INDEX.

Notice of Appeal.

(Served Oct. 15, 1918)

IN CHANCERY OF NEW JERSEY.

BETWEEN
THE MAYOR AND ALDERMEN OF JERSEY CITY,
Complainant,

and

JERSEY CITY WATER SUPPLY COMPANY,
Defendant.

On Application for Leave to File Bill of Review, &c. Notice of Appeal.

The complainant, The Mayor and Aldermen of Jersey City, hereby appeals from the order of the Chancellor made in the above entitled cause under date of October 8th, 1918, dismissing the petition of said complainant, and from the whole and every part of said order to the Court of Errors and Appeals in the last resort in all causes.

JOHN BENTLEY,
Solicitor for Complainant.

Dated October 14th, 1918.

I conceive there is good cause for appeal from the above stated order.

JOHN MILTON,
ALBERT C. WALL,
of Counsel.

Petition of Appeal.

(Served Oct. 15th, 1918)

NEW JERSEY COURT OF ERRORS AND APPEALS.

Between THE MAYOR AND ALDERMEN OF JERSEY CITY, *Complainant-Appellant,* and JERSEY CITY WATER SUPPLY COMPANY, *Defendant-Appellee.*	Petition of Appeal.

TO THE HONORABLE,
THE COURT OF ERRORS AND APPEALS,
in the last resort in all causes:

The petition of the Mayor and Aldermen of Jersey City, the above named complainant, respectfully shows:

That your petitioner finds itself aggrieved by a certain order or decree made in the above entitled cause under date of October 8th, 1918, wherein and whereby the Chancellor does adjudge that your petitioner is not entitled to the relief sought and prayed for in the petition filed by it in the above cause, and that said petition be dismissed and by each and every part of said order or decree, and your petitioner humbly appeals from each and every part of said order or decree upon the ground that the same is erroneous and contrary to the evidence in the cause, inequitable and contrary to law. Your petitioner therefore prays that the said order or decree of the Chancellor may be reversed, set aside and for nothing holden, and that your petitioner may have such relief in the premises as to this Court shall seem meet.

JOHN BENTLEY,
Solicitor for Complainant-Appellant.

ALBERT C. WALL,
of Counsel with Appellant.

Petition for Leave to File Bill of Review

IN CHANCERY OF NEW JERSEY.

BETWEEN The MAYOR and ALDERMEN of Jersey City, *Complainant,* *and* JERSEY CITY WATER SUPPLY COMPANY, *Defendant.*	On Application for Leave to File Bill of Review.

TO THE HONORABLE EDWIN ROBERT WALKER,
CHANCELLOR OF THE STATE OF NEW JERSEY:

Your petitioner, THE MAYOR AND ALDERMEN OF JERSEY CITY, a municipal corporation of this state and a city of the first class, respectfully shows:

1. On May 1st, 1908, an opinion of this Court, advised by the Honorable Frederic W. Stevens, Vice Chancellor, was filed with its Clerk in a cause wherein The Mayor and Aldermen of Jersey City was complainant, and Patrick H. Flynn *et al.* were defendants. Said opinion is printed in Volume 74 of the New Jersey Equity Reports, Page 104 *et seq.*. Said opinion is referred to for a full statement of the facts and matters in issue in the same manner as if they were here specifically alleged.

In said cause your petitioner alleged, among other things, that it had entered into a contract with Flynn for the construction of water works and that the contract had been assigned to the said Jersey City Water Supply Company and that your petitioner was compelled to accept said works notwithstanding they were not completed in accordance with the contract; that it desired to pay therefor but that the defendant could not deliver said works to your petitioner because the same had not been constructed as required by said contract; and the bill of complaint prayed, *inter alia*, that it be ascertained in such manner as the Court might deem proper, what part of said water works system the said defendants could convey to your petitioner, and what part of the consideration of \$7,595,000. should be paid by your petitioner to the said Jersey City Water Supply Company therefor.

2. Thereafter on June 4th, 1908, a final decree was duly filed with said Clerk.

3. By said decree this Court was of opinion and adjudged, *inter alia*, that the defendants, Flynn and the Jersey City Water Supply Company, had not complied with those provisions of the contract between the City and the said defendants which stipulated that the supply of water delivered to Jersey City should at all times be free from pollution, it appearing as the Court said,

> "that the works as a mechanism for the purification of the supply are not at all times adequate and reliable".

It was further provided that the defendants therein referred to should convey the water works, appurtenances, &c., to the City upon payment by the City to said company of the contract price less certain named abatements of the purchase price, of which the 7th abatement was as follows:

> "Seventh: There shall also be deducted from the contract price the cost of establish-

ing intercepting sewers and drains and sewage disposal works capable of substantially preventing the contamination of the Rockaway River above the Boonton Reservoir from the sewage of the City of Dover, the City of Boonton and the Village of Hibernia, which cost shall be hereafter determined by the Court. In lieu of and as a substitute for all or any of the sewers and sewage disposal works above referred to in this paragraph, the defendant company may, within ninety days from the date hereof, present other plans or devices for maintaining the purity of the water delivered by the company to the City throughout the year under present conditions, and estimates of the cost of the works now necessary therefor; and both parties may present evidence touching the efficiency of such plans or devices to produce the necessary results, and the cost thereof; and the defendant company may, pending the taking of testimony, with the leave of the court, upon notice, present amendments and modifications of such plans and devices."

(See opinion of Court of Errors construing the preceding paragraph, *76 Equity, p. 608;* see Paragraph 5 of this petition.)

The decree provided for a reference to a Special Master as follows, *inter alia:*

"And it is further ordered, adjudged and decreed, that it be referred to the Honorable William J. Magie, one of the Special Masters of this Court, to ascertain and report upon the cost of sewers and of sewage disposal works , and of intercepting sewers or drains necessary to substantially prevent the contamination of the waters of the Rockaway

River from the sewage of Dover, Hibernia and Boonton, and also to investigate and report upon other plans and devices as alternative remedies presented by the defendant company for delivering water to the City in a pure and wholesome condition throughout the year, under present conditions; and upon the cost of the works now necessary therefor;''

4. Said decree expressly reserved the right to apply to this Court for such further decree as might be necessary to carry the said decree into effect, in the following words:

> ''And leave is hereby reserved to either party to apply to the court, at the foot of this decree, for any such further order or decree as may be necessary to carry this decree into effect.''

5. Thereafter cross-appeals were filed on behalf of the City and the Water Company, the ninth ground in the petition of appeal of your petitioner being as follows:

> ''*Ninth:* Because the said decree finds and adjudges that the defendants, in lieu of and as a substitute for all or any of the sewers and sewage disposal works referred to in the said decree, may, within ninety days from the date of this decree, present other plans or devices for maintaining the purity of the water delivered by the defendants to the City throughout the year and under the present conditions and estimates of the cost of the works now necessary therefor; whereas the said court should have made no such adjudication in favor of the defendants.''

Thereafter such proceedings were had that the Court of Errors and Appeals on March 22nd, 1910, affirmed the decree of the Court of Chancery except as to the 5th item of abatement—a matter which has no relevance to the present proceeding. The opinion (February 28th, 1910), is printed in *76 Equity, p. 607.*

In the opinion (p. 608) the Court of Errors and Appeals declared the meaning of Paragraph 7 of the decree (set forth in Paragraph 3 hereof) as follows:

> "As we read this provision of the decree, the second part of it is in modification of the first part, the purpose disclosed by it being to relieve the water supply company from the deduction from the purchase price, of the cost of establishing sewers, drains and sewage disposal works for the prevention of the contamination of the Rockway River above the Boonton Reservoir, provided the company is able to exhibit a less expensive plan or device for preventing such contamination *and which will insure that result;* and, if the company shall succeed in doing so, then permitting the cost of the works necessary for the installation of such plan or device, instead of the cost of constructing sewers, drains and sewage disposal works, to be deducted from the contract price. So read, the decree seems to us to be manifestly fair and just to both parties and to afford no ground for criticism."

6. On April 12th, 1910, decree was made by the Chancellor on remittitur from the Court of Errors and Appeals in accordance with the decree of affirmance of that court, and the number of the 7th abatement was changed to the 6th abatement and the decree of June 4th, 1908, was in all other things affirmed.

7. The proceedings outlined above completed

what is referred to hereinafter as the "Main Case"—other proceedings have to do with the matters mooted in the reference before the Special Master in which the question was in respect of the right of the Water Company to deliver a substitute device or method for the intercepting sewers and drains and sewage disposal works referred to in Paragraph designated "Seventh" set forth in Paragraph 3 above.

8. On September 3rd, 1908, the Jersey City Water Supply Company filed its petition presenting plans and devices for maintaining a substitute for all or any of the sewers and sewage disposal works referred to in Paragraph 3 above. The system proposed was a novelty and was referred to in the said petition as follows:

> "The system of purification involved in the plan adopted is the sterilization of the water at the gatehouse below the Boonton dam by the means of oxygen liberated in an active state. Oxygen in such a state is universally acknowledged to be the most destructive agent for organic matter known. The water for a short distance below the gatehouse at Boonton will be practically sterile; in other words, the oxygen will destroy all germs, including the intestinal class, contained in the water as it leaves the reservoir. It is true that the water as delivered at Jersey City will not be sterile because it will take up in its passage through the conduits and pipes, harmless water bacteria. They will be few in number and the intestinal bacteria will not be present."

9. Thereafter witnesses were examined and evidence presented to the Special Master, and such proceedings were had that on May 10th, 1910, the

Special Master filed his report upon the matters referred to him under the final decree of June 4th, 1908, under which the Special Master was called upon——

(a) To ascertain and report upon the cost of and sewage disposal works and of intercept-sewers and sewage disposal works and of intercepting sewers or drains necessary to substantially prevent the contomination of the waters of the Rockaway River from the sewage of Dover, Hibernia and Boonton.

(b) To investigate and report upon other plans and devices as alternative remedies presented by the defendant's company for delivering water to the City in a pure and wholesome condition throughout the year, under then present conditions, and upon the cost of the works then necessary therefor.

In respect of the second question (b) referred to him, the Special Master reported that the Water Company had presented as an alternative remedy a plan and device for delivering the water in a pure and wholesome condition throughout the year; that the device was first put in operation on the 26th of September, 1908; and continued in operation since it was installed and subjected to constant observation respecting the quality of the water and particularly by comparison bacteriologically of the water as it left the reservoir, with the water as it passed into the pipe conveying it to Jersey City at the distance of about three quarters of a mile below the intake, and with the water delivered at Jersey City.

Inter Alia, the Master's report said:

"The theory upon which this plan or device is supported is this: The water in the reservoir had been found to have become, by reason of sedimentation, in the large reservoir, exposure to sunlight, &c., to be reasonably pure and free from contamination for a large part of the year. It had, however, been determined that at certain periods there was risk that the water delivered from the reservoir might be so contaminated as not to be pure and wholesome as required by the contract. The contamination had been determined to be indicated by the presence of germs, particularly of that called Bacillus Coli, which itself is indicative of the possibility of the presence of typhoid germ. The purpose of the device is to remove by chemical action, organic matter from the water, including the germs deemed to be contaminating and possibly pathogenic. It is designed to supplement the purifying action upon the water of the large reservoir.

"The plan contemplates the addition to the watĕr, as it is discharged from the reservoir into the pipe leading to Jersey City, of a minute quantity of bleach or chloride of lime. Without attempting to describe the chemical changes, it is sufficient to say that it is established by the proofs that hypochlorous acid is produced almost immediately and that the oxygen contained therein seizes upon and destroys organic matter in the water. The device included tanks in which the solution of the bleach is made by stirring, the power being obtained by the water in the reservoir. The solution when pumped into another tank is discharged through an aperture which may be increased or diminished in size, into the water flowing in the pipe. The operation requires the attention of skilled workmen to determine the chemical value of the bleach employed, the amount to be applied and the continuous operation of the plant. Much of the operation is automatic but some of it and that the most important part, must depend upon the action of the men in charge. In this respect it is similar to the operation of filtering plants when used for the purification of water.

"From the proofs taken before me, of the constant observation of the effect of this device, I am of opinion and find that it is an effective process which destroys in the water the germs, the presence of which is deemed to indicate danger, including the pathogenic germs, so that the water, after this treatment, attains a purity much beyond that attained in water supplies of other municipalities. The reduction and practical elimination of such germs from the water, was shown to be substantially continuous."

The report also stated:

"I do therefore find and report that this device is capable of rendering the water delivered to Jersey City pure and wholesome for the purposes for which it is intended, and is effective in removing from the water those dangerous germs which were deemed by the decree to possibly exist therein at certain times."

The Master also found that another plan contemplating the use of a solution of common salt after the solution had been electrolized, would be equally effective and would maintain the purity of the water.

10. On May 19th, 1910, the City filed exceptions to the Master's report on the grounds, *inter alia*—

"*3rd Exception:* Because the Master finds that chloride of lime, being the solution described, leaves no deleterious substance in the water; whereas the Master should have found that chloride of lime is a poison and will leave a deleterious substance in the water if used in sufficient quantities. That the use of this solution is an experiment, the effect of the continual use of which for a series of years as an addition to water intended for drinking and domestic purposes, is unknown and now unknowable and that its use, depending as it does, on the skill and care of employes, is too dangerous to be adopted by the complainant.

"*4th Exception:* For that the said Master has reported that he finds the plans and devices presented as an alternative remedy are an effective process which destroys in the water the germs, the presence of which is deemed to indicate danger, including the pathogenic germs, so that the water, after this treatment, attains a purity much beyond that attained in water supplies in other muncipalities. Whereas the said Master should have found that the plans and devices presented as an alternative remedy do not destroy the spore-forming pathogenic bacteria in this water and that they do not affect, remove or lessen to an appreciable extent the polluting organic matter or filth in the water.

"*6th Exception:* Because the Master reported that this device is capable of rendering the water delivered to Jersey City pure and wholesome for the purposes for which it is intended and is effective in removing from the water those dangerous germs which were deemed by the decree to possibly exist therein at certain times; whereas the Master should have reported that this device is not capable of rendering the water delivered to complainant pure and wholesome; that the sewers, when built, would absolutely prevent the sewage which entered them from contaminating this water, while these alternative plans and devices only assume to kill in this sewage those pathogenic bacteria which were known to be water-borne at the date of the execution of the contract.''

11. On November 15th, 1910, a decree confirming the Master's report, except as to so much thereof as related to the cost of sewers and sewage disposal works, and overruling the City's exceptions, was made. Said decree provided:

> ''That the said alternative plan and device hereinbefore referred to and put in use by the defendant, is approved as a substitute for the sewers and sewage disposal works, intercepting sewers and drains in the said decree suggested, except as hereinafter mentioned, and no deduction or abatement of the purchase price, except as hereinafter mentioned, shall be made because of the lack of any such sewers, works and drains or because of any defect in the works as a mechanism for the purification of the supply.''

12. Said decree confirming report contained this provision:

> ''and leave is hereby reserved to either party to apply to the Court in manner and form as such leave was reserved in the said decree of June 4th, 1908.''

Such manner and form are set forth in Paragraph 4 of this petition.

13. Thereafter the City appealed from the decree of November 15th, 1910, confirming the Master's report, and such proceedings were had that the Court of Errors and Appeals on July 11th, 1911, decided, upon the opinion of Vice Chancellor Stevens, to affirm those portions of the decree of November 15th, 1910, involved in the appeal.

A portion of such opinion of the Vice Chancellor was as follows:

> "The Master reports that the device for removing dangerous germs now in operation, is effective and capable of rendering the water delivered to Jersey City pure and wholesome for the purposes for which it was intended. I see no reason to dissent from his view."

The opinion is printed in *79 Eq. 212.*

Thereafter on August 2nd, 1911, the record was sent down to the Court of Chancery.

14. On the 11th day of October, 1911, the water plant was turned over by the Jersey City Water Supply Company to the City and the consideration decreed to be paid by this Court duly paid.

15. It appears therefore that in the course of the litigation above referred to, the law of the case in respect of the chlorination device which the Water Company was permitted to substitute for sewers, drains and sewage disposal works, called for a device designed to insure the prevention of the contamination of the Rockaway River above the Boonton Reservoir; and further, that in order to safeguard that result and not commit the welfare of the City and the inhabitants thereof to the hazard of a discovery made,

as the brief for the Water Company stated "almost under the eye of the Master, the experiments giving new light pending the testimony," it was provided by this Court that leave was reserved to the City to apply to the Court for such further decree as might be necessary to carry into effect the decree of 1908 in the main case, as well as the decree of November 15th, 1910, permitting the Water Company to perform its contract by means of a substitute device; and your petitioner avers that it was the plain purpose of this Court, as evidenced by said reservations, to safeguard the rights of the City and to leave the door of this Court open to the City in case the substitute device should not be a full, adequate and complete substitute for the intercepting sewers, drains and sewage disposal works to which this Court had decreed your petitioner was entitled; and your petitioner further avers that the result which the substitute device must insure was pure and wholesome water in accordance with the City's right thereto as established by the decree of 1908 in the main case.

By such a provisional disposition of the controversy, this Court took the only course which would permanently safeguard the rights of the City and the Water Company, saying in effect by its disposition of the matter that no good purpose will be served by making the Water Company install the intercepting sewers called for in the contract if the fact be that this substitute device will achieve the same result as sewers at much less cost; nor, on the other hand, will equity be served if the City's right to the kind of water to be provided by the contract be nullified in case the proposed device fall short of present hopes. Therefore the only just course is to permit the parties to return here for further direction so that the spirit and equity of the contract may be performed and no lesser or greater advantage accorded to either party.

16. The substitute device was not an adequate substitute for intercepting sewers at the time it was ordered, nor did it meet the requirements of the Seventh Paragraph of the decree in the main case either at the time the substitute device was approved by this Court or at any time thereafter.

And your petitioner further shows that the decrees herein mentioned have been duly enrolled.

And your petitioner further shows that since the pronouncing of the said decrees above referred to, your petitioner has discovered the matter set forth in the foregoing paragraph (16) as well as new matter of consequence in the said cause, which new matter your petitioner did not know and could not by reasonable diligence have known so as to make use thereof in the said cause previously to and at the time of pronouncing said decrees relative to the substitute alternative device for sewers and sewage disposal works.

A particular statement of such new matter is as follows:

(a) The limitations of hypochlorite treatment existent in 1908-9 have become increasingly manifest by actual experience in dealing with what is really an emergency device and not a reliable method for the treatment of water which at times is highly polluted and is subjected previously only to sedimentation and which undergoes rapid fluctuation as to its composition—all of which was true of the water entering the Boonton Reservoir in 1908-9 and has been true since.

(b) The water entering the Boonton Reservoir is too foul for treatment by filtration or any other known method of purification, and this condition has come about as the inevitable result of the factors existent at the time the Court decreed that the chlorination device was an adequate substitute for sewers.

(c) In order to prevent pollution of the Rockaway River and its tributaries, sewers and sewage disposal works are necessary and were necessary in 1909. In recognition of this, on February 4th, 1918, the City of Jersey City made application to the State Department of Health for approval of plans for the construction of a trunk sewer and sewage treatment works to prevent pollution of the Rockaway River by polluting materials from various municipalities, including Dover, situate on the watershed of the Rockaway River above the Jersey City Reservoir at Boonton, and the State Department of Health on May 7th, 1918, approved the general scheme for the construction of a trunk sewer and sewage treatment works as a sanitary measure and described the limits of territory for which such system of drains and sewers shall be constructed. Within the territory so described is all the territory within the corporate limits of the Borough of Wharton, the Town of Dover, the Borough of Rockaway, &c.

(d) At or subsequent to 1909, pipes and overflow drains through which polluting wastes from cesspools flowed directly into the Rockaway River and its tributaries, were disconnected in the belief that the sewage ultimately reaching the river would be purified by flow through soil from its point of origin. Since 1909 it has been found that the conditions as to such pollution of the river have become markedly worse due to the fact that the soil, particularly in the densely populated part of the City of Dover, has become saturated with polluting matter and is no longer capable of purifying the sanitary wastes to any substantial extent before they reach the river. The result is, and although it was not recognized in 1909, the conditions made it inevitable then that the polluted wastes of a large portion of Dover enter the Rockaway River and its tributaries directly and unpurified exactly as matter comes through a filter which is not functioning.

(e) Bacteria are stunned and not killed by the hypochlorite process which was substituted for sewers and sewage disposal works. The fact was not known to your petitioner in 1908-9 or to any of the experts or witnesses obtainable at that time.

(f) Low temperatures nullify the effect and action of hypochlorite. This fact has only been recognized in the past year.

(g) The water delivered to Jersey City is unfit for use according to the standards of purity adopted by the United States Public Health Service for waters to be used in interstate commerce and below the standards adopted by the International Joint Commission on boundary waters representing the United States and Canada in June, 1914, and was so unfit in 1909, and the requirements of said standards were proper requirements as tests of pure and wholesome water at that time.

(h) The operation of hypochlorite is to artificially interfere with the character of the water entering the Boonton Reservoir and by destroying large portions of certain bacteria to conceal serious sewage pollutions. The pollutions themselves are not destroyed by the sterilizing process but only the evidence of the pollution. This fact was only partially recognized in 1908 and 1909.

(i) The bacterial test is far less reliable than it was considered to be in 1908 and 1909. Its applicability is limited to fewer conditions than was thought to be the fact in that period. It is a test for contamination, not a test for purity. It rests on the theory that because the bacillus known as B.Coli is always found when the germ of typhoid is present, which last has not been segregated in water, the presence of B.Coli is a danger signal; but when the fact is established, as it is in this case, that pollutions enter the water and were bound so to do by conditions existing in 1908-9, it is idle to blink such a fact and rest on the results of inquiry as to whether or no bacterial tests evidence pollution. The bacterial test is merely corroborative if a survey of the watershed demonstrates the entry of pollution in unreasonable quantities, as is the case in this case. No corroboration by means of bacterial tests is necessary. In 1908-9 too much reliance was placed by the experts on both sides of the cause on the finality of the bacterial test for B.Coli. It was not then recognized, as it is now by water experts, that the bacterial test is chiefly of value where other methods of investigation are not available. There is no bacterial test which will determine whether a water is pure and wholesome.

(j) The water delivered to Jersey City is not pure and wholesome and was not in 1908-9, and the device substituted for intercepting sewers did not effect the delivery to Jersey City consumers of pure and wholesome water in accordance with the rights of the City as declared in the decrees of this Court in the litigation adverted to above.

(k) The sterilizing process does not destroy B.Welchii and the spore-forming bacteria. B. Welchii is now known to be not only an indicator of sewage contamination, but the actual cause of peritonitis, intestinal putrefaction, auto-intoxication and many other diseases—a fact only partially and dimly recognized in 1908-9.

(l) The conditions in the Rockaway Watershed existent in 1908 and 1909 and existent since were and are prejudicial to the public health of the citizens of Jersey City.

(m) There is no known method of determining how much hypochlorite or bleach should be added to the water to attain the results which it was believed in 1908-9 were attained by the hypochlorite process. If there were any ascertainable standard and if the hypochlorite were effective, then the amount added to the water should of necessity be sufficient to kill all bacteria of a harmful nature; but no such freedom of operation is possible because the dose frequently creates such objectionable tastes and odors in the water in Jersey City that consumers are unable to use it. These facts were not realized in 1908 and 1909 because it was erroneously supposed that the margin between the amount of bleach necessary to kill dangerous bacteria and the amount of bleach which would create objectionable tastes and odors was so great that the question would not become a practical one. This was and is an error.

Your petitioner therefore prays:

1: That under the leave reserved to your petitioner to apply to this Court for such further order or decree as might be necessary to carry into effect the decree above referred to of June 4th, 1908, and the like reservation in the decree of November 15th, 1910, above referred to, this honorable Court open and modify the said decrees by providing that your petitioner shall receive the deduction from the contract price referred to in the Seventh Paragraph of the decree of June 4th, 1908; or, in the alternative—

2: That your petitioner may be at liberty to file a bill of review or application in the nature of a bill of review, for the purpose of having so much of the said decrees above mentioned as permitted the Jersey City Water Supply Company to substitute the alternative plan and vice hereinbefore referred to in lieu of said sewers and said sewage disposal works, intercepting sewers and drains in the decrees mentioned, reviewed, reversed and set aside and adequate relief granted to your petitioner against the defendant, or such persons and corporations as may be liable in the place and stead of said defendant; and your petitioner prays leave to use upon this application the files of the Court.

3: For such further or other relief as may be equitable.

JOHN BENTLEY,
Solicitor for Petitioner.

ALBERT C. WALL,
JOHN MILTON,
of Counsel.

Affidavit of George A. Johnson.

IN CHANCERY OF NEW JERSEY.

BETWEEN THE MAYOR and ALDERMEN OF JERSEY CITY, *Complainant,* *and* JERSEY CITY WATER SUPPLY COMPANY, *Defendant.*	On application for Leave to File Bill of Review.

STATE OF NEW YORK, }
County of New York, } ss.:

GEORGE A. JOHNSON, of full age, being duly sworn on his oath deposes and says:

(1) I reside in Newark, New Jersey, and am a hydraulic engineer and sanitary expert, with offices at 150 Nassau Street, New York City. My specialties are water supply, water purification, sewerage and sewage disposal.

(2) For the past twenty-one years without interruption I have been engaged on work relating to water supply, water purification, sewerage and sewage disposal, investigation of epidemics and other allied lines of municipal sanitation. I have served on water and sewage projects in over 75 cities in the United States, Canada and foreign countries. Some of the more important engagements in North America being the following:

(3) Washington, D. C., St. Louis, Mo., Philadelphia, Pa., Cincinnati, O., New York City, Chicago Stock Yards, Pittsburgh, Pa., State of New York, Allentown, Pa., Wheeling, West Va., Montreal, Que., Cambridge, Mass., Trenton, N. J.,

Quebec, Can., Perth Amboy, N. J., Reading, Pa., Jersey City, N. J., Bayonne, N. J., and the Passaic Valley Sewer Commission, New York State Conservation Commission and the Bronx Valley Sewerage Commission.

(4) My connection with these water and sewage projects has included the actual prosecution of chemical and bacteriological work, as well as the dirction thereof, the supervision of design and construction and the operation of water and sewage plants.

(5) I have been connected with the Jersey City Water project at intervals throughout the past ten years, and in that period have been actively engaged on this project for at least three years. I was in charge of the operation of the sterilization plant at Boonton, N. J., for about one year from the date on which it was first put into operation, and intermittently have advised with respect to its operation since that time. I have also made a searching sanitary survey of the Rockaway River Watershed.

(6) My employment in connection with the water supply of Jersey City has covered periods when the works were owned by the Jersey City Water Supply Company and afterwards when these works had been acquired by the City.

(7) I testified as expert in the suit of Jersey City *vs.* the Jersey City Water Supply Company in the proceedings before the Honorable William J. Magie, Ex-Chancellor, serving as Special Master in this case. In conjunction with my partners Rudolph Hering and George W. Fuller I designed and supervised the construction of the sterilization plant at Boonton built in 1908 which was substituted for sewers and sewage disposal works by order of the court following the proceedings above mentioned. I was in direct charge of the oper-

ation of this plant for several months after it was first put into operation.

(8) I served as an expert for the Union Stock Yards and Transit Company of Chicago in 1908, and at that time made the first recommendation of the use of hypochlorite of lime for the continuous sterilization of a water supply. My recommendations were adopted in the summer of 1908, and the process has been almost continuously used at the Chicago Stock Yards water filtration plant since that time.

(9) In the summer of 1908, with the satisfactory results at hand from the operation of the plant at Chicago, I recommended its adoption for the treatment of the water supply of Jersey City; and after this plant had been built and placed in operation, and after I had watched the results obtained from it through a period of several months, I believed, as I testified in the spring of 1909, that the sterilization device operating at Boonton on the water supply of Jersey City was a complete substitute for the sewers and sewage disposal works mentioned in the decree in which is generally known as the "main case."

(10) My connection with a large number of water purification projects since 1908, in which projects sterilization with oxygenated compounds of chlorine, such as hypochlorite of lime, have been an integral part of the purification processes, has furnished me with information decidedly at variance with the positive assurance I felt in the spring of 1909 that sterilization of unfiltered water with these compounds was complete, reliable and easy of application. I have discovered since I testified in 1909 a number of cardinal weaknesses in the process, and as fast as these limitations became known to me I made them public, perhaps my most important contribution

to the literature on this subject being an address made before the American Public Health Association at Milwaukee in September, 1910, the title of the address being "Hypochlorite Treatment of Public Water Supplies; Its Adaptability and Limitations." This address was published in the Journal of the American Public Health Association, Vol. 1, No. 8, August, 1911.

(11) In this address I pointed out certain limitations in the chlorine sterilization process which had come to my notice since I testified in the spring of 1909 in the case of Jersey City *versus* the Jersey City Water Supply Company. A list of these limitations as stated by me are contained in the above mentioned Journal on pages 573 and 574. Among the more important of these limitations which I therein pointed out being the following:

A. Difficulties encountered in applying this process in order to get the best possible results, requiring the application of the chemical to be carried out with much care and fidelity by a competent analyst, otherwise if the dose is not adjusted to meet satisfactorily all conditions there is liable to be alternately an overdose of the chemical which will result in objectionable tastes and odors readily noticeable to the consumers, or an underdose of the chemical insufficient to sterilize.

B. Inability of the process to destroy bacteria which are embodied in particles of suspended matter.

C. It is not possible to remove or destroy all of the spore-forming bacteria in water.

(12) The opinion I now hold respecting the efficiency of water sterilization with chlorine compounds, notwithstanding the fact that it is of unquestioned worth when applied as an emergency

measure, is that it is not a process which can be considered as a reliable one for the continuous treatment of a polluted water which is subjected to sedimentation and which is subject to rapid and wide fluctuations respecting its composition.

A. It is at this date well understood that cold temperatures seriously interfere with the sterilizing action of chlorine compounds. When such germicides are applied to water whereof the temperature is low the chlorine solution in part crystallizes, forming chlorine hydrate, and in this form is substantially inactive, being carried in the water in a solid state only to become wholly active as a germicide when the temperature of the water rises and the chlorine crystals redissolve. It is clear that this is a serious limitation of the process in that under the conditions stated not only is sterilization of the water at the point of application of the germicide rendered impotent in a material degree, but also the solidification of the liquid or gaseous germicide at low temperature precludes homogeneous mixing with the water to be sterilized, and when the crystallized germicide again dissolves irregular germicidal activity necessarily follows. Furthermore, the subsequent passing into solution of the crystallized germicide may occur irregularly, some parts of the water containing the crystals being undertreated, and therefore but imperfectly sterilized, and others overtreated, producing in the water offensive tastes and odors of the dissolving germicide.

(13) If I had known when I testified before Special Master Magie what I have since learned by personal observation respecting the limitations of this process I would not have testified in the unqualified manner that I did with respect to it. I now know that the process is not continuously reliable, and that it will not effect uniformly the

positive destruction of disease germs in the Boonton Reservoir water without either filtration or diverting sewers; nor would I have testified, as I did in the spring of 1909, that this process would yield at all times a pure and wholesome water for the people of Jersey City, or that the water with sterilization is equivalent to the water which would have been delivered to Jersey City had sewers and sewage disposal works been constructed in accordance with the decree of 1908. I now know that such is not the case, but that information I did not possess in the spring of 1909 when I gave my testimony.

(14) The waters of the Rockaway River as they enter the Boonton Reservoir are always foully polluted and have been continuously in this state since 1908. This pollution comes from a variety of sources, but principally from Dover, Boonton and Hibernia. Patently, if the pollution from these sources were removed by diverting it from the watershed, the unsanitary conditions on the watershed and progressively deteriorating character of the water entering the Boonton Reservoir would not have been and would not now be a fact.

(15) There has not been a material change in the number of residents on the Rockaway River Watershed since the proceedings before Special Master Magie in 1909.

(16) There are no complete sewer systems in any of these communities on the Rockaway River Watershed. Cesspools take the place of sewers and the contents of these cesspools seep away into the ground. While years ago the ground in the neighborhood of these cesspools was of a character enabling it to absorb these sewagic wastes issuing from the cesspools, the continual application to the soil of these wastes has resulted

in supersaturation of that soil so that now the ground about the cesspools in these communities, notably at Dover, has assumed in character what may be termed a sewage-filled sponge, and unquestionably much dangerous pollution from this sewage saturated soil now finds its way, more or less directly into the Rockaway River, effecting a progressive deterioration of its sanitary quality.

(17) Furthermore, the cesspools in many instances, through the action of grease and other matters, have become so clogged that the seepage into the surrounding soil which formerly took place is now stopped for a large part. I have personally viewed numerous cesspools in and about Dover, and have noted how through such clogging these cesspools have overflowed onto the surrounding ground, and have backed up into cellars where frightfully unsanitary conditions have thus been established. At times of heavy rains and through the clandestine use of pumps operated to raise the back flow of sewage out of cellars and the like, much dangerous sewage matter is undoubtedly washed from the surface of the ground into the Rockaway River, to cause a progressive deterioration in its sanitary quality.

(18) Deposits are formed on the bottom of the Boonton Reservoir and when the reservoir water overturns, due to temperature changes and currents, these matters are brought to the surface or become mixed throughout the entire body of water in the reservoir, and thus the water issuing from the reservoir at the gatehouse is at such times in abnormally bad condition.

(19) With the fast increasing pollution of the waters entering the reservoir and of the reservoir itself, due principally, I believe, to the state of affairs now made manifest in Dover, and also due

to shortcomings respecting the varying sedimentation efficiency of the reservoir, a correspondingly increasing load is placed upon the sterilization plant,—a result which was really inevitable because of the inherent limitations of the sterilization process.

(20) My personal observations have proved to me that there is no reliable yardstick whereby the proper dose of germicide can be measured to meet all conditions of water as it issues from the Boonton Reservoir. I know that in addition to that quantity which is required to kill all pathogenic germs there must always be added an indeterminate quantity to account for the fluctuations in the character of the water which may occur without a minute's notice, due to currents, temperature changes, heavy rains, winds and the like.

(21) My personal observations have proved to me that an unfiltered polluted water like that of the Rockaway River, complicated among other things by particles of suspended matter enclosing disease germs, and in the face of disturbances which may at any time occur in the reservoir causing wide variation in the composition of the water, cannot be satisfactorily sterilized with hypochlorite of lime or with chlorine gas, nor can this treatment be relied upon to yield an innocuous water at all times.

(22) I know that disease germs can pass this treatment unkilled when the amount of germicide added is equal to and not in excess of that quantity which can be used without imparting offensive tastes and odors to the water.

(23) More than this I know that certain matters in the water, both mineral and organic, dissolved and suspended, absorb and otherwise use up indeterminate and varying quantities of the chemical without affecting directly the specific

function of the chemical in destroying the dangerous bacteria.

(24) It is clear to me that in the face of these conditions where particles of fecal matter can and do pass out of the reservoir and into the city mains in Jersey City, with every likelihood that these suspended particles may contain disease germs, there is no doubt left as to the potential unwholesomeness of the water as it leaves the sterilizing plant and as it is delivered to the people of Jersey City.

