

REPORT

OF THE COMMITTEE APPOINTED BY THE

COMMON COUNCIL OF THE CITY OF CLEVELAND,

ON THE SUBJECT OF A SUPPLY OF

PURE WATER.

CLEVELAND:

PLAIN DEALER STEAM PRESS.

1853.

REPORT.

TO THE HON. THE MAYOR AND COMMON COUNCIL OF CLEVELAND :—

GENTLEMEN :—Although at the time of the appointment of your Committee, it was intended that ample time should be taken for the examination and investigation of the different Water Works of other cities, as well as the various sources of supply suggested for Cleveland, and that no report would be expected for more than a year ; still, adventitious circumstances, beyond our control, have contributed to delay this report longer than was anticipated. It would have been made last July, but the discovery that we had based our first calculations on erroneous data in regard to elevations of ground, rendered useless and impracticable the plans we were about to recommend. Other plans had then to be examined, and new estimates made.

The exposed condition of the city, arising from its limited system of Reservoirs and Fire Engines, has prompted the Committee to continued action, and as early a termination of their investigations as practicable, considering the importance of coming to correct conclusions.

We set out with the idea that there must not only be an abundant supply of pure water, but that it must be placed at such an elevation that any building or buildings in the city could be deluged with it from the hydrants.

It has required much time to enquire thoroughly into the works erected in other cities, and also to obtain detailed information regarding the various kinds of pumping engines, particularly concerning the recently improved " Cornish " Engines.

Discrepancies in statements of the height of different points in the town where a reservoir might be placed, required examination, and finally resulted in settling the question against a reservoir on the natural surface. There is no point within reasonable distance high enough to flood the upper stories of all the buildings.

The comparative expense of an artificial reservoir near the Lake, and one of less cost, erected at a distance on higher ground, required a good deal of consideration. Also, whether subordinate reservoirs might not be made at lower levels that would supply the lower parts of the city.

It was also thought advisable to have the water of the river, and

of our wells and springs, as well as that of Lake Erie, examined chemically.

These subjects have required more time and attention than the public might readily appreciate.

The free use of water is one of the ameliorations of the age. It has come to be not only a luxury that all should enjoy, but a remedy and preventive of disease.

The benefits of the enlarged use of water, both in cleaning private premises and public streets, is apparent, in lessening sweeping epidemics and improving generally the health and comfort of the cities.

We should be relieved from the constant apprehension of sweeping fires, our tenements would become more valuable because they would become more secure; we should be better provided with public and private baths, and enjoy the purity and beauty of public fountains. Strangers seeking a residence at the west, coming from cities well provided with water, are disappointed when they discover our deficiencies in this respect.

Before the recent enlargement and improvement in the water works of American cities, the consumption for private uses, was, on an average, only forty (40) gallons a day for each family. In Boston, for all purposes, the consumption for several years has ranged from 166 to 204 gallons, and in Cincinnati in 1844 it rose to 300 gallons per day to each family.

There are in Cleveland about 5000 families, of whom not more than one half would voluntarily use reservoir water. The average of other cities, for all purposes, public and private, for sprinkling streets, for fires, manufactories and fountains, varies from 250 to 300 gallons per day to each consumer's family.

At 5000 families, the outside demand for Cleveland would not exceed 1,500,000 gallons per day, and for five years to come would not probably exceed, at any time, 1,000,000.

There are in Cincinnati 21,620 families, of whom only 5,828 rent of the water works, and they consume 1,507,650 gallons a day. The works deliver (1851) 2,600,000 gallons, and the excess goes in part to the cleaning of the streets, and the extinguishing of fires. But for the want of stringent rules much of it is stolen from the Hydrants by those who do not rent. This defect we shall refer to below.

If at the end of ten (10) years our population should be doubled, and there should be 10,000 families, all of whom should use Hydrant water, we shall need a pump that can raise as its extreme duty, 3,000,000 gallons during the working days.

Your committee do not deem it safe to build a tower of large dimensions to the height that would be necessary, say 90 feet, immediately upon the bank of the Lake.

The nearest available position for a tower is the ridge near Euclid street, distant about 3400 feet from the Lake, which is elevated above the Lake about 100 feet, and then it must be some fifty feet

high to command a flow of water to the third stories of houses in the city.

Even if it were safe to place the tower on the bank of the Lake, the cost of the additional fifty feet, would very much exceed the first fifty feet, and what would be gained by shortening a supply pipe would be mostly lost in a lengthened main delivery pipe. The estimates are, therefore, for an artificial reservoir, near Euclid street, composed of a tower of masonry, sustaining an iron tank of the capacity of 1,000,000 gallons, which is the largest we can safely adopt.

