatic draft on deep sources by steam engine power, and its distribution by elevated or by underground aqueducts, as may be preferred by the companies we seek to form, in each ward, for this purpose.

The following explanation of the plan, and of the necessity the city is under, now more than ever, of having good water in abundance, is addressed to you, not as having a distinct interest in the welfare of this community, so much as having more at stake in its health and welfare than any other class of the inhabitants; and, as holding that rank and influence, which justly determines that whatever is for your interest and convenience, must be consistent with that of all other callings, and will, of course, be done. Nor only consistent, for you have a deeper and more permanent interest in the prosperity of New-York than other inhabitants.

The home of the mechanic is not only his castle, but his permanent abode. Other people may with comparative facility and ease migrate to other places; but mechanics, from the time they establish themselves in business, begin to form a reputation and a circle of custom; they fix things convenient for their operations, and become attached to the place. Others may easily move, because they have only to carry their families, or their merchandise: but when a mechanic removes, he has to remake his establishment; re-find a circle of employers; enter into new competitions; and, however experienced in business, begin life anew.

Besides these considerations, the moment a public calamity, like that

now prevailing, comes over a commercial place, business is very much suspended; trade with the interior almost ceases; and, with demand, the means of paying journeymen. This class of our mechanics, whom opportunity may not yet have enabled to establish themselves as masters, generally have families, and they are the greatest sufferers when employment ceases. They look to the master mechanics, not only for employment in prosperous times, but for protection against the hard pressure of adversity, so far as may be in your power, by foresight and influence, to give it to them as members of the community.

Besides, you have sons, and the sons of friends, your apprentices, whom you are bringing up to your several branches of business. These also are under your protection; these must be maintained out of your savings, if the business should fall off, or be suspended, as in these sad times; and these are in turn to be your partners or successors to a healthful or an unhealthful location in trade. I do not mean to exaggerate the present evil, nor to draw a dark picture of the future, with a view, as it would seem, to some who do not know me, to engage your influence in the reception of the improvements I desire to introduce; for to myself, or even to Mr. Disbrow, it is of no great importance personally, because we have other business; but I am reasoning with you, and explaining it earnestly, under the solemn conviction that it is our moral duty to urge it; that it is a mode of peculiar usefulness to our fellow citizens, committed to our hands by a merciful Providence; and that we cannot excuse ourselves, nor forbear to offer this means of health in the most practical manner to you and to all. Still, we and you know, that men in every walk of life must have rational motives, must be convinced that what is proposed to be done is right and best, and, if *costly*, *necessary* to be done.

In urging upon you motives of interest and duty, the like may be said to that respectable body of men, the car-men of this city, whose business depends on commerce. The same may in some measure be said to that numerous class, the shop-keepers; for, if the city is deserted, their merchandise cannot be in usual demand; and so strikingly true is it, that every calling depends on every other, and on the wheels of commerce, that, like a complicate machine, if one part is deranged the whole must stop. But on no class does the *damage* fall so heavily as on the mechanics.

To immediate interest which all feel—to the interest of humanity, which all should also feel, may be added those of moral obligation, which, in a religious community, most, if not all, will acknowledge. If the poor must be always with us in some numbers, and in less numbers in proportion to good regulations and local healthfulness, the duties of religion teach us not only to relieve and alleviate, but to *prevent poverty*—the inevitable successor or consequence of intemperance.

It is no new doctrine that cleanliness is essential to the health of cities, and that pure water is necessary to life. The ancient cities of the Ro-

man empire very soon found that the most devastating disorders, even the plague, would prevail, unless they were supplied with pure water from beyond the contaminating influence of human habitations. Who does not know that at this day the modern city of Rome, which occupies a small part only of the area enclosed within the ancient walls, is still in the enjoyment of some of their ancient aqueducts, stretching on columns across desolate plains to the mountains, bringing copious supplies of pure water, which play in the public fountains, and flow to supply their else uninhabitable streets. On all sides are seen the ruins of those splendid baths, which were free to all. There is no city in Italy, and scarcely in Europe, that has not its artificial supply. And, in the United States, New-York stands alone destitute, until you shall think proper to prevent it by union of purpose.

I do not say that this is the neglect of the city authorities of the present day. The councils, I believe, are extremely anxious on this subject; nor was it the fault of former councils. Let us dwell a moment on the circumstances that have so long prevented this city from being supplied with good water. If some of you are stockholders in the Manhattan Company, you will recognise the facts.

That company was incorporated in 1799, thirty-three years ago, with no doubt the honest intention of bringing in the streams and rivers of the adjacent country, according to the language and obvious meaning of the law; and, for this purpose, were authorized to raise a capital of two millions and fifty thousand dollars, (according to printed statements,) and were authorized to manage their funds by any usual form of investment. If we may judge by recent surveys, under the authority of the corporation, they soon found that to bring in the pure and wholesome waters of the country streams, would require more than all their capital. They might have asked leave to increase it: but the city did not then contain 100,000 inhabitants. The early proprietors or directors found that perhaps, by drawing water from *wells* then on the edge or outskirts of the population, they might, at least for a while, satisfy an indulgent public; and perhaps they did; but this operation was not that which was contemplated by the law which created the company; nor if they were to dig a hundred wells would it be the performance of that work which the legislature gave them to do some time or other, for they are a perpetuity by that law. They are a perpetuity to do what they have not, nor ever had, the money power to do. I say this with no unfriendly feeling towards that institution, but that you may see for yourselves, in this law to which I refer you, that there is no reliance to be placed on them to supply the city: as their law now stands, and with their capital so limited, they cannot do it.

Can the city corporation supply the town from those external sources? It cannot without interference with the rights of that company. Will that company give them up? I should suppose not, as it would be to

give up also their banking privileges in perpetuity. If they would, is the city prepared to undertake that work? It seems not, as the representatives did not, at the last session, obtain of the legislature authority to create a public debt for that purpose.

If, then, the Manhattan Company has no authority to supply the city from wells, or perforations of the rock beneath the city, might not the corporation do it? It might. But is this the best, the most effectual, prompt and economical way to supply the city? We doubt it. We seek, therefore, to inform the public of the facts, in order to induce an enlightened public opinion. We are convinced from circumstances, that if it can be avoided, the councils do not wish to create a heavy public debt, even for this all important object; and that it will be much more difficult to obtain unanimity of opinion and resolve on that subject, than on the question of simply allowing each ward to supply itself, *the city and the liberal minded assisting those wards where there is least disposable wealth.*

Having thus spoken confidently of this method of obtaining water, it is incumbent to state the reasons for thinking that it will always be found by boring into the rock.

