REPORT

OF

The Water Supply Commission

OF

The City of Cincinnati,

February, 1883.

Amor Smith, Jr.,
W. P. Anderson,
T. W. Graydon,
Commissioners.
REPORT OF
The Water Supply Commission,
OF THE CITY OF CINCINNATI.

CINCINNATI, O., February 16, 1889.

To the General Assembly of the State of Ohio:

We herewith present to your honorable body, the conclusions reached by the Board of Experts, whom we employed to aid us in investigating the question of the water supply of the City of Cincinnati. We quote from our preliminary report of last winter, as to the men constituting this Board of Experts, and the considerations which induced us to employ them, as follows:

"The subject matter of our investigations, being of such vital importance to the City of Cincinnati, we considered it proper to employ the best possible engineering talent, to assist in our investigations, and at the same time, decided to obtain men of national reputation, who should also be free from any local prejudices or preferences.

Acting upon this theory, we secured the services of the following eminent Engineers as Board of Experts.

DE WITT C. CREGER, C. E.
Formerly Chief Engineer, City Engineer and Commissioner of Public Works of Chicago. These positions representing a continuous service of thirty-three years.

HENRY FLAD, C. E.
President of the Board of Public Improvement of St. Louis, formerly Water Commissioner of that city, and Chief Assistant Engineer on the St. Louis Bridge. Colonel of Engineers on the staff of General Grant and Sherman, during the war."
A. FTELEY, C. E.
Consulting Engineer of the Aqueduct Commission of New York City, and on the Water Supply of Brooklyn and Albany, formerly resident Engineer Boston Water Works.

CHAS. E. HERMANY, C. E.
President of Board of Engineers. Chief Engineer and Superintendent Louisville Water Works.

CHAS. B. BRUSH, C. E.
Secretary of Board of Engineers. Chief Engineer Hackensack Water Company, reorganized, of Hoboken, N. J. Professor of Civil Engineering of the University of the City of New York.

All of the above gentlemen are General Consulting Engineers, especially on the question of water supply of cities and towns.

The conclusions stated by the Board of Experts, are based on a large amount of data carefully collected, including surveys of the territory on both sides of the river, analyses, observations, experiments on filtration, etc., all of which will be placed in the hands of the Board of Public Affairs of the City of Cincinnati, according to law.

We submit the report of the Board of Experts to you, and strongly endorse the recommendations therein contained, for obtaining an adequate supply of pure water for the City of Cincinnati.

AMOR SMITH, Jr.
W. P. ANDERSON.
T. W. GRAYDON.

CINCINNATI, O., Feb. 11, 1889.

To the Honorable, the Board of Water Supply Commissioners of Cincinnati:

Gentlemen:—When we presented to you in March, 1888, our preliminary report, containing brief, but we think, decisive answers to the questions submitted to us in regard to the Water Supply of Cincinnati, we were compelled, owing to the lack of time, and engineering data, to postpone to a future occasion a more explicit statement of the reasons which led us to the opinions expressed and to the conclusions reached.

In accordance with our recommendations, you concluded, in the summer of 1888, to order the necessary surveys and examinations and to entrust them to the superintendence of Mr. Charles Hermany, Civil Engineer, of Louisville, Ky., the President of our Board.

The results obtained by him are now before us; they throw additional light upon the questions formerly investigated, and enable us to confirm in the main, with increased confidence, our original recommendations. You will find, however, in the fol-
The following report, some modifications in the details of the general plan proposed, the unavoidable consequence of a more extended investigation; new points have also been touched upon, partly at the request of your Board.

A copy of the questions submitted of the Board of Water Supply Commissioners and of our preliminary report, are hereto appended for reference.

Investigations of the character and magnitude of those under consideration, are never complete until the final workings plans are prepared; some details are liable to modification, during the progress of construction; but however desirable a more extended study of the problem might be, enough is known, in our opinion, to enable your Board to determine the best course to pursue at this important period of your administration, when you have to decide on the initial step in the work of the improvement of the Water Supply of the City.

The questions submitted to us by your Board were as follows:

QUESTION No. 1.

“Is the location of the present Intake on the Ohio River a proper one?”