There are good reasons why this reservoir should not be placed more than three-fourths of a mile east of the Court House. The loss of head in the distributing pipes will be less than if the reservoir was farther removed from the centre of the region to be watered, and the cost of the main supply pipe from the Lake would be lessened in proportion to its length. The Tower and its Tank, instead of being an unsightly pile, may be made, without additional expense, an object of architectural taste and ornament to the city.

We would strongly recommend the construction of a second reservoir of a capacity of at least 1,000,000 gallons, at some point on the brow of the hill, near the river, which, although only on the same level with table land, will yet afford an additional supply to the densely populated region of the lower levels and flats near the river. We regard this the more desirable from the necessarily small capacity of the Upper Reservoir. No estimates for such a reservoir, however, are included in the report,—its cost would be comparatively slight, as it would only be a strong cistern in the earth.

THE SOURCE OF SUPPLY OF WATER.

After having paid special attention to the streams in this vicinity—the Shaker Run, Mill Creek, Tinker's Creek, and Chagrin River—it appears to be practicable to bring either of them to the upper plain of the city. But a greater question arose at the outset, as to the quality of the water which flows in them, whether it was *pure* and *wholesome*. A sufficient examination of the qualities of the water of those streams convinces us that they are entirely unfit for the purpose proposed, and, also, even if they afforded pure water, the supply in the two just named creeks would have been extremely liable to failure. The copious springs flowing from the various banks and hill-sides south of the city, have, by many, been supposed to be adequate to a supply for general use, if properly taken up and concentrated. They are insufficient, and their waters are mostly hard and unfitted for the purpose.

Lake Erie is the only source to which we can resort for an unfailling supply of pure and soft water.

A chemical examination of the waters of the Lake shows it to be possessed of these desirable qualities in an eminent degree, equaling the Cochituate of Boston, and far excelling the famous Croton of New York. This is extremely fortunate, and the effect of its intro-

duction cannot but be strongly exhibited upon the future health of the city; for the fact cannot be disguised, that the fast increasing impurity of our wells, exercises a very deleterious influence upon those using the water from them.

The result of a chemical examination by Prof. W. W. Mather, of the water of some of our wells, springs, the Cuyahoga River, and Lake Erie, together with a comparative statement of waters in use at other places, is given in Appendix "A."

MODE OF ACCOMPLISHING THE WORK.

All experience shows that such undertakings can be carried on more economically by individuals or companies, than by municipal corporations, and also better managed after construction. In this case there is not sufficient inducement for a company of capitalists to engage in the undertaking, because the result would at first be a loss of interest. Some gentlemen have proposed to assume a part of the expense on condition that the city could furnish the remainder, say one-third.

But looking into the new charter, we see no powers whereby it can be made a mixed affair; it must be wholly a public or private work. (See section 22 and 75 of the General Law, App. "B.")

There is, we are informed, a charter existing and a company organized under it, that possibly might be of assistance in accomplishing the desired purpose, if there was a proper and sufficient understanding between it and the city, but we are not sufficiently acquainted with the vitality of its provisions, since the adoption of the New Constitution, to express our opinion of its availability. (See Appendix "C.") One thing is clear to us, the city should by no means allow the power to pass from them, of either keeping the control, or assuming it at such time as they might think proper upon certain stipulated terms.

Neither do we see any authority for taxing lands to pay water rents, except as a general tax.

The experience of other places has shown almost without exception the urgent necessity of some power to levy a special water tax upon all tenements, situated in streets through which water pipes are introduced, making it the interest of all to take the water, and preventing the great abuse so much complained of, that is, a few taking the water and paying for it, but a far greater number stealing it. Such provisions afford to the honest consumer his water at a lower cost, and enables the concern to pay its interest when it earns it.

The city and public for streets, fountains and fires, need about 100 gallons a day to each family, or about one half the whole consumption.

The large cities where Water Companies have sufficient power to cause all the water that is used to be paid for, and when the Corporation pays for that which is used for public purposes, the stock becomes a paying investment. But to realize this, those who do not pay must be prevented from using and wasting the water. In the city of New

York last year this waste and loss raised the amount charged to the paying consumers for private uses from 150 to 335 gallons per family per day.

LOCATION OF THE WORKS.

If we had within a reasonable distance a natural elevation of 150 feet, it would be advisable to extend the main supply pipe to reach it, although the expense of laying it is very great, as the annexed estimates show. In this way a large reservoir might be made containing a supply for any emergency, or for many days consumption. This is an object of importance, because the consumption of water per family is constantly increasing. In some respects Cleveland labors under disadvantages for obtaining and distributing water, which many cities do not—in the distance from the shore at which the water must be procured, and again the distance from the Lake to which it must be thrown to avail ourselves of the highest land which we have.

To obtain the Lake water as free as possible from the impurities brought in by the current of the Cuyahoga River in floods, and from the wash of the City and the sewerage, it will be advisable to erect the pumping engine and standing tower, at least as far as one mile east from the foot of Water street, and to extend the suction-pipe some 1,500 feet into the Lake to avoid the impurities near the shore; of course we must resort to steam power to raise the water.