A. Water supplies derived from surface sources are always open to pollution. This pollution may be in the form of contamination with the germs of specific diseases, or in the form of amorphous matter accompanied by large numbers of germs ordinarily considered non-pathogenic. Heavy rains on a watershed like the Rockaway River watershed of the Jersey City water supply will cause such contamination.

It is known that when an unfiltered water such as that issuing from the Boonton Dam contains such suspended matters complete sterilization with chlorine compounds is impossibe of achievement. It is furthermore known that waters so contaminated, if consumed unfiltered, will cause more or less widespread disorders of an intestinal character, such maladies in the human subject taking the form of active diarrhea and sporadic vomiting. Such an outbreak occurred among the citizens of Montclair and Glen Ridge, New Jersey, during the exceptional cold weather period in January, 1918.

The water supply of these towns comes from the Passaic River, and ordinarily is effectually filtered and afterwards sterilized with chlorine, but due to abnormal water consumption in January the filtered supply was augmented by mixing with it unfiltered but sterilized Passaic River water. Sterilization of this unfiltered water could not have been complete because of the suspended matters which the unfiltered water contained. A sharp epidemic of intestinal disorders promptly made its appearance in Montclair and Glen Ridge, following the consumption by the citizens of these communities of the mixed supply, over 2000 persons being so affected.

This circumstance still further strengthens my conviction that this sterilizing process is unreliable as a safeguard against water-borne diseases, particularly when the water contains suspended matter washed into it from the watershed, and during extreme cold weather periods. The conditions described as applying to Montclair and Glen Ridge, with respect to the unsafe use of unfiltered water which has been treated with chlorine, obtains in the Jersey City supply when conditions on the watershed and in the Boonton Reservoir are at their hygienic worst, and during extreme cold weather periods.

(25) Experience at the Boonton Reservoir sterilization plant and at other sterilization plants of the same character has shown that in the management of this process the operator is obliged to follow a hit or miss program, always endeavoring to add constantly more of the germicide than is required, but of which requirement he has no definite knowledge or assurance because of the fluctuating character of the untreated water. At times when the reservoir water is in its worst condition during storms, periods of overturns, etc., namely, during those periods of extreme danger to which Vice-Chancellor Stevens referred in his decree dated June 4th, 1908, in ordering the construction of sewers, any one of half a dozen or more disturbing elements may become active, re-

sulting in inadequate sterilization, and more than 60 hours elapse before the operators at the Boonton sterilizing plant have an opportunity to learn definitely by the only methods now known to bacteriologists and chemists whether or not the dose of hypochlorite has been adequate.

(26) To get the best possible results the application of the germicide must be so adjusted that the smallest dose will be adequate to meet the maximum requirements. Where the composition of the untreated water is subject to sudden and wide fluctuations it is the worst conditions of untreated water that control the proper size of the dose rather than its average composition. This may lead, and has led, to overdosing to a degree which produces objectionable tastes and odors in the treated water due to the chemical itself. And even such overdosing at times cannot effect the destruction of all dangerous and objectionable bacteria.

(27) The laboratory methods of analysis of water employed in 1909 were those based on the 1905 Report of the Committee on Standard Methods of the American Public Health Association. Those methods in many essential particulars are not recognized as reliable at this time. Nor are the standards of purity laid down by the Treasury Department of the United States Gvernment the same now as they were then. I firmly believe that there are a limited number of occasions, probably occurring for a number of days in every year, when the water as delivered in Jersey City after treatment at the sterilization plant at the Boonton Reservoir does not meet the necessary Governental requirements.

(28) The evidence at hand at this date shows that whereas in 1909 it was believed that the action of the hypochlorite was positive in killing

bacteria, that now in some cases the germicide stuns rather than kills dangerous and objectionable bacteria, leaving the opportunity for these bacteria so stunned to revive and thus become a menace to the public health.

(29) As a result of the progressively increasing pollution of the Rockaway River water and the steadily deteriorating quality of the Boonton Reservoir water as it leaves the dam, due chiefly, I believe, to the unsanitary conditions in Dover, and because of the limitations in the sterilizing treatment I now know to exist, I am firmly of the opinion that at intervals dangerous water is delivered to consumers in Jersey City, and that this water has had and is having at such times a deleterious effect on the health of the City. That the mortality statistics of Jersey City do not disclose positive evidence of this fact in the nature of epidemics does not in any wise alter my firm conviction that the failure to show by such statistics that the water is dangerous at intervals is due to relative freedom from typhoid among the residents of the Rockaway River watershed.

(30) Of whatever typhoid fever here has been and is occurring in Jersey City, I believe that some of it may be attributed to the disease bearing properties of the water supply as delivered to Jersey City at intervals when the treatment fails and allows disease germs to pass to the mouths of the consumers; and I believe that these dangerous periods will become much more frequent in the future than in the past.

(31) The waters of the Boonton Reservoir as they enter the sterilizing plant show sudden and wide variation in this composition. I know that it is not possible by any means now available to determine with the required degree of accuracy the amount of germicide it is necessary to apply

in order to get the best possible results. I know that there are times when dangerous bacteria will pass the sterilizing treatment unkilled and thus are liable at such times to pass direct into the mouths of the consumers in Jersey City.

(32) The only reasonably reliable guide respecting the adequacy of the dose of germicide are the results of the bacterial tests of the treated water as it flows from the taps in Jersey City. Since there is a lapse of some 60 hours between the time when the water is subjected to the sterilizing treatment and the time when the results of bacterial tests on this water are available, if the dose has not been adequate there is no opportunity to apply any correcttive measures as the water has passed on in the meantime into the distribution system and has been consumed by the people of Jersey City.

(33) Because of the facts set forth herein respecting sudden and wide changes in the composition of untreated water, the inability of those operating the sterilizing plant to adjust the dose of germicide to meet any and all conditions with the required precision, and the complete absence of proof as to whether or not the dose of germicide has been adequate until after the treated water has been delivered to the consumer, I am firmly of the opinion that there is now nothing to protect reliably the people of Jersey City from receiving at times water containing particles of feces, and disease germs.

(34) With the growing pollution of the water delivered to Jersey City there is obviously a steadily increasing menace to the health and well-being of the people of Jersey City. Of my own knowledge I know that the sterilization treatment for Jersey City, or of any unfiltered water supply, is not reliable and is not adequate, and that in

the specific case of Jersey City it is not now nor has it ever been at all times performing the office for which it was intended.

GEORGE A. JOHNSON.

Sworn to and subscribed at New York City this 4th day of March, 1918, before me, the subscriber, a Notary Public in and for said County and State duly commissioned and sworn, as witness my hand and official seal.

J. Frederick Cryer,
Notary Public, N. Y. Co.

Affidavit of George W. Fuller.

IN CHANCERY OF NEW JERSEY.

BETWEEN
THE MAYOR and ALDERMEN OF JERSEY CITY,
Complainant,

and

JERSEY CITY WATER SUPPLY COMPANY,
Defendant.

On application for Leave to File Bill of Review.

STATE OF NEW YORK, }
COUNTY OF NEW YORK. } ss.

GEORGE W. FULLER, of full age, being duly sworn on his oath deposes and says:

1. I reside in Summit, New Jersey, and am a Consulting Engineer and Sanitary Expert, with offices at 170 Broadway, New York City, giving particular attention to matters of water supply, water purification, sewerage and sewage disposal.

2. I am a graduate of the Massachusetts Institute of Technology and since my graduation I have been engaged exclusively in matters connected with water purification and sewage disposal, and the construction and operation of plants for such treatment, and the various engineering, chemical and bacteriological problems incident to the question of securing pure and wholesome water for potable purposes.

3. I first spent some months at the University of Berlin studying bacteriology and later was in the office of Engineer in Charge of the Berlin Water Works. From 1890 until 1899 I devoted 9 years exclusively to investigating means of

measuring the pollution of water supplies and particularly methods for purifying both water and sewage. This work was done for the Massachusetts State Board of Health and the cities of Louisville, Ky., and Cincinnati, Ohio. These investigations conducted under my immediate direction represented an expenditure of more than one-quarter of a million dollars and the results obtained were reported fully in official documents.

4. I have been directly concerned as consulting engineer with over 150 municipal projects having to do with the construction of water plants, sewage disposal works and the operation of the same. I have been one of the consulting engineers advising the International Joint Commission which has in charge the control and regulation of the pollution of the boundary waters between the United States and Canada. This commission is composed of three members representing Canada and three representing the United States, appointed under treaty between the United States and Great Britan, having to do particularly with the question of the determination of the degree of pollution of boundary waters and the adoption of means for its regulation and control.

5. I was a member of the Commission appointed in 1901 by the Committee of the United States Senate, having charge of the public works of the District of Columbia, to advise as to the best means of treating the Washington water supply. I was retained by the State of Missouri to investigate and testify upon the pollution of the Mississippi River and the St. Louis water supply by the Chicago Drainage Canal. This was an injunction suit brought by the State of Missouri in the United States Supreme Court in 1903. In 1906 I was retained by the International Waterways Commission to advise as to means of purifying the sew-

age of Chicago and its suburbs in the event that the Chicago Drainage Canal were to be deprived of some or all of its flow of Lake Michigan water. I was a technical adviser to the New Jersey Attorney General's office in the so-called Passaic Valley Sewerage Suit, New York vs. New Jersey, and I was an expert witness for the State Board of Health in its suit against the Town of Phillipsburg, N. J. I have advised the City of New York in the matter of pollution of its water supplies, correction of the pollution by sewers and by filtration of water and the use of hypochlorite of lime. These investigations and reports have reference to several of the Brooklyn supplies, the Croton supply for the old City of New York, as well as the new supply from the Catskill Mountains. I was a member of the committee appointed by the American Public Health Association to formulate standard methods of water analysis and participated in the reports published in 1898, 1905 and 1917. I was a member of the Central Sub-Committee under the Council of National Defense appointed in May, 1917, to advise on sanitation and engineering relative to cantonment work for the new National Army. I am now a consulting engineer retained by the United States Public Health Service, a Bureau of the Treasury Department, for emergency service on sanitary engineering matters as occasion may require in connection with conditions arising out of the present war.

6. I am now consulting engineer on matters relative to water supply and sewerage projects of the following municipalities, among others:

Montreal, Province of Quebec.
Stamford, Conn.
New York City.
Cleveland, Ohio.

Indianapolis, Ind.
Lima, Ohio.
Hartford, Conn.
Saw Mill River Trunk Sewer, N. Y.
Clarksburg, W. Va.
Wilmington, Dela.
Chester, Pa.
Huntington, L. I.
Plainfield, N. J.
York, Pa.
Bridgeport, Conn.
South Milwaukee, Wis.

7. I testified as an expert in the suit of Jersey City against the Jersey City Water Supply Company and Flynn, in the proceedings before the Honorable William J. Magie, Special Master. I personally and in conjunction with my then partners, Rudolph Hering and George A. Johnson, designed the sterilization plant at Boonton, which was turned over to Jersey City in lieu of sewers and sewage disposal works. I then believed, and at that time I testified, that the chlorine plant or sterilization device was a complete substitute for the sewers and sewage disposal works mentioned in the decree in what is generally known as the main case.

8. The sterilization of water for potable purposes as a regular procedure without the aid of water filterers was then a novelty. It had been used in England and in Germany, and at the Stock Yards in Chicago, as an emergency device for the treatment of water supply and dilute sewage, but ordinarily if not always in conjunction with water filtration plants. From the time of the installation of the sterilizing plant at Boonton, the limitations of the sterilizing process have been made manifest by actual experience. This

is particularly true in cases like the Boonton Reservoir supply, where the water contains much organic matter and is subject to rapid fluctuations and is not previously filtered.

9. My opinion (and I think the prevalent opinion among leading sanitary experts of this country) now is that sterilization by chlorine,—despite its undoubted usefulness as an emergency measure,—is not a process which can be considered as a uniformly reliable method for the treatment of a water which at times is highly polluted and is subjected previously only to sedimentation and which undergoes at intervals more or less rapid fluctuation as to its composition. As I stated four years ago concerning the Croton supply of New York City, sterilization without filtration is not adequate and is only a rough palliation for waters of this type.

10. Had I known, at the time of the reference to the Master, what I have since learned through observation and experience, I would not have testified in that case in favor of the proposition that water from the Boonton Reservoir treated by the sterilizing process, without either filtration or diverting sewers, was at all times unqualifiedly a pure and wholesome water for the people of Jersey City to drink, or that such water was equivalent in purity or wholesomeness to the water which would have been delivered to Jersey City had sewers and sewage disposal works been put in effective service in accordance with the decree of 1908.

11. Dangerous pollution of the Rockaway River and of the Boonton Reservoir water now exists and has existed continuously from 1898 to date. The pollution comes from various sources, particularly from the more densely populated portions of Dover, Boonton and Hibernia, as set forth

in the 1908 decree. If the pollution from these sources were diverted from the watershed, it is obvious that the unsanitary condition and deterioration in the quality of the water due to those municipalities would not have been and would not be encountered at the Boonton Reservoir.

12. Since the hearing before the Special Master in 1909 the general conditions on the watershed have not materially changed, and there has been but a relatively small increase in the total population on the watershed. Notwithstanding this, however, there has been a substantial change in the amount of pollution reaching the river, especially at Dover. At the time of the hearing before the Special Master, and for several years prior thereto, there was and had been a progressive elimination of pipes and overflow drains through which polluting wastes from cesspools flowed directly into the Rockaway River and its tributaries. These pipes and drains were disconnected with the intention of preventing the direct flow into the river of the contents of and cesspools and privy vaults, and to force them to leach through the soil, and thus have the sewage ultimately reaching the river derive the benefit of such purification as would be incident to its flow through the soil from its point of origin.

13. Since 1909 it has been found that the conditions as to such pollution of the river have become markedly worse, incident to the soil, particularly in the densely populated part of Dover, becoming saturated with polluting matters and being no longer capable of purifying the sanitary wastes to a substantial extent before they reach the river. At intervals impossible to forecast by any known method of test, dependent on circumstances of rainfall, temperature and wind conditions, an added burden is placed upon the purify-

ing functions of the Boonton reservoir and chlorination plant on which Jersey City relies for its protection against all pollution, including the added pollution above described, of Dover. This load, while an actual factor, was not foreseen at the time of the hearing before the Master.

14. To combat this condition at Dover, the City has been compelled to construct there two auxiliary chlorinating devices in order to improve the quality of the river water at that point and thus minimize the load at the main sterilizing plant at the Boonton dam. Notwithstanding these two auxiliary chlorinating plants, the water entering the Boonton Reservoir has become more and more polluted since 1909, because of the local circumstances of the soil pollution and saturation at Dover.

15. I am of the opinion and advised the International Joint Commission that, for a tentative standard of raw water suitable for potable use after purification, the B. coli content as an annual average ought not to exceed 500 per 100 cubic centimeters. That figure may be somewhat too low, but it was agreed to by the five other expert sanitary advisers of the International Joint Commission. There can be no doubt, however, as to the fecal bacteria in the Rockaway River entering Boonton Reservoir being far above that limit, as the records show that the B. coli content of the water averages more than 40,000 per 100 cubic centimeters. Average results of bacterial analyses are frequently very misleading as they disguise the significance of the poorest quality of water found, and which is the weakest link in the chain in this instance where the City of Jersey City is entitled on all occasions to water above suspicion as to its hygienic character. Repeatedly the river water entering the reservoir has been

shown to contain 1,000,000 B. coli per 100 cubic centimeters, equal to 2,000 times the average limit recommended to the International Joint Commission as safe for a raw water supply to be served for potable use after filtration. On many occasions the water at the Boonton Reservoir outlet (Rockaway River water which has undergone more or less sedimentation) has been found to contain more than 20 times the proposed International Joint Commission standard for the B. coli content of boundary waters.

16. The process of sterilizing unfiltered surface water supplies by hypochlorite is now known to have limitations and inadequacies not appreciated in 1909, although they undoubtedly existed then. And it has been only with increased practical experience that knowledge and proof are available of the serious effect of these limitations which existed in 1909 and do now exist to the extent of hazarding the reliability of this sterilization process for the purpose for which it was intended when installed.

17. The limitations in the sterilization process applied at the Boonton dam are now known definitely to involve a series of shortcoming among which, according to my own experiences, are the following:

(A) The efficiency of hypochlorite as a sterilizing agent depends upon the addition to the water of a quantity of this chemical sufficient to kill all dangerous and objectionable bacteria, and this in turn cannot be effected until the applied hypochlorite is sufficient to combine with the very unstable dissolved organic matter naturally present in the water. The dose, therefore, must be sufficient to meet the demands made by the sum of at least two variable items, namely, variable quantities of unstable dissolved organic matter and variable numbers of bacteria.

(B) It is known that the quantity of organic matter, principally in soluble form, which combines with hypochlorite is found to a markedly inconstant degree in the water of Boonton Reservoir, depending upon the changeable organic content of the river water entering the reservoir, the effects of sedimentation, stratification, currents, temperature and the like,—all of which factors fluctuate markedly throughout the seasons of the year. Furthermore, there is no known method by which there can be foretold, by chemical or other tests, the amount of organic matter which will combine readily with hypochlorite of lime and in addition to which indeterminate quantity there must also be added enough more hypochlorite to destroy the objectionable and dangerous bacteria.

(C) There is some physical absorption of hypochlorite solution by suspended organic matter, and in the arriving at the proper amount of hypochlorite to add to the water, account must be taken of the fact that there are varying quantities of algae, soil wash and other substances which utilize the hypochlorite in varying degrees without in any manner affecting directly the specific function of this chemical in destroying the dangerous bacteria.

(D) There are certain dissolved mineral substances, such as nitrites and ferrous iron, found at times in the reservoir water, particularly during and shortly after periods of overturn when the reservoir water is mixed from top to bottom, and which mineral substances are capable of oxidation and in this way of utilizing the hypochlorite in varying quantities before the dose is properly adjusted to destroy the objectionable and dangerous bacteria.

(E) Following heavy rainstorms and certain conditions as to temperature, stratification and the like in the reservoir, suspended particles of sewage nature reach the outlet of the Boonton Reservoir, within which particles there are objectionable and dangerous bacteria which cannot be reached by the applied hypochlorite solutions and which particles later break up or decompose *en route* to Jersey City, thus releasing living objectionable organisms which can thus reach the mouth and stomach of those who happen to drink the water in which this phenomenon occurs. Obviously the Boonton reservoir possesses varying efficiency as a sedimentation device, depending upon whether there is a large volume of water passing over the spillway of the dam or whether the water is drawn down below the spillway so that the velocity of flow of water through the reservoir is controlled largely or wholly by the relatively small volume withdrawn for the use of the city.

(F) These particles of fecal matter reaching Jersey City show the unwholesomeness of the treated water. The hypochlorite treatment is stated by some oxidize the organic matter of feces, urine and other polluting substances shown by inspection to enter the Rockaway River above the Boonton Reservoir. This statement is not true because hypochlorite oxidizes organic matter to such a nominal extent that there is no change worth talking about. Hence the unwholesomeness of the water due to intesintal discharges independent of living bacteria is practically unchanged by the sterilization process.

(G) Sterilization is effected by hypochlorite of lime directly, or in the presence of free carbonic acid by hypochlorous acid, into which the hypochlorite is decomposed. The speed of reaction as to germicidal effect between hypochlorite of lime and hypochlorous acid is quite variable, which is also true of the quantities of free carbonic acid in the water. In consequence, another capricious factor occurs in the practical management of this process.

(H) Cold weather retards the speed and lessens the reliability with which hypochlorite of lime or chlorine gas destroys objectionable bacteria. Complications also arise through some of the chlorine appearing in very cold water in a solid form, as hydrate of chlorine, and thus not being available for sterilizing purposes until the temperature of the water becomes high enough to dissolve the crystals.

(I) There are no means now known nor were there at any previous date, for measuring the aggregate amount of hypochlorite needed collectively to combine with the dissolved organic matter, suspended organic matter, nitrites and ferrous iron and the like. It is impossible to fit the dose to the sudden shifts in the quality of the water leaving the Boonton Reservoir and sterilizing plant. The margin of safety is determined by the inability to lower the dose to below the danger point and the inadmissibility of raising it above the point where the water smells and tastes of chlorine as delivered at Jersey City. The so-called danger point is the quantity of chlorine shown to be necessary by the bacterial tests, unsatisfactory and unreliable as those tests are, for killing dangerous and objectionable bacteria.

(J) The process of regulating the dose of applied hypochlorite, therefore, becomes a hit-or-miss proposition due to the factors recited above, independent of the frailties of human performance in making up accurately solutions of hypochlorite of prescribed strength, stirring and applying the same at all times in conformity with directions from those in charge with respect to the dose it is hoped will be proper.

(K) It was thought in 1909 by those in charge of the operation of the plant, that advantage might be taken of a determination of the "residual chlorine" remaining in the water at the Romine gate house (located on the pipe line leading to Jersey City and about 3,000 feet below the Boonton dam),—all with a view to keeping a certain excess of the applied chemical in the water at that point, and which excess would practically disappear before reaching the city. It was believed that in this way the amount of indicated "available chlorine" in the water at the Romine gate house would furnish a rule whereby any inadequacy of treatment at the dam could be promptly corrected. Experience shows that the management of this sterilization process for Boonton Reservoir cannot be founded reliably upon this or any other procedure.

(L) Analyses of the water at the Summit Avenue gate house have been made practically on a daily basis from the commencement of the application of the hypochlorite process at Boonton dam down to the present time. It takes some 60 hours or more for the water to flow from Boonton dam to the Summit Avenue gate house, and then for samples of the water to be collected and subjected to analysis so as to get any definite clue to the adequacy of the dose of hypochlorite applied. This means that at times of heavy storms, overturning of the reservoir, etc., viz., during periods of extreme danger to which Vice-Chancellor Stevens referred in ordering the diverting sewers above the reservoir, any one or more of half a dozen disturbing elements may creep in at the reservoir and more than 60 hours elapse before the operators at the Boonton sterilizing plant have opportunity to learn definitely from the laboratory in Jersey City whether the dose of hypochlorite has been indicated by analyses to have been adequate or not. If it has not been indicated to have been adequate, there is no opportunity to apply any corrective measures at the plant at Boonton, as the water has passed on in the meantime for a period of some 60 hours into the distribution system and to the consumers.

(M) When this sterilization process was first applied at Boonton, and at fairly frequent intervals thereafter, it was and has been found that tastes and odors, due to excessive doses of hypochlorite, have been noted in the water at Jersey City. As the years have gone by, experience has shown that due, among other things, to the increasing pollution entering the reservoir from the cesspools in Dover, it is necessary to add more hypochlorite now than formerly. In fact, I am informed that the "residual chlorine" in the water at the Summit Avenue gate house in Jersey City for weeks and months at a time ranges from *0.15 to over 0.20 part per million.* These high figures approximate one-fourth to one-half of the total dose applied at the Boonton dam and, in my opinion, constitute a serious situation concerning the limitation of sterilization for the local water supply. "Residual chlorine" frequently combines with dead organic matter in such quantities as to give objectionable tastes of an "iodoform" nature, and at the same time the dose of active available chlorine is too small to kill all the living organisms, some of which are objectionable and dangerous. The time is rapidly approaching, and has already arrived on some occasions, when there is no margin of safety between the required does of hypochlorite to effect sterilization and that quantity of hypochlorite which when added imparts objectionable tastes and odors to the water in the city.

(N) Stating the effect of the foregoing limitations briefly, it may be said in summary that this process has been found by my own experience and that of many other practical water purification experts to show decided unreliability through the absolute lack of workable means of properly regulating the dose of hypochlorite at all times, particularly during flood flows when the water is very cold, and further, if such regulatory means were available, the quality of the water of Boonton Reservoir is frequently on the verge of, and at times beyond, the limits where it is possible to avoid getting into difficulties either through objectionable tastes and odor due to the chemical itself or due to insufficient quantities of chemical applied to the water permitting the passage of objectionable and dangerous bacteria to the water consumers. This situation, in my opinion, prevailed at intervals in 1909, and the same is true now. The intermittent occurrence of bad water at the Boonton dam, when sedimentation in the reservoir is insufficient as set forth in the opinion and decree in 1909 in the main case, explains largely why the weaknesses of the process were not revealed during the limited period of my earlier observations.

18. The hypochlorite treatment does not remove B. welchii and certain other objectionable and dangerous bacteria of intestinal origin and which on account of the formation of spores it is out of the question to destroy by the hypochlorite treatment.

19. This organism is known by various names and is identical with B. *enteritidis sporogenos* which is the designation used by English bacteriologists and noted repeatedly in the Reports of the Royal Commission on Sewage Disposal of Great Britain. Ths organism is found in the in-

testinal discharges of man and animals. It is present in polluted soils, but not in virgin soil. Its presence in water and milk constitutes an element of danger as the germ is associated with outbreaks of a diarrheal nature, extremely severe to certain individuals and mild to others. Available evidence indicates that it is the cause of intestinal disturbances in some young children in ways to produce excessive anemia. In adults advanced in years it is found to produce intensive putrefaction in the intestinal tract and thus it plays an important role in the ailments associated therewith. It also appears to produce poisons capable of acting on the nervous system, and to cause other abnormal conditions, such as the so-called "autointoxication" or selfpoisoning of the individual. This organism develops in the mucus membrane of the intestines and hence is associated with various inflammations. In some cases they come under what is known as peritonitis. In other cases special inflammations caused by this organism are associated with other diseases, depending upon the part of the body affected.

20. In the evidence given before the Special Master in 1909, a large portion of the bacteriological data was in conformity with the 1905 Edition of the so-called Standard Methods of Water Analysis which was prepared by a Committee of which I was Chairman. Experience has shown that these methods were arbitrary and less satisfactory than then believed to be the case, owing to the fact that the procedure employed in the laboratory erroneously elminated species of bacteria now known to be objectionable.

21. At best the laboratory tests throw no light on the presence in the water of typhoid fever germs or other germs of specific diseases having well defined relationship to water supplies,—if we except the cholera germ and B. welchii.

22. In 1909 there was a very meager understanding as to the manner in which the applied hypochlorite solution caused the bacteria to get into such condition that they did not react in a positive manner when subjected to certain bacteriological tests. Hypochlorite, in some instances, stuns rather than kills the dangerous and objectionable bacteria, leaving the opportunity for these objectionable bacteria to become revivified and prejudicial to the public health. This phase of the process was reported to the American Public Health Association in 1913 by a Committee of which I was Chairman. Bacterial data are capricious when applied to waters that are of poor quality only at intervals and negative bacterial results should be interpreted with great caution, in relation to their sanitary significance because potential danger may at any time become an actual danger, without warning.

23. Examination of the bacteriological data shows, not as a rule, but at intervals, objectionable bacteria, and hence an objectionable hygienic quality of the water as delivered to the consumers in Jersey City. I believe that as a result of such deterioration in quality temporarily of the Jersey City water supply, it has had (and is having) at intervals a prejudicial effect on the health of the city. It is true that this effect has not been of such proportions as to produce an epidemic, and this primarily is due, of course, to the fact that typhoid fever and other water-borne diseases at Dover and elsewhere on the watershed have been conspicuously absent, as a general proposition, and particularly so on occasions when lapses in adjusting dosing of hypochlorite have occured. However, it is a fact that the water as delivered at Jersey City has been potentially dangerous and, in my opinion, the intervals of danger will be-

come more and more frequent and more pronounced in the future than in the past. In this connection it is to be borne in mind that inoculation against typhoid fever, as well as other improvements in general sanitation, go a long way towards explaining low death rates. But with a potentially dangerous water supply it is not correct to infer that low death rates are to be enjoyed regularly in the future. Neither is it correct to infer that polluted and potentially dangerus waters, subjected to sterilization, will not without warning give rise to extensive outbreaks of disease of a distressing intestinal character. I have personally found several such outbreaks and am informed that such have very recently occurred in several cities and towns of Northern New Jersey.

24. The installation of sewers for the delivery of the sewage at Dover, Boonton, Hibernia and elsewhere, to sewage disposal works located below the Boonton dam, obviously would remove absolutely all of the pollution delivered to the sewers and hence would prevent completely the entrance into the Boonton Reservoir, and the delivery into the water reaching Jersey City, of these polluting elements. This pollution certainly is not adequately removed at all times by the sterilization treatment. Hence the Boonton sterilization plant is not a full substitute for diverting sewers and sewage disposal. And in the absence of a complete substitute for sewers and sewage disposal works in order to remove the effect of pollution at Dover and elsewhere on the Rockaway watershed under conditions substantially as obtaining in 1908, there is no surety that an outbreak of intestinal diseases, such as recently has occurred at Montclair and vicinity, or even of typhoid fever, may not at any time develop in Jersey City due

to the breakdown, in any one of a dozen ways, of the chlorinating devices at Boonton, at a time when the reservoir is performing abnormally as a sedimentation device in eliminating specific pollution coming into the reservoir.

Sworn and subscribed to at the City of New York, this 4th day of March, 1918, before me, the subscriber, a Notary Public in and for said County and State duly commissioned and sworn, as witness my hand and official seal:

GEORGE W. FULLER.

NANETTA SONOPOLI,
Notary Public, Kings Co.

IN CHANCERY OF NEW JERSEY.

Between The Mayor and Aldermen of Jersey City, *Complainant,* *and* Jersey City Water Supply Company, *Defendant.*	On application for Leave to File Bill of Review.

District of Columbia }
City of Washington } *ss.*

Earle B. Phelps, of full age, being duly sworn on his oath deposes and says:

1. I reside in Washington and am now connected with the Hygienic Laboratory in the capacity of Professor of Chemistry. This laboratory is maintained by the Public Health Service, a bureau of the Treasury Department of the United States.

2. I testified at the reference before the Honorable William J. Magie, Special Master, in the Jersey City Water Suit. I was formerly a professor of chemical biology at the Institute of Technology at Boston. I was connected with the Institute as chemist and bacteriologosit of the Sanitary Research Laboratory. Before that I was employed by the Massachusetts State Board of Health as Assistant Bacteriologist at the Lawrence Experiment Station. I graduated from the Institute of Technology in 1899 in the Department of Chemistry and went directly from there to the Board of Health work. For a number of

years I carried on a consulting practice in sanitary matters in addition to my other duties. I was for two years consulting expert for the New Jersey Sewerage Commission and have also been assistant Hydrographer with the United States Geological Survey in charge of investigation relating to the purification of trade wastes and other matters relative to stream pollution. I have been employed by various cities as consulting expert in matters of water purification and sewage disposal. In 1911 in conjunction with William M. Black, Colonel (now General) Corps of Engineers, U. S. A., I made an investigation and report to the City of New York upon the effect of the discharge of the sewage of that city upon the waters of New York Harbor, with recommendations upon the location of sewer outlets and sewage treatment. I am now the Consulting Sanitary Engineer of the International Joint Commission, and a member of the Committee on Standard Methods of Water Examination of the American Public Health Association.

3. I am informed that an application is about to be made to the Court of Chancery of New Jersey for leave to file a bill to review the Jersey City Water Case particularly with reference to that part of it which obliged Jersey City to take a chlorination plant as a substitute for sewers and sewage disposal works. Since I testified in that case there has been a great advance in the science of bacteriology and the chemistry applicable thereto. The art of water purification has made a marked advance in the clearer understanding and more definite knowledge concerning matters which, at the time of the reference, were of necessity dealt with more as hypotheses and postluates than conclusions from recorded data. Previous to the reference I had experimented with chlorina-

tion as a means of treatment of raw sewage. In my judgment the substitution of hypo-chlorite treatment for sewers and sewage disposal works in connection with a public water supply of as polluted a character as that entering the Boonton Reservoir, was a most daring and novel step. The inherent weaknesses and limitations of the chlorination process had not, at the time of the reference, been revealed to the bacteriologists and chemists engaged in sanitation. In my judgment, the accepted view of the leading sanitary experts, and by leading I mean the majority of the active men in the profession, is that reliance upon clorination, unaided by filtration or by sewers and sewage disposal works, is dangerous and uncertain in dealing with a public water supply as polluted as the Rockaway River.

4. The International Joint Commission, of which I am Consulting Sanitary Engineer, called together in 1914 an advisory board of eminent sanitary engineers from both the United States and Canada for advice as to the limit of safe loading of a water purification plant. This board recommended to the Commission "that this limit is exceeded if the annual average number of B. coli in the water delivered to the plant is higher than about 500 per 100 cubic centimeters, or if in 0.1 cubic centimeter samples of the water B. coli is found 50 per cent of the time. According to this standard of purity, if, as I am informed, the Rockaway River at the Boonton dam contains an average of 50,000 B. coli per 100 cc., it is too highly polluted to be accepted as fit for purification treatment either by filtration or by sterilzation. In other words, the Jersey City water supply, because of the numerous and extensive sewage pollutions on the water shed and the character of the water of the Rockaway River and of the Boonton

Reservoir, exceeds the limit of safe loading of a water purification plant as interpreted by these eminent engineers, and the only possible way in which it could be made to qualify would be by the installation of sewers and sewage disposal works which would either carry this pollution out of the shed or purify it before discharge.

The recommendation of this International Board of Engineers represents the results of our newer and advanced knowledge of water sanitation and the limitations of purification treatment by filtration and by hypochlorites.

5. I do not know of any city in the country which relies on hypochlorite as the sole safeguard between its citizens and a water so polluted as that entering the Boonton Reservoir. The universal practice among competent sanitary experts is either prevention of the entry of pollution or filtration or both. Chlorination has a definite and valuable office, but it is only in connection with minor and incidental prevention or as a supplemental treatment in connection with either sewage disposal works or water filtration that it can be safely used.

6. There is no bacterial test which will determine whether the water is pure and wholesome. The only value of bacterial tests is to detect the presence of pollution if it exists in a form which can indicated by such a test. If bacteria are found in sufficient numbers, or if the species are of the intestinal type, these results are indicative of pollution; on the other hand their absence leaves the investigator entirely in the dark as to the real character of the water for the reason that existing pollution may be intermittent or on the other hand its bacterial evidence may have been nullified by the previous destruction of the bacteria through steril-

ization of the water. The numbers of bacteria in a natural water increase as organic pollution increases, but the bacteria may be destroyed by artificial means without removing the pollution.

The value of the bacterial test as an indicator of pollution depends on the existence of living bacteria of the intestinal type in the water which by their presence, as shown to the bacteriologists, reveal the presence of sewage pollution. If, however, these intestinal bacteria are destroyed by sterilization they fail to grow in the culture which the bacteriologist makes of the water and consequently fail to reveal the presence of sewage pollution which may really exist; consequently the sterilization of a polluted water supply by hypochlorite results in a suppression of the truth regarding the polluted character of the water insofar as its character may be indicated by bacterial tests. In other words, the sterilization of water by the destruction of the intestinal bacteria indicating pollution is analagous to destroying the thermometer when the subject of investigation is the temperature. Positive tests indicate pollution while negative tests still leave the question of pollution open.