The water in the river at this point is continuously contaminated by surface drainage and sewerage from the eastern portion of Cincinnati and the towns of Dayton and Belleview on the Kentucky side of the river, as also, at times, by the discharges of the Little Miami River. The volume of surface water and sewage, (mixed with the water taken from the river, pumped into the reservoirs, and supplied to the people of Cincinnati) constitutes frequently such a proportion of the whole, as to seriously endanger and impair the health of the people. The fact that the amount of pollution with its consequent danger to the public health, cannot be definitely or numerically determined by chemical analyses, and that its effect cannot be tabulated in death rate statistics, does not refute the existence thereof, nor insure immunity therefrom.

To fully comprehend the volume of the surface drainage and sewage that contaminates the water, it is only necessary to consider the fact, that in a distance of less than five miles, from the present Intake up-stream over 3,000 acres of urban and suburban territory drain into the river, coming from both the North and South sides thereof. The assertion is, therefore, here made, that there are times when all the water flowing by the present Pumping Station, is unwholesome, no matter from what part of the river’s cross section it may be taken. It is a rapidly increasing evil, for which one of the remedies suggested is the construction of an expensive intercepting sewer, parallel with the river, which, as will be seen hereafter, is not advisable.

The water is taken from the river so near the shore, as to at times particularly favor the pumping of the surface drainage and sewage coming from the eastern part of the City. This fact has been so frequently observed and so generally commented upon, as to have become a matter of severe public criticism upon the manner of conducting the water from the river to the Pumping Engines. Great stress has been laid upon the propriety and necessity of extending the Intake to the center of the River Channel in order to secure the best water flowing. But it is impracticable to take the water from the middle of the Channel, because the U. S. Government will not permit any obstruction to navigation greater than that which now exists in the structures constituting the present Intake, which formerly ended farther into the river than they do now, having been cut off 20 feet in 1874 at the instance of the U. S. Government.

It has been claimed that the conduits could be placed below the bed of the river and the water convey through them from the middle of the Channel to the pumps, without causing any obstruction whatever to navigation. Such conduits are entirely inadmissible, because they would convey the water most heavily charged with sand and sediment, which would prove so destructive to the pumps and valves as to seriously affect their operation, neither would it be practicable to prevent such conduits from filling up entirely with sand and gravel. The approximate
equivalents of such conduits have been tried several times at this pumping station; they soon were filled up with sediment and were subsequently abandoned.

To prevent the silting up of such inlet pipes, it has been suggested, that, by attaching elbows to the ends of them and extending their open ends down-stream, the silting up process could be prevented.

At the Owensboro, Ky., Water Works Pumping Station, an inlet pipe was laid, extending about 291 feet into the river. It silted up and had to be abandoned. A new pipe was laid extending 396 feet into the river, with an elbow at the end, turned down-stream fourteen feet, and resting upon a ledge of rock. It also silted up and had to be taken out by a wrecking-boat crane, cleaned and relaid. In relaying it, the mouth was turned down-stream as before, with an arm 18 feet long placed at an angle of about thirty degrees with the horizon. The arm ended with a vertical 90 degree curve with its open end downwards and stopping four feet above the rock, so as to have always a body of water four feet deep flowing between the mouth of the pipe and the rock, thereby avoiding the heavier sediment. This device is now in successful operation; it forms an obstruction in the river seven feet above the bed, such as would be inadmissible in the river at Cincinnati.

At the Evansville, Ind., Water Works, an inlet pipe was laid upon the bed of the river, and it was rendered useless by the silt.

At Covington, Ky., both the intake and the system of distributing pipes in the city have been filled up with sand and the pumps and valves greatly injured by the use of an inlet pipe laid upon the bed of the river, as suggested for the Cincinnati Pumping Station.

In conducting water to pumping machinery from a sediment-bearing river, such as the Ohio, it should always be taken from the highest level practical above its bed, in order to avoid taking in with the water the heavier sediment that flows near the bottom. This in a river where the depth varies seventy feet from low to high water, can only be accomplished by building an Intake, pier or tower that will permit the water to be taken at will at any desirable depth below the surface.

The construction and maintenance of such an Intake is inadmissible at the Front Street Station, because of the obstruction to navigation produced thereby.

The structures constituting the present Intake although not as perfect as could be desired, are such as experience has demonstrated to be the best under local conditions; with existing circumstances they cannot be improved.