The engine and pump should be powerful enough to afford a supply of 3,000,000 gallons by daylight, which is ample for private, public, and manufacturing uses, until our population reaches 75,000.

It should be of the first character in structure and reliability, particularly when we consider that from want of high grounds upon which to construct a reservoir of great capacity, we must rely upon a smaller one being constantly supplied by the faithful working of the engine, assisted by a duplicate reserve when the occasion shall demand.

Long experience in England, and partial experiments in this country has proved, in our opinion, that the Cornish Engine and Pump, and Cornish Boilers are altogether preferable, doing much greater duty, for the same amount of fuel and attendance, than any other, and, although they cost slightly more in original construction, the saving in the items named, many times compensates the interest on the additional cost. Some facts showing this will be given below. Your Committee, therefore, feel bound to recommend decidedly their adoption; indeed, your Committee throughout have based their estimates upon the cost of the best and most durable character of Water Works, instead of the cheapest; yet the estimates will compare favorably with the cost of construction for similar works in other cities, as will be shown by instances cited in other parts of this Report.

As near as we can ascertain the cost of the plan, which, after

mature deliberation and comparison with others, we feel inclined to recommend, will be as follows, viz :

| | | |
|--|------------|------------------|
| One pure Cornish Engine and Boilers capable of elevating 3,000,000 gallons by daylight 150 feet high..... | \$30,000 | |
| One reserve duplicate do..... | 30,000 | |
| Stand Pipe and Tower 150 feet high, 20 inches diameter, 1½ inches thick, at \$50 per ton..... | \$1,290 50 | |
| Enclosing same with brick tower..... | 3,500 00 | |
| | | <u>4,790 50</u> |
| Aqueduct or suction pipe to be of boiler iron ¾ inch thick, 40 inch diameter, to extend 1500 feet into the Lake, will cost for material and construction, 8 cents..... | 18,840 00 | |
| Drudging, cribbing and laying same..... | 6,000 00 | |
| | | <u>24,840 00</u> |
| Rising main—3,500 feet long, 20 inch diameter, 1 inch thick, weighing about 285 lbs. per foot lineal at 2½ cents per pound..... | 24,937 50 | |
| Excavation, lead, and laying the same..... | 5,250 00 | |
| | | <u>30,187 50</u> |
| Stone tower sustaining iron tank 100 feet diameter, and capable of containing 1,000,000 gallons, in all 50 feet high, say..... | 55,000 00 | |
| (This is a rough estimate, for we have not the means of an exact calculation.) | | |

DISTRIBUTING PIPES.

We have estimated for about 10 miles of water pipe, including the 16 inch descending main, which will supply the city from the reservoir, giving circulation through all the other pipes, gradually diminishing in 10 inch, 8 inch, 6 inch and 4 inch pipes, covering the whole extent of district to be supplied with water, viz :

| | | |
|--|------------|-------------------|
| 2000 feet descending main, 16 inch diameter, ¾ inch thick, weighing about 145 lbs. per foot..... | \$6,475 00 | |
| Labor, lead, and laying the same..... | 2,250 00 | |
| | | <u>\$8,725 00</u> |
| One mile 10 inch main, 9-16 inch thick, weighing 65 lbs. to the foot lineal, at 50 per ton..... | 8,580 00 | |
| Lead and labor laying same..... | 3,960 00 | |
| | | <u>12,540 00</u> |
| Two miles 8 inch main, 9-16 scant, weighing about 55 lbs. per foot lineal, at \$50 per ton..... | 14,520 00 | |
| Lead and labor laying same..... | 6,864 00 | |
| | | <u>21,384 00</u> |
| Two miles 6 inch main, ½ inch thick, weighing about 35 lbs. per foot..... | 9,240 00 | |
| Lead and labor laying same..... | 5,280 00 | |
| | | <u>14,520 00</u> |
| Four miles, 4 inch, water pipe, ½ inch thick scant, 30 lbs. per foot..... | 15,840 00 | |
| Lead and labor laying the same..... | 10,137 50 | |
| | | <u>25,977 50</u> |
| Stop cocks for distribution..... | 7,000 00 | |
| Boxes, covers, &c..... | 2,500 00 | |
| | | <u>9,500 00</u> |
| Hydrants, 350 in number..... | 8,750 00 | |
| Handling, draying, distribution delivery and labor not included..... | | <u>10,000 00</u> |

REAL ESTATE.

| | |
|--|--------------|
| Lot on Lake shore for Engine house, &c., lot on Ridge near Euclid street, and land damages for laying rising Main..... | 20,000 00 |
| Engine house and buildings..... | 15,000 00 |
| | 321,214 50 |
| Contingencies, engineer, &c., say 10 per cent..... | 32,121 45 |
| | \$358,335 95 |

We have stated that the Cornish Engine and Boiler were, in our opinion, much the most economical and reliable. This view is derived from the following comparative results of duty performed for fuel consumed by Cornish, condensing, and high pressure engines in various places named.