7. The bacterial test is not in any sense a substitute for an inspection of the watershed of a surface water supply. A bacterial test is only one method for investigating the character of a water supply. It is chiefly of value where other methods of investgation are not available. If sewage pollutions of a surface supply can actually be observed by an inspection of the shed, no laboratory test is necessary to establish the fact that such pollustions are occurring. The degree of sewage pollution depends on the volume of sewage compared to the volume of water at any given time, and by reason of the occurrence of rainfall

or of low water, it fluctuates violently and is intermittent. A bacterial test at the point of delivery of a surface water supply may readily give misleading results as to the existence of dangerous pollutions on the watershed. The value of bacterial tests has often in the past been exaggerated by engineers and by public health authorities. In recent years and especially since 1909, the limitations of such tests have become more clear and they have been assigned to a more subordinate position in the science of water investigation.

The presence of B. Coli in water is a danger signal and indicates human pollution, but the absence is no indication of purity and wholesomeness unless a survey of the sources shows that no pollution enters the water. Therefore, when the sanitary expert knows from a survey of the sources that pollution is entering the water, he should be guided by this information regardless of the bacterial tests and adopt those measures which are universally considered the only safe ones, viz.: prevention of the entry of the pollution or its removal filtration.

8. Experience has shown that it is frequently impossible to administer to a water supply as highly polluted as is the water supply of Jersey City, a dose of hypochlorite or chlorine large enough to guarantee the destruction of all intestinal bacteria without at times causing a taste of chlorine in the water at the point of consumption. At the present time I am informed that the dose required to destroy the dangerous bacteria has been increased to such a point that free chlorine is constantly present in the water delivered to Jersey City as shown by laboratory test, and frequently to such an extent that it is tasted in the water by the consumers of Jersey City. This is a limitation of the hypochlorite treatment which is

characteristic and is now generally recognized by professional men. The correct size of the dose cannot be accurately determined at any given time by any labortory test of the water for the reason that the only available tests are bacteriological and these require cultivation for two days. During this period of 48 hours such great changes in the degree of pollution can occur as to entirely destroy the value of the test. Consequently it is now recognized that the quantity of hypochlorite necessary to prevent danger is, under conditions of this sort, a matter of the purest guess work and cannot be regulated by any scientific standard.

9. Since the reference, many bacteriologists have noted that the bacteria were often present after chlorination treatment, sometimes in numbers known to be greater than originally present in the water, a result which was set down to no better cause than that such examinations are necessarily delicate and difficult and that these apparent results were due to unskillfulness of examination. In my opinion and in that of many other bacteriologists, the explanation of these observations lies in the fact that the bacteria are devitalized rather than destroyed by the chlorination process, and that they multiply after the treatment. This view as to the temporary suspension of the vitality of the bacteria is proved by the investigations of a number of bacteriologists which show that while less virile organisms among the bacteria may be killed, more hardy forms revive and become the nuclei for a large secondary growth. Since the chlorination process was first introduced as a treatment for a public water supply in Jersey City, one limitation after another affecting its efficacy has been revealed. The fact referred to above is the lat-

est of these limitations, which have come to light. The understanding of this matter is a matter of the last two or three years.

10. There is another respect in which the hypochlorite plant should not be recognized as a substitute for sewers and sewage disposal works on the watershed. Inasmuch as sewage pollutions and bacteria are inseparable, it is certain that when the bacteria of the intestinal type arrive at the outlet to the Boonton Reservoir at the point where the hypochlorite solution which treats the water is administered, these bacteria because they are inseparable from sewage, are accompanied by a certain volume of sewage pollution. In the years 1908 and 1909 it was assumed by some chemists that the effect of hypochlorite was to oxidize or destroy organic matter as well as to kill bacteria. As a consequence it was thought that hypochlorite treatment exercised a purifying effect so extensively that it not only killed bacteria but burned up by wet combustion all the organic matter by which these bacteria were accompanied. More recent investigations now make it clear that such destruction or burning up of organic matter does not take place and that the only effect of the hypochlorite treatment is on the vitality of the baceria themselves. As a consequence any sewage accompanied by bacteria which arrives at the outlet of the Boonton Reservoir is conveyed unaltered to Jersey City, excepting for such effect as the hypochlorite may have had on the bacteria themselves, so that the water delivered in Jersey City contains all of the sewage which it contained as it left the outlet of the Boonton Reservoir. Inasmuch as the installation of sewers and sewage disposal works for Boonton, Dover and Hibernia would remove the human sewage of these municipalities from the water of the Rockaway River,

it is obvious that the hypochlorite plant by its very nature cannot in any sense act as a substitute for such sewers and sewage disposal works so far as the removal of the sewage of Dover, Boonton and Hibernia is concerned.

EARLE B. PHELPS.

Sworn and subscribed to at Washington, District of Columbia, this 8th day of December, 1917, before me, the subscriber, a Notary Public in and for said District, duly commissioned and sworn, as witness my hand and official seal.

B. A. Bowles,
Notary Public, D. C.

(Seal)

Affidavit of J. William Griffin.

IN CHANCERY OF NEW JERSEY.

BETWEEN THE MAYOR AND ALDERMEN OF JERSEY CITY, *Complainant,* *and* JERSEY CITY WATER SUPPLY COMPANY, *Defendant.*	On Application for Leave to File Bill of Review.

STATE OF NEW JERSEY }
COUNTY OF HUDSON }

J. WILLIAM GRIFFIN, of full age, being duly sworn on his oath deposes and says:

1. I reside in the City of Jersey City, and during the past twenty years have been superintendent of various water companies and plants in the State of New Jersey, including the Municipal Water Works of the City of Jersey City. I was superintendent of the Jersey City Water Works from January, 1906, to June, 1913, and also from October, 1916, to May, 1917. My duties as superintendent of water during the period 1906 to 1913 were such as to make me the executive officer in charge of the Water Department of Jersey City. I had full charge of the water distribution system in the city, the pipe line, the Boonton Dam, the Boonton Reservoir, and the watershed of the Rockaway River. This included the gate house and the chlorinating plant after the same came into the possession of the city. I am and have been familiar with the sanitary conditions on the water shed and above the Boonton Reservoir from 1896 to the present time. Prior to 1906, as far

back as 1896 I was superintendent of the New York and New Jersey Water Company, which company supplies Bayonne. I was also superintendent of the New Jersey Suburban Water Company during the period of 1903 to 1906. This company supplies water to Kearney, East Newark, and Harrison. Since 1896 I have kept myself informed as to the sanitary conditions of the Passaic River and its tributaries, including the Rockaway River watershed.

I am a member of the American Water Works Association, and a member of the Executive Council of the New Jersey Sanitary Association. Through these two societies and through the current literature I have kept in touch and informed myself as to the purity of water supplies and the treatment thereof.

2. I am familiar with the testimony given in the case of the Mayor and Aldermen of Jersey City vs. Jersey City Water Supply Company, and also the reference before the Honorable William J. Magie, Special Master in the said suit. This cause was tried while I was superintendent of water for Jersey City, and among my other duties I assisted in the preparation of the main case and the reference.

3. I am informed that an application is about to be made to the Court of Chancery of New Jersey for leave to file a Bill to review that part of the preceding in the litigation above referred to which obligated Jersey City to take the chlorination plant in lieu of Sewers and Sewage disposal works mentioned in the decree advised by Vice-Chancellor Stevens, June 4th, 1908.

4. On October 11th, 1911, the Boonton water works came into the possession of the City in accordance with the decree of this court and on the payment of the purchase price. The operation

of the Boonton water plant fell to the control of the then Street and Water Board of Jersey City and I was superintendent. The Street and Water Board engaged the services of Dr. George E. McLaughlin as sanitary advisor and bacteriologist. Prior to that time he had been bacteriologist for the Jersey City Water Supply Co. and had made an analysis of the water after its chlorination which analyasis was used in the suit and reference as part of the exhibits of the Jersey City Water Supply Company, the contractor building the water works. Dr. McLaughlin began his duties for the city on January 1st, 1912, and from that time on to the present time has made frequent analysis of the water delivered to Jersey City and reported on them, at least during my incumbency, monthly to the Street and Water Board. The monthly reports of Dr. McLaughlin during the winter and Spring of 1912 showed the water delivered to Jersey City to be of a good quality bacterially. On July 27th, 1912, Dr. McLaughlin in submitting his report to the Street and Water Board advised the Board that the Boonton Sterilization plant, which the Court decreed to be in lieu of the sewers and sewage disposal works, mentioned in the original decree, June 4th, 1908, to be taxed to or very near its limit of efficiency and urged the erection of an intercepting sewer along the Rockaway River. The Street and Water Board employed Mr. George A. Johnson who had also been employed by the Jersey City Water Supply Company, the contractor in the erection of the chlorination plant and who was familiar with the possibilities of the chlorination plant and sewers and sewage disposal works proposed for preventing the pollution of the Rockaway River, to make an investigation and survey of the Rockaway River water shed. After several months of investigation during which time he had a representative make a thorough survey of the water shed, he submitted a report to the Board of Street and Water Commissioners under date of December 27th, 1912. This report embraced 231 pages, together with blue prints and exhibits; among the other recommendations contained therein being the following beginning on page 19:

1. "Steps should be taken at the earliest possible date looking to the construction of a trunk sewer along the Rockaway River in order to intercept the sewage from Dover, Rockaway and Boonton, carrying this sewage to some point below the water works dam at Boonton. At this point a sewage disposal plant should be constructed, and the sewage purified before its discharge into the river below the dam. In the design of the sewer provision should also be made for taking in the sewage from Wharton, although the construction of a sewer system there is not considered to be of immediate necessity."

2. "A small temporary hypochlorite plant should be installed at the outlet of Ford's Pond. Another one is needed on the grossly polluted stream entering the Rockaway River below Mercer Street, Dover, between the railroad tracks and the McKiernan-Terry Drill Company building, Dover. These plants would effectively sterilize a large part of the sewage now entering the river at these points, pending the construction of the trunk sewer and connecting sewerage system. There are a number of other points in Dover at which it may be desirable to install temporarily small inexpensive hypochlorite plants."

3. 'For the outlying districts a contract

should be prepared and let immediately for the construction of concrete vaults for all privies so located as to be likely to pollute the various tributaries of the Rockaway River, either directly or by surface wash at times of heavy rains.''

4. 'A thoroughly well systematized sanitary control of the water shed should be organized.''

With reference to the sterilization plant on page 23, Mr. Johnson made the following statement: ''With the sterilization plant at the Boonton dam operated as at present ,its efficient performance is assured, provided it does not become overtaxed.'' This report to the Street and Water Board, as stated, was received December 27th, 1912, and was immediately turned over to me as superintendent of water for my recommendations and action.

Regarding the first recommendation made by Mr. Johnson that steps be taken at the earliest possible date looking to the construction of a trunk sewer along the Rockaway River. I felt that inasmuch as the Court had decreed that the sterilization plant was in lieu of the trunk sewer and sewage disposal works that Jersey City within a year after the Court's decree should not be burdened at its own expense by this intercepting sewer recommended by Mr. Johnson. The plant which the Court had given to Jersey City in lieu of the trunk sewer had been in operation more than a year and it was my feeling that the evidence on which the Court arrived at the conclusion that the disinfecting plant was in lieu of the trunk sewer must have been so conclusive and founded on such evidence that as superintendent of water for Jersey City I should not take the responsibility of constructing the intercepting sewer which the Court had denied us. I felt that Jersey City had every right to expect that the decree of the Court substituting the disinfecting plant in lieu of the sewers and sewage disposal works was the proper solution of our water problem.

Regarding the second recommendation above referred that small hypochlorite plants be installed at the outlet of Ford's Pond and at Mercer Street, Dover. This was immediately done.

Regarding the third recommendation above mentioned for the building of concrete vaults for all privies so located as to pollute the various tributaries of the Rockaway River. We could find nothing in the law or in the statutory provisions that would allow us to go on a man's property and construct these privies, and so this was not done.

Regarding the fourth recommendation that a thorough sanitary system of the water shed should be organized, this was immediately put into effect and a sanitary engineer was employed to take charge of the patrol as organized. The sanitary engineer employed was one recommended by Messrs. Johnson and McLaughlin, and it so happened that he was the sanitary engineer who had made the sanitary survey for Mr. Johnson on which he based his report to the Street and Water Board of December 27th, 1912.

5. In order to check the finding of Messrs. McLaughlin and Johnson I got in touch with the State Board of Health and requested that they have an inspection made of the Rockaway water shed for the purpose of ascertaining officially the condition of the water shed.

Accordingly on February 19th, 1913, the State Board of Health instituted an independent survey of the Rockaway River water shed. This survey was continued through February, March, April and May of 1913, and as a result of said survey a report containing 157 pages was prepared, a copy of which was delivered to Jersey City. This report was a most complete investigation of conditions on the water shed and was accompanied by a number of maps and photographs. The entire report is summarized and the summary and recommendations are contained on page 17, thereof, and as relating to the hypochlorite plant and the intercepting sewer on the water shed are as follows:

"The purpose of the inspection, described in this report, was to ascertain the exact condition of that portion of the water shed of the Rockaway River from which water is obtained to supply Jersey City, to secure the abatement of all pollutions maintained on that watershed in violation of law, and to gather data which would point out the best methods to be pursued in protecting the watershed in the future.

As is shown in the introduction, this water shed is quite densely populated, and three-quarters of its population is in close proximity to the stream. Because of the hilly character of the country, a very large proportion of the rainfall soon finds its way into the stream, affording the maximum opportunity for pollution from surface wash. Besides the polluting matter added to the river in this way, there is serious direct and continuous pollution from Dover, Rockaway and Wharton, and portions of Boonton which are all unsewered. The flow of the stream is rapid in most places, and the distance from its headwaters to the Boonton reservoir is short, affording but limited opportunity for purification by sedimentation.

Bacteriological anaylses which have been made at frequent intervals by employees of the Jersey City Water Department show that the degree of pollution of the water as it enters the reservoir is such that it is quite unfit for potable use at that point. In the reservoir considerable purification by sedimentation takes place. This purification, however, is by no means complete enough to render the water safe for domestic purposes, and the water is therefore treated with calcium hypochlorite as it leaves the reservoir. This treatment has been adequate to protect the users of the water up to the present time. It has been found necessary, however, because of the increasing pollution of the river, to increase the dose of hopochlorite from time to time, in order to secure a sufficient reduction in the number of bacteria in the water. At the present time an amount of hypochlorite, equivalent to approximately 0.7 parts of available chlorine per million parts of water, is being added. It is not possible to use a much larger dose than this, without producing objectionable tastes and odors in the treated water; a condition not in itself dangerous to health, but so objectionable to the senses that it will not be tolerated by the water consumers. It is, therefore, imperative that something be done in the near future to check the increasing pollution of the river; for unless some action is taken, the time will soon come when the amount of hypochlorite which it is permissible to add to the water will no longer suffice to secure adequate sterilization, and it will then be necessary, either to abandon the supply, or to resort to some other method of purification. The only other method available is filtration, and the construction of a suitable filter plant, large enough to filter the water used by Jersey City, would cost a very large sum, probably close to a million dollars.

The most serious and direct pollution which the river receives comes from Dover, in a manner described later in this report. This cannot be abated to any extent until the town is equipped with a complete system of sanitary sewers, and some means for the purification of its sewage. Sections of Boonton, and all of Rockaway and Wharton need to be sewered also. The sewage of these municipalities, even after treatment in sewage disposal works, could not be safely discharged into the river at a point so close to the head of the reservoir. The most feasible plan to care for this sewage, a plan which has already been proposed and which is likely to be carried out in the near future, is to construct a trunk sewer along the line of the river, into whch sewage from the sanitary sewers of Wharton, Dover, Rockaway and Boonton could be discharged, and by this means lead the sewage to a point below the reservoir and there treat it before it is returned to the river. Inasmuch as this river is used as a source of water supply some distance below Boonton, the treatment of this sewage should be carried on with more than ordinary care, so that the purity of the water supplied below would not be jeopardized. Later, it would be advantageous to extend this sewer up the river to take in the Hibernias and Mount Hope. If this plan is carried to completion, most of the burden of polluting matter, which is now taxing the plant at Boonton to nearly the limit of its capacity, would be removed." * * *

"The hypochlorite plant at the Boonton Dam is the vital point of the whole system. Unless this is managed in such a manner that the hypochlorite is added to the water *at all times* in proper amounts, the supply will become unsafe." * * *

Shortly after the investigation of the State was completed and the report submitted the form of government in Jersey Ciy was changed and the office of superintendent of water was abolished.

It is my opinion and belief that the limitations surrounding the use of hypochlorite for the protection of a water supply so badly polluted as is the Rockaway River supply and was at the time of the suit in 1908 that the same cannot be relied upon as an effective device for continually purifying the water at all times. These limitations first began to make themselves partially manifest in 1912 at the time of the report of Dr. McLaughlin to the Street and Water Board, and of the investigation and report of Mr. George A. Johnson above referred to. Since those reports were made to the Street and Water Board the limitations of the chlorine process have become more and more apparent until at the present time when the latest limitation has been brought to the public attention, namely, that the bacteria are not destroyed as the Master found, but are stunned and at low temperatures the action of the chlorine is negative.

During my incumbency as water superintendent from 1906 to 1913 the sterilization plant at Boonton was operated under my supervision. During the interval from the time the plant was turned over to the city on October 11th, 1911, to June, 1913, I was never able to secure a formula or rule for applying chlorine or bleach in a proper proportion. When the plant was turned over to the city by the contractor no definite formula or rule was given me by the contractor nor was any known whereby a proper and adequate amount of chlorine could be added to destroy the bacteria contained in the water and at the same time not impart a disagreeable and unhealthy taste and odor to the water as delivered to Jersey City. Another limitation of the hypochlorite plant was the inability to follow the pollution with the proper amount of chlorine based on bacterial tests. The bacterial tests on the water did not follow the application of chlorine for forty-eight hours, and consequently I have never been sure that the proper amount of bleach was being applied until the bacterial tests were supplied forty-eight hours after the application of the chlorine. These limitations manifested themselves during my incumbency as superintendent of water. Since that time I am informed, and know of my own knowledge that other limitations have developed which show that the hypochlorite plant cannot be depended upon at all times to adequately safeguard the health of the people of Jersey City.

My personal knowledge of conditions on the water shed of the Rockaway River dates back to 1896. During the period from 1896 to 1906 I was familiar with conditions on the shed and made frequent inspection trips over the shed. From 1906 to 1908, during the interval when Jersey City was considering the question of taking over the Boonton water works and relieving the contractor of his contract obligations I made frequent and thorough examinations of conditions on the water shed with particular reference to pollutions in Port Oram (Wharton), Dover, Rockaway, Boonton, and Hibernia. At that time many pipes were discovered pouring pollution directly into the river or its tributaries, also overhanging privies. As these were called to the attention of the contractor they were in many cases removed and the sewage which had reached the river through these pipes was stored on the premises of the pollutor in cesspools. During this period many new cesspools were constructed in Dover to receive the sewage which had formerly been discharged into the stream. During the period from 1908 until October 11th, 1911, when the City came into the possession of the Boonton Water Works these same conditions obtained. As direct pollutions were discovered they were abated, the pollutor making other arrangements to dispose of his sewage matters. As the direct pollutions were stopped the pollutors would discharge their sewage into cesspools, and as these cesspools became filled with sewage matters they would be cleaned out and the sewage taken away from the premises. It was well known in 1908 and 1909 that practically all premises in Dover received water from the public water supply, aggregating at that time a total daily consumption of more than 400,000 gallons. These 400,000 gallons of water supplied to the citizens of Dover had to be disposed of in some manner after use in the households in the town. It was my belief, that this dirty water was to be disposed of in the cesspools in the manner I have mentioned. During the period from 1906 until the city took possession of the plant in 1911, on frequent visits to Dover I saw no evidence that the cesspools were not properly performing their functions. There was no apparent evidence of their becoming filled or overflowing.

Affidavit of J. William Griffin

Following the acquisition of the water plant by the City, in 1911, under my direction the City installed a most stringent patrol of the water shed. It was our endeavor to control the water shed in such a way that no direct pollutions could reach the river. The condition of the shed as to direct pollutions was continually improved until the office of superintendent of water was abolished in 1913. On my reappointment to this office in October, 1916, it again became my official duty to go over the water shed. I found that conditions as to direct pollutions were in practically the same condition as in 1913; that is, there were no records of any direct pollutions where the polluter could be located and the pollution abated. I found that during the time the office of water superintendent had been abolished the City had taken great steps and had spent many thousand of dollars in a general clean up of the water shed. I found that the boulders had been removed from the streams in order to remove obstructions and provide smoother channels for the water to pass over; that in places retaining walls had been built; that weeds and rubbish along the banks of the streams had been removed; that portions of the property owned by the City adjacent to the reservoir had been cleaned of trees, and that rubbish which was washed into the streams after rainfalls had been removed and was being removed. In other words there was a general clean up of the Rockaway River and its tributaries, putting the same in a much more presentable appearance and better in a sanitary way than the plant was at the time it was turned over to the City by the contractor in 1911.

However, conditions on the water shed which were not apparent prior to 1913 gave me much cause for alarm. I discovered that the subsoil in Dover had become so surcharged with sewage matters as to cause many of the cesspools in the Town to overflow and sewage to find its way into the river by flowing over sidewalks and gutters and thence into the river.

This condition became so serious during the Winter of 1916 and 1917 that it became the object of special investigations and efforts on behalf of the City to prevent or minimize so far as it could the effect of this dangerous pollution. The situation assumed such proportions that as superintendent of water, I spent much time in Dover on a study of these conditions using all diligence to minimize the danger to Jersey City so far as could be done. Sewage matters flowed across the sidewalks, through the gutters and into the river or its tributaries. It also backed up into the cellars of many of the houses in Dover, in some cases sufficiently high to put out the fires in the furnaces. In the case of the Birch property on Morris Street and Railroad Avenue the sewage rose in the cellar and put out the furnace. The owner in order to prevent serious damages to himself pumped out the sewage matters into the gutters from which it flowed directly into the Rockaway River. From my observations at this time and from subsequent observations made during the past summer I am firmly of the opinion that the gravelly subsoil which constitutes in a large measure the underlying stratum in Dover has become so filled with sewage matters that it can not longer assimilate the sewage which reaches it through these cesspools. This condition, in my judgment, is so bad that any new sewage now being discharged into the cesspools displaces an equal amount of sewage from the soil into the river. My knowledge of conditions in Dover leads me to believe that the underground conditions there constitute one reeking cesspool. I have made investigations as to this subsoil condition in Dover as recent as November 6th, 1917, and in my opinion, the underground conditions in Dover as relating to the storage of sewage matters is daily becoming worse, and substantially all of the cesspools in the central portion of Dover overflow either directly or indirectly into the Rockaway River.

My investigations made during the current year also disclosed the fact that there are but four scavengers in Dover who are licensed to clean out these cesspools. Each of them has a tank wagon holding about 500 gallons. These wagons at the present time are the only means of removing 600,000 gallons of polluted matter discharged into the subsoil of Dover daily. I also made an inspection of the site on which one of these scavengers discharges the contents of the cesspool wagon. This site on which he discharges the contents of the cesspools is also so situated that at each rainfall the discharges from the cesspool which he places on the ground is washed into one of the tributaries of the Rockaway River. This site is just outside of the city limits of Dover and about 1,000 feet easterly and above the stream draining the Richards Abbatoir.

In 1908, at the time of the reference before the Master, the Jersey City Water Supply Company, the contractor was using 0.4 parts of available chlorine which equals ten pounds of chloride of lime per million gallons of water treated. After the City acquired the plant it was necessary to steadily increase the amount of chloride of lime added to the water on account of the release of stored pollution from Dover, Boonton, and Hibernia, especially Dover. It was impossible for the city to control the pollution in Dover as I have above outlined. Our only remedy, therefore, was to increase the amount of chlorine. The amount of chlorine added during the time I was superintendent of water reached 0.8 parts or twenty pounds of chloride of lime per million gallons of water. This amount of chloride of lime added to the water has been sufficient at times to cause disagreeable tastes and odors in Jersey City, and during my incumbency I received many complaints from consumers on account of the unpleasant taste and odors to the water. I reside at 121 Garrison Avenue, Jersey City, and have frequently noted a strong taste and odor in the water. The taste and odor was similar to iodoform, said taste and odor being so disagreeable that I have refrained from drinking the water.

With my knowledge of conditions in the water shed existing back, as I have stated, to 1896 including a thorough study of the pollutions and their abatement, I am firmly of the opinion that there is no solution for the water problem of Jersey City other than the construction of an intercepting sewer for the purpose of removing the pollution from Dover, Boonton, and Hibernia from the water shed and that this was true when the contract between the City and the Contractor was entered into.

I became so convinced of this fact during my tenure of office as superintendent of water that together with the Mayor and the Street and Water Board I conducted negotiations during 1912 and 1913 with the Towns of Boonton and Dover and arranged with them tentative plans for constructing an intercepting sewer beginning at Dover and paralleling the Rockaway to a point below the Boonton Dam, and so designed as to take all of the sewage from Boonton and Dover. I also arranged with the constituted authorities of Boonton and Dover that they were to construct complete collecting sewerage systems in both towns, pass ordinances compelling each of the property owners to connect to the same and discharge all of their sewage through the intercepting sewer to a point below the Boonton Reservoir. These nogotiaions were so complete and conducted to such a point that contracts were drawn up between Dover and Boonton on one hand and Jersey City on the other hand providing for the construction of these intercepting sewers. This contract was actualy ratified and signed by the Mayor and Council of Dover on behalf of the town of Dover, but owing to the change of government in Jersey City in June, 1913, these contracts were never consummated on behalf of Jersey City.

Under these contracts Jersey City was to build and pay for the intercepting sewer and disposal works and Dover and Boonton were to pay for the various laterals in their respective municipalities.

(Signed) J. WILLIAM GRIFFIN.

Sworn and subscribed to before
me this 19th day of April, 1918.

(Signed) ELEANOR SCHENK,
Notary Public of N. J.

(SEAL.)

Affidavit of Charles E. North.

IN CHANCERY OF NEW JERSEY.

Between The Mayor and Aldermen of Jersey City, *Complainant,* *and* Jersey City Water Supply Company, *Defendant.*	On application for Leave to File Bill of Review.

State of New York }
County of New York } ss.:

Charles E. North of full age being duly sworn on his oath deposes and says:

Qualifications

I am a consulting sanitary expert, forty-eight years of age, conducting a private practice in my office at No. 30 Church Street, New York City, which I established in 1908. I was graduated as a physician and bacteriologist at Columbia University school of medicine, taking the full undergraduate and post graduate courses in medicine and bacteriology. I served as Director of the Department of Bacteriology of the Lederle Laboratories for three years before entering my own private practice. I am a member of the New York County Medical Society, The American Medical Association, The American Public Health Association, Secretary of The American Academy of Public Health, Secretary of the National Commission on Milk Standards, and Chairman of the

Mayor's Committee on Milk, New York City, 1917. Have operated private laboratories for testing water and milk, and for general sanitary work in chemistry and bacteriology.

In 1908 I was employed by Jersey City as bacteriologist and consulting expert in the litigation then being conducted between Jersey City and the Jersey City Water Supply Company. During 1908, 1909, and 1910, I made numerous inspections of the Rockaway River water shed. I inspected repeatedly all sources of pollution, and followed up all branches of the Rockaway River, including its smallest tributaries. From all of these tributaries I took samples of water for bacterial analyses, and from many points in the Rockaway River from above Dover to below the Boonton Dam, including many samples from the mouth of the Rockaway River and from the Boonton Reservoir. I also made bacterial tests on numerous samples of water taken before and after treatment by the hypochlorite plant located below the Boonton dam, and on samples of water at the point of delivery at Jersey City into the high service reservoir. Many of these anlyases were presented by me as evidence in my testimony on behalf of Jersey City in the litigation above mentioned.

For a period of two years after the litigation was completed, (1910-1912), I was employed by Jersey City as bacteriologist for the Street and Water Board, and during that period I made regular daily tests on samples of water taken from the point of delivery to Jersey City, and on weekly samples from the mouth of the Rockaway River and from the Boonton Reservoir before treatment with hypochlorite at the outlet leading to Jersey City. I ceased my work as bacteriologist for Jersey City in January, 1912.

In an unofficial capacity I have occasionally visited the Boonton Reservoir, the hypochlorite plant, and the Rockaway watershed, in the interval between 1912 and 1916.

In December, 1916, I was again retained by the Mayor and Commissioners of Jersey City as consulting sanitary expert. I made inspections of the Rockaway watershed, and especially of the Town of Dover, on January 6th, August 31st, and September 14th, 1917. On August 31st I visited only the Town of Dover. On the other two occasions I inspected also the sources of pollution at Rockaway, Liondale, Powerville, and Boonton.

Extent and Character of Pollutions of the Rockaway River above the Boonton Reservoir

From my frequent inspections of this watershed in the years 1908 to 1912, and my inspections in 1917, my conclusion is that the present condition of the Rockaway watershed is far worse than in 1908 because the quantity of dangerous pollution has greatly increased. I base this opinion on my personal observation of the following facts:

(1) The Rockaway River runs through a valley for the most part having steep banks and adjacent to high hills. This is especially true at Dover and at Boonton, the two largest cities in the watershed. The watershed is sparsely settled, consisting mostly of woodland and wild uncultivated land, excepting on the river banks themselves, where a population of about 20,000 people is clustered directly on the river in five settlements within a length of about fifteen miles. There is no outlet for the sewage of these people excepting the Rockaway River. 90% of the dwellings are within one quarter of a mile of the river, and

consequently 90% of the sewage is deposited close to its banks.

(2) The sewage from all of the dwellings, excepting a portion of Boonton, is deposited in cesspools.

(3) Pipe lines for the overflow from these cesspools leading to the Rockaway River have been removed or closed up by the Jersey City inspectors of the watershed.

(4) In my recent inspections at Dover I noted that the City has a municipal water supply, but no sewerage system. Consequently all water used by dwellings, stores, factories, etc. must run into the cesspools.

(5) The cellar of the Mansion House Hotel was flooded with sewage about six inches deep in semi-solid form, and having a very foul sewage odor.

(6) Sewage had risen up through the cracks in the cement floor of a house directly across the alley in the rear of the Mansion House.

(7) There were four inches of liquid sewage in the cellar of a public restaurant near the D. L. & W. depot, and it was flowing from the mouth of a large cesspool located in the cellar.

(8) Two doors below this restaurant the soil and grass in the front yard of a private dwelling was caved in, and the hole plugged with boxes to prevent passers by from falling in. The odor of sewage arose from this place, and I could see gray liquid material looking like sewage in the mouth of the opening. The men operating a wagon for pumping out cesspools were present and were arranging with a large hose to pump out the liquid which has caused this cave in.

(9) There was an overflow and accumulation of sewage on the surface of the ground adjacent to several cesspools located in the rear of a group of houses at the foot of Morris Street, less than 100 feet from the river bank.

(10) A gray colored liquid, foul smelling like sewage, was flowing directly into the river at the foot of Sussex St., from a drain pipe under the cement conduit.

(11) Human sewage was being discharged from a drain opening in the stone wall near Mercer Street bridge.

(12) There was a large drain from Ford's Pond, and a plant for treating the fluid in the drain with chlorine gas.

(13) A very large stream of sewage was flowing into the Rockaway River out of a large drain under the McKernan Drill Works, and another chlorine gas plant was located here for treating this sewage.

(14) The long row of privies in the rear of the houses along the river in East Dover has been moved from the banks, which they overhung in 1908, so that most of them were located at present at least ten feet from the river bank.

(15) During the ten years, 1908-1918, the cutting off on the outlets of cesspools, and the constant flow of the municipal water supply has resulted in the saturation of the soil of the City of Dover with sewage deposits, so that now the soil can hold no more sewage. Consequently, the sewage is now reaching the Rockaway River either directly through drains, or indirectly through subsurface seepage, or surface overflow. In times of heavy rain there must be an enormous wash of sewage from the saturated ground of Dover into the Rockaway River.

(16) At Rockaway I twice inspected the factory called the Liondale Dye, Bleach & Print Works in 1917. I saw on my visit in September that there was no water flowing over the dam across the Rockaway River, but that all of the water of the river flowed into the race-way lead-

ing to the bleachery. Below the bleachery the water in the race-way was badly discolored and carried a heavy mass of suspended matter of gray color. The several pools and stone wall dams in the raceway were covered with heavy gray slime, and a strong odor of chlorine gas, or bleaching powder, was noticeable. Below the dye works, where the race-way rejoined the river, the gray water from the race-way constituted the chief part of the stream. I was informed that the sewage of the four hundred employees in this bleachery is discharged into this race-way. I believe that this is true, as no other possible outlet for sewage could be seen.

(17) At Powerville I observed the rag-mill located directly on the bank of the river. No river water was passing over the dam, but all water passed through a race-way which flowed under the rag-mill. In the storage sheds of the mill I saw large bales of brown colored rags of soiled and unsanitary appearance.

(18) At Boonton I noted that a large part of the city is located on the steep bank of the Rockaway River, and that sewage from the dwellings must because of gravity flow toward the river. I saw a large flow of sewage flowing from the Brook Street sewer down a channel in the inclined railway of the Morris & Essex Canal into the water of the lower level of the canal. The race-way of the large iron works called the Cooper-Lord Estate joins the canal at this point, and is separated from the canal by three wooden flap gates intended to prevent a back-flow of canal water into the race-way if the water level of the race-way should be lower than the water-level of the canal. These gates looked ineffective for this purpose. One of them was elevated so that there was a full opening and it could not operate. The other two

were not water-tight. It is certain that the heavy sewage deposit at this point could flow back into the race-way and through the nearby outlet of the race-way directly into the Rockaway River.

(19) The iron foundry of the Cooper-Lord Estate located at the bottom of the deep gorge at Boonton is directly on the Rockaway River, and all drainage and sewage from employees must flow directly into the Rockaway River.

(20) The Eastern part of Boonton is below the Morris Canal, and directly above the Rockaway River. Many dwellings and stores and one large factory are located so that drainage must necessarily flow directly into the Rockaway River.

(21) I observed a stream of discolored water flowing from four inch iron pipe under a garage in Morris Street discharging into a street gutter, which emptied directly into the Rockaway River.

(22) I noted that Boonton has a local water supply, but no sewerage system, excepting the Brook Street sewer. Since the majority of dwellings depend upon cess-pools, the municipal water supply after being transformed into sewage must reach the Rockaway River by seepage or surface overflow.

(23) I visited Hibernia many times in the period 1908-1912, and observed that this mining village is not equipped with a sewage system. I am informed that the population is to be increased shortly to one thousand families, which will mean at least five thousand persons. This is certain to result in the contamination of several small streams tributary to the Rockaway River on the banks of which this village is located, with the wash from the out houses and the contaminated water pumped from the mines.