There are in present three lines of pipe in the river which are silted up and out of use, one sixty inches, and two, each forty inches in diameter. A sixty inch pipe extended heretofore, from the mouth of the upper aqueduct out into the river with an elbow and branch turned down-stream fitted with a four by twelve foot strainer; it filled up also and was removed.

In this connection it is proper that we should not restrict our remarks to the Intaking Channel proper, but that we should refer also to the present location of the whole of the Intake and of the structures immediately connected therewith.

The present Pumping Station is a practical and striking illustration of the rapid growth of Cincinnati. The works have been in operation 53 years, commencing with a population of about 35,000, until to day they are called upon to supply the wants of 350,000 people and to protect several hundred millions of property from fire.

The Pumping Works have been extended and their capacity increased from time to time in order to keep up with the constant and rapid growth of the city and its consequent demand for water.

The grounds of the Pumping Station have become conspicuously inadequate to the requirements of a large watersupply. The total want of storage room for coal is to be especially noted.

Owing to its position, the risk of fire with its disastrous consequences to the Pumping Station, are much greater than is justified by prudence.

This condition of things is not uncommon. In this respect, the history of Cincinnati has reproduced the experience of other
important cities of the United States where the original accommodations for water deemed abundant and even extravagant in extent at the outset, have been found after comparatively few years, entirely inadequate to the public wants.

For the above reasons, we think that the location of the present Pumping Works on the Ohio River is not now the proper one.

**QUESTION No. 2.**

"Is it practicable and advisable to improve the present Pumping Station?"

Some of the facts given before in connection with the location of the pumping works, namely:

a—The want of proper proportion between the present condition of the Pumping Plant and the magnitude of the water interests of the city.

b—The difficulty of securing a supply of pure water, increased by the restrictions imposed by the maintenance of navigation.

c—The risk of fire.

d—The general want of sufficient room for the requirements of the pumping operations;

Would be sufficient to justify a negative answer.

Other reasons, however, must be considered in relation to this question.

Most of the pumping engines are antiquated in design and in construction. As a result of this defect and of the inconvenient character of the additions made from time to time to the pumping machinery; also of the lack of sufficient ground, the pumping operations cannot be conducted in an effective and economical manner.

The cost of pumping at this station amounts to about $12.75 per million gallons, which is more than is found to be the cost in other cities provided with modern engines.

In addition to the drawbacks just enumerated, the pumping house proper, has not the substantial character which should be possessed by a structure which is to support and protect from weather and from incursions of the river, a system of elaborate machinery; the failure of which, even for a short time, would be felt disastrously in every home and in every business place.

It may be suggested that the masonry can be strengthened, that the antiquated machinery can be changed; but it must not be forgotten that these delicate operations must proceed as the pumping plant is doing its indispensable work without a diminution of the supply furnished.

Under these conditions the feat is possible, but it is not practicable, much less desirable.

The site covered by the works could be increased at a large cost by the taking of neighboring property, but the undesirable condition would remain of leaving the Station on the narrow strip of land, located between a set of railroad tracks, constantly occupied by switching engines and trains of cars on one side, and the Ohio River on the other.

In no case could the carrying out of the suggestions just made, relieve the water system from the objection of a supply, taken at a point on the river where the water is contaminated.

In our opinion, it is neither practicable nor advisable to enlarge and improve the present pumping station.

**QUESTION No. 3.**

"Is it practicable and desirable to supply Cincinnati with wholesome water, from a system of Driven Wells?"

Large amounts of water are daily pumped from Driven Wells, and while many disappointments have occurred from the non-fulfillment of extravagant hopes, it is a matter of record, that, in some cases, good results have followed a resort to that mode of obtaining water.

The cases where large volumes of water are thus obtained, are few, however, and no continuous supply has been secured, which can compare with the magnitude of the supply needed for this city.
Although aware that great results are often obtained from new and bold moves in the domain of Science and of Industry, we do not think that professional men could be justified in advising in a matter of so vital importance, a course which, at the best, must be called experimental.

On that ground alone, the idea of supplying the city with water, obtained solely from Driven Wells, should be peremptorily dismissed from consideration by your advisers.

We owe it to you, however, to add a few additional remarks upon this subject.

Men generally like a touch of the mysterious, and because the source from which Driven Wells procure water is unseen, some people are prone to expect extraordinary results, which they would pronounce impossible if they were to proceed from causes well open to inspection. The laws of supply and demand cannot be ignored, and if ground is expected to yield one-hundred millions gallons per day, they must be replaced under penalty of exhaustion.