If we are correctly informed, at the Cincinnati Water Works, a direct action condensing engine, but with Cornish boilers, which altogether cost 37,000 dollars, elevates 3,000,000 gallons water 175 feet for 90 bus. coal consumed, the furnace room remaining cool and comfortable. In same building a double or combination high pressure engine, which cost 75,000 dollars, elevates, operating under the same circumstances as the condensing engine, 3,000,000 gallons water 175 feet for 175 bushels coal consumed, requiring three times the labor of attendance, and the furnace room being extremely hot and uncomfortable.

At the Pittsburgh Water Works a high pressure engine elevates 2,500,000 gallons of water 150 feet for 275 bushels coal consumed.

The East London Water Works, England, pure Cornish Engine and boilers have raised 1,000,000 gallons a moderate height for *two* bushels coal consumed, while the experience of most of our cities, generally High pressure or Condensing engines, shows the same duty would have cost from 30 to 90 bushels.

However, the performance of the East London Water Works in that case was extraordinary, but it may be safely estimated that the fuel necessary for raising 3,000,000 gallons of water 150 feet, would be as follows :

| | |
|---|------------|
| By the purely Cornish Engine and Boilers..... | 45 bushels |
| “ condensing “ “ “ | 100 “ |
| “ high pressure “ “ “ | 200 “ |

The general cost for operating, including oil, hands, firemen, &c., for the three different kinds of engines and boilers, may be estimated to compare with each other much the same as the consumption of fuel.

If the plans are matured at an early day and the work vigorously prosecuted, they can probably be completed so far as to become available, to a considerable extent, within two years from this time. Meanwhile the present system of reservoirs should be largely and promptly increased.

It may not be inappropriate in this connection for your Committee to allude to the necessity of the Council making arrangements for an

extensive system of sewerage to be prosecuted simultaneously with the progress of water works. The same engineering and superintendence can carry out both the plans without much additional expense, as they have a mutual relation to each other. The system of sewers must necessarily be calculated so as to discharge the drainage of the city as far from the suction pipe of the water works as possible.

Our acknowledgements are due to many gentlemen abroad, connected with the water works of other cities, for the pains they have taken to assist in the object of our enquiries. We are indebted to Mr. E. W. Smith, of New York, engineer to the Ocean Steam Navigation Co., and especially to Mr. T. R. Scowden, Engineer of the Cincinnati Water Works, for much of the information upon which we have based our calculations and estimates of cost, and the comparative utility of engines; his experience in examining the establishments of England and France, as well as of the American cities, has been very great, and has been freely placed at our service.

To secure, at the earliest possible moment, the best and most economical plan for the details of these works, we respectfully suggest the appointment by the Council of a competent Hydraulic Engineer.

The qualifications which such a person should possess, are of a higher order than many persons would suppose at first view. It is a branch of engineering by itself, in which a critical knowledge of details is indispensable, an acquaintance at the same time with theoretical mechanics and hydrostatics.

Such a person could, in connection with a committee of the Council, or with a Board of water commissioners, have power to adopt a final plan for the whole work, while the requisite financial arrangements were being made.

Mr. Scowden, of the Cincinnati Water Works, to whom we have alluded, is a gentleman whose science and experience entitle him to great confidence in the planning and execution of such works, and we feel no hesitation in suggesting his name to the Council for that purpose.

Mr. Smith also informs us that he has devised a system of Water Works, not yet made public, which he thinks more desirable than any in use. He has not communicated the details, but would desire the privilege of bringing it to the consideration of the Council under stipulated arrangements.

Of course, if his plans should prove the most satisfactory, he alone would be the proper person to superintend their construction.

WILLIAM CASE,
W. J. WARNER,
J. P. KIRTLAND,
CHAS. WHITTLESEY.

APPENDIX "A."

REPORT
ON THE
COMPOSITION OF THE WATERS OF CLEVELAND,

BY
W. W. MATHER,

1852.

COLUMBUS, DEC. 25, 1852.

WM. CASE, ESQ., CHAIRMAN OF THE COMMITTEE ON WATER WORKS
FOR THE CITY OF CLEVELAND :

MY DEAR SIR :—In accordance with your wish, I have made an examination of the waters of Cleveland and its vicinity, having reference to the existing and future supply of the city.

The waters of wells and springs now used, and the waters of the Cuyahoga and Lake Erie have been examined with reference to their purity and adaptation for use.

The following waters have been examined :

No. 1. Well water, from a well about 50 yards west of the Theatre, between Superior and Centre streets, from the oldest part of the city. This water is used for many purposes, but is not much used for drink. Its taste is unpleasant and color yellowish, the water is hard and contains much organic matter.