The effect of the Pollution of the Rockaway Water Shed on the Water Supply of Jersey City

From my knowledge of the number and character of the pollutions on the Rockaway water shed, the extent of the water shed, and the size of the Rockaway River, and from my knowledge of many other municipal water sheds which I have visited, it is my conclusion that the Rockaway River is more foul, and that the water supply of Jersey City is more grossly polluted with human sewage than any municipal water supply I have ever seen. The concentration of a comparatively large population on a very short and very small stream of water magnifies the proportion of pollution to the amount of water, so that at times the Rockaway River is little more than an open sewer.

The Boonton Reservoir.

The geography of the reservoir is such that the inlet from the Rockaway River and the outlet to Jersey City are both located at the same end less than one-half mile apart, while the reservoir itself is over two miles long. As a consequence, the water supply does not receive the full benefits of sedimentation indicated by the size of the reservoir, but the arrangement provides for a short circuit when the wind is in the right direction for the polluted water of the Rockaway River to be blown across the north end of the reservoir toward the conduit to Jersey City with scanty time for sedimentation.

It is positively certain that in times of freshet when the entire water shed is suddenly washed with heavy rains so that surface pollutions quickly reach the river, that the entire volume of water in the north end of the reservoir is replaced by the polluted water of the Rockaway River, and consequently the conduit to Jersey City receives the surface wash of the water shed, and that on such occasions the reservoir as a mechanism for sedimentation is of little value.

If water polluted with sewage once enters the outlet of the conduit from the reservoir at Boonton to Jersey City, there is no way in which such sewage can escape from the conduit but the organic matter and the bacteria composing this sewage must be carried directly to Jersey City.

Sewers and What they Would Accomplish

When pollutions once occur, they can never be "prevented". Liquid pollutions, which compose a large part of sewage, cannot even be removed. The only effective means so far discovered for the prevention of pollution of surface water supplies consists in the independent handling of sewage through a system of pipes which will carry the sewage out of the water shed before it has gained access to the water supply. Sewers so constructed as to carry away the sewage of Dover, Boonton, Hibernia and other towns out of the water shed would entirely prevent the pollution of the Rockaway River from the sewage of these towns. The prevention of the pollution of the Rockaway River above the Boonton reservoir by the sewage of these towns and cities, in my opinion, cannot be accomplished in any other way.

Local sewers in each municipality can be constructed so as to collect all sewage from all dwellings now using the municipal water supplies and all cesspools can then be abolished. All dwellings within the city limits of each municipality which are within reach of the local sewers can be connected with the same, including the dwellings using their own water supply and equipped with privies. These latter can be furnished with municipal water and then be connected with the local sewers and their privies can then be abandoned. In this way all of the sewage of all of the municipalities can be collected into the local sewers. The sewage in the local sewers can be received into large intercepting sewers located between each inhabited area and the banks of the river so that no sewage will be discharged into the river. From the intercepting sewers the sewage can be discharged into a large trunk line sewer which runs through the watershed from the highest inhabited area to the lowest carrying all of the sewage from the water shed and conveying the same to some point below the Boonton reservoir.

There is no Substitute for Sewers.

The pollution which the Rockaway River now receives from the cesspools and privies can be absolutely prevented in this way. The removal of the human pollutions would mean the removal of that portion of contamination which is not only most dangerous, but which is most obnoxious to consumers of water in Jersey City. This pollution cannot be prevented in any other way. Therefore there is no substitute for sewers for the prevention of the pollution of the Rockaway River above the Boonton Reservoir.

The Hypochlorite Plant

I have frequently inspected the hypochlorite plant installed for the purpose of sterilizing water at the Boonton Dam. Shortly after the plant was erected by the Jersey City Water Supply Company I visited the same together with other experts in 1908 and examined its operation. I frequently visited the plant during the years 1908 to 1912, and have occasionally inspected the plant since that time. The building contains an equipment consisting of tanks and pipes and valves for the mixing and discharge of a solution of bleaching powder into the large water pipe penetrating the dam, in which pipe the water of the Boonton Reservoir is conveyed to Jersey City. The dose of the solution of bleach is administered to the water through a small pipe or jet which runs from the dosing apparatus to the large water pipe. Through the jet there is a constant discharge of the bleaching solution into the water passing from the reservoir to Jersey City.

The Sterilizer Removes Nothing from the Water

The bleaching solution that flows from the jet mixes with the water in the pipe line regardless of what the character of the water in the pipe line may be. The water in the pipe line may be clean or it may be dirty; it may be clear or it may be full of suspended matter; it may be pure or it may be polluted with sewage; and yet the bleaching solution from the jet will mix with it just the same. In short, the process performed by the station located at the foot of the Boonton dam is a process which simply adds a dose of bleaching solution to the water which is discharged from the Boonton Reservoir into the pipe line running to Jersey City. It is a process by which a chemical compound is added to the water. It is not a process by which anything is taken away. It is not a process which pretends to remove anything from the water which the water may contain when it reaches the point where the dose is administered. If particles of solid filth are floating on the surface or are carried in suspension, or if the water carries a quantity of pollution in liquid form when it arrives at the place where the dose of bleach is administered, nothing happens to these pollutions. They are not prevented. They are not removed. After the water has flowed past the jet which discharges the dose of bleach, the pollutions in the water are still there. If the pollutions consisted of solid matter the solid matter is still there. If they consisted of liquid matter, the liquid matter is still there. Consequently, all of the pollutions which are in the water in the pipe line as it leaves the Boonton Reservoir still remain in the pipe line after the water receives its dose of bleach and these pollutions are carried by the pipe-line to Jersey City and are distributed to the consumers of water in Jersey City. In short, the station located below the Boonton dam erects no barrier to the transference of sewage from the Rockaway water shed to the consumers of water in Jersey City. If the water of the Boonton Reservoir contains sewage, the water delivered to Jersey City will contain sewage.

Killing Bacteria the Only Function of the Sterilizer

Killing bacteria is the only function of the bleaching powder plant below the Boonton dam. It aims to be a sterilization station. The solution of bleaching powder has a chemical effect on the organic matter of which the bodies of bacteria are composed. The bleaching powder contains lime, and oxygen and chlorine. It is admitted that the lime is inert and had no effect on bacteria. The oxygen and the chlorine both unite with the organic matter in the water. The oxygen "oxidizes" and by the majority of investigators, ten years ago, it was believed that it was this "oxidizing" effect of bleaching powder that killed bacteria. Chlorine is a poison. It is the same poison extensively used in the trench warfare in Europe as poison gas. Chlorine poisons bacteria. It is well recognized as one of the strongest disinfectants. There has been a change of opinion during the last ten years regarding the action of bleaching powder, and the majority of investigators now believe that it is the poisonous effect of the chlorine which kills bacteria. In fact, liquid chlorine is itself being extensively substituted for bleaching powder in water disinfection, and is found to be even more effective than bleaching powder in the killing of bacteria.

The water as it proceeds to Jersey City after receiving the dose of bleaching powder carries in it all of the pollutions it carried before, and all of the bacteria. The only change which has occurred as a result of the dose of bleaching powder is that the majority of the bacteria are dead, a minority are stunned, and a few still remain alive.

The station, whether it be called a sterilizing station, or a hypochlorite plant, or a chlorine disinfecting plant, by its very nature and service cannot in any way prevent the sewage on the watershed from polluting the water. It cannot remove from the water any pollutions which have once gotten into it. It cannot make dirty water clean or foul water pure. The hypochlorite plant does not set any limit to the kind of pollution, or to the degree of pollution. It offers to sterilize the liquid brought to it for treatment, whether that liquid be water, or water slightly polluted with sewage, or water heavily polluted with sewage, or entirely sewage. Sewers and sewage disposal works on the shed determine the kind of pollutions, and the degree of pollution, they are, therefore, necessary to establish the sanitary character of the water before it is treated at the sterilizing station.

The Sterilizer Does not Burn up Pollutions

In 1908 it was believed by some experts, and accepted by the Court, that the oxygen in the bleaching powder actually burned up the bacteria in the water, and also burned up other organic matter, whether liquid or solid, contained in sewage. The impression was created that regardless of the quantity of bacteria, or quantity of sewage, carried in the water before it reached the hypochlorite plant, the oxygen in the bleaching powder added to the water by the hypochlorite plant would be sufficient to entirely burn up these pollutions, so that the water after leaving the hypochlorite plant would be free from all pollution and all organic matter. There is abundant experimental evidence to show that this conception was incorrect, and that the effect of the oxygen upon the organic matter in the water is so slight that the difference between the amount of organic matter before treatment and after treatment is too small to be detected by any ordinary method of chemical analysis. The pollutions are not burned up by the oxygen, but still remain in the water after the oxygen has been added.

The Hypochlorite Plant is not a Reliable Sterilizer

The hypochlorite plant is not a reliable sterilizer for the following reasons:

(a) *It breaks down at times.*

The running of this plant depends on human agents. The solution of bleaching powder and water must be made periodically by the employees, and the quantity required for the dosage of the water delivered to Jersey City must be administered to the water in the conduit, not only every day, but every hour, every minute, and every second, otherwise sewage and sewage bacteria will pass the sterlizer untreated. Employees of the plant admit that on a number of occasions the supply of bleach and of chlorine gas has run out, or the dosing mechanism has become impaired so as to interfere with the administration of the dose. On these occasions the water of the reservoir has passed to Jersey City untreated.

(b) *Interference of organic matter.*

The oxygen and chlorine in the bleaching powder unite with the organic matter in the water, whether that organic matter consists of bacteria or other vegetable or animal material. When other vegetable or animal material is in excess it uses up the oxygen and chlorine to such an extent that the amount remaining available for the killing of bacteria is greatly diminished. When such organic matter is in excess, the only way the destruction of bacteria can be guaranteed is by the administration of an excessive does. Since, however, the occurrence of such excesses of organic matter in the water take place without notice to the operators of the plant, it is physically impossible to adjust the dose to the water so as to guarantee that there will be a sufficient amount to destroy bacteria at all times. The result of this is that at times the bacteria which indicates sewage pass by the sterilizer and reach Jersey City. This is illustrated in a series of tests recently performed under my direction in my own laboratories, as follows:

Date	*Positive test for B. Coli*
1917	
Dec. 4	0
" 5	0
" 6	0
" 10	+ 1 cc.
" 11	0
" 13	+ 10 cc.
" 14	+ 10 cc.
" 17	+ 1 cc.
" 19	0
" 20	0
" 21	0

From the above tabulation it appears that on December 10, 13, 14, and 17, living b. coli, which are the intestinal organisms indicating sewage, were found in the water flowing from the outlet of the conduit from Boonton where it discharges into the high service reservoir at Jersey City. On two of these occasions, December 10 and 17, these organisms were present in 1 cc. of water, indicating serious contamination with sewage.

(c) *All Bacteria Not Killed.*

B. Welchii and spore forming bacteria are not killed by the sterilizer. The dose of hypochlorite regularly used in the hypochlorite plant at the Boonton Dam is not sufficient to destroy those species of bacteria which forms spores because the spores are surrounded with a hard shell which is not penetrated by the disinfectant, consequently such spores pass by the sterilizer and reach Jersey City in a living condition. Among these is a species of bacteria known as B. Welchii. This is commonly found in the intestines of human beings and warm blooded animals. It is particularly abundant in the intestines of human beings. These bacteria are also abundant in sewage and in water which has been contaminated with sewage. The B. Welchii has been spoken of for a number of years as one of the soil bacteria, because it has been frequently found in the earth. Recent studies have shown that it exists only in soils which have been contaminated with the discharges of human beings or of some warm blooded animals. As a consequence, the presence of B. Welchii either in soil, or in water, or in sewage, or in milk, indicates contamination with intestinal discharges.

In the year 1908 this species of bacteria was not well known, and its place in nature, and its position as an indicator of sewage contamination had not been established. Since the year 1908 a large amount of research work has been done on this organism, and its importance as an indicator of contamination has secured a recognition which it was impossible to establish in 1908.

(d) *Infection Due to B. Welchii.*

This species of bacteria is now known to be not only an indicator of sewage contamination but actually the cause of a long list of serious infectious diseases including diarrhoea, ulcers of the stomach, appendicitis, peritonitis, and intestinal putrefaction and intoxication.

(e) *Special tests for B. Welchii on the water delivered to Jersey City.*

In order to determine whether the hypochlorite plant at the Boonton Dam as operated at the present time is capable of killing the spores of B. Welchii, a series of special tests were made in my laboratories beginning October 3, 1917, and ending October 31, 1917. These tests were made on samples taken from the tap delivering water in my laboratory in Jersey City, and also from samples taken directly from the outlet of the conduit delivering water to Jersey City from the Boonton Reservoir. The results of these tests are as follows:

Date 1917	*Samples from*	*Number of samples*	*Samples containing B. Welchii*
Oct. 3	Laboratory tap	14, 10 cc. each	8
9	" "	14, 1 cc. "	2
10	Outlet of conduit	8, 1 cc. "	3
10	" " "	6, 10 cc. "	4
10	Laboratory tap	8, 1 cc. "	2
10	" "	9, 10 cc., "	2
13	" "	3, 10 cc. "	3
13	" "	2, 1 cc. "	2
15	Outlet of conduit	9, 1 cc. "	1
15	" " "	10, 1 cc. "	2
15	" " "	10, 10 cc. "	10
25	" " "	10, 1 cc. "	3
26	" " "	10, 1 cc. "	2
27	" " "	10, 1 cc. "	2
29	" " "	10, 1 cc. "	2
31	" " "	10, 1 cc. "	3

In the above record it is clear that on every occasion that the water delivered to Jersey City was tested, whether from the tap in the laboratory, or from the conduit delivering water to the City, B. Welchii were present. This is positive evidence that the hypochlorite plant does not destroy the spores of this species of bacteria, and the presence of these intestinal organisms is positive evidence that the water is polluted with sewage, and that the hypochlorite plant cannot destroy this evidence.

12. *Free Chlorine is constantly present in the water delivered to Jersey City, indicating that the dose of hypochlorite used in the hypochlorite plant at the Boonton Dam has reached its limit.*

A series of special tests were made under my

11, and ending December 21, 1917, from samples of water delivered to Jersey City by the conduit, to determine the presence of free chlorine. This free chlorine, if present, shows that the amount of bleaching powder or chlorine being used at the hypochlorite plant at the Boonton Dam is in excess of the amount which will unite with the organic matter in the water. Such an excess indicates that the size of the dose of this disinfectant has reached its limit of efficiency, and that any larger dose simply means an excess and a waste of chlorine.

Tests were made by the standard methods for determining the presence of free chlorine, and the results were as follows:

Date	*Sample from*	*Free chlorine in parts per million*
1917		
Dec. 11	Outlet of conduit	.05
12	" " "	.07
13	" " "	.06
14	" " "	.07
17	" " "	.07
18	" " "	.07
19	" " "	.06
20	" " "	.07
21	" " "	.08

On one of my visits to the water shed in 1917 I conversed with the employees operating the plant, and have conversed with Dr. McLaughlin, and Mr. Breitske, who have supervised the operation of this plant since that time. All of these persons have informed me that the quantity of hypochlorite being used at the present time gives to the water a dose of from .7 to .9 parts per million of available chlorine. This is more than twice the quantity of chlorine used when the plant was first direction in my laboratory, beginning December operated in the year 1908. My knowledge of the operation of other hypochlorite plants indicates that in other municipal supplies it is recognized that .9 to 1.0 parts of available chlorine represent the extreme limits of dosage, beyond which chlorine can actually be tasted in the water.

My tests for free chlorine show that the limits of dosage for Jersey City water have already been reached in the dose now administered, and that in spite of this increased dose B. Welchii are constantly present and B. Coli occasionally present in the water delivered to Jersey City, consequently while the dose has reached its limit, the bacteria indicating sewage still remain alive in the water.

13. *The stunning effect of hypochlorite and chlorine on bacteria in water.*

I have read the report of Dr. Harry W. Redfield in which he states the results of his bacterial tests on the water delivered to Jersey City and shows that while B. Coli are some times not found in the standard period of time required for testing the water by the standard methods, yet these bacteria revive in the water after several days and are found in a living state. I endorse Dr. Redfield's conclusion that the hypochlorite acts only as an anesthetic on these bacteria, and not as a disinfectant. Other bacteriologists of my acquaintance have made the same statement to me concerning the effect of chlorine on bacteria in the water, namely, that tests made during the first day or two might indicate a water free from pollution, but if the same samples of water are tested later on the bacteria will revive and sewage bacteria will be found to be present. I have conducted experiments in my own laboratories to ascertain whether this is true regarding Jersey City water, and find that bacteria which are not present in the samples tested within 48 hours will reveal their presence in 72 hours and in 96 hours.

14. *Montclair Epidemic.*

I have read the affidavit of Dr. E. C. Levy regarding his investigations of the epidemic of intestinal disease occurring in Montclair, West Orange, Glen Ridge, Bloomfield, Kearney, and other places on the distributing system of the East Jersey Water Company in January 1918. I kept in touch with these investigations while they were in progress, and have closely studied the statistics showing the number of cases and the dates on which they occurred in each city and town, and have considered the statements of the water company and the health officers regarding the changes in the character of the water which took place at this time. I also conducted the laboratory tests on samples of water collected from some of these cities and towns during this same period.

I have had considerable experience in the investigation of epidemics as a part of my regular practice. As a result of these investigations, reports of which I have published, I feel qualified in passing judgment on the significance of the facts collected by Dr. Levy in his investigation of the intestinal outbreak above mentioned. My conclusions are as follows:

(1) That the outbreak of intestinal disease in Montclair, Glen Ridge, Bloomfield, and other nearby towns in New Jersey supplied by the East Jersey Water Company in January 1918 was directly caused by pollution of the water supply.

(2) That this pollution was due to the addition to the water supply of polluted unfiltered Passaic River water, and that the application of chloride of lime for sterilization purposes was ineffective

in preventing this pollution from reaching the consumers of the water in a form that would cause intestinal trouble.

(3) That the failure of hypochlorite to render the pollution harmless was due to the extensive pollution of the water and the extremely cold temperature of the water which prevented the hypochlorite from being effective.

(4) That the Rockaway watershed is a part of the Passaic watershed and that the Rockaway River water is more polluted than the Passaic River water above Little Falls.

(5) That the conditions which created the epidemic of intestinal disease in the consumers of Passaic River water may be duplicated at any time by the Jersey City consumers of Rockaway River water.

15. *Inefficiency of solutions of hypochlorite for disinfection at low temperatures.*

The efficiency of hypochlorite or chlorine gas in the disinfection of water is greatly reduced and practically nullified when water reaches the temperature of ice water. I base this statement on the following evidence:

(1) Bacterial tests made by me on samples of sewage taken before and after treatment with chlorine gas at Dover show that during extremely cold weather the effect of the gas on the bacteria in the sewage is so greatly reduced that the numbers of bacteria after treatment are very large and the process is entirely ineffective in sterilizing the sewage.

(2) Laboratory tests on water delivered to Montclair, Bloomfield, and Glen Ridge during the period when these cities were receiving untreated water show an enormous increase in the numbers of bacteria in the water delivered to these towns

during the extremely cold weather occurring at the time of the intestinal outbreak.

(3) Laboratory experiments conducted in my laboratory during the months of January and February with waters highly polluted with bacteria held at different temperatures show conclusively that at temperatures below thirty-eight degrees Fahrenheit the effect of solutions of hypochlorite in the destruction of bacteria is greatly reduced, not only in the doses commonly used for sterilizing municipal water supplies, but in much larger doses.

(4) Chemical experiments are on record showing that near the freezing point of water chlorine gas in solution is crystallized so that it becomes inert in the sterilization of bacteria.

(5) The history of water sterilization plants in America ever since these plants were installed has shown during extremely cold weather that when water reaches the temperature of ice water the efficiency of the sterilization process is impaired. Many simultaneous outbreaks of intestinal disease in other cities and states occurred during the same cold weather period which marked the occurrence of the epidemic in Montclair, N. J. Reports of these investigations show that these outbreaks occurred where polluted water was treated with chlorine gas or hypochlorite. They were undoubtedly due to the failure of this treatment to properly kill bacteria during the period of low temperatures.

16. *The limitation of the bacterial test as a test of purity.*

When Jersey City and the contractor in the year 1899 agreed to enter into a contract to provide the city with pure and wholesome water it was assumed by both sides that there was some method whereby at the conclusion of the contract both the contractor and the City would be able to ascertain whether the specification of the contract requiring the contractor to furnish pure and wholesome water had been fulfilled. A close study of the contract does not anywhere indicate that either the contractor or the city intended that the test of purity should be the laboratory test or an examination of the water for bacteria. In fact, every reference to the purity of the water in the contract itself shows clearly that there was only one method for determining the purity in the mind of the contractor and of the City, namely, an inspection of the water shed to determine whether pollutions had been prevented.

The laboratory examination for bacteria as a test for purity was not introduced into the controversy between the contractor and Jersey City until the year 1904, five years after the contract had been signed. In 1899 the bacterial testing of water was in its infancy, and even in 1904 bacteriologists had not yet agreed on standard methods which were universally accepted. The state of the science of water sanitation of that date shows clearly that the majority of water sanitarians were opposed to the bacterial testing of water as a sufficient test of purity of surface water supplies, and placed their reliance on the inspection of water sheds as a much more reliable method for determining the purity of surface water supplies.

In the second litigation, begun in 1908, the Jersey City Water Supply Company, the successor to the contractor, built up its case against Jersey City on the assumption that the bacterial test was the only test of purity, and that the point of delivery in Jersey City was the only place at which such test of purity should be made. It was these two assumptions which enabled the Jersey City

Water Supply Company to offer to the court and to the city the hypochlorite plant or sterilizer established at the Boonton Dam, for the reason that such a sterilizer through the destruction of bacteria would make it possible to wipe out all evidence of sewage pollution so that the test of purity by the laboratory examination for bacteria made at the point of delivery in Jersey City would give to the water a clean bill of health.

The novelty of the bacterial testing of water in the year 1908 from the distance of the present date is now clearly apparent. Water bacteriologists are still unable to agree on standard methods which are finally and universally accepted. Bacterial methods of water examination have been modified and changed several times since 1908 by the committee of experts appointed by The American Public Health Association to consider this subject. The multiplication of bacterial laboratories, and the wider use of bacterial tests which has taken place since 1908, and especially the multiplication of hypochlorite plants, and the necessity of testing municipal water supplies before treatment and after treatment with hypochlorite, has furnished a mass of new knowledge regarding the significance of bacterial tests of water which show at this date limitations of the value of the bacterial test which were not apparent in 1908. These limitations are as follows:

17. *Negative tests are insufficient evidence of purity.*

It is now accepted by all water bacteriologists that when the results of a bacterial test of a water sample are positive, that is to say, when the results show the presence of intestinal organisms in sufficient numbers that these indicate pollution. On the other hand, negative results, that is to say, the absence of intestinal bacteria do not justify giving the water a clean bill of health, but still leave the question of its purity an open one. Negative results are recognized now to mean only that the particular sample of water under examination fails to reveal the presence of intestinal bacteria, but such failure cannot properly be interpreted to mean that such water is free from pollution at all times, for the reason that the sample may not have been a representative sample, or because the bacteria indicating the presence of pollution may have been killed by artificial means; consequently water bacteriologists are trained at the present time to insist upon a further knowledge of the history of the sample of water which they examine, and of the character of the source of supply, and such changes as may modify the character of the water from its source to the point at which the sample was taken, before being permitted to render an opinion as to the significance of the bacterial test. In short, while a positive test justifies immediate condemnation, a negative test does not justify approval, but the suspension of judgment.

18. *Sterilizer destroys significance of bacterial tests at the point of delivery.*

The significance of bacterial tests of samples of water taken at the point of delivery of a municipal water supply to a municipality depends entirely on what natural or artificial interferences with the normal bacterial contents of the water have taken place before the water reached the point of delivery. For example, in a surface water supply from a water shed which is entirely free from sewage pollution, and in which there has been no interference whatever with the normal course of the water from its source to its point of delivery, the bacterial test at the point of delivery would come nearly to giving a true index of the purity or impurity of the water received from the water shed. On the other hand, where it is recognized that serious sewage pollutions exist on a water shed, and that these pollutions are intermittent in character and in volume, and may at times be small and at other times great, the testing of samples of water at the point of delivery may on any given day give a most erroneous index of the real character and danger of the water supply.

The destruction of bacteria by a sterilizer placed between the water shed and the point of delivery entirely destroys the significance of the bacterial test at the point of delivery in so far as this test can be used to indicate the degree of sewage pollution of the water. For example, such a sterilizer will operate on sewage itself in a manner which will often give a bacterial test which without other knowledge of the character of the fluid would lead to the erroneous conclusion that the sample of fluid was free from bacterial evidence of sewage pollution.

19. *Bacterial tests of samples of water taken at the point of delivery in Jersey City are not a correct measure of the sanitary character of the Jersey City water supply.*

In order to determine the value of the bacterial test on samples of water taken at the point of delivery in Jersey City there were made under my direction during the month of December, 1917, a series of tests of water samples collected from various parts of the Rockaway water shed. The location of the points at which these samples were collected is shown on the attached map. Results of the analysis are shown in the following tabulation.

Affidavit of Charles E. North

Source of Sample	*Date*	*Sample No.*	*Bacteria Per CC*	*B Coli*	*Conclusion*
Dover					
Outlet Ford's	Dec. 3	1	500,000	* .1 cc	Sewage
Pond above	4	15	100,000	* .1 cc	"
sterilizer	5	15	20,000	* .1 cc	"
	6	15	9,000	* .1 cc	"
	10	15	4,300	* 1. cc	"
Dover					
Outlet Ford's	Dec. 3	2	23	* .1 cc	Sewage
Pond after	4	13	12	0	?
sterilization	5	13	10	0	?
	6	13	10	0	?
	10	14	40,000	* .1 cc	Sewage
	12	13	5,000	* .1 cc	"
	17	13	28,000	* .1 cc	"
	19	13	8,400	* .1 cc	"
	21	13	3,200	* .1 cc	"
Dover					
Sewer under	Dec. 3	3	1,000,000 *	* .1 cc	Sewage
drain Morris St.	4	14	500,000 *	* .1 cc	"
	5	14	2,500,000	* .1 cc	"
	6	14	2,600,000	* .1 cc	"
	10	13	35,000	* .1 cc	"
	12	14	92,000	* .1 cc	"
	17	14	1,900,000	* .1 cc	"
	19	14	144,000	* .1 cc	"
	20	14	2,500,000	* .1 cc	"
	21	14	3,000,000	* .1 cc	"
Dover					
Mercer St.	Dec. 3	4	400,000	* .1 cc	Sewage
sewer before	4	9	63,000	* .1 cc	"
sterilization	5	9	4,800	* .1 cc	"
	6	9	63,000	* .1 cc	"
	10	9	?	?	
	12	9	6,500	* .1 cc	"
	17	9	100,000	* .1 cc	"
	19	9	184,000	* .1 cc	"
	21	9	160,000	* .1 cc	"
Dover					
Mercer St.	Dec. 3	5	17,000	* .1 cc	Sewage
sewer after	4	10	19,000	* .1 cc	"
sterilization	5	10	40	* 1. cc	?
	6	10	50	0	?
	10	10	10	*10	?
	17	10	1,700	* .1 cc	Sewage
	19	10	3,200	* .1 cc	"
	21	10	18,000	* 1. cc	"

Affidavit of Charles E. North

Source of Sample	*Date*	*Sample No.*	*Bacteria Per CC*	*B Coli*	*Conclusion*
Dover					
Rockaway River middle, opposite Mercer St. Sewer	Dec. 3	6	80,000	* .1 cc	Sewage
	4	11	12,000	* .1 cc	"
	5	11	4,500	* .1 cc	"
	6	11	12,000	* .1 cc	"
	10	11	2,600	* .1 cc	"
	12	11	1,500	*10 cc	?
	17	11	800	* .1 cc	Sewage ?
	19	11	1,400	* .1 cc	Sewage
	21	11	10,000	* .1 cc	"
Rockaway River					
25 feet East of Dickersons Bridge 1/4 from North Shore	Dec. 3	7	100,000	* .1 cc	Sewage
	4	8	800	* 1 cc	Sewage ?
	5	6	4,300	* .1 cc	Sewage
	6	6	2,000	* 1 cc	Sewage ?
	10	6	1,600	* .1 cc	Sewage
	12	6	1,600	* .1 cc	"
	17	6	1,900	* .1 cc	"
	19	6	800	* .1 cc	"
	21	6	2,600	* .1 cc	"
Rockaway River					
25 feet East of Dickersons Bridge. Middle of River	Dec. 3	8	56,000	* 1 cc	Sewage
	4	7	1,000	* 1 cc	Sewage ?
	5	7	22,500	* .1 cc	Sewage
	6	7	1,300	* .1 cc	"
	10	7	1,700	* .1 cc	"
	12	7	1,800	* .1 cc	"
	17	7	2,500	* .1 cc	"
	19	7	1,500	* .1 cc	"
	21	7	2,500	* 1 cc	"
Rockaway River					
25 feet East of Dickersons Bridge 3/4 from North Shore	Dec. 3	9	140,000	* 1 cc	Sewage
	4	6	9,000	* 1 cc	"
	5	8	6,000	* .1 cc	"
	6	8	1,400	* 1 cc	"
	10	8	2,000	* 1 cc	"
	12	8	1,700	* 1 cc	"
	17	8	2,700	* .1 cc	"
	19	8	1,800	* .1 cc	"
	21	8	1,600	* .1 cc	"
Liondale Headrace					
Intake under Rail-Road	Dec. 3	10	53,000	* .1 cc	Sewage
	4	5	2,400	* 1 cc	"
	5	5	6,700	* 1 cc	"
	6	5	1,200	* 1 cc	"
	10	5	1,600	* 1 cc	"
	12	5	1,800	* .1 cc	"
	17	5	1,000	* 1 cc	"
	19	5	400	* .1 cc	"

Source of Sample	*Date*	*Sample No.*	*Bacteria Per CC*	*B Coli*	*Conclusion*
Liondale Tailrace					
Middle, entrance	Dec. 3	11	4	0	?
of Rockaway River	4	4	5	0	?
	5	4	2	* 1 cc	?
	6	4	3	* 1 cc	?
	10	4	22	* .1 cc	Sewage ?
	12	4	16	*10 cc	?
	17	4	25	* 1 cc	?
	19	4	13	* 1 cc	?
Rockaway River					
Entrance of	Dec. 3	12	7	*10 cc	?
Liondale Tailrace.	4	3	12	0	?
3/4 from North	5	3	20	* 1 cc	?
Shore	6	3	12	* .1 cc	Sewage
	10	3	20	* 1 cc	?
	12	3	3	0	?
	17	3	50	*10 cc	?
	19	3	200	*10 cc	?
Rockaway River					
Entrance of	Dec. 3	13	44,000	* .1 cc	Sewage
Liondale Tailrace.	4	2	1,600	* 1 cc	"
Middle, Rockaway	5	2	320	* .1 cc	"
River	6	2	2,500	* 1 cc	"
	10	2	1,400	* .1 cc	"
	12	2	2,000	* 1 cc	"
	17	2	2,000	* 1 cc	"
	19	2	600	* 1 cc	Sewage ?
Rockaway River					
Entrance of	Dec. 3	14	43,000	* 1 cc	Sewage
Liondale Tailrace.	4	1	7,000	* 1 cc	"
1/4 from North	5	1	1,600	* .1 cc	"
Shore	6	1	2,400	* 1 cc	"
	10	1	720	* .1 cc	"
	12	1	1,300	* .1 cc	"
	17	1	1,700	* 1 cc	"
	19	1	450	* 1 cc	"
Rockaway River					
At Mercer St.	Dec. 4	12	700	* .1 cc	Sewage ?
sewer, 3/4 from	5	12	6,000	* .1 cc	Sewage
North Shore	6	12	10,000	* .1 cc	"
	10	12	1,500	* .1 cc	"
	12	12	2,100	* .1 cc	"
	17	12	3,000	* .1 cc	"
	19	12	1,000	* .1 cc	"
	21	12	2,400	* .1 cc	

Affidavit of Charles E. North

Source of Sample	Date	Sample No.	Bacteria Per CC	B Coli	Conclusion
Dover					
Overflow from Cesspool, Hotel and Hendershots Cafe North Warren Street	Dec. 4	16	1,000,000 *	*10 cc	Sewage
	6	16	25,000	* 1 cc	"
Blackwell Street					
Drain	Dec. 17	19	1,800	* .1 cc	Sewage
	19	19	400	* .1 cc	?
	21	19	3,200	*10 cc	?
Brook Street					
sewer Boonton canal incline plane	Dec. 18	21	500,000	* .1 cc	Sewage
	20	21	160,000	* .1 cc	"
Rockaway River					
above outlet of tailrace Cooper Lord Est. Boonton.	Dec. 18	22	1,600	* 1 cc	Sewage
	20	22	32,000	* .1 cc	"
Mouth of Rockaway River					
Harris St. Boonton	Dec. 18	20	4,200	* .1 cc	Sewage
	20	20	50,000	* 1 cc	"
Rockaway River					
Longwood Valley at Berkshire Bridge	Dec. 5	16	250	* 1 cc	?
Rockaway River					
Bridge Wharton Textile Works	Dec. 5	17	700	* .1 cc	Sewage
Tailrace					
Wharton Textile Works	Dec. 5	18	360	* .1 cc	Sewage
Jersey City, N. J.					
outlet of conduit High Service Reservoir	Dec. 4	17	10	0	?
	5	19	8	0	?
	6	17	4	0	?
	10	16	5	* 1 cc	?
	11	1	2	0	?
	13	1	1	*10 cc	?
	14	1	4	*10 cc	?
	17	20	3	* 1 cc	?
	19	20	2	* 0	?
	20	23	1	0	?
	21	20	12	0	?

20. *Summary of results of bacterial tests.*

A review of all of the samples taken shows remarkable changes in the character of the water in different parts of the shed. Beginning at the most remote point of the Longwood Valley near the source of the main branch of the Rockaway River, the numbers of bacteria were only 250, and these were not very largely increased when the river reached Wharton, which is above Dover, the samples there being 700 and 360, respectively. As the Rockaway River leaves Dover the water contains several thousand bacteria per cc., and continues to have this character as it passes through Rockaway and Boonton to its mouth.

There are three sterilizing mechanisms located on the water shed, two in Dover, and one at Rockaway.

The chlorine gas sterilizer at Ford's Pond, Dover, when operating, kills the bacteria in the sewage from Ford's Pond, so that at times the sewage is free from B. Coli and the bacterial test shows not more than 10 bacteria per cc.

The chlorine gas plant located at the Mercer St. sewer, Dover, occasionally works with sufficient power to kill all of the B. Coli in that sewage and reduce the numbers of bacteria to not more than 10 per cc.

It is noteworthy that after such sterilization the sewage from these two places corresponds closely in its bacterial analysis with the water delivered to Jersey City.