A water shed, of sufficient size, to furnish such an amount of water must be large, and the underground storage reservoirs necessary to successfully bridge over the dry months, should contain many day’s supply.

From well established practice, such a reservoir above ground, should be about 25,000 feet long, 10,000 feet wide, and 10 feet deep, equivalent to about six months’ supply, at the rate of 100,000,000 gallons per day.

The same volume of water, underground, however open the material may be, would occupy a space several times greater. Such natural underground reservoirs may exist, but their position cannot be easily defined.

If the expected volume of water is to come from a stream, we know from experience how deceptive the filtering capacity of the ground is, and how seldom filtering galleries, built in pervious ground, on the margin of streams with generous dimensions, have rewarded their designers with the expected supply of water. If galleries, hundreds of feet long, many feet in width, exposing hundreds of square feet of gravel surface, have failed to furnish a large supply of water, what can be expected from a number of pipes, each exposing a free surface of only a few inches.

Driven Wells may strike a pervious stratum, through which water, if removed in large quantities, may flow very freely; but they are the exception rather than the rule, and no wells, or systems of wells of this description have approached, in flowing capacity, the volume of water necessary to supply Cincinnati.

Whatever be the source from which it is expected to draw water through driven wells, it would take at best, a series of years of constant pumping, before the capacity of the source can be tested.

While uncertainty in regard to the quantity of the water to be obtained from Driven Wells, should be a sufficient reason to exclude this mode of supply from all present consideration, the objection against that system of supply is increased in the present case, by the fact that the water which can be reached by Driven Wells is hard limestone water, wholly unsuitable for all the purposes of a water supply, except, perhaps, that of drinking.

Moreover, a system of water supply through Driven Wells, projected upon a basis of 50,000,000 gallons daily, to start with, and of double that number of gallons per day in the near future, would be an undertaking involving such an endless multiplicity of parts and details as to make it both difficult and costly to maintain, and cannot be considered as a reliable method of supplying a large city continuously.

This is especially the case in regard to the Dayton Sand Bar, which has been suggested as the proper locality for a system of Driven Wells, and where a large part of the pumping plant would be frequently under water, beyond any possibility of examination and repairs.

**QUESTION NO. 4.**

“What source of supply do you recommend?”

The Ohio River is recommended as the source of supply.

Its headwaters are in the Sand-stone region, the water from which is very soft. For 100 miles above the city, it flows through
a limestone district, but the degree of hardiness which the water attains by the time it reaches Cincinnati, is about in the neighborhood of five degrees. This is very near the limit at which water becomes objectionable for domestic purposes. There is no other source of supply available to Cincinnati, however, which is anywhere near this limit.

The water obtained from Driven Wells on the Turkey Bottoms is over 28 degrees. The water in the Miami River and Tributaries range from 11 to 15 degrees.

The many chemical analyses which have been made of the Ohio River water during a period of 35 years demonstrate on the whole, that it is wholesome and suitable for a public water supply; provided that it is taken from the river at places uncontaminated.

The volume is abundant at all seasons of the year, and the city can be supplied therefrom by the simplest and least costly system of works, not excepting any other system of supply within reach of Cincinnati, either physically or financially.

It is, in fact, the only source of supply, which, all things considered, can be consistently recommended.

Much weight is added to this statement by the concurrence of opinion of the engineers who have investigated the subject within the past 25 years.

**QUESTION NO. 5**

"What location do you recommend for the Pumping Station?"

The question of location of the Pumping Station is so intimately connected with the location of the Intake; of the system of pipes; of the reservoirs, and of all other structures connected with the proposed work, that it would be difficult to consider it separately, and it has been deemed proper to include in the following answer, the aggregate results of our study of the whole plan in this particular.

Having stated in the preceding remarks, that the Ohio River is recommended as the source of supply, and that the water of the Miami River is undesirable in several respects, it follows that the point at which, in our opinion, the water should be taken, must be on the Ohio River, above the mouth of the Miami, and at such distance above it, as shall secure favorable conditions, within reasonable limits of expenditure.

Markley Farm has been under consideration for years, as the most desirable site for the location of the Head Works of the new Supply, especially, on account of its alleged facilities for the construction of a large reservoir or reservoirs. There are not in the neighborhood, any grounds favorably situated for their construction, and attention was probably called to the Markley Farm from the fact, that it was the only available site for the storage of water at a high level.