Experience must be our best guide on this occasion; but if besides we have facts in science to sustain and justify the expectations founded on that experience, you will be the better satisfied.

The island of New-York is for the most part rock. Under the city, this rock is every where found, after passing through a bed of loose sand, which, at the corner of Bleecker-street and Broadway, has been found to be 48 feet deep; at the Dry Dock, 100 feet; at Greenwich, 70 feet. Mr. Disbrow began to bore the rocks for water at New-Brunswick, in 1825, inventing implements in succession, till he commands the operations with perfect certainty, and can make a small steam engine do most of the labour.

He perforated the rock, bringing up water nearly to, and sometimes above the surface, in *nine* instances, in New-Jersey; two in and near Philadelphia; one at Baltimore; one at Harper's Ferry armory; one at Paulus Hook; two at Greenwich village; one at Shaw's botanic garden, near the Asylum, nearly our highest ground, where it stands only 18 feet from the surface; one at the corner of Bleecker-street and Broadway, 442 feet deep; and several in this city, down to the rock, affording good water. But those in the rock always soft and fine water, as the purest spring.

My theory on this subject is, that a ridge of primitive rock of the kind called *gneiss* (which differs from granite only in containing *mica*, and in being in minute stratifications or layers, though compact in its crystallization) stands, as may be seen in the higher ground, sloping towards the west, rather steep at first, but, as may be seen in the great well of the city tank, gradually becoming less and less steep, and probably at length horizontal, and then extending towards the Alleghany mountains, changing

to granite; for we know that those mountains are primitive granite, and slope both west and east, underlaying westward the great valley of the Mississippi, and eastward the secondary rocks and diluvial hills and vales, or those formed by the flood, which constitute the surface of the country from hence to those mountains.

We find the primitive rock to be in layers or strata.* Those of the Bleecker-street perforation towards the bottom, are 9 feet, 8 f. 13 f. 14 f. 16 f. 11 f. thick, water being struck between each, and finally in such abundance as to rise to within 30 feet of the surface of the ground.

These layers are recognised in geology as usually occurring. It is also known that gneiss passes into granite. There is *no inconsistency*, therefore, with that science, in supposing that the strata we see here continue to the Alleghanies, and that the water we find between them comes from the clouds, which perpetually condense on those summits, and fill their elevated caverns and reservoirs with this pure water, which thus, by nature's own subterraneous aqueducts, are brought to our reach, and prevented from escaping to the ocean by the rise of the strata under the whole range of our principal seaport cities, in the form of a barrier, which detains and offers it providentially to our acceptance. If so, and thus far experience warrants this conclusion, we should gratefully accept it as a source incomparably purer and better adapted to our wants than any stream or river could be, even if easily brought in. It is invariably soft-and pure: it comes to us through no channel exposed to vegetable and animal decompositions: it has been liable to receive no gaseous or mineral impurity.

Do you need this water?

The answer to this question is fraught with both curious and momentous facts. Permit me briefly to state them.

One of the board of aldermen last year, Dr. Townsend, submitted an inquiry to the Lyceum of Natural History, "whether they had in their researches examined the chemical constitution of the springs of this island, the matters with which they are impregnated, and the effect which the geological stratification of the island or the vicinity of the sea may have in deteriorating their qualities?"

A committee of professional men were appointed to answer it, highly qualified, it must be confessed, in point of philosophy and chemistry, but not of patience. It could not fairly be expected, however, that gentlemen so busy would, like a committee of parliament, hold long sittings, and call on those persons for information supposed to be competent to impart it. They stated, from geological premises only, that perforations in the primitive rock of this island would be utterly useless, because the strata appeared to them to be nearly perpendicular in position.

* This is the name of the rock supposed to have been first formed under the "face of the deep."

In this, being mistaken, their conclusion was erroneous; but although, fortunately for this city, mistaken in this one point, they, with great candour, expose, in other topics, the real disadvantages under which this city labours, now aggravated by the epidemic passing over us, and invited to return by causes which what they say goes far to explain.

They say, of the purity of the New-York waters, that, by analysis, every pint was found to yield ten grains of solid matter, consisting of magnesia, soda, lime, potash, and *extractive matter*, constituting what is called hard water—and corrupt water.

Referring you to their report, page 8, "From whence," they ask, "are "derived these 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 filled 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, the obstacles to the transmission of water from the surface by dwellings and pavements, are estimated "to carry off into the rivers nearly one half of the water which falls from "the atmosphere. In the neighbourhood of large open squares, it is consequently observed, that the wells are more pure, but they must sooner "or later partake 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 communicate "a ropy appearance to the water; and the water of 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, which 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 sandbank 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 one "hundred tons of excrement every twenty-four hours. In these deposits

"we may find all the ingredients detected by analysis, and which destroy "the purity of our waters.

"The coldness of our pump water conceals the impurities when swal- "lowed. 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."

The committee (Joseph Delafield, J. E. De Kay, John Torrey, George Chilton, T. Dewey, Jeremiah Van Rensselaer) further say, "Your in- "quiry 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. "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."

This respectable committee further say, "From whatever quarter the "supply is obtained, it must be from places beyond all possibility of ever "being surrounded by a dense population. It must also be procured in "sufficient abundance to provide for the wants, not only of the present, "but future generations."

Such being the actual condition of New-York, as regards its wells and the nature of the soil on which the city stands, we may further add, as a concurrent cause of bad water, that the underground drainage is for the same reason an additional cause of impure well water, and the surface drainage is rarely of such declivity, with bad pavements, as to carry off the house offal freely. It is detained to decompose, or the pavement being open, permits this foul water to soak gradually in.

The inquiry naturally arises, whether other cities have not similar soil beneath them? London has a hard blue clay; Liverpool is on red sand- stone; Edinburgh is on rock; Boston on hard pan over rock; Phila- delphia on a soft tenaceous clay, underlaid by the primitive rock. No other place has, to my knowledge, a deep, loose, sandy soil, like this of New-York.

We have ample testimony to the unsuitableness of the well water for domestic uses; its unfitness for bathing and washing. We now come to the inquiry how far water is required to wash the streets.