One has only to inspect these sewers to recognize the undesirability of the contamination even though the sewage may be sterilized with chlorine.

21. *Liondale race-way example of Jersey City supply in miniature.*

The Liondale bleachery at Rockaway may be considered as a sterilization plant using bleaching powder. The number of employees ranges from 200 to 400, and all of their sewage is discharged from a small septic tank directly into the race-way. In this way the race-way receives a heavy sewage pollution. At the same time and at the same place the addition of large quantities of bleaching powder results in the sterilization of this sewage so that bacterial tests of the fluid in the tail-race are actually at times sterile, and far superior to the character of the bacterial results obtained from samples of water in the head-race before it reaches the Liondale bleachery.

The attached chart shows the arrangement of the buildings and the location of the Rockaway River and race-ways of the Liondale works. The dotted lines near the bottom of the chart indicate the position of the race-way which receives the sewage of the employees of the plant. On the left, #5 indicates the point at which samples were taken of the water entering the race-way. Between the buildings the letter "S" indicates the point at which the sewage of the employees is introduced into the race-way water, and also the point at which the water receives heavy doses of bleaching powder. At the right, #4 indicates the point in the tail-race from which samples were taken, and further to the right, #3, #2, and #1 indicate points in the Rockaway River at which samples were taken.

Reference to the attached tabulation of bacterial results shows the remarkable changes in bacterial character of the water of the race-way as a result of the use of bleaching powder. In short, we have here in miniature a typical example of the conditions of the entire water supply of Jersey City. #5 represents the source contining considerable pollution. "S" represents serious additional pollutions of the supply, followed by the use of hypochlorite for sterilization purposes. #4 represents the finished product, which because of sterilization, contains no evidence of sewage pollution. It is obvious that the bacterial test at point #4, which may be called the point of delivery, is entirely misleading and in no way a true and proper indication of the real character of the fluid discharged by this race-way. The bacterial test is phenomenally low, and yet no one would have the courage to proclaim that the fluid discharged by the race-way is pure and wholesome water.

22. *Jersey City supply artificially altered in bacterial character.*

After the several artificial alterations in the character of the water on the water shed, brought about by the two gas plants at Dover and the bleachery at Liondale, the water of the Rockaway River is further altered in character by the operation of the hypochlorite plant at Boonton. This sterilizing station constitutes the final act of artificial interference with the bacteria which are the real indicators of pollution. The serious sewage pollutions in the water shed are unable to manifest presence if their indicator is destroyed. Not the pollutions themselves but merely evidence of pollutions have been destroyed.

23. *Rockaway River water is unfit for purification by any process.*

The International Commission on Boundary Waters, representing the United States and Canada, in June, 1914, came to the following agreement regarding the sanitary character which a water should have in order to be fit for domestic use after any kind of purification process. Their statement is as follows:

"While present information does not permit a definite limit of safe loading for a water purification plant to be established, it is our judgment that this limit is exceeded if the annual average number of B. Coli in the water delivered to the plant is higher than about 500 per 100 cubic centimeters, or if in 0.1 cubic centimeter samples of the water B. Coli is found 50 per cent of the time."

According to this standard, the water of the Rockaway River is unfit for purification by any process, and is unfit as a public water supply for domestic use.

24. *Water delivered to Jersey City is unfit for use in Interstate Commerce.*

The United States Public Health Service in November, 1914, promulgated a standard of purity for waters to be used in interstate commerce. This standard requires: "Such water shall contain not more than 2 B Coli per 100 cubic centimeters."

On the 11 days in December upon which the water delivered to Jersey City was tested by me, there were 4 days on which the water contained B Coli in excess of this standard, on which occasions it was therefore unfit for use in interstate commerce. If the B. Welchii, also an intestinal organism, were used as the basis for this same standard, then in the series of tests made by me for B. Welchii on 10 days in October, 1917, of water delivered to Jersey City, on every one of these days B. Welchii was present in sufficient numbers to condemn this water as too impure and unfit to be used by interstate carriers.

25. *The water supply of Jersey City not pure and wholesome.*

It is my opinion that the water supply of Jersey City is not pure and wholesome, because it is seriously polluted with sewage, and that the citizens of Jersey City are drinking sterilized sewage.

The only remedy for the sewage pollutions on this water shed is a trunk line sewer to carry the sewage out of the shed.

The remedy for suspended matter or other pollutions than sewage pollutions is the sedimentation reservoir, and in addition to this a filtration plant.

For unavoidable and accidental contaminations and to give an additional guarantee against dangerous bacteria, the hypochlorite plant or sterilizer is an effective mechanism.

All four of these devices may be necessary to insure the purity of this water supply.

The character of the work performed by the trunk line sewer is unique, in that it carries out measures of prevention and takes care of pollutions before they have in any way caused damage. None of the other three mechanisms in any sense can act as a substitute for sewers rendering this kind of service.

If Jersey City water supply is to be kept pure and wholesome it must be decent and clean as well as sterilized.

The hypochlorite plant by its nature cannot be a substitute for sewers.

The bacterial test is a test for contamination and not a test for purity. The bacterial test by its nature cannot be a substitute for inspection of the water shed. In surface water supplies inspection of the water shed is the most important test of purity.

CHARLES E. NORTH.

STATE OF NEW YORK, }
County of New York, } ss.:

On this 18th day of March, 1918, before me personally came Charles E. North, to me known and known to me to be the individual described in and who executed the foregoing instrument, and he duly acknowledged to me that he executed the same.

CHARLES E. NORTH.

ELMORE W. SCHENCK,
Notary Public,
N. J.

Affidavit of Clyde Potts.

IN CHANCERY OF NEW JERSEY.

Between the Mayor and Aldermen of Jersey City, *Complainant,* and Jersey City Water Supply Company, *Defendant.*	On Application for Leave to File Bill of Review.

STATE OF NEW JERSEY, }
County of Hudson, } ss.:

CLYDE POTTS of full age, being duly sworn on his oath, deposes and says:

1. I reside at Morristown, New Jersey. I am a consulting engineer with an office at 30 Church Street in the City of New York. I graduated from Cornell University with the degree of Civil Engineer in 1901, and since then I have devoted my time exclusively to the design, construction and operation of sewerage and waterworks. I am a member of the American Society of Civil Engineers, of the American Public Health Association, of the New England Water Works Association, of the American Water Works Association, besides a number of other technical societies and am a Past-President of the New Jersey Sanitary Association. When the Department of Health of the State of New Jersey was reorganized in accordance with the recommendation of the Economy and Efficiency Commission I was appointed a member of the Advisory Board by Governor Fielder and have occupied this position for three years. At

the present time I am employed as sanitary expert by the Department of Justice of the United States to assist in the defense of certain patent litigations involving sewage disposal brought against the Federal Government.

During the time I was in College I paid particular attention to subjects relating to water supply and was employed by the United States Geological Survey, and by New York State on experimental work at the hydraulic laboratory at Cornell University. The object of this experimental work was to derive formula from original research work to be used in the work of the New York State Barge Canal and the Geological Survey on stream measurements. After graduating from Cornell I was for a time engaged at the Spring Garden Testing Station in Philadelphia. It was the purpose of this experimental station to derive data for which the water filtration system of the City of Philadelphia was to be designed. In 1902 and 1903 I was engaged on investigations of the hydraulics of the Great Lakes as conducted by the United States Lake Survey. Since 1904 I have been engaged continuously on problems relating to sanitation. I have designed a very large number of sewerage systems and sewage disposal works, water systems and water purification works, and conducted a number of investigations relating to sanitation. I designed and built the sewerage system or sewage disposal works, or both at the following places:

Newton, Washington, Morristown, Chatham-Madison, Verona, Ocean Grove, Belmar, Bridgeton, Salem, Beverly, Milltown, and South Bound Brook in the State of New Jersey.

West Haven, Greenwich, Hamden and Stratford in the State of Connecticut.

Hanover, Carbondale, Nazareth, East Stroudsburg, Sayer, and Washington in the State of Pennsylvania.

Havre de Grace and Easton in the State of Maryland.

Ravenna in the State of Ohio.

Oneonta, Goshen, Monroe, Waverly, Ithaca, Briarcliff Manor, Suffern, Hornell in the State of New York; besides many others.

In 1909 I was engaged by the Oystermen's Association of South Jersey to investigate and advise what improvements could be made in the sanitary conditions surrounding the production of oysters at the Maurice River Cove, and have made other similar sanitary investigations.

During 1916 I was employed to design and prepare, and did design and prepare, estimate of cost for a joint trunk sewer to collect and treat the sewage of a portion of the City of Wilkes-Barre, a portion of Hanover Township, the Borough of Ashley and Wilkes-Barre Township in the State of Pennsylvania.

During 1917 I was engaged by municipalities of Rahway, Cranford, Garwood, Roselle Park, Kenilworth, Union, Springfield and South Orange to design a joint trunk sewer and disposal works for the purpose of disposing of the sewage in the Rahway Valley and protecting the Rahway River from pollution; being in many respects a problem similar to that of the Rockaway River. Prior to that time I had been retained by the City of Rahway to advise them as to what method they could adopt that would protect their water supply from pollution by the municipalities on the river above Rahway.

On November 13, 1917, I was employed by the City Commissioners of Jersey City to design a trunk sewer in the Rockaway Valley for the purpose of gathering up the sewage of Wharton, Dover, Rockaway and Boonton, for the purpose of protecting the Rockaway River from pollution matters now entering it. At the time of my employment to prepare plans for these protecting works in the Rockaway Valley I was also retained to supervise the construction of the same after the plans had been submitted and approved by the Commissioners; the City Commissioners already having passed a resolution for the construction of this sewer for the purpose of preventing the pollution of the water shed. Surveys for these plans have been completed; the plans have been prepared and filed with the City Commissioners and with the State Department of Health.

These plans were approved by the State Department of Health on April, 1918, at which time the Department passed a resolution of which a copy is hereto attached.

2. I am familiar with the conditions on the Rockaway River water shed of the Jersey City water supply and have been familiar with the same since 1908, since which time I have made studies and investigations of sanitary conditions existing there.

In 1912 I was employed by the Sewerage Commission of the Town of Boonton to design a sewerage system for that town, and in 1916 I was engaged by the Sewer Commissioners of the Town of Dover to design a sewerage system and sewage disposal works for that town. During 1908 and immediately thereafter I made surveys and investigations on the water shed for a trunk sewer and sewage disposal works, for the purpose of removing the sewage from the Rockaway River Valley, and testified before the Master in the reference of the previous suit as to this survey and the subsequent plans which were prepared for the sewerage work. During the Fall and Winter of 1917 and 1918 I conducted an investigation with special reference to the sewerage conditions now existing in the Town of Dover.

3. I am informed that an application is about to be made to the Court of Chancery for New Jersey for leave to file a Bill of Review with the idea of asking the Chancery Court to consider the hypochlorite plant at Boonton, in order to ascertain if it really was in lieu of the sewers and sewage disposal works required by the original decree of Vice-Chancellor Stevens. The knowledge surrounding the art of water purification and the protection of water supplies has been materially clarified during the past eight years. The relative values of the devices for the purification and protection of water supplies are now being better understood than they were eight years ago. This applies particularly to the subject of treating water with hypochlorite. In 1908 the question of disinfecting a water supply as large as the Boonton supply, and one so badly polluted, was purely speculative. It is true that from the view point of destruction of bacteria this method of disinfecting the water as disclosed by the short-term experiments made for the Chancery Court in 1908 gave rise to a hope that this might prove an effective and cheaper means of purifying water. It's limitations existent then, untested by experience, have been revealed by the test of time. During the past eight years certain vital limitations have demonstrated which makes the use of chlorination on a water supply as badly polluted as is the Rockaway River, and was in 1908, a dangerous proceeding and one that continually holds a menace over the consumers in Jersey City. These short-comings or limitations may be enumerated as follows:

(a) Inability of the chlorine to penetrate particles of solid matter and reach the bacteria contained therein.

(b) Lack of any positive or accurate control whereby the amount of chlorine added can be proportioned to the amount needed by the pollution.

(c) Uncertainty as to the destruction of dangerous bacteria until analysis are made on the water delivered to the consumer in Jersey City.

(d) At times of heavy pollution the amount of chlorine required is so great as to produce unpleasant and unhealthy tastes and odors in the water delivered to the consumer.

(e) The after growths of the bacteria in the treated water indicate that the effect on certain of the dangerous bacteria is one of stunning rather than destruction.

(f) The chlorine does not destroy the spore bearing bacteria some of which are of a pathogenic nature.

(g) Complete or nearly complete suspension of disinfecting properties of hypochlorite when water is at or near freezing temperature.

These limitations have come to light during the past eight years. Some of them have come to light only during the last three or four years. The last limitation I have named has been forcibly brought to the attention of the public and the engineering profession only during the past winter. During the severe winter weather through which the country has just passed the water supplies have been greatly affected especially in the eastern part of the United States. In particular those communities supplied with polluted surface water supply relying only on disinfection as a sole means of purifying the same have been subject to a water-borne disease of an intestinal nature. This disease has been especially prevalent through Montclair, Bloomfield, Elizabeth and other communities, which, owing to the scarcity of water supplies, were compelled to use as emergency supplies polluted water that was only treated with chlorine as a disinfecting agent.

I think that these limitations are now generally recognized by the professional men engaged in sanitary work.

4. The Towns of Dover and Boonton, and the Boroughs of Rockaway and Wharton are provided with municipal water supplies, and practically all of the inhabitants of these places use the municipal supply. None of these places have a sewerage system for the public whereby the water used by the inhabitants could be discharged. While my investigations of the sanitary condition due to the lack of sewerage in the watershed cover all four of these places the greater portion of my time was confined to Dover as the sanitary conditions there have advanced to a more critical state than in either of the other three places.

In civilized and enlightened countries there are certain well-defined principles of sanitation. Among these, two are particularly applicable to the situation existing on the Rockaway River Water shed. It is well recognized that a municipality should have an adequate and pure water supply and it is equally well recognized that this water supply after being spent in the domestic uses of the various households should be collected and disposed of in such a manner as not to injure the municipality producing the same, nor be turned at large in such a way as to injure the water supply in any other municipality.

The towns of Boonton and Dover and the Boroughs of Rockaway and Wharton on the Rockaway Valley Water shed each have a municipal water supply maintained for the convenience and health of the inhabitants. None of these places, however, has a public sewerage system for the purpose of collecting and conveying the spent water supplies to a proper mechanism for disposing of the same, but the sewage is disposed of by each individual householder in a cesspool. In other words the sewage disposal method in each of these places is the old-fashioned method of cesspool disposal. All four of these municipalities lie on the gathering ground of the water supply of Jersey City.

As before stated I am familiar with physical conditions in Dover and particularly relating to the sewerage conditions in that town, and have been so since 1908. In 1908 I made a study of sewage conditions in Dover for Jersey City a part of which was used in the previous trial. Again in 1915 at the instance of the Sewerage Commission in the Town of Dover I prepared a draft of plans for a sewerage system in said Town, and also sewage disposal works to treat the sewage. In 1912 at the instance of the Board of Sewerage in the town of Boonton I made surveys for, and prepared a set of plans for sewering the town of Boonton, and also sketch plans for disposal works for treating the same. At the present time there are no municipal sewerage systems in either Dover or Boonton. The prevailing method of disposing of sewage in these places is what is commonly known as the cesspool system. Both towns have liberal supplies of water. In the case of Dover the plant is a municipal one, and is controlled by the Board of Water Commissioners. Boonton is supplied by water from the United Water Company. In each case almost the entire population is supplied with water from the public supplies. This water after being used in the houses in the ordinary domestic operations is discharged into cesspools. The cesspools in both Dover and Boonton are what is known as the leaching type, as they are built in such a way as to readily facilitate the passage of the liquids from the sewage into the subsoil. Frequently these cesspools are constructed in pairs, the first one overflowing into the second; the purpose of the first being to retain the major part of the solids, the liquid sewage overflowing into the second cesspool where it can be more readily passed to the subsoil. In this way the likelihood of the cesspool becoming greased up or stopped is obvious and the liquids can pass more readily into and through the soil than in cases where only one cesspool is in use.

In my examination of conditions, particularly in Dover I find that this method has been adopted there in many instances.

The business portion of Dover lies in a flat valley immediately on the banks of the Rockaway River. The subsoil contains a stratum of large loose boulders. That portion between the Rockaway River on the south; the canal on the north; Mercer Street on the east; and Sussex Street on the west, has been filled in to a considerable depth with loose materials. I am informed and from an inspection of conditions in this vicinity, believe that it was formerly the bed of the Rockaway River.

The sanitary survey of the flat central portion of Dover, by Mr. F. E. Caldwell, discloses the presence of cesspools and privies. Some of these, to my own knowledge were previously connected didectly to the Rockaway River. As these cesspools were cut off from the river, one by one, an extra burden was thrown on to the subsoil in Dover as a purifying mechanism. In 1908, from examinations which I made in Dover. I saw no evidence that this subsoil condition as a purifying mechanism for sewage matters was taxed to or near it's capacity. During examinations I have made, however, during 1916, 1917, and 1918 in the town of Dover I find that the subsoil conditions in Dover by reason of the tremendous burden which has been placed upon it no longer has the power to assimilate and dispose of the sewage matters which escape into it from the cesspools. This has brought about a condition of affairs where the cesspools frequently become filled and overflow into the gutters and then into the Rockaway River and it's tributaries. There is also a decided movement of the underground waters which are sewage charged from the leaching cesspools towards the Rockaway River. Subsoil conditions are so bad and the subsoil water is so sewage laden that it is impossible to make an excavation in the town of Dover in the flat section which I have above described, without having the excavation become filled with sewage charged subsoil waters.

As engineer for the Board of Sewerage in the town of Dover, from investigations which I have made, I became convinced that there existed in the town such an unsanitary condition as regards the lack of sewers that it was impossible to construct additional houses in the town, and that there was a lull in building operations in Dover due largely to, if not entirely, a lack of a proper sanitary method of disposing of sewage matters. Many of the business blocks on the main street, which is Blackwell Street, have sewage continuously in the cellars. From my investigations I find a number of owners of business properties in the town had been compelled to line the inside walls of their cellars with water-tight concrete in order to prevent the sewage laden subsoil waters surrounding their cellars from percolating through the walls and thereby into the cellars. I have seen such waters percolate into cellars which have not been so protected.

During the past seventeen years I have been employed to make surveys and design sewerage works in upwards of two hundred cities and towns which had, prior to that time, either been without sewers or were but partially sewered, and I am of the opinion and so give it, that never have I seen a town that was so urgently in need of some method of scientifically collecting and disposing of it's sewage matters as is the town of Dover.

It is difficult for one who has not made a study of conditions in Dover to believe that such conditions could exist, and it is difficult for one not familiar with sewerage conditions to give proper weight to the conditions that exist in Dover as they affect the health of the people there and the people of Jersey City who use the Rockaway River as a water supply.

Beyond any question the larger part of the spent water supply of Dover, amounting to upwards of 600,000 gallons daily reaches the Rockaway River in a more or less direct manner. Even the contents of cesspools which are but imperfectly and improperly removed are carried a short distance outside of Dover and deposited on to the surface of the ground, in many instances in the immediate vicinity to tributaries of the Rockaway River. It can, therefore, be said that the cesspool system as now in use in Dover does not remove any of the polluting matter from the watershed.

From an investigation which I have made during the past several years I find that there are but four licensed scavengers in the town, and these licensed scavengers have but one wagon each which is used for removing contents of the cesspools. From an inspection which I made of the sites where these wagons are customarily emptied I estimate that each wagon cannot make more than three trips a day after being loaded. Summing these up it is seen that these four scavengers can remove not more than 6,000 gallons of sewage matter daily from the town of Dover. These 6,000 gallons, of course, are not removed from the water shed and there is some question in my mind as to whether the sewage would not be safer in the cesspools than it is on the spots where they dump it, considering the subject from the standpoint of the people of Jersey City. My investigation of this matter leads me to believe that the cesspools are not cleaned out with any thought of the protection of Jersey City's water supply, but rather for the convenience of the householder who does not desire the sewage matters to back up and flow across his yard as they do in many cases in Dover.

Assuming that these four cesspool wagons I have mentioned worked 365 days a year, which of course, they do not, it is perfectly obvious that they could remove but one per cent of the spent water supply or sewage created in the town of Dover. This leaves 594,000 gallons daily of spent water supply to be assimilated by the soil or to find it's way directly or indirectly into the Rockaway River as the case may be.

I have computed the available area in the central portion of Dover, and making deductions for the ground occupied by houses, streets, canals, the river, and other impervious surfaces, I am of the opinion that there is not available in the flat portion of Dover sufficient soil area on which to dispose of this amount of sewage if the same were applied in accordance with a scientific formula and in accordance with the requirements of the Massachusetts State Department of Health, which department was one of the pioneers in a study of the treatment of sewage by broad irrigation or intermittent filtration.

5. During the practice of my profession I have come in frequent contact with the Department of Health of the States of New York, New Jersey, Pennsylvania, and Maryland and I have found that in these states the bacterial examination of water supplies is regarded as corroborative. In each case the Department required an inspection of the water shed for the purpose of ascertaining if any pollution gets into the water, and the bacterial tests of the water itself are regarded as supplemental and used only to verify the findings of the physical inspection. I might say that it is recognized that a bacterial test showing the absence of pollutions would not be regarded in itself as sufficient evidence for approving a source of supply. On the other hand when bacterial examinations show the presence of human pollution without a physical examination of the water shed it would be sufficient evidence for condemning the supply. In other words any water supply or source of the same is not favorably passed upon except and in conjunction with a thorough sanitary inspection of the water shed. Bacterial tests are used only as corroborative evidence in reaching a favorable decision as regards any water supply.

The water supply gathered on the Rockaway River water shed, by the bacterial test is badly polluted where it enters the Boonton Reservoir. In fact the bacterial test discloses so much pollution that under the rulings of the Treasury Department the waters of the Rockaway River are not considered fit for use by any treatment of water purification now used. A physical inspection of the Rockaway water shed above the Reservoir shows that large amounts of polluting matter do reach the Rockaway River. In this case the bacterial test made at the mouth of the Rockaway River corroborate the physical inspection of the source of pollution above. The method of treatment adopted, however, in order to render this water pure and wholesome for the consumers in Jersey City consists of a device for the purpose of destroying this corroborative evidence without in any way affecting the sources of pollution on the water shed, which up to the present time still exist.

6. I am familiar with the location and operation of the Liondale Bleach, Print, and Dye Works at Rockaway. I have made surveys and investigations in and about the Liondale plant in order to understand the conditions as affecting the waters of the Rockaway River which prevail in the Liondale plant. I am informed that upwards of 300 employees are engaged at the Liondale plant. From investigations which I have made I know that the sewage from these employees during the day time is collected in tanks located at the point marked "A" on the blue print of the Liondale properties attached hereto. From this tank the sewage overflows into another tank located in the basement of the building, and at a point indicated on the map by the letter "B". At this point an average of 58 pounds of chloride of lime per day is added to the sewage and from there it is discharged into the race-way running down through the Liondale yards and from the raceway goes directly into the Rockaway River. In addition to the sewage of the employees of the Liondale plant the following amounts of different chemicals or the residue after their use in the manufacturing process also escape into the Rockaway River.

120	lbs.	Alumnia Sulphate
120	"	Chlorine
732	"	Soda Ash
440	"	Lime
120	"	Caustic Soda
914	"	Sulphuric Acid.

These spent trade wastes are discharged into the river with about 2,000,000 gallons of water. These wastes and the sewage I have above referred to are discharged from the mill into rerace-way whence they pass into the Rockaway River at a point of about 300 feet below. In their passage through this race-way an unsuccessful attempt has been made to remove some of the grosser solids. The entire amount of matter discharged by the Liondale plant, however, reaches the Rockaway River. This river is discolored for a distance of one thousand feet on the southerly side, and in contrast to the clear water on the northerly side of the stream. This prevails for a distance of about one thousand feet below the point where the race-way enters the river.

During the Fall of 1917 bacterial analysis were made of the water at the following points:

1st. At a point in the river above the Liondale plant, where the water enters the head-race of the Liondale plant.

2nd. At a point in the tail-race receiving the sewage I have above described where it enters the Rockaway River.

3rd. At a point on the southerly side of the Rockaway River, about 200 feet from the tail-race, which shows the discoloration from the sewage from the Liondale plant, as I have above described it.

4th. From the clear water on the opposite bank of the Rockaway River, unmixed with the trade wastes from the Liondale plant.

These four points are shown more definitely by numbers on the blue print of the Liondale properties attached hereto. An examination of the bacterial analysis as made by the North Public Health Laboratories shows that the sample collected at No. 1 contained bacteria per cc. and B. Coli or intestinal bacteria in 0.10 cc. The sample collected from the highly discolored water at No. 2, after receiving the additional sewage from the Liondale plant, as I have above recited, showed bacteria per cc. and an entire absence of B. Coli or intestinal bacteria. The sample collected from the still highly discolored water containing the sewage from the Liondale plant showed bacteria per cc. and an entire absence of B. Coli or intestinal bacteria. Sample No. 4 from the clear water on the north side of the stream showed bacteria per cc. and B. Coli or intestinal bacteria present in cc.

The results of these analysis confirm the statement previously made that bacterial analysis should be looked upon as merely contributory, and in no way indicating the presence or absence of human pollutions in water supplies. Here we are treated to the spectacle of having a river water which is already polluted with human sewage receiving the sewage of 500 people additional, besides a large volume of trade wastes from the manufacturing process of the Liondale plant, and then yielding, on an analysis, a sterile water, viewed in the light of bacterial examinations only. Along with the wastes of the 300 employees of the plant and the large volume of trade wastes the Liondale plant discharges sufficient germicide into the river to destroy the bacterial content not only in their own wastes, but in upwards of three million gallons of river water which they use in their manufacturing process. This confirms the opinion that I have previously given, that bacterial examinations are only contributory to an actual physical inspection of the source of supply.

(Signed) CLYDE POTTS.

Sworn and subscribed to before me }
this 13th day of May, 1918. }

Eieanore Schenk,
Notary Public
(L. S.) New Jersey.

Department of Health,

State of New Jersey

Jacob C. Price, M. D., Director of Health.
R. B. Fitz-Randolph, Assistant Director.
Trenton

Hon. M. I. Fagen,

Director Department of Streets and Public Improvements,

Jersey City, N. J.

Dear Sir:

At a meeting of the Department of Health of the State of New Jersey, held Apr. 9, 1918, the following preamble and resolution were adopted:

Whereas, application has been duly made to the Department of Health of the State of New Jersey, as provided in Chapter 210 of the Session Laws of 1899 as amended by Chapter 72 of the Session Laws of 1900, and by Chapter 313 of the Session Laws of 1904, and in accordance with

Chapter 297 of the Session Laws of 1908 as amended by Chapter 309 of the Session Laws of 1912, and also in accordance with Chapter 288 of the Session Laws of 1915, for approval of the conditions under which the City of Jersey City proposes to build sewerage works consisting of a trunk sewer extending from the Borough of Wharton to a point below the Jersey City Reservoir, near Boonton, and sewage treatment plant, consisting of Imhoff tanks, activated sludge treatment and chlorine disinfection, the effluent to be discharged at the point shown upon the plans in the Rockaway River below Jersey City Reservoir and to operate the same, therefore be it

Resolved, That the plans and specifications accompanying said application be and the same are hereby approved, and permission is hereby given to the said City of Jersey City to build said works in accordance with said plans and specifications, be it further

Resolved, That permission is further given to operate the said plant when constructed in accordance with said plans and specifications, the permission to operate being subject to the following conditions:

I. That the permit is revocable at any time or subject to modification or change when in the judgment of the Department of Health of the State of New Jersey such revocation, modification or change shall be necessary.

II. That the issuance of this permit shall not be deemed to affect in any way action by this Department on any future application that may be made for permission to discharge additional sewage or effluent into the waters of this State.

III. That both the sewer system and the sewage disposal works shown by plans approved this day shall be fully constructed in complete conformity with such plans or approved amendments thereof.

IV. Provided that the operation of the sewage treatment plant shall be supervised by a qualified chemist, bacteriologist or engineer who shall give his whole working time to the control of the plant and making necessary routine chemical and bacteriological determinations as shall be required from time to time by this Department.

V. That Jersey City shall file with this Department prior to June 1, 1918, copies of contracts or agreements made with the municipalities of Wharton, Dover, Rockaway, Rockaway Township and Boonton for the taking up and disposing of wastes from those municipalities including trade wastes from factories and information as to what steps either at present or prior to 1920 will be taken by Jersey City to aid in treating wastes from the following places: Hibernia, Denville, Rock Ridge, Mt. Tabor, Picatinny Arsenal, Allen Mine, Teabo Mine, Richards Mine, Mt. Hope Mine, Wharton Textile Mill, the Liondale Bleach, Dye and Print Works, Field and White Paper Co. at Powerville, the portion of the shores of Estling Lake and Cedar Lake occupied by summer residents.

Date, Apr. 11, 1918.

JACOB C. PRICE,
Director.

The following resolution offered by Dr. Henry Spence on May 7th, 1918 was read and adopted by the State Department of Health of the State of New Jersey:

WHEREAS, An Act entitled "An Act to authorize cities having a public water supply derived from sources beyond the city limits to protect the same from pollution, by providing for any portion of the territory from which such water is derived or through which it flows a system of sewers or drains in order to take up, carry off and dispose of the sewage or other polluting matter, and providing also for the raising and expenditure of money necessary for the purpose'', was approved April 1, 1907 (P. L. 1907, Chapter 28); and,

Whereas, The City of Jersey City, a municipality of this State, derives its public water supply from a source beyond its city limits, to wit, from the Rockaway River at the Jersey City Reservoir near Boonton, New Jersey; and,

Whereas, The records of this Department show that the water of Jersey City has been polluted by wastes from the municipalities, towns, mills, dwellings, etc., situated on the watershed of the Rockaway River above the Jersey City Reservoir at Boonton, and that in many sections and instances it is impractical to satisfactorily dispose of such polluting material without adequate sewerage systems; and,

Whereas, M. I. Fagen, Director, Department of Streets and Public Improvements of Jersey City, has made application on February 4, 1918, for approval of the plans and a definition in a general way of the limits of the district within which and for which the proposed scheme for sewerage shall be effective;

Therefore, by virtue of the provisions of Section 2 of said Act, as said Section 2 was amended by Chapter 206 of the Laws of 1913,

Be it Resolved, that the general scheme for the construction of a trunk sewer and sewage treatment works be approved by the Department of Health of the State of New Jersey as a sanitary measure; and, Be it Further Resolved, that the limits of the district or territory for which such system of drains and sewers shall be constructed are described in a general way as follows:

1. All the territory within the corporate limits of the Borough of Wharton.

2. All the territory within the corporate limits of the Town of Dover.

3. All the territory within the corporate limits of the Borough of Rockaway.

4. Such portions of the territory within the corporate limits of the Town of Boonton as are within the area draining to the Rockaway River above the Jersey City Reservoir at Boonton.

5. Such lands as are situated within 2500 feet of the line of the proposed trunk sewer.

6. And also the lands owned or to be acquired by Jersey City situated adjacent to and below the Jersey City Reservoir at Boonton.

7. The residential sections and mines in the territory extending from the Borough of Wharton in the northeasterly direction to and including the Teabo Mines.

8. And provision shall also be made for the future extension of the district to include the Towns of Hibernia and Denville.

9. The district as above-described may be extended upon application of Jersey City, or any municipality situated and located either wholly or in part within the drainage area of the Rockaway River above the Jersey City Reservoir at Boonton, if, after hearing given to representatives of the municipalities and persons affected, such extension is deemed advisable.

Affidavit of F. E. Caldwell.

IN CHANCERY OF NEW JERSEY.

BETWEEN
THE MAYOR and ALDERMEN OF JERSEY CITY,
Complainant,

and

JERSEY CITY WATER SUPPLY COMPANY,
Defendant.

On application for Leave to File Bill of Review.

STATE OF NEW YORK, County of New York, ss.:

F. E. CALDWELL, being of full age and being duly sworn on his oath, deposes and says:

1. I reside in East Orange, New Jersey. I am a civil and sanitary engineer, and have been engaged in engineering since 1901.

2. I received my technical education at Clarkson School of Technology, and since 1904 I have been engaged particularly in sanitary engineering as relates to the construction of sewerage systems, sewage disposal works, and problems relating to water supplies.

3. In 1908 and 1909 I assisted in making investigations and collecting data to be used in the reference of the suit between the Mayor and Aldermen of Jersey City and the Jersey City Water Supply Company, and testified in regard to some of the technical features before Vice-Chancellor Magee. I am familiar with the physical characteristics of the Rockaway Watershed above the Boonton dam, particularly with reference to the

sanitary conditions of the same, and have been so since 1908 and 1909 at which time I made a survey of the Rockaway River from Dover to Boonton and assisted in preparing designs and estimates of cost for a sewerage system for the purpose of removing the polluting matter from the Rockaway Watershed.

I am informed that an application is about to be filed asking leave for a review.