While recognizing the usefulness and desirability of high level reservoirs when they can be secured at a reasonable cost, and built under favorable conditions, we think that where the source of supply is abundant, as it is in the Ohio River, they are not of absolute necessity, and that modern pumping engines of the best type and construction offer as great security against interruption of the supply as large storage reservoirs, provided there is a proper surplus of pumping power.

Moreover, the first cost and expense of maintenance of abundant pumping facilities, is far less than is required in the case of large reservoirs; besides, the water is less liable to deterioration in transit between the source of supply and the consumer.

If settling basins are considered necessary, they should be placed in preference at such elevation, if they can be so built within reasonable outlay, as to supply the city directly by gravity, without the necessity of pumping the water by two lifts.

The elevation of a reservoir as formerly proposed for Markley Farm, is not favorable, as the "Head" would not be sufficient to convey the water economically to the City, and such deficiency in the pressure would necessitate a costly increase in the number of pipes conveying the water to Eden Park Reservoir.

The only merit that belongs to the Markley Farm project is, in our judgment, the fact that the site is adapted to constructing an acceptable Intake at minimum cost; there is no point on the
North bank of the river between Front street station and the Markley Farm, suited for this purpose; but this single advantage is more than counter-balanced by the cost of building the proposed reservoir, of adding to the number of delivery pipes and of increasing their length.

It being undesirable, for obvious reasons, to look for a location above Markley Farm, the site for the Pumping Station should be at a point as near to the mouth of the Miami as would combine the double advantage of a favorable location for settling reservoirs, and for an Intake in the Main Channel.

The point on the river about opposite the Pumping Station of the new Covington Water Works, unites these advantages; the Channel on the South Side presenting unequaled facilities for the taking of water at all stages of the River, and the location is equally favorable whether the remaining portion of the works be established on the Kentucky or the Ohio Side.

If built on the Kentucky shore the plan of works would comprise mainly: the pumping station on the shore with an Intake tower; a system of pipes to convey the water to the point selected for settling reservoirs; a system of settling reservoirs; pipes conveying the water to the town of Bellevue, opposite Washington street in Cincinnati; two tunnels through which the pipes cross the river; and lastly, an extension of pipes to reach Eden Park Reservoir.

The plan of works on the Ohio side, includes the Intake on the Kentucky shore proposed for the first plan, conveying the water thence by a tunnel to the pumping station on the Ohio side; a system of settling reservoirs on the ground selected between the mouth of the Miami river and the town of California; and a system of pipes conveying the water therefrom to Eden Park Reservoir; the pipes being carried over the Miami river on a bridge, and laid through "Turkey Bottom."

### Works on the Ohio Side.

**ESTIMATE OF COST.**

<table>
<thead>
<tr>
<th>For Supply Per 24 Hours.</th>
<th>50,000,000 gallons.</th>
<th>Additional cost when increased to 75,000,000 gallons.</th>
<th>Additional cost when increased to 100,000,000 gallons.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Real Estate, including Right of Way</td>
<td>$65,000</td>
<td>150,000</td>
<td>200,000</td>
</tr>
<tr>
<td>Intake Tower on Kentucky Shore and Tunnel under Ohio River</td>
<td>150,000</td>
<td>$100,000</td>
<td>200,000</td>
</tr>
<tr>
<td>Engine and Boiler House</td>
<td>200,000</td>
<td>250,000</td>
<td>350,000</td>
</tr>
<tr>
<td>Pumping Engines and Boilers</td>
<td>800,000</td>
<td>$250,000</td>
<td>300,000</td>
</tr>
<tr>
<td>Pipe Lines connecting Pumping Station with Settling Reservoirs</td>
<td>55,000</td>
<td>22,000</td>
<td>44,000</td>
</tr>
<tr>
<td>Settling Reservoirs</td>
<td>1,000,000</td>
<td>400,000</td>
<td>600,000</td>
</tr>
<tr>
<td>Pipe Lines from Pumping Engines to Eden Park Reservoir</td>
<td>1,368,000</td>
<td>684,000</td>
<td>1,050,000</td>
</tr>
<tr>
<td>Gate Wells, Stop Gates, Standpipe, Bridge across the Miami River</td>
<td>262,000</td>
<td>17,000</td>
<td>38,000</td>
</tr>
<tr>
<td>Engineering and Contingencies, 10 per cent.</td>
<td>$390,000</td>
<td>$147,300</td>
<td>$294,600</td>
</tr>
<tr>
<td>Totals</td>
<td>$4,290,000</td>
<td>$1,020,300</td>
<td>$1,757,900</td>
</tr>
</tbody>
</table>
The foregoing estimates show that the difference in the first cost between the two plans is not large, but the extra height to which the water would have to be lifted on the Kentucky side, in order to reach the only location which has been found available for settling reservoirs, being about 140 feet, the operating expenses would be much greater; the excess of yearly expenditure, if capitalized at 4 per cent. would represent not less than two millions of dollars, for a pumpage of 75,000,000 gallons per day.