No. 2. Well water, from Prof. Cassels' well, on the ridge on Euclid street, two miles from the city. This water is colorless and very pure and soft.

These two waters give the extremes, one as nearly pure as the water of the sand and gravel beds can be in that region, the other contains filtered impurities so as to be unpotable.

No. 3. Water from the Cuyahoga River, taken at a time of *low water* in August, at a depth of ten feet, at the Rail Road Bridge, so as to avoid the impurities of the surface and the slime of the bottom. This water is clear and soft and almost limpid, and by standing some

days becomes entirely limpid, with scarcely perceptible light flocculent sediment.

No. 4. Water from Lake Erie, taken about one mile eastward of the Light House, about one-half mile from the shore. This water was entirely limpid, cool, and pleasant to the taste, when drawn from the lake in a calm, sultry evening in August, the hottest season of the year. This water was taken at various depths, from the surface to the depth of twelve feet, mostly from the latter depth.

No. 5. Water from the spring at Jones' Livery Stable, near the Court House, south of the Forest City House. This water is hard and not pleasant to the taste, though much used.

No. 6. Water from the spring on the bank at the junction of the blue clay and marl, with the over-laying sands and gravel. This is hard, but esteemed the best drinking water in the vicinity.

No. 7. Water from W. W. Mather's well in Columbus. This contains much carbonate of lime and some muriate of lime in solution, like all the waters of Columbus.

No. 8. Water of Mr. Perry's well on Euclid street, Cleveland. This is soft, good water.

No. 9. Water from the well of Mr. Van Deckan, near the corner of Kinsman street and Lover's Lane. This is a soft water and considered very good though not as pure as Nos. 8 and 2.

These waters, Nos. 8, 9 and 2, are from the gravelly soil at a distance from the contaminating influences of a dense population, and are strikingly different in the quantities of organic matter from Nos. 1, 5 and 6, from the densely populated part of the city.

The following table shows the weight of the saline, earthy and organic matters in a gallon of 231 cubic inches of the waters named below :

| No. | CLEVELAND WATERS. | Specific Gravity. | Color and Transparen'y | Grains wt. of solid matter in gallon. | Grains lost by ignit'n | Grains wt. of organic matter in gallon. | Grains wt. of earthy and saline mat.in gal. |
|-----|--|-------------------|----------------------------------|---------------------------------------|------------------------|---|---|
| 1 | Well 50 yards w. of Theatre. | 1.00207 | yell'ish. | 79.23 | 28.69 | 11.78 | 62.14 |
| 2 | Prof. Cassel's well (Euclid st.) . . . | 1.00004 | limpid. | 1.56 | 0.13 | — | 1.43 |
| 3 | Cuyahoga river. | 1.00006 | almost colorless, became limpid. | 5.54 | 0.60 | 0.20 | 5.04 |
| 4 | Lake Erie. | 1.00005 | limpid. | 2.54 | 0.80 | 0.20 | 1.74 |
| 5 | Jones' Stable, near Court House | | " | 30.03 | 5.08 | 3.08 | 24.95 |
| 6 | Spring und'r b'k s. w. " " | | " | 25.17 | 5.54 | 3.24 | 19.63 |
| 7 | W. W. Mather's well, Columbus | | " | 27.72 | 5.50 | 0.30 | 22.22 |
| 8 | Mr. Perry's well, Euclid st. | | " | 15.24 | 2.77 | 0.27 | 12.47 |
| 9 | Mr. Van Deckan's well, Kins. st. | | " | 14.12 | 6.24 | 0.94 | 7.88 |
| 10 | Lake Erie, near the shore. | | " | 8.33 | 3.49 | 0.24 | 4.84 |

most. ox. iron

It will be seen from the above that the well water No. 1 is very impure, and from its color and taste it appears to be and is unpotable. The soil there, and throughout the higher portions of the city, is composed of sand and gravel beds, and all the impurities from drains, sinks, &c., that filter through these beds, contaminate, in some degree, the waters of most of the wells and springs in the older settled portions of the city.

Nos. 5 and 6 show the same effect, but in a less marked degree. No. 7 indicates the general characters of the Columbus limestone waters of the purest kind.

Nos. 8 and 9 indicate the general characters of the waters of the sandy and gravelly soil about Cleveland, where there are no causes of contamination like those of a city. They may both be considered out of the city, and are considered very good waters.

No. 10 is water taken from Lake Erie near the shore outside the piles, where the water was eight to ten feet deep, about one mile east of the Light House. It shows distinctly the influence of the land springs from the blue marly clay and sand, by the greatly increased amount of ferruginous, saline and organic matters contained in it, above those found in No. 4, which expresses more nearly the proper composition of the Lake water.