4. During the Fall of 1917 I made particular studies of the sanitary condition of Dover with relation to the disposal of sewage matters in said town. I find that the Town of Dover has a municipal water supply and that the disposal of their sewage is by the cesspool method. Dover has a population of approximately 9,000 inhabitants, eighty-five per cent of which is located in the lower portions of the town. The section between the canal on the north; the Lackawanna Railroad on the south; Salem Road on the East, and the railroad viaduct on the west, all of which is in immediate proximity to the Rockaway River might be said to be densely populated. I have made a survey of the cesspools and privy vaults in this section of the town and have plotted the same up, and a map of it is hereto annexed. I find that in this section there are 370 cesspools and 172 privy vaults. During the time I was making my survey in Dover I found a number of these cesspools overflowing across the surface of the ground, the contents eventually reaching the Rockaway River. I also found that practically all of the cesspools shown on this map were filled to within one foot or so of the surface of the ground. These cesspools are built by the property owners or contractor employed by them with substantially no supervision by the constituted authorities. In no

case has any records been kept as to the construction of these cesspools and the Board of Health of Dover at the present time is without information as to where the same are located or how many are situated in the area I have shown on the map annexed hereto. So far as I know the map which I have prepared is the only record that has been compiled showing these points of pollution on the water shed. The cesspools which were being constructed while I was making the survey in Dover were of the leaching type, that is, without a bottom. The sides were made of loose filed stone to permit percolation of the sewage through them. During the period while I was making the sanitary survey in the town of Dover which extended from November 14th to January 13th, I made investigations as to how often the contents of the cesspools was removed and by whom, and the points to which it was taken. I found that there were four licensed scavengers in Dover whose business it was to clean out cesspools, each of whom had one iron tank-wagon holding about 500 gallons. In addition to these four the proprietor of one of the hotels has two iron tank-wagons which were secured primarily for the purpose of taking care of the sewage from his hotel. During my observations in Dover a comparatively small per cent of the sewage originating in the town was carted out of the town by these tank-wagons. In my judgment not more than one per cent of the spent water supply from the homes in Dover during this period was removed by the tank-wagons. During a portion of the time covered by my observations the extreme cold weather and heavy snow fall suspended all efforts to remove the contents of any of the cesspools. I made an investigation of the points to which the cesspool contents were carted by the scavengers and ascertained that the wagons were hauled in all cases to points just beyond the town line and emptied on the surface of the ground in such a way that the rain falls would wash the same into the Rockaway River or its tributaries, no care being taken to bury the cesspool contents or otherwise throw any safe-guard around them to prevent their reaching the river or its tributaries. On January 13th I made an inspection of the site on which John R. Bennett, one of the scavengers disposes of the contents of the cesspools cleaned out by him. This site is on the Salem Road about one half mile south of Blackwell Street and just outside of the limits of the Town of Dover. This site is on the low flat ground bounded by Salem Road on the west, the Rockaway River on the north and a tributary of the Rockaway River on the east. This tributary of the Rockaway River meets the river at a point below Dickerson Bridge. The ground on which these matters are dumped is of an impervious nature already surcharged with ground water. I attach hereto a photograph taken on January 13th which shows the contents of cesspools which have been dumped on this ground and frozen. The dark, discolored matter in the center of the picture being frozen contents of cesspools. On the left is one of the wagons in which the materials are carted from Dover. A second picture is also attached which shows one of the wagons, the valve in the rear of which is opened. It is by opening this valve that the contents of the wagon are dumped. These valves by their very nature cannot be tight and as the wagons are carted along the street and over the bridges over the Rockaway River the contents of these wagons are dropped along the roads. The second photograph attached hereto shows a wooden tank into which the scavenger some times dumps the contents of the wagon. This tank is located as shown in the vicinity of the barn. At the time of my inspection the contents of it was frozen. The frozen contents stood within about four feet of the surface of the ground and showed no indication that any new material had been dumped in since some time back. In my judgment the antiquated methods of collecting and disposing of the sewage of Dover which is now in vogue in that town is not only unsanitary and constitutes a menace to the health of the people of Dover, but in my judgment is a positive menace to the purity of the waters of the Rockaway River. The only remedy for the existing unsanitary conditions, in my judgment, is the construction of a sewerage system for the purpose of collecting the sewage of the Town of Dover and adequate disposal works for treating the same after its collection. I am satisfied that only an extremely small per cent of the polluting water supply of Dover is removed from the cesspools, the balance of which percolates away through the ground eventually finding its way into the Rockaway River. The portion which is removed from the Town of Dover by the tank-wagons is not removed from the water shed, but is, in my judgment as dangerous or more dangerous to the purity of the Rockaway River than if it was left in the cesspools. During my investigations in Dover I had to reinspect a number of the cesspools covered by my earlier inspection. The reinspection in every case showed that the sewage level in the cesspool remained substantially constant, notwithstanding the fact that not any of the contents had been removed in between. Occasionally I would find a cesspool, the sewage surface of which had stood within a foot or so of the surface of the ground to be overflowing on reinspection, but the general rule was that the sewage level remained in the cesspools about constant. In my mind this indicates one of two things: First, that the cesspool has some direct overflow connections to the river or to some of its tributaries, or second, that the water from the cesspool is percolating away through the porous soil holding the level of the cesspool about constant. I am inclined to believe that in the majority of the cases the latter situation is true. At No. 9 Morris Street I found the former situation to be true. At that place an overflow pipe was connected directly to a drain leading through Morris Street into the Rockaway River. This drain was uncovered under the directions of the Dover Board of Health and disconnected. A photograph of this drain I append to my affidavit.

This to my mind is an indication that the sewage level in the gravelly subsoil of Dover stands practically at the same level as the sewage in the cesspool. This is further borne out by the fact that the sewage matters contained in the gravelly subsoil percolate through the cellar walls at many places in the Town, and as a consequence sewage stands on the floors of the cellars to more or less depth. I have observed this phenomenon in many of the cellars of Dover. At one place to which my attention was called, namely, No. 7 Warren Street, in order to prevent the sewage matters from percolating through the cellar walls into the cellar the owner caused an extra tight or inside wall of cement to be constructed to stop the water which had formerly been percolating through the stone foundation. At a later time he found it necessary to increase the height of this cement wall as the sewage matters rose to a higher level than the cement wall thereby percolating through the walls and flowing over the top of the same. I also discovered that at No. 23 Blackwell Street the same conditions prevailed and this same expedient was adopted to prevent the subsoil water from percolating through the cellar walls. The same situation existed and the same remedy was used at 31 Dickerson Street, to prevent the sewage matters from percolating through the cellar walls. In these places I have named, the subsoil sewage waters were by these means prevented from entering the cellars. I have seen a large number of cellars, however, where this expendient was not adopted and consequently the cellars contained sewage matters which have percolated through the cellar walls.

5. My investigations of the Rockaway Valley watershed during November, December and January were extended to include the situation at the Liondale Bleach, Dye and Print Works at Rockaway. The Liondale Bleach, Dye and Print Works as the name indicates conducts a bleaching and cloth printing establishment. They employ about 300 men and women in the plant. Toilets and comfort stations are provided in the plant for the conveniences of these employees. The sewage when collected from the toilets passes into a large overflowing cesspool. The overflow of this cesspool passes through a disinfecting apparatus and from there into the tail-race from the mill and thence into the Rockaway River. In the process of manufacture the Company uses daily the following amounts of chemicals:

120 lbs. Alumnia Sulphate.
177 lbs. Chlorine.
732 lbs. Soda Ash.
440 lbs. Lime.
120 lbs. Caustic Soda.
914 lbs. Sulphuric Acid.

The spent chemicals from the process of manufacture together with approximately 2,000,000 gallons of water carrying these spent chemicals also passes into the tail-race and thence into the River. An effort has been made to convert this tail-race into a partially purifying mechanism. An attempt to accomplish this was made by building loose stone dams across the tail-race at various intervals just before its contents are discharged into the Rockaway River. It was apparently the purpose of these loose stone dams to settle out and strain out the manufacturing waste carried from the mill into the river before the water was discharged into the river. The device, however, is entirely non-effective as there are breaks in the dams and the mill wastes as discharged through the tail race reach the river in exactly the same condition as they leave the mill.

On the following dates I collected samples from the points numbered 1, 2, 3, 4, and 5 on the map showing the Liondale Bleach, Print and Dye Works and which is attached hereto:

December 3rd, 4th, 5th, and 6th, 10th, 12th, 17th, 18th, 19th, 20th, and 21st.

At point No. 5 the water of the Rockaway River enters the head-race to be used in the process of manufacture at the dye works. At the point marked 4 the wastes from the mill, including the sewage from the 300 workers is discharged into the Rockaway River. Three, two, and one are points in the south side of the river, the middle of the river and the north side of the river, respectively. During all of the time I collected samples the water at the point marked 5 was clear and sparkling. A sample collected at the point marked 4 was cloudy and contained suspended matter. This discolored water as it passed from the tail-race did not mix with the river water immediately, but at the bridge where the samples 3, 2, and 1 were taken its demarkation was clearly evident. Sample No. 3 taken on the south side of the river was taken from this water from the tail-race before it was mixed with the sewage. At the point marked 1 on the north side of the river the water was clear and sparkling as it was at point No. 5 at the head-race. Likewise 2 taken from the center of the river. These samples as I collected them were delivered to Dr. North's Laboratory in Jersey City. I am informed by him that the sample taken from point No. 5 on the bacterial test, showed sewage pollution notwithstanding that the water was clear and sparkling. I am also informed that the sample taken at the point marked No. 4 which constituted the trade wastes from the mill including the sewage from the 300 workers and which was cloudy and contained suspended matter was, from the bacterial standpoint, pure.

6. I have been engineer in charge of the construction of the sewerage systems at the following places:

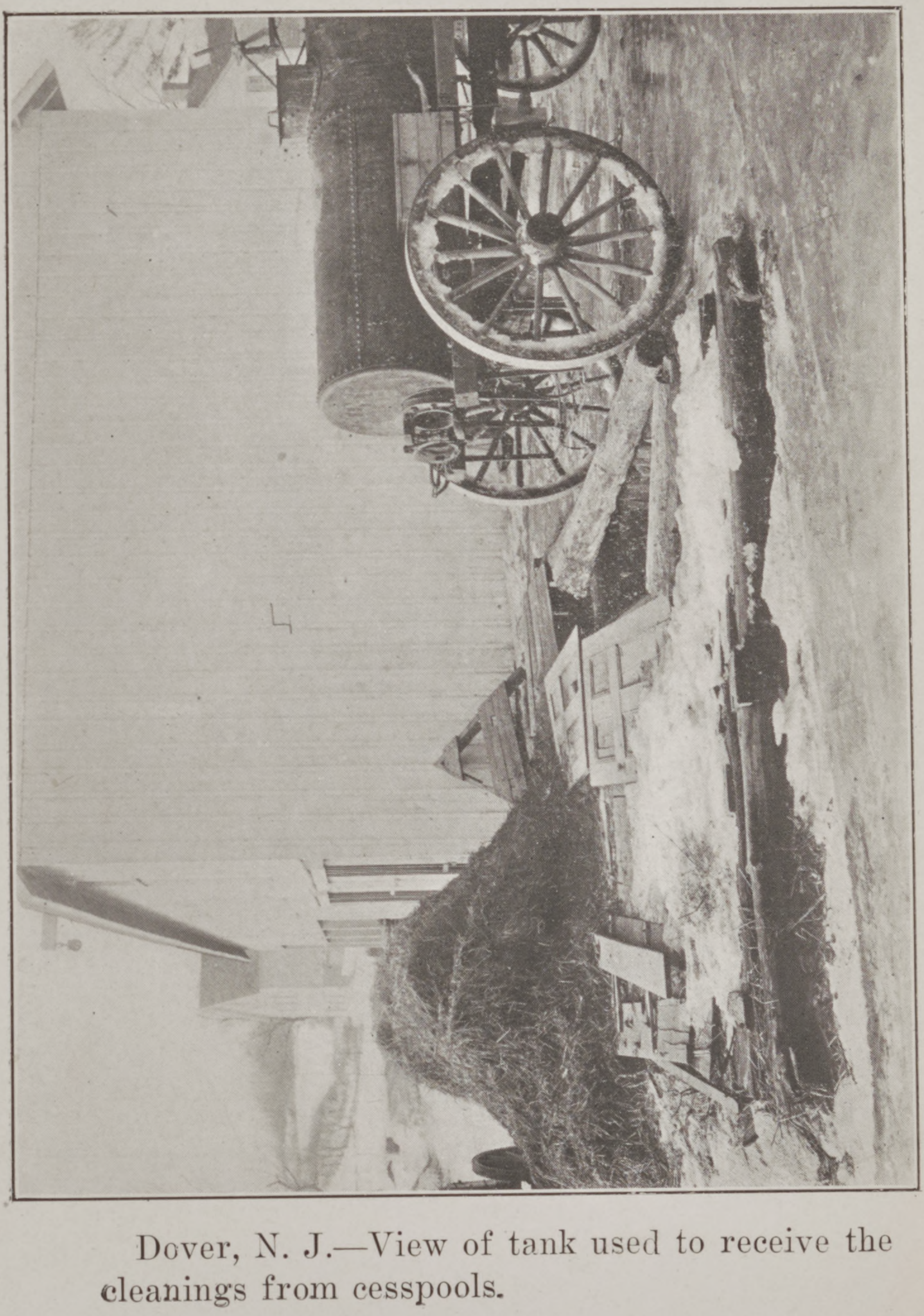
Havre de Grace, Md.; West Haven, Conn.; Newton, Morristown, Salem Verona and Bogota, New Jersey.

At all of which places the sewerage systems were initiated by the City officials, but none of these places, nor have I ever seen a place that was so sorely in need of a sewerage system in order to properly carry away and treat the human wastes of a city as is the Town of Dover.

(Sgd) F. E. Caldwell.

Sworn and subscribed before me this 8th day of February, 1918.

Agnes I. Gray,
Notary Public,
(Seal) Kings Co.



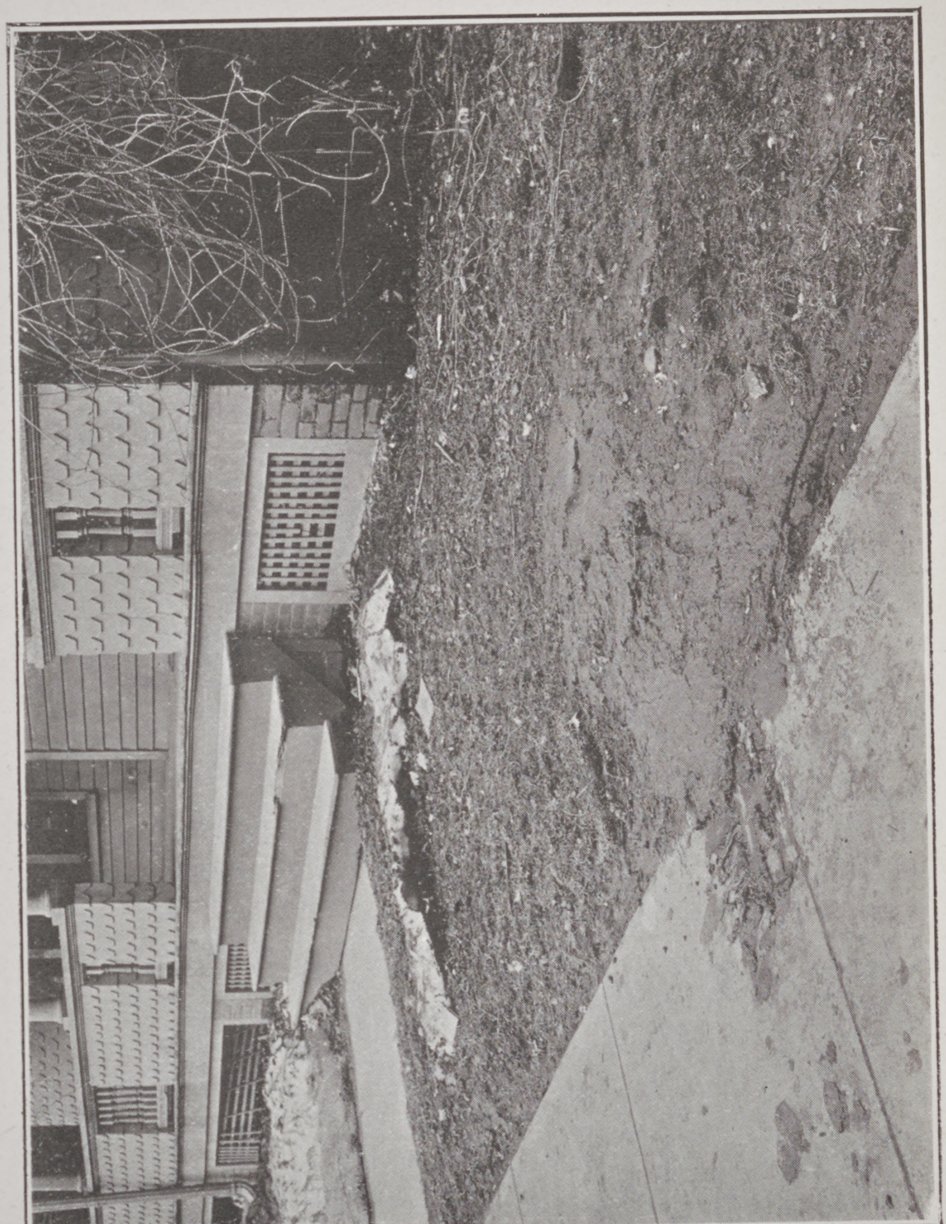
Dover, N. J.—View of tank used to receive the cleanings from cesspools.

Dover, N. J.—Cesspool dumping on Bennett Farm.

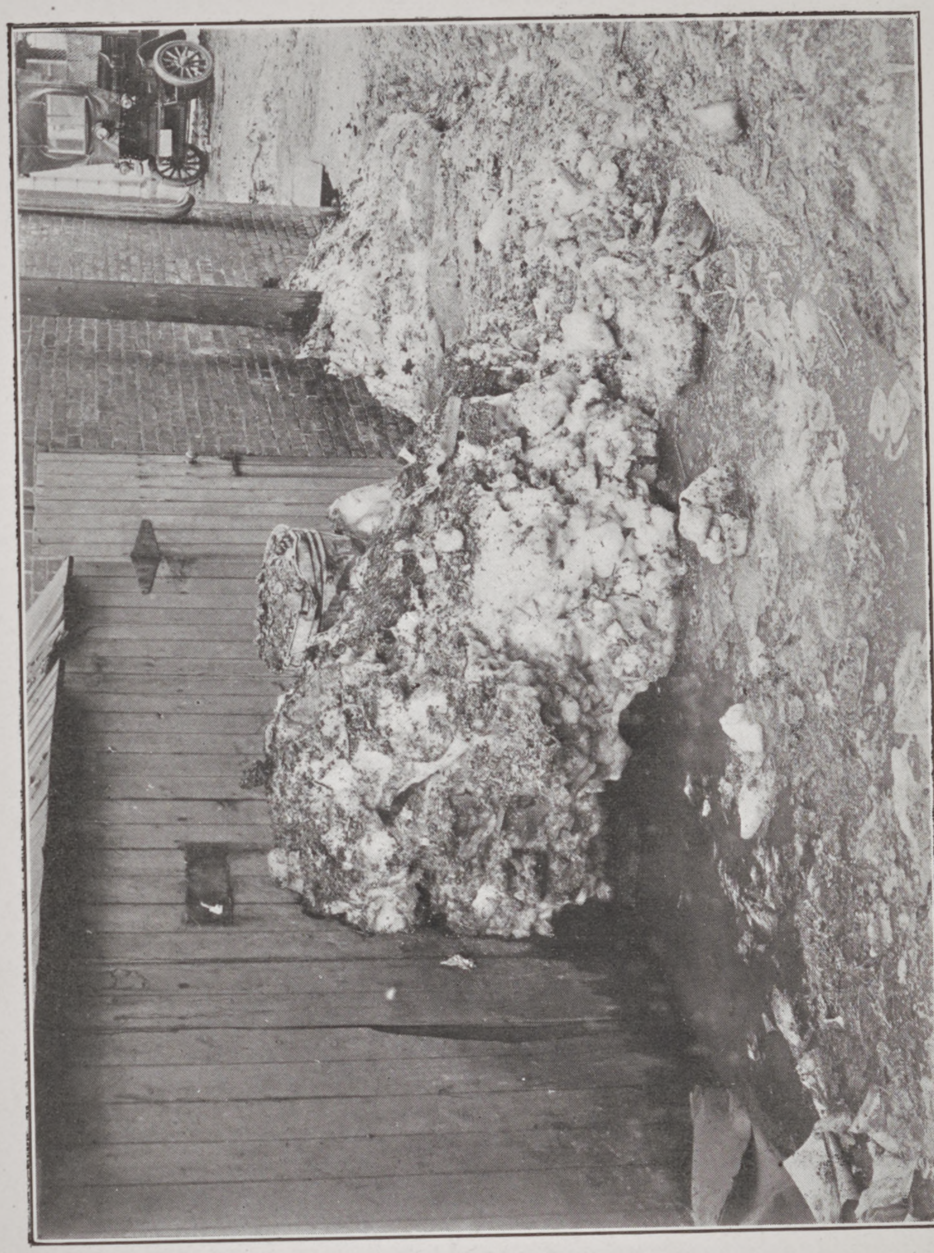
Dover, N. J.—Overflowing cesspools rear of 71 Blackwell Street.

Dover, N. J.—Another of same, showing sewage running along the surface.

Dover, N. J.—Cesspool rear of 12 Dickerson Street.



Dover, N. J.—Cesspool front yard of No. 15 Essex Street.



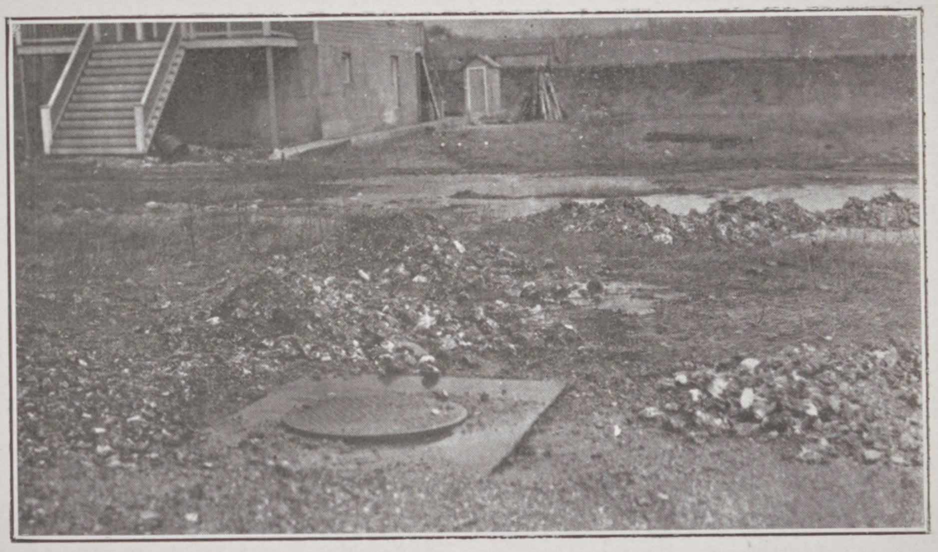
Dover, N. J.—Cesspool rear of 16 Blackwell Street.

Dover, N. J.—Broken tile over cesspool 9 Morris Street.

Dover, N. J.—Uncovered cesspool 71 Blackwell Street.

Dover, N. J.—Pump used in cleaning cesspool at 71 Blackwell Street.

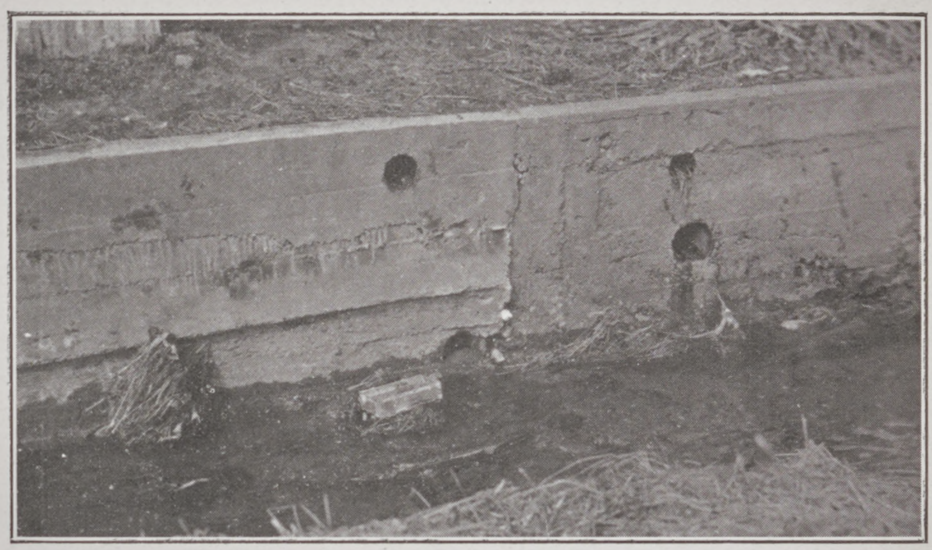
Dover, N. J.—Solid matter, 12 Dickerson Street.



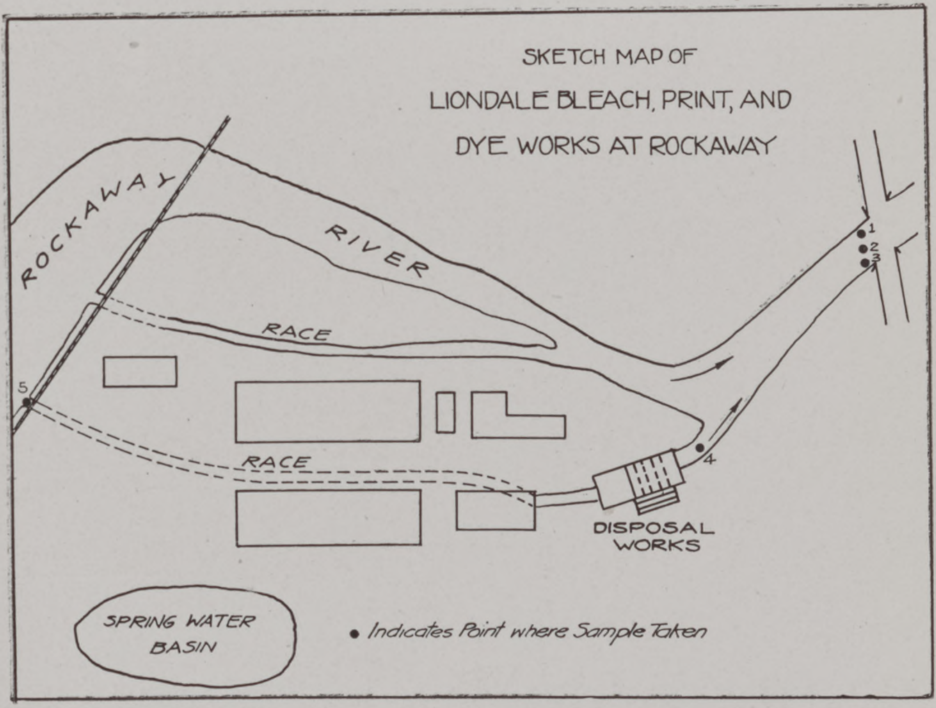
Dover, N. J.—Overflowing cesspool rear of Belmont School.

Dover, N. J.—Overflowing cesspool No. 12 Salem Street.

Dover, N. J.—Another picture of No. 12 Salem Street.



Dover, N. J.—Sewer connection through concrete wall No. 18 Trenton Street.



Affidavit of Frederick C. Lambert.

IN CHANCERY OF NEW JERSEY.

Between THE MAYOR AND ALDERMEN OF JERSEY CITY, *Complainant,* and JERSEY CITY WATER SUPPLY COMPANY, *Defendant.*	On Application for Leave to File Bill of Review.

STATE OF NEW JERSEY, }
County of Hudson, } ss.:

FREDERICK C. LAMBERT, of full age, being duly sworn on his oath deposes and says:

1. I reside in Jersey City, New Jersey. I am a practicing physician in Jersey City and have been such for twenty-three years. I am a member of the Practitioners Club in Jersey City; a member of the Hudson County Medical Society; a member of the American Academy of Science; a member of the American Public Health Association, and other state and national societies. I have served on the Board of Health of Jersey City, and at one time was president of the Board, and was president of the Board of Health in 1906 at the time of the suit of the Mayor and Aldermen vs. the Jersey City Water Supply Company before Vice-Chancellor Stevens. In that year, as president of the Board of Health of Jersey City, I made an investigation of the sanitary conditions in Dover and with some reference to the prevalence of typhoid fever in the Town of Dover.

I am familiar with the water supply of Jersey City and have been since the question of a pure water supply was agitated in Jersey City. Since 1906 I have visited a number of water supplies at different cities in the United States with a view of ascertaining the sanitary conditions of water sheds throughout the country. Since 1906 I have made some particular studies with reference to what constitutes a suitable gathering ground for producing a pure and wholesome water both from a study of academic questions and from investigations of actual existing supplies.

2. On January 31st of the present year I again visited Dover for the purpose of inspecting the sanitary conditions existing there, with special reference to the disposition of the sewage matters originating in the town of Dover. Since I visited the water shed and gate house in 1906 I know that the water now being sent to Jersey City is disinfected with hypochlorite of lime for the purpose of destroying the dangerous bacteria contained in the water. On my last visit to the water shed during the present year I observed that conditions have changed materially since my visit during 1906, and changed for the worse so far as the sanitation of the Town of Dover is concerned. During my earlier inspection in 1906 the only pollutions to which my attention was directed was what might be termed as direct pollutions, that is, pipes carrying sewage or the overflow of cesspools into the river. Since my visit in 1906 I know that many of these direct connections into the river have been removed. The removal of these pipes carrying sewage directly into the river has caused the sewage matters to be confined to the cesspools or has permitted them to percolate from the cesspools, thereby reaching the river indirectly through the gravel subsoil of Dover. I noticed that the

sanitary conditions in Dover, due to the lack of a sewerage system were extremely bad. The gravel subsoil has become so charged with sewage from the percolating cesspools that numbers of the cellars in the town show evidence of the sewage from the subsoil percolating through the cellar walls and into the cellar and standing on the floor of the cellar. To my mind the cesspool method of disposing of sewage as is in vogue in Dover has brought about an appalling situation there and one that menaces the users of the Rockaway River as a water supply in Jersey City. It is particularly fortunate that during the last ten years there has been no epidemic of typhoid fever or other water-borne disease on the watershed for, in my judgment, if a serious outbreak of typhoid fever or other water-borne disease should occur in the Town of Dover it would be communicated to the consumers of water in Jersey City.

3. I do not regard the hypochlorite plant installed by the Jersey City Water Supply Company at Boonton as an adequate, continuous or proper mechanism for purifying the water supplied to Jersey City, and in my judgment, the proper way to so safeguard the water would be by removing the pollution now entering the Rockaway River at Boonton, Dover and the other towns on the watershed.

4. During the past four or five years there are many times when the water as delivered to the consumers in Jersey City *has an unpleasant and unhealthful taste and odor.* I have myself frequently caught this odor and tasted the chlorine in the water and many of my patients have complained to me regarding the tastes and odors which they have noticed in the water, and have sought my advice as to whether these tastes and odors were unhealthful or not. In my judgment, they

are unhealthful, as in my own case they prevented me from using the normal quantities of water which the system demands, and this same thing, of course, is true with my patients and other people in Jersey City who are compelled to use the water as a water supply.

(Sgd) FREDERICK E. LAMBERT.

Sworn and subscribed before me this 18th day of March, 1918.

ROBERT F. ROUTH,
Notary Public,
(Seal) N. J.

Affidavit of Ernest C. Levy

IN CHANCERY OF NEW JERSEY.

Between THE MAYOR AND ALDERMEN OF JERSEY CITY, *Complainant,* and JERSEY CITY WATER SUPPLY COMPANY, *Defendant.*	On Application for Leave to File Bill of Review.

STATE OF NEW JERSEY, }
County of Hudson, } ss.:

ERNEST C. LEVY, of full age, being duly sworn on his oath deposes and says:

I graduated from the Medical College of Virginia in 1890 with the degree of Doctor of Medicine. From 1897 to 1900 I was professor of Histology, Bacteriology, and Pathology in the Medical College of Virginia. I am a member of the

American Public Health Association, the American Association for the Advancement of Sciences, the American Medical Association, the Medical Society of Virginia, the American Academy of Public Health, and of the National Commission on Milk Standards. In 1900 I was president of the Richmond Academy of Medicine and Surgery I have been engaged in public health work exclusively since 1900, and during that time I have followed the advancement of all branches of the science of sanitation including the investigation of water supplies and the construction of water works. I was expert to the Water Department in the City of Richmond, Va. from 1904 to 1906, and was chief health officer of the City of Richmond, Va. from July, 1906 to May, 1917. During this entire time I have been a consulting sanitarian and have been engaged in the investigation of a number of epidemics, including those at Waterville, Maine; Bluefield, W. Va.; and Danville, Va. among others. Also during the time of my incumbency as health officer in the City of Richmond I handled all the outbreaks of different epidemics there. During the summer of 1917 I was engaged as special investigator for the city of New York on the Mayor's Committee on Milk.

2. On November 22nd, 1917 I visited Dover for the purpose of making a sanitary inspection of that town as it related to the pollution of the Rockaway River, with special reference to its sewerage facilities. While on this inspection I observed the following points:

(a) Dover at the present time is unsewered although it has a water supply which is generally used by the inhabitants. The sewage originating from this water supply is disposed of in cesspools.

(b) The sewage was inadequately disposed of by the cesspool method.

(c) The sewage percolated from the cesspools into the subsoil and was standing in the cellars of several of the buildings in the Town, including the Mansion House, Price's Photograph Gallery, and the building on the corner of Railroad Avenue and Sussex Street.

At Hotalen and Hendershot's restaurant at No. 7 North Warren Street, the proprietor showed me and explained to me that he had constructed an inside cement wall to prevent the sewage from percolating through the walls of his building into and on his cellar floor. I observed that it had been necessary for the proprietor to raise the heighth of this false wall from time to time as the sewage level in the ground outside of his building rose.

(d) The cesspool back of No. 9 Morris Street was overflowing and a stream of sewage was flowing across the surface of the ground. The cesspool back of Hotalen and Hendershot's was overflowing and a stream of sewage from this cesspool was flowing along the gutters into a catch basin and thence into the canal which joins the Rockaway River one block below.

(e) I observed that in this same vicinity an excavation which had been made for a new cesspool stood well filled with sewage water which had percolated into it from the surrounding soil.

(f) I also observed an excavation for a cesspool at the house at the corner of Richards Avenue and Mercer St. This was a new house not completed and, of course, unoccupied. The excavated cesspool was entirely new but had already become nearly filled with sewage matter percolating into it from the surrounding soil, although never having been used as a cesspool.

(g) I also observed that at No. 34½ Dickerson Street, a house owned by Mrs. Yongelson, the cesspool was filled to within a few inches of the surface of the ground and sewage from the cesspool was percolating through the soil and through the walls of the cellar into the house.

(h) I also observed the cesspool at the Dover Hotel. The sewage level in this cesspool stood to within a few inches of the top of the ground.

(i) I also observed the cesspools back of Price's Photograph Gallery at No. 23 East Blackwell Street. I noticed that the sewage in these cesspools was almost level with the top of the ground, and I further observed that Mr. Price, the proprietor, had built his toilets in the cellars up sufficiently high to prevent the sewage from the ground water standing outside of his building getting into and flowing over the tops of his toilet fixtures. At the time of my inspection notwithstanding this precaution the sewage was very nearly over the tops of the toilet fixtures owing to the high sewage level in the soil outside of his building. Price's cesspools and building are within a few feet of the Rockaway River.

(j) From excavations which I have observed on Blackwell Street I noted that the subsoil conditions of Dover consisted of large, loose boulders making a porous soil well adopted for the flow of sewage matters through it from the leaching cesspools. This subsoil condition was of such a nature as to form natural channels readily permitting the sewage from the cesspools to flow through them directly into the river, and without having the benefit or advantage of any filtration or straining action whatever.

My observations in Dover were such as to firmly establish in my mind the belief that the cesspools of Dover, which are of a percolating type do not hold back the sewage to any marked degree, but permit it to pass through the soil and directly or indirectly into the Rockaway River or its tributaries. In some instances, as I have observed the sewage from these cesspools, owing to the high sewage level in the ground surrounding them, backs up and flows over the tops of them directly into the Rockaway River. In my judgment a trunk sewer for collecting the sewage of Dover and taking the same out of the water shed is the only feasible and practicable plan for preventing dangerous pollution of the Rockaway River.