You require no argument to prove the need of pure air to good health. I shall, however, presently show how essential it is by the effects its im- purity produces. It is sufficient to remind you generally, that there is now no provision in this city for carrying off the foul decaying matter daily received in the gutters, though the grosser and heavier parts are

swept up and carried off, but leaving the finer and humid particles behind to infect the air. Those streets which run parallel to Broadway and the Bowery, are so level as to exhibit an imperfection of drainage exceedingly pernicious. I hope the consequences will not convince the inhabitants before the present summer is past, how much they need a copious supply of water of some kind to wash them.

The imperfection of the pavement certainly is a great obstacle to the street drainage; and when I recollect the cleanliness, smoothness, and delightful walking or riding in the streets of Florence, paved with square slabs of smooth granite, a little inclined to the centre, so as to cause all the water, and all the dirt, to be as far from the windows of their houses as possible in the street, where, in fact, narrow streets are clean, and therefore the houses and lots not undervalued; I cannot but hope the day will come when this improvement will be superadded to those of which New-York is capable.

The actual impurity of the air, notwithstanding our elevated situation between two rivers, is not at this time to be regarded as a light matter, because it is a concurrent predisposing cause of the cholera, and putrid fevers. It concurs with the neglected alleys and courts, and cellars and hovels, to produce that general state of impure air, which, being heavier than the atmosphere, rests and accumulates among us, impairing the vital energy, till at length overpowered.

Let us not hesitate, as we value the lives of our friends and connexions, to investigate and admit the facts, and by tracing the origin and progress of the danger, understand its nature and its remedy. Its cure we must leave to physicians, and its extinguishment to the merciful Disposer of events; but in this trust it is our duty to use all the means in our power, relying that they will be blest; for since the plague of London and of Rome, no disease has swept over countries and cities as this has; no other has visited the cities of America as this is likely to do, unless the predisposing causes which *second* this subtle foreign poison shall be removed. Experience has shown that it is not a transient evil, or an epidemic that passes once over, and returns no more.

Experience shows that though *locally progressive*, cholera is *not a transient epidemic*. It is now fifteen years since it manifested itself in Asia; and it still rages there with aggravated violence, passing and repassing, or reviving in the same cities and districts.

A glance at the history of it shows what we have to do. Medical men may assign it whatever name or rank is proper in science, still by whatever symptoms or phenomena known, there is no mistaking *facts*, which show the nature of its source; and consequently the radical remedy. It is by considering the circumstances that have evidently originated, nurtured, and invited the poison of cholera, and comparing them with those of a like nature in our own cities and country, that we can understand and feel the necessity of thorough precautions. We may thus prevent its recurrence, or disarm it of half its mortality. To this

end I select a few facts, that warn and instruct us, while they encourage confidence in proper measures. Happily they are the same which promote general health and comfort.

You will recollect that this fatal epidemic manifested itself in 1817, at *Jessure*, 60 miles from Calcutta, and soon after reached that large city; but though its victims were many, it did *not* spread, like the plague, *from person to person*.

Writers on this disease have said little descriptive of the locality where it first appeared; nor any thing of those changes in the condition of the people, which war and destitution has, in modern times, produced. Human life is in Asia esteemed of little value. Labour is so little productive, that the great body of the inhabitants subsist on rice alone. The climate is hot, and the Ganges, with its numerous branches, flows past many cities and villages, and is made, by a prevailing superstition, the receptacle of their dead.

The physical laws of nature throughout the world being the same, like causes must every where produce like effects, differing only in degree and complication. The most virulent poison may exhale in such small proportions as to be harmless; but it may also evolve in large quantity, and be so accumulated or concentrated, as instantly to destroy life, as we often see when men happen incautiously to descend into a *dry well, where carbonic acid gas* has settled.

It is well understood that in all decomposition of animal and vegetable substances the oxygen of the air combines with the carbon and hydrogen of the decaying substance, and that the gaseous products are light *carburetted hydrogen* and *carbonic acid*, and, when animal substances are present, ammonia. The former is generated spontaneously in great quantity at the *bottom* of *stagnant pools*, during summer and autumn.

And still another elastic principle is supposed to arise from putrefying vegetable remains in the *noxious miasms of marshes*. The origin of these is obscure. Chemists say, every attempt to obtain them in an insulated state has hitherto proved abortive.

But analysis cannot seize on these volatile principles; analogy may interpret their nature. The final result of decomposition is vegetable mould, which *Saussure* describes as discovered to consist of the above mentioned gases.

It is highly probable that they may emanate from such places, either in large quantities, or in a very concentrated quality; displacing the pure air, and substituting themselves for it. It is fifty per cent. heavier than the atmosphere, and inclines to settle into low places, unless ventilated. Its weight is favourable to its concentration. This gas is constituted of equal volumes of carbon and oxygen gas; and it is a curious property of gases *to blend without increase of volume*, as in this instance: and probably though as yet *known* to chemists in only two proportions, there may be nothing in the laws of nature to prevent their condensation, or *redoubling of strength*, without changing the proportion of the constituents. We

know that gases are compressible—that they often take a denser form, and combine. Carbonic acid gas will combine with water without increasing its bulk.

Now as we know that carbonic acid gas is the food of plants, both through the medium of the water they take up, (by means of their roots,) and derive from the air by their leaves, which, during the day, by the influence of light, give out pure oxygen, retaining the carbon, we perceive that when it is in excess, it must remain in the atmosphere; that growing plants take up no more than they can digest, *leaving the excess*. Thus, slovenly husbandry, neglected puddles and foul cellars vitiate the air: medical works are full of cases in which such neglects have been the cause of fevers in families and neighbourhoods. In cities we have not the benefit of much growing vegetation. The excess of carbon produced here, enters into the water exposed to it, although this city is remarkably well ventilated.

It is likely that when a heavy shower occurs, the air is purified by the rains abstracting this gas. Electricity is but an attendant circumstance, the cause, perhaps, of the collection of the vapours which constitute the cloud.

But as the *carbonic acid gas* is the food of plants, they must have the faculty of attracting their food; and even when in great excess, it may be *attracted*, though not absorbed, and being thus drawn or attracted along from plant to plant, and place to place, may explain the progress of this ærial poison.

We are informed that, in 1818, the cholera travelled from the Ganges throughout the vast peninsula of India, at the rate of about *two miles a day, at the same time in all directions:* and I venture to conjecture that it may have been in this way that it proceeded. This supposition will not be found inconsistent with the history of the progress of the cholera.