No. 2 is remarkable for its purity; few natural waters equaling it.

Nos. 3 and 4 are also purer than is usual for natural waters, and as these are the waters that must be looked to in future, for a supply to the city, it is important to examine them more in detail, and to compare them with other waters used in other places.

The following table shows the composition of waters used in the eastern cities compared with those proposed at Cleveland:

| | GRAINS SOLID MAT- TER PER GAL. | LOSS BY IGNITION |
|---|-----------------------------------|---------------------|
| Croton Water, used in New York..... | 10 93 | 4 28 |
| Schuykill, used in Philadelphia..... | 5 50 | 1 24 |
| Cochituate, used in Boston (surface)..... | 1 85 | 0 63 |
| do (from the Lake, 65 feet below)..... | 3 37 | 1 16 |
| Hunkerkill, near Albany..... | 5 00 | 0 64 |
| Normankill, " "..... | 6 80 | 1 43 |
| Patroon's Creek, near Albany..... | 6 08 | not detr'd. |
| Hudson River " "..... | 6 32 | 1 24 |
| Mohawk River, near Falls..... | 7 88 | not detr'd. |
| Cuyahoga River, water at R. R. Bridge, Cleveland..... | 5 54 | 0 50 |
| Lake Erie..... | 2 54 | 0 80 |

It will be seen from the above table that the Cuyahoga water is far purer than the Croton water, and fully an average of the other streams used to supply cities in the East, while the water of Lake Erie is purer far than any of them except Cochituate, and is more than the average of even that water, so celebrated.

The water of Lake Erie is usually clear, and always cool and pleasant to the taste, and if taken from some depth below the surface to avoid floating objects and scum, and some height above the bottom to avoid drifting sediment, and at some distance from the shore to avoid the earthy matter in suspension from the action of the surf, is as good, wholesome, and pure water as can be obtained, and as any city need desire.

The following table shows the relative purity of the water used in London, Albany and Cleveland:

LONDON.

| | | | ANALYST. |
|---|-----|---|----------|
| Long Aere, deep well, brewery..... | 56 | 8 | Brande. |
| Royal Mint..... | 37 | 8 | “ |
| Lambeth Brewery..... | 50 | 0 | “ |
| do shallow well..... | 110 | 0 | “ |
| Old Street Brewery, deep well..... | 38 | 9 | “ |
| Well in St. Paul's Church Yard..... | 75 | 0 | “ |
| Well in St. Giles' Holborn..... | 105 | 0 | “ |
| Trafalgar Square Fountain, deep well..... | 68 | 9 | “ |

ALBANY.

| | | | |
|-------------------------------------|----|----|--------|
| Well in Lydin's street, Albany..... | 19 | 24 | Emmons |
| Well at Old State House..... | 36 | 00 | “ |
| Well at Exchange..... | 64 | 68 | “ |
| Well at Capital Park..... | 65 | 52 | “ |

CLEVELAND.

| | | | |
|--|----|----|--------|
| Well 50 yards west of Theatre..... | 76 | 23 | Mather |
| Spring near Court House..... | 30 | 03 | “ |
| Spring under bank S. W. Court House..... | 25 | 17 | “ |

The well waters of all cities become more or less impure in the course of time, and are less and less suitable for a beverage in proportion to the time the city has been densely peopled, and in proportion as the soil and subjacent earthy materials permit the rains and other waters, and refuse and filth from houses, stables, and manufactories, to filter downwards into the earth. The inhabitants of all cities are obliged, at some time, to discard the waters of common wells and have recourse to Artesian wells, or to supplies of water by art, from streams and lakes, brought by aqueducts or pumped up by steam or water power.

The preceding tables show the great disparity in the purity of city and well waters, and the water of streams used to supply the inhabitants of cities; and that the water of Lake Erie, proposed to be used to supply Cleveland, is as pure and good as the best of them.

The well water No. 1 in Cleveland is very impure and unpotable, and contains per gallon:

| | GRAINS WT. |
|---|------------|
| Sulphate and carbonate of lime..... | 17.55 |
| Sulphuric acid in soluble part..... | 14.09 |
| Sulphate of magnesia obtained by crystallization..... | 1.84 |
| Chlorine in soluble part..... | 13.68 |
| Nitric acid, magnesia, ammonia, potash and soda..... | 16.90 |
| Organic matters, impurities from leaching..... | 11.78 |
| Water of crystallization and loss..... | 0.49 |

76.23

The Lake waters Nos. 4 and 10, contain a little carbonate, sulphate and muriate of lime, magnesia and oxide of iron. The minute analysis of these are not yet completed. The oxide of iron is by far most abundant of the earthy constituents in No. 10, and the organic matter also is more abundant than in the water, No. 4, taken

at a greater distance from the shore. The waters 4 and 10 show the extremes of relative purity of the waters that may be expected to be raised by water works at the different seasons of the year. No. 10 was taken in October near the shore after violent storms on the Lake, and after the leaves had fallen and communicated all the organic matter that would be dissolved by the waters.