The conditions in Dover are such as will steadily grow worse until the relief of a trunk sewer is given the town. These conditions, already intolerable, are such that should an outbreak of epidemic occur in the Town of Dover it would be communicated to Jersey City through the water supply, and the conditions in Dover are so unsanitary due to lack of sewerage as to favor the outbreak of such an epidemic at any time.

3. I am advised that the only mechanism for purifying the waters of the Rockaway River from the time they leave the Dam to the time they reach the consumers in Jersey City is the reservoir and disinfecting apparatus at the Boonton Dam. This disinfecting apparatus is for the purpose of destroying the bacteria by chlorination.

This method of disinfecting water supplies as the sole method of purifying the same was, so far as my knowledge goes, first applied at the Boonton Dam by the Jersey City Water Supply Company, and since that time has been adopted as a means of purifying water at a number of other places, including the supply of the East Jersey Water Company at Little Falls, and the supply of the Middlesex Water Company at their Robinson's Branch at Rahway; besides a number of other places throughout the United States. In my judgment this is not a safe, adequate or proper method of purifying surface water supplies collected from polluted areas, owing to the limitations which this process has developed during the ten years it has been installed at the Boonton Dam. These limitations were not understood at the time the plant at Boonton was installed, but have since been developed by experience. Without going into these limitations in detail, in my judgment, the real and positive test of the limitations of the use of chlorine as a sole means for disinfecting surface supplies was forcibly illustrated during the extreme cold weather of the past winter when such a supply was furnished to the following municipalities in the State of New Jersey:

Montclair, Glen Ridge, Bloomfield, West Orange, Kearney, East Newark, Harrison, Nutley, and Bayonne.

These places were supplied with a chlorinated surface water supply by the East Jersey Water Company at Little Falls.

I made investigations of the epidemic in these towns in order to ascertain its relation to the water supply.

During the month of January, 1918, there occurred in Montclair and certain other New Jersey communities an epidemic of acute digestive disorder characterized by vomiting, diarrhea and abdominal pain. Preliminary inquiries pointed so strongly to the likelihood of this outbreak being due to water that a more complete study was made along epidemiological lines and a number of laboratory tests were made of the water supply.

Montclair, West Orange, Glen Ridge, Bloomfield, Kearney, Harrison, East Newark, Nutley, Bayonne, Paterson and Passaic are supplied by the East Jersey Water Company with water taken from the Passaic River at Little Falls, New Jersey. Paterson and Passaic are supplied by a different line from that which supplies the other communities. This water is ordinarily treated by mechanical filtration followed by chlorination. Late in December, 1917, the East Jersey Water Company being unable to get a sufficient amount of water for its purposes added to their filtered water a considerable amount of unfiltered water taken directly from the Passaic River at Little Falls. This water was treated with chlorine in the form of so-called chloride of lime.

Within a short time it was noticed that a number of persons in Montclair were taken ill with the symptoms above noted. This became so pronounced that on January 22, 1918 I began a survey of the situation. It was found that in none of the communities above mentioned had the health officer himself at this time started any investigation. Since then, however, at a suggestion, a complete canvass has been made by the health officers in Montclair and Glen Ridge. As a result of this, 1,629 cases were found in Montclair and 480 in Glen Ridge. A similar study is now being made in Bloomfield under my direction. I have already found 300 cases in Bloomfield, and this investigation will undoubtedly bring to light many hundreds more.

Inquiries which I have made in Harrison, Kearney, East Newark, Nutley and Bayonne show that the epidemic unquestionably reached these communities, but it has not been possible to investigate the conditions as thoroughly as in Glen Ridge and Bloomfield. Apparently Paterson and Passaic have not been affected, as later noted.

Laboratory examination of the water supplied by the East Jersey Water Company from its plant at Little Falls have been made from samples collected in Montclair, Glen Ridge, and Bloomfield. These examinations show that the water supply of these communities on certain recent dates contained altogether too great a number of bacteria and a number of the samples have shown the presence of B. Coli, an intestinal organism.

The particular object in view in making the study of this epidemic and of the water supply of Montclair and the other communities was because of the exceptional opportunity afforded to judge the efficiency of chlorination as a means of protection against dangerously polluted water under extreme conditions of cold weather as a number of communities are relying upon this method of protection. Especially was this study undertaken for the light it would throw upon the inadequacy of simple chlorination as a means of purification for the water supply of Jersey City.

For the present purposes it is not necessary to go fully into details as to what has been accomplished, but the following conclusions have been reached:

I. During January, 1918, Montclair, West Orange, Glen Ridge, Bloomfield, Kearney, Harrison, East Newark, Nutley, and Bayonne suffered from an epidemic of acute intestinal disorder. My investigation has convinced me that this epidemic was undoubtedly due to the water supply for the following reasons:

1. There is no other possible explanation for the simultaneous outbreak in a group of nine communities all of which receive the same water supply, while a number of other nearby communities receiving different water supplies escaped.

2. Unfiltered water from the Passaic River, treated with chlorine was supplied these communities prior to and during the epidemic.

3. Laboratory tests which I have made of the water supply of Montclair, Glen Ridge and Bloomfield showed a contaminated water, while the large number of tests made for the health officer of Montclair also showed marked increase in the bacteria count, during the time that the unfiltered chlorinated water was being pumped.
them myself. My occupation is such that I use

4. Differences in the distributing system explain why Paterson and Passaic did not suffer as did Montclair, Glen Ridge, Bloomfield and the other communities above mentioned.

II. The mechanism of infection was as follows. Owing to the extreme cold weather there was:

1. Decreased efficiency in the treatment of sewage entering the Passaic River above Little Falls.

2. A lesser degree of dilution owing to a diminished flow in the river.

3. Intestinal bacteria are known to survive longer in cold water than in warmer water.

4. The bacteriocidal action of chlorine is lessened or completely checked when the water to which it is added is at or near the freezing point.

III. Application of the foregoing facts to the water supply of Jersey City.

1. From partial investigation of the watershed of the Rockaway River at Dover made by me on November 22, 1917 it is evident that this stream, which constitutes the source of water supply for Jersey City, is highly and dangerously polluted, being unsafe for human consumption unless efficiently and uninterruptedly purified. There is a large amount of contamination by human excreta, which is always a potential source of danger and which becomes actually dangerous if any of this polluting material comes at any time from persons suffering from typhoid fever or other intestinal disorders, or if it comes from persons who are

carriers of the organisms of these diseases. This is liable to occur at any time.

2. The recent epidemic in Montclair and other cities affords convincing proof of the unreliability of chlorine treatment alone as a means of making dangerous water safe under all conditions.

3. Chlorination alone cannot, therefore, be regarded as adequate protection for the water supply of Jersey City. If chlorination alone is relied on, and nothing done either to lesson the great amount of contaminating material which at present enters the Rockaway River or to purify the water more effectively, it is, in my opinion, only a question of time when Jersey City must suffer from an outbreak of typhoid fever or other diseases clearly due to its water supply.

(Sgd) ERNEST C. LEVY.

Sworn and subscribed before me this 18th day of February, 1918.

ELEANORE SCHENCK,
(L. S.) Notary Public of N. J.

Affidavit of Stephen Fallon

IN CHANCERY OF NEW JERSEY.

Between The Mayor and Aldermen of Jersey City, *Complainant,* and Jersey City Water Supply Company, *Defendant.*	On Application for Leave to File Bill of Review.

State of New Jersey, }
County of Hudson, } ss.:

Stephen Fallon, of full age, being duly sworn on his oath, deposes and says:

1. I live at 125 Manhattan Avenue, Jersey City, and I have lived here for years.

I am a professional masseur. For five years I was assistant athletic instructor at the University of Pennsylvania, and also athletic instructor for the Philadelphia National Baseball Club, and also the Chicago National Baseball Club. I was also athletic instructor for the Washington, D. C. Club, and the New York Baseball Club of the American League. I am now occupied as a professional masseur, and all of the leading doctors of Hudson County recommend my services to their clients in important cases that need a professional masseur.

2. I do not now nor have I ever used intoxicating beverages in any form, nor do I use tobacco in any form. My occupation has been such that I have not only advised others to abstain from the use of these things, but have also abstained from

the myself. My occupation is such that I use large quantities of water for bathing purposes and also drink large quantities of water, and advise my clients to do the same.

3. At my house on Manhattan Avenue I take water from the public water supply in Manhattan Avenue. I have been advised by the city officials that the connection from the main which supplies water to my house is taken direct from the 72″ steel pipe line leading from the Boonton gate house. I know this to be so because my house is situated at a higher elevation than the distributing reservoir in Jersey City and myself and neighbors consequently receive water by direct pressure from the Boonton dam.

At the present time I am unable to use the water supplied to me by Jersey City on account of the strong taste and odor of chlorine which the water contains. All of the water which is used for drinking purposes in my house is bottled spring water which I am compelled to purchase. The water supplied by Jersey City has so much chlorine as to make it impossible for me to use it for drinking purposes. This situation has existed since 1912 at which time I complained to the old Board of Street and Water Commissioners. I have also made complaints to the city since that time.

4. From my experience in the training of athletes I know it is essential in order to keep the body in proper and healthy condition that proper amounts of wholesome water be taken into the system daily. I know that the water supplied my house in Jersey City is not a healthy or wholesome water because it is impossible to drink the proper amount, or any amount, of it necessary to keep the body in proper physical condition.

In my judgment any water which people will not drink on account of unpleasant tastes and odors is unhealthy.

(Sgd) STEPHEN FALLON.

Sworn and subscribed before me this 5th day of April, 1918.

ROBERT RIVERTON,
Comm. of Deeds,
N. J.

Affidavit of Howard S. Forman

IN CHANCERY OF NEW JERSEY.

Between
The Mayor and Aldermen of Jersey City,
Complainant,

and

Jersey City Water Supply Company,
Defendant.

On Application for Leave to File Bill of Review.

State of New Jersey, }
County of Hudson, } ss.:

Howard S. Forman, of full age, being duly sworn on his oath, deposes and says:

1. I am a practicing physician in Jersey City where I reside, and where I was born. I graduated from Princeton in 1893 and from the College of Physicians and Surgeons in 1896. I spent two years in the Methodist Episcopal Hospital of Brooklyn, New York, from 1897 to 1899. I am a member of the Practitioners Club in Jersey City, also the Hudson County Medical Society. I am chairman of the Medical Advisory Board of the Federal Draft; Chairman of the Health Committee of the Chamber of Commerce; and Medical Attending Physician of Christ Hospital.

2. I visited the disinfecting plant at Boonton on January 21st, 1918 for the purpose of ascertaining the method employed for purifying the water furnished the City of Jersey City, and at the same time I inspected the water shed from which Jersey City derives its water supply, particularly at Boonton, Rockaway and Dover.

I learned that the town of Dover while it has a municipal water supply has no sewerage system. The sewage from the 10,000 people residing in Dover is disposed of largely in cesspools. The main part of Dover is flat and very little higher than the Rockaway River on the banks of which it is situated. The hills rise up on both sides of Dover and to considerable heighth and in such a way as to confine Dover to the immediate banks of the Rockaway River. All of the rain fall in Dover reaches the Rockaway River very quickly and easily, the gutters of many of the streets leading directly into the Rockaway River. I observed a number of cesspools in the town, the sewage level in some of them standing nearly to the top of the ground. Dover is so situated and the slope of the ground is such that the contents of these cesspools, which I am told are of the leaching type, could if the soil were suitable easily find their way into the Rockaway River. I am told that less than one per cent of the sewage matters put in these cesspools is pumped out so that I am of the opinion that the subsoil conditions are such as to permit the other 99 per cent to percolate through the ground and thence into the Rockaway River. I observed while I was in Dover a number of cellars in the town. In each instance I noticed that there was evidence of sewage percolating or having percolated through the cellar walls into the cellars some of which contained sewage matters at the time of my inspection. This leads me to believe that the subsoil conditions in Dover are so charged with sewage matters that it readily finds its way into the cellars of the town.

When in Dover I took my lunch at the leading hotel in the town. After luncheon I was taken into the cellar of the hotel by the proprietor who informed me that sewage had been standing in the cellar, but had been pumped out the day before. The evidences of the sewage having stood in the cellar were plainly visible, and the stench remaining from the sewage having been in the cellar was very pronounced. This stench was also noticeable on the main floor of the hotel.

3. As a result of my inspection on the 21st of January I am of the opinion that a sewer should be constructed for the purpose of removing the sewage of Dover and Boonton from the water shed in order to prevent the pollution and contamination of the Rockaway River, and I do not consider the disinfecting plant at the Boonton Dam an adequate substitute in lieu of such sewer for the purpose of preventing the pollution. I am of the opinion that a sewer should be provided for the purpose of conveying the sewage matters originating in Dover out of the water shed. In my judgment the unsanitary conditions now prevailing in Dover has resulted from the lack of proper methods of disposing of the sewage of Dover, and is a menace to not only the health of the people of Dover, but to the people of Jersey City as well, who drink the water collected on the watershed of which Dover forms a part. The unsanitary conditions of Dover due to lack of proper sewerage is, in my judgment, at any time liable to cause an epidemic which if it is a water-borne disease will be communicated to the people of Jersey City through the water supply.

(Sgd.) HOWARD S. FORMAN.

Sworn and subscribed before me this 18th day of March, 1918.

S. W. Garrison,
Notary Public,
of N. J.

Affidavit of Joseph Anderson, Sr.

IN CHANCERY OF NEW JERSEY.

Between
THE MAYOR AND ALDERMEN OF JERSEY CITY,
Complainant,

and

JERSEY CITY WATER SUPPLY COMPANY,
Defendant.

On Application for Leave to File Bill of Review.

STATE OF NEW JERSEY,
County of Hudson, ss.:

JOSEPH ANDERSON, SR., of full age, being duly sworn on his oath deposes and says:

I. I am a Counsellor at Law with an office at 15 Exchange Place, Jersey City, and live at 2742 Boulevard, and have lived there since December, 1913.

2. I have frequently noticed that the water at my house on the Boulevard has an unpleasant taste and odor. In July and August of the year 1917, my family and I lived at my place in Park Ridge, in Bergen County, in this State. I have two wells upon my place. One is an artesian well and the other is a driven well from which the water is drawn by hand-pump. The water from this latter well is clear and cold and refreshing. My family and I became very much accustomed to the use of the water from this well during our stay there during the summer time and drank it constantly whenever in need of water. We returned home to the house on the Boulevard about September first,

and began to use the city water. The taste and odor were bad and were so pronounced that the children did not want to drink the water. The grown up members of my family objected to the water as much as the children. As nearly as I can judge, the unpleasant taste and odor were due to the chemicals with which the water of our city of Jersey City is treated. I am informed that the water furnished my house on the Boulevard is drawn through an auxiliary main directly from the 72 inch pipe line which brings the water from the Boonton Reservoir to Jersey City, and does not go into the Summit Avenue Reservoir.

3. The tastes and odors which I frequently noticed in the water are so unpleasant and disagreeable as to interfere with my enjoyment of the use of the water.

(Sgd) JOSEPH ANDERSON, SR.

Sworn and subscribed to before me this 15th day of April, 1918, at Jersey City, N. J.

Henry Ewald,
Master in Chancery
of New Jersey.

Affidavit of Jacob J. Vreeland

IN CHANCERY OF NEW JERSEY.

Between THE MAYOR AND ALDERMEN OF JERSEY CITY, *Complainant,* and JERSEY CITY WATER SUPPLY COMPANY, *Defendant.*	On Application for Leave to File Bill of Review.

STATE OF NEW JERSEY, } ss.:
County of Morris. }

JACOB J. VREELAND, of full age, being duly sworn on his oath, deposes and says:

I reside at Dover, New Jersey; am 42 years of age and am a practicing architect in Dover and vicinity. I was a member of the General Assembly of the Legislature of 1917 and was re-elected this year. I have resided in the City of Dover all my life. Since 1881 I have lived at #52 North Bergen Street, which is about 500 feet from Rockaway River. My father owned a number of houses between the Morris Canal and the River, located generally between Essex and Passaic Street. I own three houses in the same district at the present time. Members of my family own other houses in the same district which were inherited from my father. Thirteen residential properties in said district are owned by our family. Consequently I have always been very familiar with real estate conditions in that vicinity apart from my experience as a practicing architect, supervising the construction of buildings in the same district. I am familiar with the sub-surface conditions throughout the town of Dover. Generally speaking the sub-surface conditions in the Town of Dover may be divided into two classes: First, that in the territory bounded by Essex Street on the west, Mercer Street on the south, the Morris Canal on the north, and the Rockaway River on the south, as the first district, and the balance of the Town might be classed as the second district. I live in the first district, and have lived there since 1881. This district is a filled district formerly having been a swamp. At the time my father built his house in this district he excavated about from twelve to eighteen inches to get a footing for the foundation, and the cellar was then built entirely above ground, the water table being about seven feet above the swamp level. The foundation rests on gravel which I believe to have been the bed of the old river. Later from three to five feet of fill consisting mainly of garbage, ashes and other refuse material was spread through this first district. On top of this refuse fill about a foot or fifteen inches of top soil was carted in from other portions of the Town. My father's experience was the general experience of each other person who built a house in this same district. Before this fill was made in the first district as I have classified it, a comprehensive system of underdrains were laid throughout the district about 8,000 lineal feet in all. Generally they were built of loose field stones forming the side walls with large stones laid across the top to form a cover. These drains were laid loose and collected the waters that percolated or flowed through the filled-in ground. These drains collect into a main drain and discharge at Mercer Street, and this outlet is now spoken of as the Mercer

Street Sewer. The balance of the central portion of Dover can be classified as the second district. This district is of sandy gravel formation underlaid with a stratum of large loose boulders.

The portion of Dover covered by Districts Nos. 1 and 2 is shown on a map entitled "Map of central portion of Dover, N. J. showing location of cesspools and privy vaults and their proximity to the Rockaway River and tributaries, 1917", a copy of which is hereto annexed. I am familiar with the cesspools shown on this map, with their construction, and the character of the soil into which they have been built. These cesspools generally are about six feet in diameter and seven or eight feet deep. These cesspools are built without bottoms, the sides being laid up of loose stones, and in some cases covered with railroad iron and block stone flag, and in others drawn in at the top with a small cover or vent. I have designed and supervised the construction of many such cesspools in Dover, and I know that they are designed to permit percolation of the water contained in them through the soil. These percolating cesspools have cost between fifty and eighty dollars, according to size. When cesspools are built tight so as to prevent percolation they cost more, about two hundred and twenty-five dollars. I know of but one tight cesspool in the Town of Dover. There are approximately 800 cesspools in the Town of Dover, and on the map to which I have referred there are approximately 370 cesspools in the central portion of Dover and 172 privies. Since I have lived on Bergen Street, I know of a number of instances, up to the present time, where the cesspools have never been pumped out.

Prior to 1905 or 1906 there were a number of privies overhanging the Rockaway River or its tributaries in the Town of Dover. These, however, were removed through either the efforts of Jersey City or the Jersey City Water Supply Company. Prior to 1908 a large number of the owners of cesspools in the Town of Dover had so arranged them as to overflow through pipes directly into the river or into some of the tributaries of the Rockaway River. In 1908 and thereabout, through the efforts of Jersey City or the Jersey City Water Supply Company, a large number of these overflows leading to the river or its tributaries had been cut off or sealed up. This cutting off of the overflows caused the sewage from the cesspools to percolate into the gravelly soil underlaying the Town of Dover, and to gradually fill up the voids in the gravel. In the beginning the soil had the capacity to assimilate this percolated water as a filter, but within the last two or three years it has apparently lost this power to assimilate the sewage from the cesspools as is instanced by the fact that a number of cellars in the Town are being pumped out to keep them from filling up with sewage. In some cases it stands in the cellars to a depth of several inches, forming a scum of sewage in the cesspool. This is especially true of one of the leading hotels in Dover. This applies particularly to District No. 2 in which the two hotels are located. This is further instanced by the fact that in the construction of new cesspools in the Town as soon as the excavation is made for a new cesspool it immediately becomes filled nearly to the surface with black putrid water or sewage matters which comes through the soil from surrounding cesspools. In many instances the ground is so saturated that it will not leach or percolate from the cesspools, but instead backs up and runs out through the top of the cesspool on to the ground, thence into the gutters and finding its way into the Rockaway River or its tributaries.

This condition of the subsoil of Dover and the inability to construct new cesspools and thereby provide for sewerage has put an end to building operations in the town. Housing conditions are entirely inadequate in the central portion of the town, mainly on account of the insuperable difficulty in way of building or maintaining cesspools.

In addition to the sewage standing in the cellars of the hotels, as I have before noted, I know of my own knowledge that sewage stands in the cellars of many of the business houses on Blackwell, Dickerson, Sussex, Morris, and Bergen Streets, streets lying parallel to the Rockaway River and not more than 200 feet to 400 feet away from it and constituting the main streets of the Town of Dover.

It is difficult for anyone who has not seen the actual conditions to realize that such conditions could exist in any civilized community in the Atlantic States.

The stench or affluvia coming from the cellars and overflowing cesspools is most noxious particularly during the months of July, August and September, and in the winter time when the ground water plane raises the already high sewage plane in the gravel, I have known instances where it backed into the cellars of houses to such an extent as to put out the furnace fires, and the owners had to rig up pumps to pump the same into the gutters in order to restore fires in the dwellings.

From these conditions no relief is possible by the cesspool system. This fact has been recognized by the citizens of Dover, for a long time, and they have endeavored in every way to provide for the construction of a sewage system, but the City of Jersey City has consistently opposed all efforts along this line because of its unwillingness to have the effluent of such a system flow into the Rockaway River. On the other hand, the cost of continuing such a sewage system from Dover to a point below the Boonton Dam, a distance of about 13 miles, would so increase the cost of such a system that the City would be unable to meet it. We have been extraordinarily lucky in Dover in not having an epidemic of disease attributable to bad sewage conditions.

When, to the saturation of the soil brought about by the agencies I have referred to, is added the super-saturation due to melting snow and heavy rain fall, the amount of pollution carried directly into the river from the cesspools, privy vaults and cellars of Dover, is greatly increased. The conditions which exist at the present time are steadily becoming worse.

(Sgd.) JACOB J. VREELAND.

Subscribed and sworn to before me this
14th day of January, 1918.
JOHN M. MILLS,
Notary Public
of N. J.

Copy of map is attached to affidavit of Caldwell.

Affidavit of Michael I. Fagen.

State of New Jersey, }
County of Hudson, } ss.:

Michael I. Fagen, of full age, being duly sworn, on his oath deposes and says:

I am the Director of the Department of Streets and Public Improvements of the City of Jersey City, and as such have general charge of the Water Department of said city.

In the Fall of 1917 the City Commissioners learned that Dr. H. W. Redfield, a bacteriologist, in charge of Inspection Micro Biology for the Bureau of Chemistry of the U. S. Department of Agriculture, had recently examined water coming from the Boonton Reservoir, and it was reported that Dr. Redfield had found that the chlorine process did not always kill the bacteria, but frequently resulted merely in stunning them temporarily.

Thereupon, on October 23rd, 1917, the City Commissioners passed a resolution requesting the Department of Agriculture to make the results of Dr. Redfield's labors available for use by the City in this application; and in due course the Department of Agriculture forwarded a copy of Dr. Redfield's report.

Annexed hereto is a true copy of said report, with the exception of the first eighteen pages thereof, these pages being largely devoted to a description of the date of collection of the samples referred to.

The investigation made by Dr. Redfield was not at the instance or indeed with the knowledge of the City authorities. He was not in the employ of the City, nor has he received any pay from the City for services in connection with the work set forth in said report, nor has he any claim against the City for said work.

Affidavit of Michael I. Fagen

I have read the foregoing petition and I am credibly informed and believe that the statements and allegations therein made are true.

MICHAEL I. FAGEN.

Subscribed and sworn to before me this 4th day of June, A. D. 1918.

W. B. JEWELL,
Notary Public of N. J.

The investigational samples taken at the railroad stations on Sept. 13, 17 and 18 were obtained in order to determine whether any contamination which might possibly be found in the official samples (which were taken on the trains) was due to the water supply or to contaminated drinking tanks. The possibility of ice contamination was eliminated by the fact that the ice did not come in contact with the water in any of the tanks.

The investigational samples taken on September 14 were obtained in connection with the inspection of the Rockaway River watershed. This inspection was made by automobile over a considerable portion of the water shed of the Rockaway River from which the supply of Jersey City is drawn. On this trip I was assisted by Inspector Frances P. Hamill in an official capacity.

The Rockaway River watershed is fully described in the following excerpts from a report by George Johnson, which is of a public character and is in the possession of the Jersey City authorities. The excerpts were selected by me.

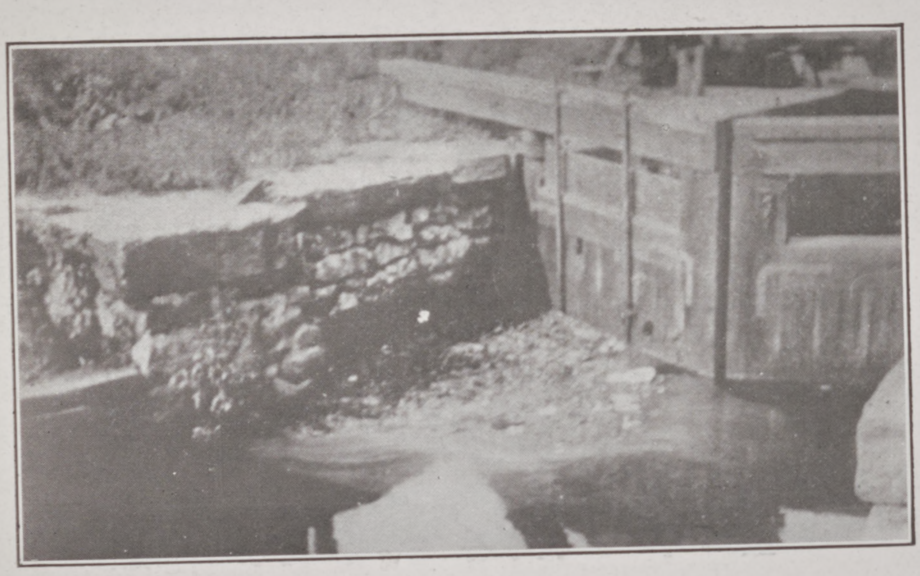
The accompanying maps are also of a public character, and are of the Rockaway River watershed.

The following are observations made by me during the rapid inspection of the water shed on September 14, 1917.

The river is narrow and was on September 14 very shallow, being on the average only a few inches deep.

Beginning at Dover and proceeding down the river, my inspection revealed the following sources of pollution:

—No. 1—



Lock gates of Morris and Essex Canal where it joins and comingles with the Rockaway River just above the Sussex St. Bridge in Dover. Picture was taken from the bridge. Sample No. Inv. 5118 taken from the mixed water of the river and canal at the middle of the bridge showed 11,100 bacteria on plain agar.
at 27°, 24 hours and confirmed B. Coli in 0.1 cc.

Affidavit of Michael I. Fagen

Note accumulation of filth on surface of water from sewage which has entered river or canal above.

—No. 2—

Retaining wall of river at foot of Morris St., Dover. Square hole is outlet of chlorine treated effluent from Ford's Pond which drains a large number of houses on the steep banks surrounding it. Two private drains may be seen to the left of square hole and one to the right. Between this pipe to the right and the square hole is an irregular hole in the wall which cannot be seen in the picture but from which a continuous stream was flowing. A sample of this, No. Inv. 5119, showed 519,000 bacteria on plain agar 37°, 24 hours and B. Coli confirmed in 0.001 cc.

The yards abutting the retaining wall are used as private dumps.

These private drains offer relief to the overflowing cesspools of Dover.

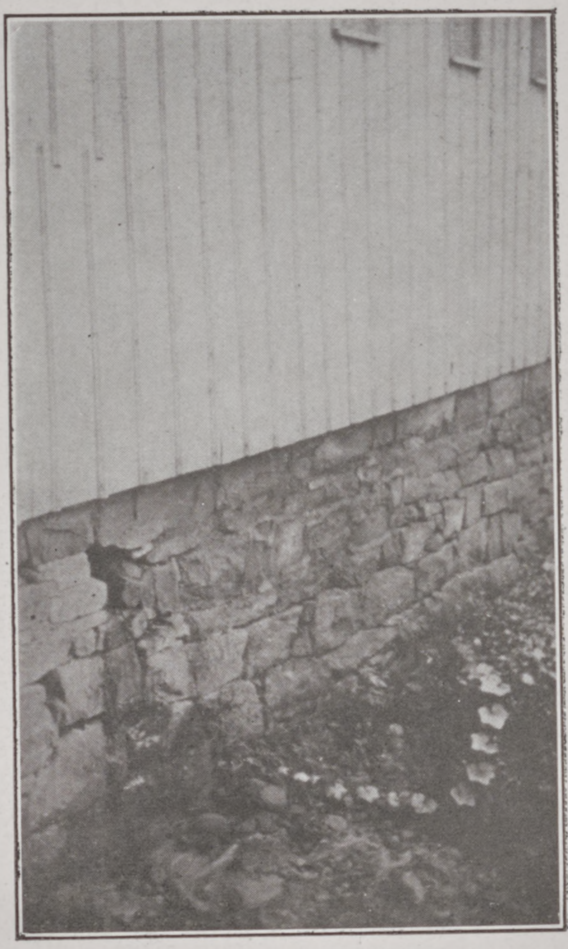
—No. 3—

Open cesspool on Essex Street, Dover, near D., L. & W. R. R. Station, where the ground had become so saturated with sewage that it caved in. A storekeeper on the corner three doors away claimed that the sewage standing in his cellar came from this cesspool. There was a restaurant next door.

—No. 4—

Privy on bank of river just above N. Bergen St., Dover. Which was seen to be occupied at time picture was taken. While the sign to the left was not meant to apply to the privy, it does very aptly apply. There are many of these "home supplies" to the Rockaway River in Dover. Note convenient drain below right corner of privy.

—No. 5—

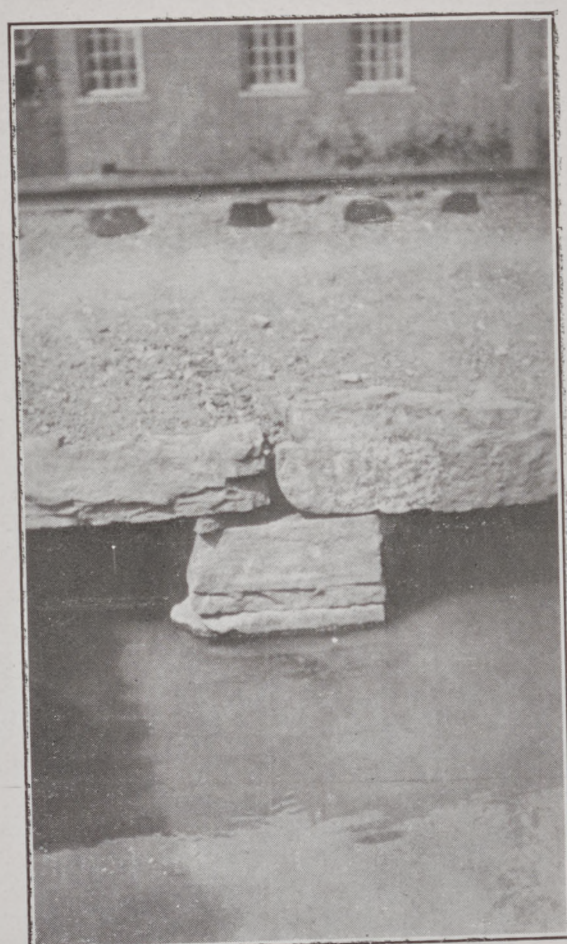


Human excrement coming through opening in retaining wall of river. Taken from bridge at N. Bergen Street, Dover.

—No 6—

Retaining wall of river with Dalman and Teipel Auto Repair Shop above, Dover, N. J. Note sewer opening on left side of picture. Taken from opposite bank of river giving some idea of width of the stream.

—No. 7—



McKiernan-Terry Drill Works, tracks of Central Railroad of New Jersey and opening of sewer about 100 feet below Mercer Street, Dover. This is the opening of an 8,000 foot sewer, which drains the north end of Dover (see Johnson's report page 58) and which is shown in detail on the map which follows.

Sample No. Inv. 5117 was taken between the Drill Works and the railroad track from the open sewer and showed 44,400 bacteria on plain agar, 37°, 24 hours with confirmed B. Coli in 0.001 cc.

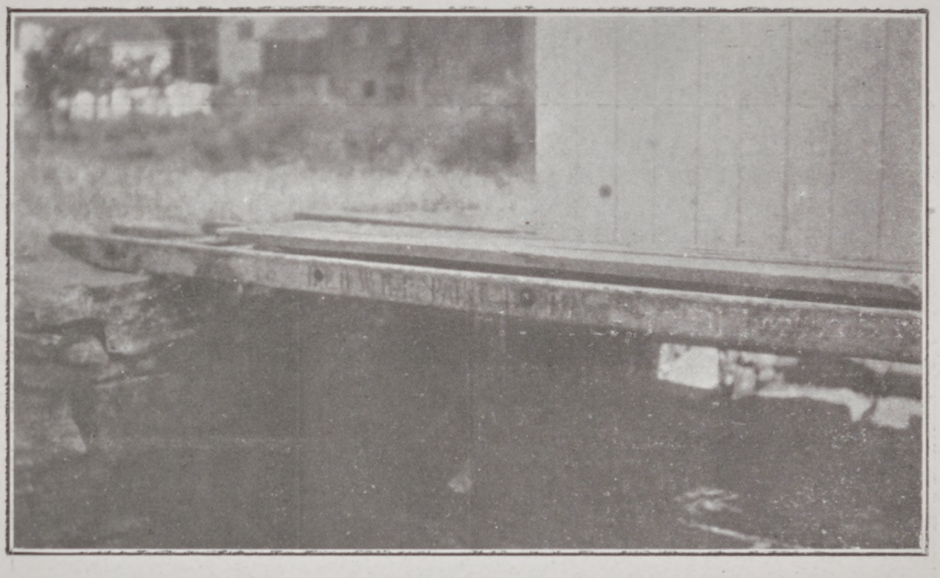
Sample No. Inv. 5115 was taken from the opening at the left of the picture which is about five feet above the place where chlorine is added and showed 47,600 bacteria on plain agar, 37°, 24 hours with confirmed B. Coli in 0.01 cc.

—No. 7—

McKiernan-Terry Drill Works; track of Jersey Central Railoard; sewer with chlorine treatment house suspended above it; rock baffles below house. Rockaway River in foreground with treated sewage flowing into it. Estimated that sewage was about one-fourth the volume of the river.