In Dr. Kirk's pamphlet, now in circulation among us, the account given of it by Dr. Mickle, many years a surgeon in the British army in India, is contained. I quote a few remarkable passages, serving to sustain my argument. His brigade fell in with the epidemic as it progressed southward. The commanding officer endeavoured to avoid it by giving a new direction to his line of march; but this precaution was unavailing; it attacked them notwithstanding, and within the first twenty-four hours, there were 130 cases out of 4,500 persons; a proportion fourteen times greater than occurred in New-York, on the 21st of July, the day of greatest mortality.

He says, it was known sometimes to attack only the camp *followers* in the rear of the line. Sometimes one wing was exempt, while the other was infected: (perhaps the ground they occupied was dry, or the officers more vigilant over their men.) Sometimes a particular house in a cantonment successive years gave the disease to the officers who occupied it, but did not spread from thence: (probably its cellar or some other part was filthy.) Particular spots and tracts of country have had it more fre-

quently than others; (perhaps low ground and stagnant waters were there.) At certain ferries the passing columns were always affected. Sometimes one regiment would encamp for the night on low ground, another on high; the latter only would be exempt. Sentinels in the former have been known to fall at their posts, and die in an hour. Detachments have arrived, having the disease without communicating it. Others have given it to some in every corps; (probably predisposed by bad habits.)

A whole army of 90,000 men having lost 8,000 in a few days, have been saved its further ravages by a forced march to a mountainous district. *Cavalry* appears to have been remarkably exempt.

On these and other facts, Dr. Kirk remarks, "They teach most de-"cidedly the great fact of cholera being an epidemic disease, *resulting* "*from localities often very minute;* and evinces how much *predisposition* "may modify the influence of the poison."

Indeed this was singularly exemplified in the march of a party of young officers from Madras to the interior of India, in which, in the course of 560 miles, they passed through localities of the cholera, and left it behind *four different times, and on none of these occasions did this disease occur among them beyond the tainted spot.*

Such *tainted spots* were sometimes found to be a bazar or market-place alone. But sometimes it appeared to be one occupied by crowded numbers. On a certain religious festival, it is said that between one and two millions of people assembled on the shore of the *Ganges*, when, from their exposure to the exhalations and the night air, the cholera destroyed 20,000 in six days. Or, it may be asked, since numbers and *night air* have not invariably produced such effects, did it not arise from the use of the *tainted stream?*

These remote facts are confirmed by many in the history of the progress of this disease in Europe; and we may now say our own country.

It seems to me its capricious occurrence, progress, and recurrence, are to be accounted for by no other conceivable agency than by this gas, highly concentrated, as it travels in water, flies in the air, and creeps on the ground.

From India it crossed the Persian gulf, and (as no better explanation is given) probably in the foul bilge-water of some vessel that had been at Madras. It spread up the shores of the Euphrates, and winter and a desert stayed it from passing into Syria. But in the spring it reached this extensive country, and in *August*, 1823, the city of Tripoli, on the shore of the Mediterranean. But this town, unlike that of the same name on the Barbary coast, being on the side of a steep mountain, enjoying the advantages of good air, good water, and incidental cleanliness, few were attacked, and it subsided for this time.

At about the same period, it passed northward, on the eastern side of the Caspian sea, to *Astrakhan;* but, after prevailing to some considerable extent, subsided on the approach of winter, also, for that time.

During the next six years, it continued to prevail in India, but did not occur in Europe till most unaccountably it appeared at Orenburg, in Russia. But the war between this country and Persia may have occasioned some intercourse. Here it commenced in August, and continued till February, (1830.)

In July of this year, it again appeared at *Astrakhan*, and of course soon began to progress among the villages on the Wolga, and reached the great city of Moscow, in the autumn: the Russian armies returning from Persia, and proceeding at this period to Poland by this route.

At Moscow, it continued till February, 1831. destroying 4,000 inhabitants out of 300,000. It reached St. Petersburgh, and with about the same loss. In August, it reached Berlin; in September, Vienna; in October, Hamburg: and late in October, *England*.

At Sunderland, where it first appeared, the authorities and physicians were unable to trace its arrival. Ships had, indeed, arrived from the continent, but no one had been ill with cholera on board; but still it might have arrived in those vessels, it appears to me, consistently with its being this poisonous gas.

From Sunderland it was slow in proceeding northward to Newcastle; but it did so, and prevailed in that city to a considerable extent; and suddenly broke out at Gateshead, on the opposite side of the river, on a shift of wind in that direction, and in one night and morning, fifty cases occurred; but, these were among people who dwelt in very filthy houses, and breathed the foulest air.

Dr. Kirk says, that no man can read over the list of these sufferers, without seeing clearly that *all these unfortunates lived in a corrupted atmosphere.*

The epidemic from Newcastle spread to Edinburgh; but here the most prudent precautions were taken to disarm its virulence by cleanliness and succour: consequently few were its victims in that large and crowded capital.

At the manufacturing village of Paisley, it had commenced its course; but the people with laudable spirit made common cause of it, and by dint of washing within and without (by the fire engines) drove it off: *nor was this unphilosophical.* The dashing of water on the houses not only cleaned them, but incorporated the *carbonic acid gas in the atmosphere with the water*, which by its copious flow washed away much material of the co-operative poison in the filth of the streets.

London was, in its turn, visited, but in the same inexplicable manner, unless we suppose some vessel to have carried the poison in her hold; for the villages between this city and Sunderland remained untainted. It did not, however, then take hold of London, as was to have been expected. The season of the year was propitious to her safety.

Paris was reached in like manner, and suffered more severely. The times had unsettled the pursuits of regular industry. Predisposition to

affections of the stomach and bowels had been observed. Some of the ancient parts of this city are very narrow, contracted and crowded, and besides, it is supplied with water from the *river Seine*, which flows through the middle of it, receiving its drainage. In Paris, the cholera prevailed severely, in some instances reaching the most opulent in society.

At Liverpool, it made but a slight impression. This city has a rock foundation, sloping enough for rapid drainage, and on a rapid river; nor is the climate more than mild. Perhaps relying too much on their natural advantages; perhaps precautions being relaxed, the epidemic has *re-appeared*, and *also re-appeared in London*, with more malignity than before, most probably in Southwark, where they have no pure water.