In regard to the importance of the purity of water and its freedom from organic impurities, we cannot perhaps do a better service than allude to the influence of such waters in the case of cholera.

It is supposed by many that the limestone water in Cincinnati induced the cholera, but that those persons who used river or cistern water, mostly escaped the malignant form of the disease.

In Sandusky, where the cholera has been severe at different periods, the limestone water is no stronger than at Cincinnati or Columbus. In many places where limestone water is used the cholera has prevailed little or not at all. There are, it is believed, other causes, and it is supposed from observations thus far made*, that it is due mainly to the decomposing organic matter in the water used as a beverage.

At Sandusky the town is built on limestone rock. The bottoms of the cellars of many of the houses are the smooth, solid limestone. The rock is impervious to water. The wells of most parts of the town receive their water entirely or mostly from the leaching of water through the thin soil and gravel covering the rock from one to eight feet. The water from rains and other sources leaching through only this slight thickness of porous soil, cannot but be contaminated with organic impurities of the drains, sinks, privies, stables, &c. of the city. This alone is enough to induce disease in the hot season of the year. Some of the wells in the upper part of the city are dug deep in the limestone. It was observed by some, that the surface water, after leaching through the soil, was weeping into their wells at the upper surface of the rock, and carrying the surface impurities into them, and to guard against this source of contamination, some of the citizens built tight walls laid in cement, to exclude such water. The water of such wells is as strong limestone water as any, but malignant cholera is said not to have visited any family that took such precautions.

At Columbus, all the well water is limestone water, but the parts of the town where cholera has most prevailed, have been where the leached impurities of the city have contaminated the water, or where the wells have been dug in filled earth, where ponds or marshes formerly existed.

At Norwalk and Milan, the wells are dug in the sand ridge, the ancient beach of the lake, where the water is comparatively pure, and population has not become so dense as to contaminate the water. No malignant cholera has there prevailed.

* Mr. David Christie published several letters in the True Democrat, at Cleveland, in the Autumn of 1849, giving numerous facts on this subject, to which readers are referred; and he has communicated many of the following facts in regard to the Cholera.

At Mansfield, where the wells are deep, and the water comes into the wells from the sandstone rock, no cholera has prevailed; but in parts of the town where the wells are shallow, and receive the surface impurities, it has prevailed.

At Cleveland, near the Medical College, where wells were dug into the mud of an old pond now filled up; and also near the cemetery, where a few wells received water that had filtered through that receptacle of the dead, the cholera is said to have been very malignant and fatal.

At Oxford, Ohio, where the wells are shallow, and receive surface water soon after rains, the cholera prevailed with great virulence; but at the University, where the well is deep and unaffected by rains or drouth, there was no cholera.

The same remarks that have been made in regard to the freedom of water from decaying organic matter in the case of cholera, apply with equal force to other diseases in the hot season of the year.

The filtering of water through argillaceous soils, serves to purify it in a high degree from organic impurities, but the sandy and gravelly open soils of Cleveland, do not produce this effect in as high a degree as is desirable in water that is used as our daily beverage.

Respectfully, your ob't. serv't.,

W. W. MATHER.

APPENDIX "B."

SEC. 22. They shall have the power to provide a supply of water, by the construction and regulation of wells, pumps, cisterns, reservoirs, or water-works; and for the purpose of establishing or supplying water works, any municipal corporation may go beyond its territorial limits; and its jurisdiction, to prevent or punish any pollution or injury to the stream or source of water, or to water works, shall extend five miles beyond its corporate limits.

SEC. 75. The city council of any city, in which water works are or may be constructed, shall establish a board of three trustees, to be known as the trustees of water works, who shall be elected by the qualified electors of the city, and hold their office for the term of three years, but it shall be so provided that one of said trustees shall be elected annually; the trustees of water works shall manage, conduct, and control the city water works, furnish supplies of water, collect water rents, and appoint all necessary officers and agents, under such rules and regulations as the city council may prescribe; when any city shall have contracted a debt in respect of water works, the rents and incomes which may arise therefrom, shall be kept a separate and distinct fund, to be applied to the payment of the expenses of constructing and repairing the works, the payment of such debts, or the creation of a sinking fund for its redemption.

APPENDIX "C."

AN ACT to incorporate the "Cleveland Water Company."

SEC. 1. *Be it enacted by the General Assembly of the State of Ohio.* That Philo Scovill and his associates for the time being, their successors and assigns be, and they are hereby created a body corporate and politic, for the purpose of supplying the village of Cleveland, in the county of Cuyahoga, within the present corporate limits thereof, with good and wholesome water, by the name of the "Cleveland Water Company," and by that name shall be, and are hereby made capable in law of suing and being sued, pleading and being impleaded in Courts of Record, or any other place, whatever may have a common seal, and the same may alter or renew at pleasure, and shall be capable of taking, holding, and acquiring any real, personal, or mixed, provided that all such real estate, shall be necessary for effecting the objects of this incorporation.