As usual in such cases, each plan possesses advantages and disadvantages on which opinions may differ, but in view of the important difference, just mentioned in the cost of pumping, other differences should be overlooked, and we recommend as the best location for a pumping station and for settling reservoirs, the grounds already referred to on the Ohio side of the river, between the mouth of the Miami and the town of California.

QUESTION No. 6.

"What method of clarification, if any, do you recommend?"

The establishment of the pumping station at the locality just recommended would avoid the pollution to which it is exposed at the Front street Station. This result, however, is not sufficient. The water from the Ohio River, for a period of about eight months in the year, must be clarified, if it is to meet the reasonable requirements of the domestic and the manufacturing needs of the people of Cincinnati.

Experience has shown that subsidence, in settling reservoirs, removes from the water a portion of the sediment contained, and while the degree of clarification obtained by such means is not satisfactory, when the amount of matters in suspension is small, the proportional of improvement of the water increases as it becomes more turbid. On the whole the results to be thus obtained justify the outlay necessary for building settling reservoirs, the cost of which is included in the foregoing estimate.

Filtering alone, we think, can remove fully, or nearly so, the suspended matter which interferes with the clearness of the water.
This process, however, which must be adapted to the local conditions and requirements of each case, has never been resorted to on a large scale for the water of the Ohio, or in this climate, or even in the United States; and the structures necessary to carry it out cannot be safely designed without further information such as may be obtained from the elaborate experiments now in progress; the continuance of which we hereinafter recommend.

When sufficient information has been collected, if it is desired to obtain a higher degree of clarification, data will be at hand to determine the character of the necessary structures and the cost thereof.

In addition to the preceding remarks, which answer the questions presented to us last year, the following is submitted in compliance with the directions contained in the following resolution of your Board, dated, November, 1888, and at the request of your Consulting Engineer, and also in accordance with the result of his investigations.

RESOLVED, "That the Consulting Engineer be requested to survey and report to the Board the cost and advisability of constructing a sewer along the North Bank of the Ohio River, to such point below the present intake of the Water Works, as to prevent contamination of the Water."

The construction of the sewer is suggested only in view of the possible retention of the present Pumping Station. As we are of the opinion that the latter ought to be removed to a higher point on the River herein-before indicated, it therefore follows that we cannot consistently recommend the construction of the sewer; we consider it as wholly inadvisable, even if it could be built at a reasonable cost. The surveys and estimates requested by your Board have been made, however, and we find that this structure would cost not less than two and a quarter millions of dollars.

The main conclusions reached by this Board may be summed as follows:

1st—It is imperatively necessary for the integrity and for the purity of the water supply of Cincinnati, to abandon the present pumping station.

2nd—The Ohio River should be the source of supply.

3rd—The best location for the Pumping Station is the Ohio Shore, between the mouth of the Miami River and the town of California.

4th—The Intake should consist of an inlet tower on the Kentucky shore with a tunnel leading therefrom, under and across the Ohio River to the Pumping Station.

5th—Settling Basins should be built to improve the quality of the water.

Before bringing this report to a close we think it important to call your attention to the unfinished condition of the work of research begun last year, on account of the lateness of the season at which the surveys, examinations and experiments recommended by us in our preliminary report were commenced, it was found impracticable to fully complete them. The experiments on filtration have only lately been commenced, and the field work of the surveys needs to be extended further, notably the soundings and borings in the river.

In order that the city may realize the greatest benefit from this work, it should be completed.

The experiments on settling and filtration should by all means be uninterruptedly carried on for at least two years to come.