Its transmission to America is easily explained on the supposed nature of the poison.

It will be recollected, for example, that the ship Brutus had lain for a considerable time in a port where the *choleric atmosphere* prevailed, and full long enough to have imbibed its poison; and though with the usual crew of such a ship, they might not have been infected, when we recollect that she had on board 330 *passengers*, who must have been below deck, and breathed in a stagnant atmosphere during the night, it is by no means astonishing that the cholera should have broken out among them. The weather is described as fine the first six days, but on the seventh, they began to sicken, and thirteen in one day were buried in the deep. The agitation of the ship had now caused the poisonous gas to evolve. They returned to Liverpool, with the loss of eighty-one, or one in four. This ship could not have been provided with the precautions usual in American ships.

The emigrants who crossed the Atlantic to Canada earlier in the spring, although exposed to the atmosphere of Liverpool, made the passage in a cooler season, and did not sicken till about the time of their arrival. Unfortunately, they landed in the lowest and dirtiest quarter of Quebec; and those who deemed themselves happy to get quickly off for *Montreal*, did not find themselves there better situated, and the cholera broke out *among them and the near inhabitants*, at the same time in both places. Thus, the disorder which had devastated half the old world, was probably transmitted to the new.

It was doubtless impossible long to stay or bar out by any military or quarantine regulations, a subtle poison, capable of passing in so many ways into the United States. Infected persons must have eluded the feeble police of our country, and New-York, as *most predisposed*, received, or manifested *earliest*, the fact of its reception. Since then, while it has lingered, and spread and aggravated in Montreal, it has taken its course up along the waters of Canada and the United States, westward. It crosses New-Jersey, infecting her villages, and assails the city of Philadelphia, unfortunately, at a season of the year when her local situation (flanked by fresh waters, and supplied alone from one of them,) is unpropitious to its mildness. The Schuylkill water, though originally most acceptable,

has lost some of its mountain tributaries by the interception of the canal, and spreads too wide and shallow to be the *best* summer source of supply. But should this prove to be the fact, there might be rock water raised in her several wards, as proposed for New-York.

Our seaports are too intimately connected in commerce not to be interested in the health and prosperity of each other.

As nothing short of a miracle can now arrest the course of the cholera in our country, we cannot attribute its spread to *individual cases of imprudence*, which would, ordinarily, have no such resulting malady. The generally existing causes, foreign and domestic, predisposing to sink beneath the effect of the slightest deviation from strict prudence, is altogether new and extraordinary, and means must be adapted to this new state of things; at least, such as will deny the foreign enemy a domestic ally.

The actual danger of recurrence is greater than the original danger of occurrence. It has begun to subside by the benevolent and inestimable exertions of the relieving committees, and the mild, but decided measures of the Corporation. But the occasion of these benevolent measures still continues, and may demand, perhaps, more exertion on the part of the latter.

No doubt the epidemic has surprised us; it was not expected so soon. The Atlantic, it was hoped, would prove too wide. It was erroneously supposed to travel only in the air, or in packages of merchandise. It has eluded the vigilance of the world, and is here; nor will it ever be stayed, mitigated, or controlled by any other than the most decided measures of defence, by those ameliorations in cities, and in the habits of the people, which prevent predisposition. Places and cities must have within them whatever improvements promote health and comfort, and may thus subdue this fell destroyer. It must pass through the country, and carry off its thousands; but whether it shall *repass*, depends, under Providence, on ourselves.

To recapitulate: We have seen the origin of this now universal poison. We have seen it spring from natural causes, in extreme. We have seen that it travels by land, by water, and by air, and is naturalized and aggravated by *local congeniality.*

It may be satisfactory to some to see, that appearances in the disease itself warrant this theory of its nature.

We have seen, unquestionably, that the same gas which thus poisons animal life, nourishes vegetation. Plants, however, as before observed, receive *no more* of it than they can digest and analyze, giving back the oxygen to the atmosphere; but animals receive it in excess. *In health, respiration throws it out of the blood.*

Pure air consists of *twenty-one parts oxygen gas and seventy-nine nitrogen gas*; but gases and vapours, without uniting with it, *float in the air.* The carbon, derived from the worn-out humours and fibres, is thrown into the current of circulation by a peculiar set of vessels, (the absorbents

distributed throughout the frame,) and, reaching the heart, is impelled by it to the lungs, and there spread to their surprisingly extensive surface, to be discharged through appropriate pores; whilst through others, the blood receives oxygen from the air, to refresh, and warm and revive it; then returning to the other chambers of the heart, it is thence impelled throughout all the human frame; and in its course receives that milky fluid, which, sucked by a thousand minute mouths from the intestines, comes to supply renewed nutrition.

This bland fluid is prepared by an inexplicably complicated apparatus performing the digestion, and then by the absorption of it by the numerous vessels called the *lacteals*. But experiments on the blood have shown, that *spiritous liquors are never digested*, but somehow get into it, *unchanged, raw and crude*, and as stimulating as they are on the tongue and stomach. It is really astonishing that this acrid substance should at first only intoxicate, when it would seem it ought to be expected to kill. There is, however, a great struggle of the system to defend itself, and perhaps the skin and the kidneys carry off some of it; but too much goes also to all the vital organs.

Spirit, in chemistry, called alcohol, is thirteen parts out of twenty-three, or more than half, carbon. It swells the proportion of *excrementitious matter* in the blood, often so much as to overpower the lungs as the organ of its discharge. In like manner it surcharges the liver, and produces obstructions or torpidity in that vital organ, which secretes the bile essential as a stimulant of the intestines.

If, therefore, alcohol is received into the blood at a time when an epidemic prevails whose cause is a poison in the blood of *the same nature*, it is not astonishing that the intemperate are its first and surest victims; but the fact that they are so rather tends to prove the correctness of the theory now suggested. For among the phenomena of cholera is thickness of the blood; its congestion about the heart; the inability of the lungs to free it of its carbonic acid; coldness of breath.

The actual pathology or operation of this very mortal disease is not inconsistent with this theory. Some (and among them the celebrated physician in Paris, M. Broussais, whose lectures are here in circulation) are of opinion, that the disease consists of an *inflammation throughout the whole intestinal canal*, produced by a poison taken in food or drink, ordinarily and gradually, and attacking the knots of nerves which are found in the intestines, (called ganglia,) communicating with the spinal marrow; and thus, by *inflammation thereof, causing the spasms* incident to this disease; and that the struggle of nature to expel the poison from the blood, by the medium or agency of the intestines, produces a dissolution of the blood itself, and the discharge of its more fluid part through that medium, as well as by the skin.