SEC. 2. That the capital stock of the company shall be twenty-five thousand dollars, with power to the Company to increase the sum at pleasure to fifty thousand, the said stock to be divided into shares of fifty dollars each, and it shall be deemed personal property, and may be transferred, in such manner, as the said Company by their laws may direct, provided that nothing herein contained shall be so construed as conferring on the said body politic the powers of banking.

SEC. 3. That the control and direction of the operations of said Company shall be in a Board of three Directors to be chosen annually at such time and in such manner as shall be directed by the by-laws of said Company, and the first election shall be holden at some convenient and proper place in such village, at such time as may be designated by any three members of said Company, by giving at least fifteen days notice in some newspaper published in said village. The said Board of Directors shall have power to appoint such agents as they may deem necessary, and to make and ordain all necessary by-laws, rules, and regulations for the government and control of said Company, its operations and interests, and to call in the capital stock of said Company in such instalments as they may deem proper.

SEC. 4. That it shall be lawful for said Company to enter into or upon the lands and tenements of any person, and to make and construct, in, over, or through the same, cisterns, reservoirs, aqueducts, pipes, and water courses, as may be necessary to effect the purposes of this incorporation, doing no unnecessary damage to said lands and tenements; provided that said Company shall pay to the proprietors of all such lands and tenements, such compensation for any and all such

damages as shall be assessed by three disinterested persons, to be appointed by the Court of Common Pleas of said county of Cuyahoga, on the application of the party injured, or by suit at law, by the party injured, as in other cases, for the amount of which damages when assessed or recovered, the individual property of any member of said Company, shall be liable, and may be taken for the same.

SEC. 5. That the said Company shall also have power, and are hereby authorized to enter upon, dig, and excavate the streets, alleys and public square of said county and village in suitable places, for the erection and maintaining such suitable cisterns, reservoirs, aqueducts, pipes, and water courses, as may be necessary for effecting the objects of this incorporation; provided the same be done with as little detriment and obstruction to the public convenience as the nature of said works will admit; and provided also that the said streets, alleys, and squares shall be left in as good condition as they were before the same were dug or excavated.

SEC. 6. That if any person shall willfully and maliciously break down, injure, or impair, any of the machinery, engines, works, or devices of said Company whatsoever, the person so offending shall forfeit and pay to the said Company double the amount of damages sustained by such injury, to be recovered by action of debt in any court having cognizance thereof.

SEC. 7. That said Company shall have power to lease, sell, contract and receive pay for all the water to be so as aforesaid, brought into the said village, at such prices as may be agreed upon by the parties to such contracts, provided that the cisterns, reservoirs, and outlets of such water shall always be free and open for the purpose of extinguishing fires in said village (without any charge therefor.)

SEC. 8. That this act shall be deemed a public act, and shall be benignly construed for the purpose therein expressed in all courts and places whatsoever.

SEC. 9. That any future legislature shall have power to alter or amend this act, provided that the property of said Company shall not be thereby divested, nor directed to any other purpose than the objects herein expressed.

DAVID T. DISNEY, Speaker of House of Rep.

SAMUEL R. MILLER, Speaker of Senate.

January 25th, 1833.

AN ACT to amend an Act entitled "An Act to incorporate the Cleveland Water Company," passed January 25, 1833 :

SEC. 1. *Be it enacted by the General Assembly of the State of Ohio,* That the several provisions of the act to incorporate the Cleveland Water Company, passed January 25, 1833, be and the same are hereby declared to apply to and embrace the corporate limits of the city of Cleveland, and county of Cuyahoga, as fully and explicit-

ly as the provisions of said act are declared in the same to apply to and embrace the corporate limits of the village of Cleveland, and county of Cuyahoga.

SEC. 2. The capital stock of said Company is hereby increased to one hundred thousand dollars, in shares of fifty dollars each, with power to said Company to increase said capital in like shares to two hundred thousand dollars, if such increase shall be necessary to carry out the object of said corporation.

BENJAMIN F. LEITER, Speaker of House of Rep.
CHAS. C. CONVERSE, Speaker of Senate.

March 19, 1850.

SECRETARY OF STATE'S OFFICE, }
Columbus, May 6, 1850: }

I hereby certify that the above is a correct copy of the original roll on file in this office.

HENRY W. KING, *Secretary of State.*

On the 8th of February, 1850, the charter was accepted and carried into effect by the subscription of \$27,000 to the capital stock.

Subsequently, viz: May 4, 1850, an organization was effected by the choice of officers.