We therefore recommend that the present investigations be completed, and that the results be carefully collated and tabulated for the benefit of the citizens.

Respectfully submitted,

CHAS. HERNANY, President.
CHAS. B. BRUSH, Secretary.
HENRY FLAD.
DEWITT C. CREGIER.
A. FTELEY.
CINCINNATI, Ohio, March 12, 1888.

TO THE WATER SUPPLY COMMISSIONERS OF THE CITY OF CINCINNATI.

Gentlemen:—The Board of Engineers, to which you have submitted certain questions in regard to the Water Supply of the City of Cincinnati, after such personal examination as seemed necessary of localities in and adjacent to the city, and after obtaining information from the large mass of printed documents and written communications which were submitted, and hearing such persons as were expected to possess information on the subject,—beg leave to report that they arrived at a unanimous conclusion on all the questions submitted to them, but that the time at their command is not sufficient to prepare a full report, particularly since one of the members of the Board has been called away by urgent public business.

But as it seems to be of paramount importance to your city, that the conclusions at which we have arrived should be made known to you and to the people of Cincinnati at the earliest possible date, we have deemed it proper to submit this as a preliminary report, answering briefly and succinctly the questions submitted, and to defer giving a full statement of the reasons which have guided us in arriving at our conclusions until we have had time to properly arrange and to formulate the views of the different members of the Board.

The questions and our answers thereto may be briefly stated as follows:

No. 1.—Is the location of the present Intake on the Ohio River a proper one?

Answer.—No.

No. 2.—Is it practicable and advisable to enlarge and improve the present Pumping Station?

Answer.—It is not.

No. 3.—Is it practicable and desirable to supply Cincinnati with wholesome water from a system of Driven Wells?

Answer.—No.

No. 4.—What source of supply do you recommend?

Answer.—The water should be taken from the Ohio River, above the Little Miami River, and from an inlet, tower, or pier, placed on the northern or right bank of the river.

No. 5.—What location do you recommend for the Pumping Station?

Answer.—This question cannot be fully answered until further examination and surveys have been made. We recommend that a competent engineer should be selected at once to proceed with this work.

The necessity for such action will become apparent to you when we state as we now do, that, in our opinion, the plan of constructing a storage reservoir on the Markley Farm is impracticable, for reasons which will hereafter be more fully given.

No. 6.—What method of clarification, if any, do you recommend?

Answer.—No definite plan can be recommended at present, but we believe it advisable that the engineer selected for making the surveys and examinations above referred to should also be intrusted with the duty of instituting a series of experiments on the applicability of the different methods now in use for clarifying the water by settling and filtering, and that this should be done on a scale sufficiently large to admit of its serving as a guide in arriving at an intelligent conclusion, both as to the practicability and cost of the process. We may in our full report...
definitely indicate the nature and extent of the experiments which we consider necessary.

Besides the questions answered above, several others have been submitted verbally by members of your Commission. To those questions we reply as follows:

It would be unsafe to rely on a single line of supply-main under any circumstances.

The supply-mains should be of cast iron.

We consider the use of a supply-main of cast iron, 62 inches in diameter, as not warranted by practical experience.

The main supply pipes, where laid in embankment, should be placed at a safe distance apart.

We beg leave to call your attention to the fact that the surveys may be made within a month or two, sufficient if properly directed, to determine the general system to be adopted, and that therefore the construction of the new works will not be materially delayed. Early relief may be received in this way by the City, if necessary means for prosecuting the work are promptly obtained.

There are several feasible methods of utilizing the water taken from the Intake located as above proposed, beyond the Little Miami River, for supplying the City. The one that is most practicable can easily be determined as soon as the surveys have been made, and the plans prepared.

It is not practicable to obtain from Dayton Bar a permanent supply of water for Cincinnati.

In conclusion, we deem it pertinent to say, that from every point of view, we cannot too strongly urge prompt action in the pressing and very important matter of an increased and improved water supply for the City of Cincinnati.

While for reasons above stated, we are not prepared to submit an estimate, we are inclined to believe that the cost of any system of supply which we may be prepared to recommend, will not exceed Six Million Dollars.

Respectfully submitted,

HENRY FLAD. CHAS. HERMAN Y, President.
DeWITT C. CREGIER. CHAS. B. BRUSH, Secretary.
A. FTELEY.

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