Certain it is that this effect is so great as to almost suspend every function of the vital organs; the pulse ceases, stricture comes over the gall duct, and the kidneys suspend secretion.

Sometimes examinations after death show *gangrenous spots in the stomach*, such as poison produces, which shows the probability of Dr. Broussais' theory of the disease; though it is never the effect of poison to produce such a general struggle in the whole system. *There are therefore concurrent causes affecting the nerves and the blood.*

It is therefore obvious to common sense, why taking *alcohol* at such a time precipitates the blow impending; why any imprudence in eating, that disturbs the digestion, and irritates the bowels, may hasten it;—for the poison derived from air or water may be lurking in the system, and one act of intemperance of either kind may cause the blow to fall; or, at least, heighten or aggravate the premonitory disorder, in which the first remedies might else have been efficacious.

Having thus shown you the probable cause of the naturalization of the epidemic cholera, as well as the nature of this gaseous poison, at once foreign and domestic, the question brought home to every American citizen, and especially those inhabiting our seaports, is,—How we may avoid secouding this Asiatic scourge; and how, finally, it may be mitigated, perhaps completely prevented?

The answer has been *indicated* in the history of this epidemic. We have seen what sort of places and people it finds most prepared and ready to receive it, and that foul air and foul water are the medium of the poison. The remedy then is, the removal of the cause of these, and the actual substitution of their contraries, pure air, pure water, and no street corruption. But where is pure water to be had; without which we can have no wholesome food, nor public cleanliness.

The long expected water works of Manhattan we have shown relate to rivers; and we know the Corporation has no present power to provide pure water for the city. We therefore deem it fortunate and providential, *that there has meanwhile been found ample sources of pure and soft water in the rock beneath the city;* and in so many instances, that there can be no reasonable doubt that it will *always* be found, by boring for it.

In my recent pamphlet, I have shown how it happened that the committee of the Lyceum were under erroneous impressions in regard to the effect of borings for water: therein proving, from principles in geology, that this water must come from the Alleghany mountains, between the layers of the primitive rock; that is, the oldest and deepest rock known. Because we see that this rock is the kind which appears in the middle of the island, sloping to the west, and probably meeting the sloping layers which form the Alleghany mountains; and thus the mountain water is brought in a natural subterraneous aqueduct, between the layers or strata of this oldest rock, to the seacoast, under those of more recent formation, and even under the rivers.

This same pure water is reached by boring, under all the principal cities of the middle states, and each may and will partake of it by this means.

But great as this advantage will be, it may be long before it is realized, unless the mechanic interest of New-York should duly value it. It will no doubt be immediately sought for by the most wealthy, in squares and small sections; but however so far beneficial, *it is not a partial supply of pure water that is to relieve the city of New-York.* It ought to be done generally, and on a liberal scale, sufficient for all purposes.

The exigency of this visitation is unfortunately no transient evil. Experience has before, and often taught every American city, in a voice from the grave, a lesson they have been too slow to learn of the well regulated cities of Europe, that wherever people have been crowded together, precautions must be taken to preserve health. The laws of nature are now asserting their dominion, and the due chastisements of Providence on the sin of uncleanliness is visiting our charitable institutions and our prisons, and our not less noisome abodes of the poor and wretched. Experience has every where taught the same truth, that the poison thus generated is not confined to the sources of its origin, but travels up to the abodes of opulence and power. There can be but one opinion, and there ought to be but one voice on this subject.

Amongst the auxiliary means of pure air may be named *good pavement.* It is generally the system of New-York, to drain by the surface; consequently, house-slops must be continually thrown out. If this be unavoidable, they ought not to be allowed to stagnate, but be made to flow quickly away.

We should in this respect also take example of the cities of Italy, which, centuries before this continent was discovered, had risen to commercial greatness. They are in the same latitudes and climate as ours. Florence is wholly paved with *flat stones*, and a gentle slope to the middle line carries all the dirt and water, if there be any, to the middle, where it is easily collected by sweeping, and taken up without dust; and where rain has double the effect in washing it away.

As most of the streets of New-York are in bad order, permitting puddles of foul water every where to form, new pavement must soon be lain, and *as well done it will be cheapest in the end*, we may hope to see a method adopted that will throw the gutter in the middle, and its bad air further from the windows. In a commercial city drayage should be facilitated, and no doubt a horse will draw much easier on flat stone than on round pebbles.

Other nuisances there are in crowded parts of the city, impairing the purity of the air, which might be remedied, as there are means.*

By natural situation, New-York is eminently capable of enjoying the purest atmosphere of any city in the union. It might be made not only attractive of mercantile business, but be a place of summer resort, much more than it is. It cannot be denied, that with all its natural advantages, this is the least agreeable of our seaport cities in the summer season. The same improvements, however, which would make it

* This is said to be an inoffensive way of building houses of office.

healthful and convenient to the inhabitants themselves, would make it agreeable and attractive to strangers. And the difference in prosperity and profit between the undisturbed activity of business during the summer season, and the scattered and distressed state of the inhabitants at present, is a loss of more money in a few months than it would cost to put New-York in permanent good order in all respects; and such is the prevailing opinion.

I have addressed this explanation to you, as a body, not only in numbers the most influential in the measures the community must be induced by their own interest to take, but because you are the most permanent class of the inhabitants; and because you can well understand the description of the mechanism of the operations. You can see through the difficulties which the ingenuity of Mr. Disbrow has surmounted, and the sure effect of the implements. You can also best judge of the several methods of distribution I shall also describe.

It is true, these things might have been communicated to the common council, but we all know the obstacles which arise in all deliberative bodies before public opinion is formed. No member of a legislature or council but wishes to do what would prove agreeable to his constituents; these must have had an opportunity previously, therefore, of understanding the nature of any great measure of public utility, otherwise there will be *delay*. By bringing this subject thus at once before you and the community, we save time. Members will at the next election be chosen, knowing what their constituents wish in this respect; they will have no occasion to delay; and if the subject must go before the Assembly for authority, it may then go early the ensuing session.

After explaining to you our methods and plans as patentees, I must offer you our reasons for preferring *Ward Companies*.

It may be recollected, that the old method of drilling into the rock was by means of a spring pole, which lifted the chisel, driven down to give the blow by one or two men. There was in this a want of force and of accuracy, which rendered it difficult to drill far. Perfect *trueness* and perpendicularity was necessary to be had in the perforation, and heavy blows to make progress in hard rock. Accordingly, a machine was devised to lift the shaft of the drill always with precision, and to let it fall from as much elevation as the steel chisel would bear, the blow being given by force of gravity. The chisels are formed all exactly of the same size and shape, and the jointed shaft is so formed as to be stiff and strong,—the lower part of iron, the upper of wood. A steam engine can be applied to the lifting. The chips or dust are brought up by a valved cylinder.

When a perforation is thus made two and a half inches diameter, and abundance of water found rising rapidly, if for a large supply the bore is to be reamed larger, say seven or eight inches diameter. To do this novel work in this art, a peculiar tool is used, and a rotary motion given to its shaft. When the perforation is in earth, or as far as it may be so, a cast iron tube is settled down by great force as fast as the earth is excavated, and its joints made tight by a ring of iron, and wedging.

Thus, a small iron well may be sent down in earth or rock to the depth of four or five hundred feet, and all the upper sources of foul water kept out.

The water commonly rises up in the bore or tube to the surface, or near the surface of the ground. Whatever is its rise or height, from the lowest orifice through a layer of rock, may be considered its *head.* Consequently, if the column of water in the bore can be quickly removed by steam engine power and a pump, the water will flow into the bore through the lower orifice with a velocity equal to that with which it would flow through an orifice in a dam of equal height. Therefore it is our joint invention to avail of this flow, and by mechanical means specified in our patent, derive from any one orifice or boring, all the water its discovered head permits to be derived.

To this end, we place our chamber at once at the bottom, and make one spear to carry not only one box in the chamber at bottom, but put on a number of successive boxes, which we call relief boxes, to bear each its share of the column of water, that the lower box may be relieved of the pressure or weight of a high column, and the tube itself of such a great pressure as would otherwise strain it, or require much more thickness.

The quantity of water derived from each perforation will be known on trial. It may be fully equal to the hydraulic velocity due to the head of water. The stroke of the engine being in the same proportion; and the stroke may be long or short, quick or slow, as the arrangement of the machinery may be.

Thus, one perforation and one steam engine may be sufficient to supply each ward of the city of New-York, if the perforation is very successful.

The Bleecker-street perforation is 442 feet deep, and, with a six horse engine, delivers 44,000 gallons in twenty-four hours; but it is capable of affording more.

I have ascertained by inspecting an aqueduct, at the city of Hudson, where the source is, at times, but just enough, the quantity actually *requisite* to families. There are 4,500 persons who receive the water, and its quantity is (by the average of several modes of computation) two gallons a person in twenty-four hours, including enough for domestic animals, but *not* for washing, being a limestone spring. If an equal quantity be allowed for washing, it is twenty gallons a day to a family of five persons. This supposes no waste, and no use for washing streets. Their aqueduct leads to cisterns sunk in the street, holding three hogsheads, and when full, a float closes the inlet cock, and the water passes on to others. The quantity pumped out is spontaneously reinstated by the opening of the valve; and as the pumps are not numerous, and the water is fetched from a somewhat inconvenient distance, people are rather saving of it. The tax for the water is from two to ten dollars a year, according to numbers. Hudson alone, of the North river cities, is free from cholera.

In Philadelphia, the supply to the city is two millions of gallons a day,

which is, to 165,000 inhabitants, twelve gallons each for all purposes, or sixty gallons a day to a family of five persons. This ample allowance provides for washing the streets. They pay from five to twelve dollars, according to numbers and rooms.

If a boring of the rock is made to yield, as I suppose practicable by our apparatus, 120,000 gallons in twenty-four hours, it would supply sixty gallons to 2,000 families, about as many as the population of one of the wards of the city of New-York.

It will be no small advantage to have the source of supply *within the ward;* because whatever mode of distribution may be determined on, the water will have to run less distance from its source to pervade it, and will require less expense, because the *main pipes need not be so large.*

There are three modes of forming aqueducts for its distribution.

1st. By laying iron pipes under ground, with hydrant posts (as at Philadelphia) along the side walks.

2d. By laying iron or wooden pipes to fill small reservoirs at every two or four hundred feet, as at Hudson, with pumps in them.

3d. By an elevated aqueduct, or a pipe on pillars, with downward pipes in the hollow of the pillars, opposite every two houses. When the two former are used, every house along by which the water is led, is taxed by law, according to the number of persons in the family and rooms in the house. When the latter mode is used, it may be voluntary with the families to take it or not; those receiving it having keys to the hydrants, and paying about the same as is customary in other places.

The practice of carrying the water by pipes into cellars has been generally abandoned, both on account of its wastefulness and unhealthiness.

The cistern plan is not favourable to street washing, as it requires *labour to pump the water*, and unless it were done by many at the same time, there would not be enough raised to be effectual.

The hydrant posts, upward or downward, admit of doing it by merely turning the cock and discharging the contents of the reservoirs. If the elevated aqueduct be used, it will discharge also the water in the main pipes.

As to frost, the *hydrant posts* are the most subject to its effects; water must stand in them, unless stopped off. The *cistern plan* is, perhaps, best on this account, as the water is in winter drawn nearly out of the pump by a tap; but a few *extra* strokes are then necessary to discharge the water when wanted. The elevated pipe and downward hydrant may be drawn off in severe nights, to prevent freezing.

Considering the importance to the city of having a *liberal supply for purposes of public cleanliness*, and a plan requiring no more capital than is necessary to effect these important purposes, I am much inclined to prefer the *elevated aqueduct;* perhaps, however, because *it is novel, and my own invention.* My fellow citizens will judge of it, however, themselves, should opportunity of its establishment occur.

It remains now to give a few short reasons why we prefer *ward companies*.

1. If the reasons for supplying the city with pure water are such, and half as urgent as I have supposed, there is no time to be lost. The Asiatic pestilence is here, and will remain traversing our cities and villages so long as it shall meet with co-operation. Ward companies can supply the city quicker than the corporation could do it; and there will be emulation among them.

2. Ward companies can supply it *better* than the corporation, as such, because it will be done on so different a principle, that instead of having a motive to do as little as will merely answer the purpose, the ward companies will have every motive to make the supply general, in order that it may be profitable. And as the inhabitants have a direct and deep interest in the healthfulness and cleanliness of their parts of the city, each will stipulate for the right to wash the courts, alleys, side walks and gutters of the street.

3. If the corporation were to undertake it, a public debt must be created, under express authority of the legislature. This would occasion loss of time if obtained, and that sanction as to this mode, or any other mode, must be subsequent to definite arrangements, to be carried before the assembly, as the basis of the application. Why did not the representatives last session apply? Did not the rights of the Manhattan Company over the waters of Westchester stand in their way?

4. If ward companies are established, each acts separately; but, being capable of union, the city has within it an equal number of sources and systems, that may be united, instead of one like that of the city tank. These several companies may co-operate in case of a great fire, or in case of need, to wash and clean thoroughly any particular quarter of the town.

5. Those who are most interested in the health and welfare of the city, would have this means of safeguard against pestilence and fire committed to their own hands, and by making it a common property appendant to their estates, they have a *mutual interest* in its perfection and perpetuity: and whenever a man sells his house, the purchaser would be very likely to buy his share in the water works too, however much above par.

6. Every ward would then become interested in having the gutters properly placed, that less water might keep them clean.

7. Public baths for the promotion of health may be in every ward. Pure water might not alone be palatable to those accustomed to spirits; but ginger and molasses and water to the labouring people might become a usual substitute for spiritous liquors, if the water were only wholesome.

8. There would be ample opportunity for the city corporation to take stock in those wards most needing its aid; and those also who might be disposed from liberality of views, or public spirit, to join therein.

9. The whole might be carried on nearly at the same time; preference, however, being given those wards where the councils are of opinion it is most needed.

10. There is ample capital to be had for works of this kind, when founded on sure principles. The wealthy of the city of New-York have never, it is truly said, manifested any reluctance to be taxed for the public good when measures have clearly *that effect.* There is much more uncertainty about the supply from Westchester in the summer season than from the primitive rock. Our summers are often extremely hot and dry; and engineers in their calculations for the supply of canals here, are obliged to make much larger allowances than they do in England and even in France. No work can be constructed to bring in the water, though at the expense of *three millions*, without this liability, and that also of its interruption by accidents that the carelessness or unfaithfulness of a single labourer might cause. It should never be left in the power of an enemy to cut off the water of a whole city. When brought to our borders from the country at that expense, it has still to be distributed at more than all the expense of the ward companies would amount to. The best possible supply would have been by good wells to every house, but this was impossible; wherefore the next safest plan is to put the supply as much as possible in the power of the proprietors of them.

11. In a community so rapidly growing as this, the demand must fast increase. But the present generation does not wish to anticipate needlessly the wants of an age to come. It is the gradual creation of a form of *personal* estate to the amount of two millions of safe property, wherein societies, widows and orphans might invest without hazard. It would be an excellent mode of investment, too, for the savings bank, and shares might be at moderate sums, for the accommodation of the provident.

12. The Boston aqueduct, which was in my care early in life, brings the water in logs into that city, from a large pond five miles distant, for the use of families in washing, and the price was twelve dollars a year for this use only. The aqueduct shares is a property still considered among the safest and best. The logs are bored by water power.

Having maturely considered how we may best introduce and render these improvements extensively useful to the city, and having concluded that *ward companies* would be preferable: if seconded in this persuasion by the public, they may at once be formed, and application early made to the assembly for their incorporation, which no doubt the representatives of the city will obtain, if it be the wish of their fellow citizens, approved by the mayor and councils.

Convinced of the expediency of this mode of proceeding, we deem it advisable thus to submit the subject to you in your respective wards, persuaded that your deliberations and opinions will be seconded by the inhabitants in every calling and profession; and perhaps a petition to the common council will be circulated seasonably for subscription in each, that the force of opinion may be ascertained.

With a view to leave nothing in doubt, we have in our first *pamphlet advertisement*, proposed the terms, (page 13.) of the cost of boring in earth and in rock: and for reaming out and enlarging the bore to eight inches diameter, amounting to 10,400 dollars for 400 feet: though not likely to be necessary to go so deep, unless on the high ground, (as the Bleecker-street perforation.) That of Mr. Shaw's, on still higher ground, was 112 feet deep only from the surface. Mr. Underwood's, 120 feet, and Mr. Guy Richards's, 202 feet: both in Greenwich. Mr. Strong's, at Paulus Hook, 250 feet. Those on the low ground on the East river, 100 feet, down to the rock. Washington market and Crain's distillery, 72 feet, to the rock.

The terms proposed (page 10) were, "that mechanics' work and personal services should be paid for as usual. That when the *net income* to the stockholder is more than seven per cent., the patentees shall jointly receive half the surplus revenue over that ratio, the other half going *additionally* to the stockholders." These are very moderate terms, just leaving a probability that the patentees will get remunerated if the ward companies are formed, and the water *generally supplied;* but we reserve the supply of baths, breweries, sugar houses, and manufactories, because these must require separate preparations. This offer, however, is not to be considered *a standing one*, beyond the present summer; and we hope it may be found acceptable before the next session of the assembly.

When it is recollected what immense resources the city of New-York enjoys; how much it is in her power to be the centre of the union, as well in arts as in commerce; her extensive natural and artificial navigation; and that already the assembly has authorized rail-roads, which will facilitate travel and the winter transportation to this capital; that a northern rail-road through Haarlem is likely to pass through counties in Connecticut and Massachusetts, rich in iron and other products; and while one branch goes on to Vermont, another may, in Stockbridge, turn west to the city of Hudson and Schoharie county, and the central west; that the southwestern counties will either reach this market, by the route now designated by law, or by uniting with the Susquehanna and the coal trade route, combine great advantages, and come straight across the northern counties of New-Jersey to this city; and that both these lines lead to Lake Erie and the head of *steam navigation* on Alleghany river, opened up to Hamilton, within our state, by a New-York mechanic, (Thomas Blanchard.) so as to ultimately connect the trade of this city *directly with the great valley of the Mississippi;* —there does seem every encouragement and motive to make the city of New-York *healthy*, so far as depends on human prudence, foresight, and liberality: trusting with sincerity and faith that all such endeavors will be attended with the blessings of Him of whom is the breath of life.

J. L. SULLIVAN, CIVIL ENGINEER:
Also, in behalf of LEVI DISBROW, MECHANICIAN.

NEW-YORK, August, 1832.