Sample No. Inv. 5116 was taken from treated sewage as it flows around rock baffles and showed 12,000 bacteria on plain agar 37°, 24 hours with confirmed B. Coli in 0.01 cc.

—No. 8—

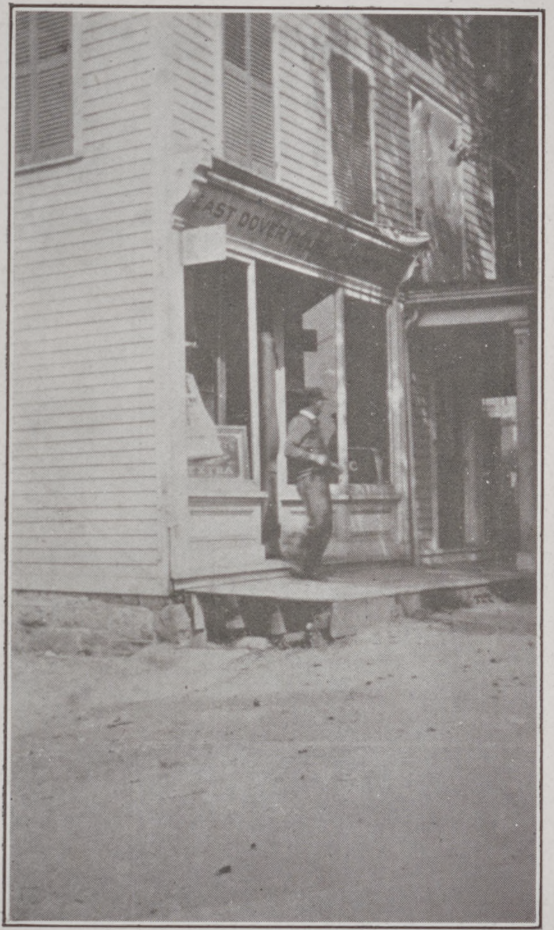


Rear of chlorine treatment house over sewer below Mercer St., Dover. The chlorine flows under pressure from a tank in the house through pipes to porous submerged earthenware heads which are below the floating board seen in the foreground. The function of the board is to prevent the escape of unabsorbed gas as much as possible. Note accumulation of filth held back by board. The size of the chlorine doseage is dictated from Jersey City.

—No. 9—

Rockaway River, looking down stream from Mercer Street bridge, Dover. Treated sewage entering on left. Note diminutive size of river and also proximity of dwellings.

—No. 10—



East Dover Hotel photographed from bridge.

—No. 11—

In lower left corner is opening beneath the bridge of drain from East Dover Hotel. A large accumulation of the grayish deposit generally seen at the openings of sewers was noted on the wall below the mouth of the drain.

—No. 12—

Privies near Rockaway River a short distance from East Dover Hotel.

Note slovenly appearance of the surroundings. Taken from in front of Hygienic Ice Company's plant.

—No. 13—

Houses and privies on bank of Rockaway River about 2½ miles below Dover. Note close proximity of privies to river. A very large number of such scenes could have been photographed.

—No. 14—

Houses and privies on Rockaway River just above Boiler Works. Note large number of privies in small picture.

Sample No. Inv. 5114 was taken from far bank of stream at this point. It showed 10,500 bacteria on plain agar, 37°, 24 hours and confirmed B. Coli in 0.01 cc.

—No. 15—

Boiler Works on Rockaway River about 3 miles below Dover. Employs about 50 men. Sewage goes directly into river.

Between this point and the town of Rockaway, which is about one mile below, a grist mill was noted which was diverting the entire flow of the river for power purposes. Across the bridge from this mill was another mill which was pouring a large volume of waste into the river.

—No. 16—

At Rockaway is the Liondale Print Works which employs about 300 men. The sewage from these and a very large amount of trade waste goes into the river through the tail-race. Note Johnson's report pages 36 and 51. The picture was taken from the D., L. & W. tracks west of the factory and just south of the head race to show the extent of the buildings. The Boonton Reservoir is 8 miles below. The map which follows shows the plan of the factory.

—No. 17—

Dam in Rockaway River at Liondale Print Works Shows all water of river being diverted to go through headrace from which picture was taken. Houses in background sewer into river. Much floating excrementitious matter noted in river at this point.

Sample No. Inv. 5113 taken from water as it enters headrace showed 375 bacteria on plain agar 37°, 24 hours and confirmed B. Coli in 0.1 cc.

No. 18.

Rockaway River between Liondale Print Works and bridge below. Note very marked discoloration and turbidity of water, all of which had gone through factory. River about 40 feet wide here. Much floating material was noted and also streamers, one to two feet long, of algae attached to stones and indicating much sewage pollution. The river at this point and especially as it came through the tail-race from factory smelled very strongly of chlorine, probably from the emptying of bleach tanks. Around the factory on Main and Mill Streets are a large number of houses with privies. Open drains were seen leading from these to the river or tail-race of the factory.

It is claimed that the factory has an experimental activated sludge plant for treating the sewage of the employees.

A memorandum regarding the pollution of the Rockaway River by the Liondale Bleach, Dye and Print Works follows:

This memorandum is of a public character and is in the possession of the Jersey City authorities.

Liondale Memorandum.

No. 19.

At Powerville which is 2 ¾ miles above the Boonton Reservoir is the dam shown above. No water is flowing over it for the reason that all the water of the river was being diverted into the head race of the Field & White Co. paper mill. The river and canal commingle at this point.

Sample No. Inv. 5121 was taken from this head race and showed 428 bacteria on plain agar, 37°, 24 hours with confirmed B. Coli in 1.0 cc.

No. 20.

Rockaway River flowing away from Field & White Co. paper mill at Powerville. An inspection of the mill showed that old rags and clothing, carpets and door mats, which were filthy almost beyond description were being used as raw material. The claim was made by Mr. H. B. McCormick, who was in charge of the mill that the river water was used for power purposes only. If this is true it is strange that sample No. Inv. 5120 of the water taken from the river just after leaving the mill showed 12,900 bacteria on plain agar 37°, 24 hours with confirmed B. Coli in 0.01 cc., which is an increase of approximately 5,000 per cent in the pollution of the water over what it was on entering the mill.

Affidavit of Michael I. Fagen

Especial attention is called to the report of George Johnson, pages 38, 39 and 52, concerning this paper mill (often called rag mill) which is considered one of the very worst sources of poullution on the river.

Mr. Rosevar, who is heavily interested in this mill is a resident of Jersey City.

No. 21.

Norton Iron Works at Boonton on the J. Cooper-Lord Estate. Employs about 1,000 men. All sewage from these goes into the river. The river is diverted through a head-race about one mile above the factory and is used for power purposes. Head race is seen in foreground of picture where it is at same level as lower level of Morris and Essex Canal.

No. 22.

Opening of Brook Street sewer in Boonton. It flows from a concrete gutter between the tracks of the incline plane to the lower level of the Morris and Essex Canal.

Sample No. Inv. 5122 taken at this point showed 1,020,000 bacteria on plain agar 37°, 24 hours with confirmed B. Coli in 0.001 cc.

This sewage is supposed to be carried away by the canal but has excellent chance of getting into head race of Norton factory as next picture will show. See Johnson's report pages 39, 40, 53, 54, and 55.

No. 23.

Morris and Essex Canal at point where it receives Brook St. Sewer in background. Head race of J. Cooper-Lord Estate factories in foreground with "Automatic" gates between. These gates were designed through the combined efforts of Messrs. Rudolph Hering, E. W. Harrison, J. Waldo Smith, and John H. Cook and Emil Knichling and are supposed to prevent absolutely the canal water from entering the head race. Note, however, that the gate on the left was found turned up so that it could not possibly operate. Note also the accumulation of filth on the surface of the upturned gate. When inspection was made on September 14, the water was flowing from the head race to the canal, but it is said to flow in the opposite direction about 5 per cent of the time.

Sample No. Inv. 5123 which was taken from the head-race about 10 feet away from the "Automatic" gates showed 85,000 bacteria on plain agar, 37°, 24 hours with confirmed B. Coli in 0.1 cc.

No. 24.

Silk mill at foot of Morrison Avenue about one-half mile above Boonton Reservoir. Employs about 300 men. Sewage from these flows through a bed of ashes into the river.

Sample No. Inv. 5125 was taken from an open drain on Morrison Avenue coming out from in back of a garage. This drain flows into the river near the Silk Mill. The sample showed 217,000 bacteria on plain agar, 37°, 24 hours with confirmed B. Coli in 0.01 cc.

About half way between the silk mill and the reservoir Sample No. Inv. 5124 was taken from the river to give an idea of the character of the water entering the reservoir after it has been subjected to the sources of pollution cited, and to hundreds of others not cited, and also to the effect of dilution from it's purer tributaries. This sample showed 57,900 bacteria on plain agar, 37°, 24 hours with confirmed B. Coli in 0.1 cc.

A source of pollution seen on this trip which was not photographed was the new real estate development know as Mountain Lakes which has an estimated population of 1,000. It lies about half way between Boonton and Danville.

From the inspection which has been briefly described, corroborated by the laboratory results cited, but one characterization can be made of the Rockaway River; namely, that by the abuse of man, it has been converted into an open sewer. This fact has been virtually recognized ever since 1908, at which time the Jersey City Water Supply Company petitioned the court to be allowed to sterilize this sewage by chlorination before offering it for sale. This petition was granted and the chlorination plant was installed and has been operated ever since.

It is my strong belief that a water as grossly polluted as is that of the Rockaway River should never be used either chlorinated or unchlorinated for these reasons.

1. The chlorination process is dependent upon machinery, human beings and a proper supply of

chemicals. The machinery may break down, the human beings may make mistakes and the supply of chemicals may become accidentally exhausted.

2. In a water as greatly polluted as this, there are comparatively large amounts of protein material and there are also large numbers of putrefactive bacteria which split these proteins to poisonous products. These are believed not to be destroyed by the action of chlorine.

3. In a water as grossly polluted as this, a relatively heavy dosage with chlorine must be employed, the dosage depending roughly upon the amount of organic matter present.

4. A water as grossly polluted as this is certainly a filthy product. The chlorination is inherently incapable of removing the filth; it is depended upon only to remove the bacteriological evidences of it. Hence the product is still a filthy one.

In order to ascertain what effect chlorination had upon the bacterial content of this water a visit was made late in the afternoon of September 14 to the so-called sterilizing plant located below and near the eastern end of the dam at Boonton. I presented my business card, a sample of which is herewith shown,

to Mr. J. W. Demmers, who presented himself as being in charge of the plant. I told him that I was investigating the quality of the water being supplied to interstate trains in Jersey City and toward that end I wanted samples of the water before and after treatment. He directed me to a tap in the water wheel which he said was the tap from which those in control of the plant took their samples of untreated water. After allowing the water to run from this tap for about five minutes I took a sample of it. This sample, which was No. Inv. 6026, showed 248 bacteria on plain agar at 37°, 24 hours and confirmed B. Coli in 1.0 cc. in lactose broth at 37°, 48 hours.

A special guard was furnished by Mr. Demmers and with him a trip was made to the Romaine gate house which is located on the main pipe line about one mile north of the chlorination plant and from which a sample of the water immediately after chlorination was obtainable. I removed a section of the board flooring above the water in the gate house, allowed about five minutes to elapse so that any dust or contamination which had dropped into the water when the flooring was moved might have a chance to be carried away and then took a sample by submerging a sterilized wide-mouthed bottle, being careful to move the bottle continuously through the water with the open mouth in the most advanced position so that no contamination from my hand might enter it. A strong odor of chlorine arose from the water, indicating that it was being very heavily dosed.

It had been my understanding that liquid chlorine was being used for treating this water, but Mr. Demmers told me that they had discontinued it's use, for which he claimed not to know the reason, and that they had returned to the use of calcium hypochlorite. He showed me the hypochlorite mixing and feed tanks .

The bacteriological examination of the sample taken at the Romaine gate house, which was started about six hours after the collection of the sample, showed 9 bacteria on plain agar at 37°, 24 hours. These were all fished and inoculated into lactose broth and none of them produced gas.

After 48 hours, the lactose broth tube which had been inoculated with 10 cc of the sample showed 30 per cent of gas. From it two Endo plates were prepared but with negative results. After 72 hours, this tube contained 50 per cent of gas and Endo plates were again prepared but gave negative results. A stained smear made from the lactos broth tube after 72 hours, showed a rather long rod shaped spore former which indicated B. Welchii. Therefore a portion of the culture was heated to 80° for 10 minutes and inoculated into milk. A stormy fermentation indicating B. Welchii was obtained.

Subsequent inoculations were made from the original lactose broth tube onto Endo plates with negative results until the culture was 312 hours (13 days) old, when positive results were obtained and typical B. Coli of fecal origin isolated.

In the meanwhile, the lactose broth tube which had been inoculated with 5 cc. of sample had developed 10 per cent of gas at the end of 120 hours which has increased to 40 per cent at the end of 312 hours (13 days). Endo plates made from the 120 hours (5 days) culture gave positive results and from them typical B. Coli of fecal origin was isolated.

The finding of B. Welchii, which is a sewage organizm of fecal origin and the delayed fermentation with the subsequent isolation of typical fecal B. Coli from two different portions of the sample furnishes strong evidence that chlorination does not entirely destroy the bacteria of fecal origin as has ben claimed for it. On the contrary, the indications are that these fecal bacteria are stunned and forced for a time to suspend their biological activities, which are later resumed; a conclusion which is also indicated by the results obtained from the samples taken at the railroad stations which will now be described. The details of the collection of these samples appeared in the early pages of this report.

Sample No. 1 S. 1621 P. taken on September

13 from faucet of drinking tank in car of C. R. R. of N. J. showed 38 bacteria on plain agar at 37°, 24 hours and no gas in lactose broth after incubation for 5 days.

Sample No. 1 S. 1622 taken on September 13 from faucet of drinking tank in car of B. & O. R. R. showed 9,150 bacteria on plain agar at 37°, 24 hours and no gas in lactose broth after incubation for 5 days.

Sample No. 1 S. 1623 P. taken on September 13 from faucet of drinking tank in car of P. & R. R. R. showed 163 bacteria on plain agar at 37°, 24 hours and 10 per cent gas in lactose broth from 5 cc. inoculation after 4 days incubation. Upon isolation the gas producing organism agreed in it's biological activities most nearly to "B. aerogenes, probably not of fecal origin" when compared with the classification given on page 108 of The Standard Methods of Water Analysis published by the American Public Health Association in 1917, but differed from this classification in the important detail that it produced indol in comparatively large amounts. While the classification reads "Indol, usually——," "and therefore does not exclude an indol producing organism from this group absolutely, yet it hardly seems proper to include a strong indol producer in this group, especially when the text books make statements like the following quoted from a Text Book of Bacteriology by Hiss & Zinsser, 1916 Edition, page 453, "It differs from the colon bacillus, furthermore, in that it is capable of fermenting poly-saccharides such as starch, and *does not form indol* upon peptone media." My own experience, moreover, has been that B. aerogenes does not form indol.

The organism isolated differs from typical "B. coli of fecal origin" in it's methyl red and Voges-Proskauer reactions and from "B. aerogenes of fecal origin'' given in the A. P. H. A. classification in it's adonite and indol reactions.

While the Methyl red and Vosges-Proskauer reactions are very important ones for classification purposes they are not considered by some to be more important in this group than the indol reaction and hence it seems to me that the only thing which can be said about this organism is that it is a member of either the B. Coli or B. aerogenes groups, of fecal origin, the biological activities of which have been modified by the chlorination treatment.

This discussion applies to the gas producers isolated from samples No. I. S. 1624, I. S. 1629, I. S. 1631, I. S. 1632, Inv. 5109, Inv. 5110, Inv. 5111, Inv. 6030, and Inv. 6031 and will not be repeated in connection with them.

Sample No. I. S. 1623 P was allowed to stand in the laboratory exposed to daylight for seven days and was then inoculated again into lactose broth. No gas was produced, showing that no contamination was introduced at the time of the first inoculations and indicating that the attenuated organism in it which had given a delayed production of gas at the time of the first inoculation had subsequently become more attenuated or had died during the holding period.

Sample No. I. S. 1624 P. taken on September 13 from faucet of drinking tank in car of L. V. R. R. showed 137 bacteria on plain agar at 37°, 24 hours and an organism giving delayed gas production in 10 cc. inoculation. Five per cent of gas was formed in 72 hours and an organism isolated which had exactly the same characteristics as the gas producer in I. S. 1623. The delayed gas production indicates that the chlorination had stunned this fecal organism rather than killed it.

This sample also was allowed to stand in the laboratory exposed to daylight for 7 days and was then inoculated again into lactose broth. No gas was produced showing that no contamination was introduced at the time of the first inoculations and indicating that the attenuated organism in it which had given a delayed production of gas at the time of the first inoculations had subsequently become more attenuated or had died.

As all of the foregoing samples were taken from trains at the station of the C. R. R. of N. J., the investigational samples taken at that station on that same day will now be given.

Sample No. Inv. 5109 taken up September 13 from hydrant between tracks 4 and 5 in station of C. R. R. of N. J. showed 114 bacteria on plain agar, at 37°, 24 hours and 35 per cent gas in 48 hours from 0.1 cc. portion. Organism isolated has same characteristics as the gas producer in I. S. 1623.

The fact should be noted that in the case of this sample as in the cases of No. I. S. 1623 P, I. S. 1631 P, Inv. 5110, Inv. No. 5111, Inv. 5112, Inv. 6028, Inv. 6030, Inv. 6031 and Inv. 6032 has been produced in shorter time and in larger amounts as the sample was more and more diluted. This is significant for the reason that eight out of the nine samples taken from the hydrants and taps at the R. R. stations (not from the drinking tanks of the cars) and therefore truly representing the Jersey City Supply behaved in this same manner, which is the manner in which sewage samples often behave where the other organisms seem to have when present in large numbers in the lower dilutions, a restraining influence upon the formation of gas by the colon bacilli.

Sample No. Inv. 5110 taken on September 13 from hydrant between tracks 8 and 9 in station of C. R. R. of N. J. showed 187 bacteria on plain agar at 37°, 24 hours and 35 per cent gas in 48 hours from 0.1 cc. portion. Organism isolated had some characteristics as the gas producer in I. S. 1623.

Sample No. Inv. 5111 taken on September 13 from tap in wash room of station of C. R. R. of N. J. showed 299 bacteria on plain agar at 37°, 24 hours and 35 per cent of gas in 48 hours from 0.1 cc. portion. Organism isolated had some characteristics as the gas producer in I. S. 1623.

It should be noted that the results from samples Inv. 5109, Inv. 5110, and Inv. 5111, which theoretically should be almost identical, were so in fact, showing that these samples were in no way contaminated accidentally and that they truly represent the quality of Jersey City's water supply delivered through the high pressure service on September 13, 1917, as that is the service upon which the station of the C. R. R. of N. J. is located.

The station of the Erie Railroad is located upon a different service, however, as it is supplied by gravity from the Bergen Reservoir, otherwise known as Reservoir No. 3, in which the water is said to remain for about two days. From all that is known concerning the so-called self-purification of water, it would be expected that true to the actions of sedimentation, sunlight, inanition and predatory organisms, the water from this reservoir should be of better quality than the water from the high pressure service. What was actually found was as follows:

Sample No. I. S. 1625 P taken on September 13 from faucet of drinking tank in car of Erie R. R. showed 142 bacteria on plain agar at 37°, 24 hours and confirmed B. Coli in 0.1 cc. after 48 hours.

Sample No. Inv. 5112 taken on September 13 from tap in Erie R. R. station showed 57 bacteria on plain agar at 37°, 24 hours and 35 per cent gas in lactose broth from 1.0 cc. inoculation after 48 hours incubation. Upon isolation the gas producing organism agreed in it's biological activities most nearly to "B. cloacae, may or may not be of fecal origin" of the A. P. H. A. classification. It was, however, an indol producer which would indicate that it really belonged in the B. Coli class or else that the culture was a mixed one of B. Coli and B. Cloacae with the latter in predominance.

From these results it is seen that on September 13 the total number of bacteria and the concentration of the gas producers were both less in the supply from the Bergen Reservoir than from the high pressure service as theory would demand. This, however, was not the case with the samples taken on September 18, and especial attention is called to samples No. Inv. 6030, Inv. 6031 and Inv. 6032 to be described later.

Samples were again taken at the C. R. R. of N. J. Station on September 17, which was three days after the Jersey City authorities had had an opportunity to know of my presence in the vicinity and of what I was doing. A slight improvement in the laboratory findings was found in the case of the water taken directly from the hydrants and taps in the station, which water truly represents that supplied by the high pressure service.

Sample No. I. S. 1626 P taken on September 17 from faucet of drinking tank in car of C. R. R. of N. J. showed 40,000 bacteria on plain agar at 37°, 24 hours with a bubble of gas in lactose broth from 10 cc. inoculation after 72 hours. This bubble had not increased after another 24 hours and Endo plates were prepared but with negative results.

The sample was allowed to stand in the laboratory for 3 days and was then inoculated again into lactose broth. From a 10 cc. inoculation, a bubble of gas was obtained in 16 hours which had increased to 10 per cent in another 24 hours. From this, typical "B. coli of fecal origin" was isolated. The facts that no gas was obtained from the first inoculations, while a delayed gas formation was obtained after the sample had stood for three days indicates that during this period of storage the B. Coli of fecal origin which had been stunned by a heavy chlorination, had recovered sufficiently to exhibit their typical biological activities.

Sample No. I. S. 1627 P taken on September 17 from faucet of drinking tank in car of B. & O. R. R. showed 955 bacteria on plain agar at 37°, 24 hours with confirmed B. Coli giving 10 per cent gas in 48 hours from the 10 cc. inoculation.

Sample No. I. S. 1628 P taken on September 17 from faucet of drinking tank in car of L. V. R. R. showed 1770 bacteria on plain agar at 37°, 24 hours with no gas produced in lactose broth after 5 days. This sample was allowed to stand in the laboratory for 3 days and was then reinoculated into lactose broth. No gas formation occurred showing that no accidental contamination had occurred at the time of the first inoculation.

Sample No. I. S. 1629 P taken on September 17 from faucet of drinking tank in car of P. & R. R. R. showed 3,470 bacteria on plain agar at 37°, 24 hours with 5 per cent of gas in 48 hours from the 10 cc. inoculation. This amount of gas did not increase on longer incubation. An organism was isolated having the same characteristics as discussed under I. S. 1623 P.

Sample No. Inv. 6028 taken on September 17 from hydrant between tracks 3 and 4 in station of C. R. R. of N. J. showed 159 bacteria on plain agar at 37°, 24 hours and 15 per cent of gas in lactose broth in 48 hours from 1.0 cc. inoculation. The amount of gas increased on longer incubation. An organism was isolated which corresponded to "B. Coli of fecal origin" of the A. P. H. A. classification except that saccharose was fermented. While this classification reads "Saccharose, usually——" which with the other characteristics cited would describe B. Coli communis, it has been my experience that B.Coli communior which does ferment saccharose, is very much oftener found in water which has received fecal pollution and therefore I must regard this sample as containing a typical B. Coli of fecal origin.

This interpretation is corroborated by samples No. Inv. 5118, 5117, 5115, 5116, 5114, 5113, 5120, 5122, 5123, 5125, 5124, all taken on the water shed.

In this sample the fact discussed under sample No. Inv. 5109, of gas being produced in shorter time and in larger amounts in the higher dilutions was noted.

Sample No. Inv. 6029 taken on September 17 from tap in wash room in station of C. R. R. of N. J. showed 74 bacteria in plain agar at 37°, 24 hours. The gas production in this sample was interesting in that it was the exception to the rule. This was the only one of the nine samples taken from taps and hydrants in the railroad stations in which a longer time was taken for the production of gas as the dilutions increased. Lactose broth inoculation from 10 cc. showed 10 per cent gas in 48 hours; from 5 cc. showed 5 per cent gas in 72 hours and from 1 cc. showed 10 per cent gas in 96 hours. Organisms were isolated from the 5 and 1 cc. portions which agreed in all respects and which most closely corresponded to "B. cloacae, may or may not be of fecal origin" of the A. P. H. A. classification. The characteristics in which they did not correspond were in their adonite and indol reactions.

The closest proximity to the behavior shown by these organisms in causing fermentation was in sample No. Inv. 5112 in which a bubble of gas was produced in 24 hours in 5 cc. inoculation while it required 48 hours for gas to form in the 1.0 cc. inoculation. In this case, the organism isolated again corresponded most closely to "B. cloacae, may or may not be of fecal origin" being irregular only with regard to indol production.

No samples were taken at the Erie Railroad station on September 17.

On September 18, four days after the Jersey City authorities knew of my presence and activities, samples were taken at the railroad stations again. With regard to total count, the samples taken from the hydrants and taps were even better than the samples taken on September 17, but no improvement is to be noted with regard to gas producers.

Sample No. I. S. 1630 P taken on September 18 from faucet of drinking tank in car of B. & O. R. R. N. J. showed 14 bacteria on plain agar at 37°, 24 hours and no gas in lactose broth.

This sample was allowed to stand for 2 days in the laboratory and was then again inoculated into lactose broth. After 96 hours incubation in a 10 cc. portion 10 per cent of gas was produced which increased in another 24 hours to 30 per cent. From the 96 hour culture B. Coli communior was isolated.

Here, once more, we have a typical fecal organism which recovered it's power to exert it's biological activities only after an appreciable period of time.

Sample No. I. S. 1631 P taken on September 18 from faucet of drinkink tank in car of B. & O. R. R. showed 160 bacteria on plain agar at 37°, 24 hours, and 50 per cent gas in 48 hours from 1 cc. inoculation. Fifteen per cent gas was obtained in 96 hours from 0.1 cc. inoculation. Organisms isolated from these fermentation tubes correspond most closely to "B. aerogenes, probably not of fecal origin," although the organism from the 1.0 cc. portion differed in it's gellatin and indol reactions while that from the 0.1 cc. portion differed in it's indol reaction only. The significance of this organism has been discussed already under No. I. S. 1623.

This sample was allowed to stand in the laboratory for two days when it was again inoculated into lactose broth. Gas was obtained from all 10 cc. portions. From all the same organism was isolated which corresponded most nearly to "B. cloacae, may or may not be of fecal origin" differing from it in adonite and indol reactions and having exactly the same characteristics as the organism isolated from Sample No. Inv. 6029.

It will be noted that this organism has the same characteristics except for the amount of gas produced in saccharose as that isolated from the 1.0 cc. portion of this sample before it had stood in the laboratory and which was said to correspond most closely to "B. aerogenes, probably not of fecal origin." This latter classification was made because of the fact that it corresponded as closely to that as to anything and the organism isolated from the 0.1 cc. portion of that sample corresponded most closely to that organism. The important point to consider is that practically none of the organisms isolated from the chlorinated samples correspond to the A. P. H. A. classification, which leads to the conclusion that they have been modified by this chlorination process but are still organisms of fecal origin. Work upon the chlorination of pure cultures and of mixed cultures of known organisms is undoubtedly called for, and such work is herewith promised.

Sample No. I. S. 1632 P. taken on September 13 from faucet of drinking tank in car of P. & R. R. R. showed 64 bacteria on plain agar at 37°, 24 hours and 10 per cent gas in lactose broth after 48 hours incubation. The amount of gas did not increase. An organism was isolated which had the same characteristics as the organism discussed under I. S. 1623.

Sample No. I. S. 1633 P. taken on September 18 from faucet of drinking tank in car of L. V. R. R. showed 62,400 bacteria on plain agar at 37°, 24 hours and gas formation in 0.001 cc. which was the highest dilution made. An organism was isolated from the 0.01 cc. portion which corresponded to B. Coli communior except in it's adonite reaction, while from the 0.001 cc. portion an organism was isolated which had the same characteristics as the organism discussed under I. S. 1623.

Sample No. Inv. 6030 taken on September 18 from hydrant between tracks 8 and 9 in station of C. R. R. of N. J. showed 17 bacteria on plain agar at 37°, 24 hours and gas from 0.1 cc. portion in 24 hours. Same organism as in I. S. 1623 was isolated.

Sample No. Inv. 6031 taken on September 18 from tap in restaurant on main floor in station of C. R. R. of N. J. showed 25 bacteria on plain agar at 37°, 24 hours and gas from 1.0 cc. portion in 72 hours. Note that here as usual was delayed gas production. Same organism as in I. S. 1623 was isolated.

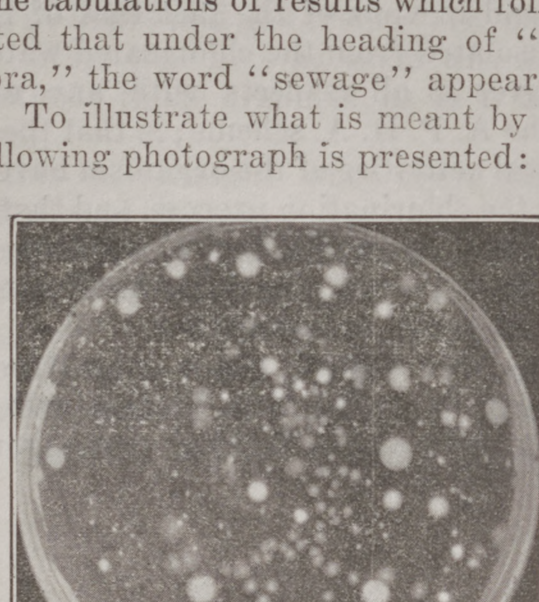
On this day samples were again taken at the Erie Railroad station.

Sample No. I. S. 1634 P taken on September 18 from faucet of drinking tank in car of Erie Railroad showed 156 bacteria on plain agar at 37°, 24 hours with 15 per cent gas in 24 hours from 5 cc. inoculation and 15 per cent gas in 48 hours from 1.0 cc. inoculation. From the 5 cc. portion an organism was isolated which corresponded most closely to "B. aerogenes of fecal origin" of the A. P. H. A. classification, differing in it's indol reaction, while from the 1.0 cc. portion an organism was isolated which corresponded most closely to "B. Coli of fecal origin" differing in it's adonite and saccharose reactions and having exactly the same characteristics as the organism isolated from the 0.01 cc. portions of I. S. 1633 P.

Sample No. Inv. 6032 taken on September 18 from tap in wash room in station of Erie Railroad showed 15 bacteria on plain agar at 37°, 24 hours and 15 per cent gas in lactose broth from both 5 cc. and 1 cc. inoculations after 72 hours' incubation. This had increased to 45 per cent after 120 hours. An organism having the same characteristics was isolated from both cultures. It corresponded most closely to "B. coli of fecal origin" of the A. P. H. A. classification, differing in it's gelatine reaction. To account for this, the explanation might be offered that I was working with a mixed culture of B.coli and a gelatine liquefier, but it does not seem likely that this same accident should happen in two different portions of this culture. What seems more likely, in view of the fact that this organism exhibited delayed fermentation and in view of the fact that of the 24 organisms isolated from the chlorinated water, 20 failed to agree in all respects with any of the classes of the A. P. H. A. scheme; is that the original biological activities of the organism have been changed by the chlorination process, and that originally this organism was a typical non-liquefying B. Coli communis and was introduced into the water through fecal contamination.

Comparing this sample which came from the Bergen Reservoir to the Erie Station with samples No. Inv. 6030 and 6031 which came from the high pressure service to the C. R. R. of N. J. Station on the same day, it will be noted that the count on agar is slightly lower as would be demanded by theory (see discussion under No. Inv. 5111), while contrary to theory, the concentration of the gas producers is not lower, and moreover the sample from the Erie Railroad station yielded an organism more closely resembling typical "B. coli of fecal origin" than did the samples from the C. R. R. of N. J. Station. The most reasonable interpretation to place upon this fact is that during the storage period of approximately two days in the reservoir, the fecal B. Coli had a chance to recover somewhat from the effects of the chlorination and to resume it's usual biological activities. This theory is supported by the fact that from the original inoculations of No. I. S. 1630 P no gas producers were obtained, while after the sample had stood for two days in the laboratory, from the 5 cc. inoculation, a gas producer was obtained which showed the same characteristics of delayed fermentation and which proved to be typical B. Coli communior. Exactly the same thing was found in sample No. 1626 P. with the exception that it stood for 3 days between examinations and that B. Coli communis was isolated.

In the tabulations of results which follow, it will be noted that under the heading of "Character of Flora," the word "sewage" appears in many cases. To illustrate what is meant by this term, the following photograph is presented:



Under the heading "Highest Dilution in Which Fecal Bacteria Confirmed" certain bacteriologists may disagree with me regarding my figures, which include the indol producers which correspond most closely to "B. aerogenes, probably not of fecal origin" of the A. P. H. A. classification. But as already explained I believe that these organisms because of their power to produce indol are really of fecal origin. Much depends upon the basis of judgment which the bacteriologist had adopted; for example, I know of a water bacteriologist who was employed to find fecal bacteria as seldom as possible, who adopted as his standard for such organisms the formation of exactly 50 per cent of gas in lactose broth in 24 hours which decreased to exactly 45 per cent in 48 hours. Needless to say he found very, very few fecal bacteria in the water which he examined and he would have found only one in the samples which I examined, including those taken on the watershed.

Summary.

1. The Rockaway River is grossly polluted from human sources. So great is this pollution that without consideration of any laboratory findings, which are in reality only corroborative evidence, the water in my opinion has gotten beyond the point where it might be used for drinking purposes without regard to what forms of known treatment processes are applied to it.

Contrary to what is indicated in the classification of the A. P. H. A. but in agreement with my own experience with sewage polluted waters, the saccharose fermenter, B. Coli communier, was the predominating fecal organism found in the samples taken on the watershed.

2. The natural processes of purification set to an appreciable extent in the Boonton Reservoir by the water drawn from the reservoir is still polluted with filth of human origin.

3. The chlorination process apparently reduces the total number of bacteria in the water although I am not sure that such is the case as I neglected to replate samples after they had stood for a while and it may be that the count, contrary to the usual procedure, will increase due to the recovery of the organisms from the effect of chlorination.

4. The chlorination process so affects the gas producing organisms of fecal origin that

(a) Some of their cultural properties are changed. Found in nearly 80 per cent of the isolations.

(b) They show delayed fermentation and the amounts of gas formed are not normal.

(c) They are unable for a time to grow and function but later recover from this condition and function nearly normally.

5. Nearly 90 per cent of the samples of the water as delivered to consumers in Jersey City showed gas produced in shorter time and in large amounts as the sample was more and more diluted in making inoculations. This is a condition normally found in examinations of sewage but not in examinations of good drinking water.

6. B. Welchii, a typical sewage organism was found in the only sample of chlorinated water in which a search for it was made.

7. The agar plate flora from nearly all samples was predominantly a sewage flow.

8. Evidence was found of a further pollution of the water in the drinking tanks of railroad cars which travel interstate.

In Charge,
Inspection Microbiology.

On Petition, &c., Cause to Show Cause.

IN CHANCERY OF NEW JERSEY.

Between THE MAYOR AND ALDERMEN OF JERSEY CITY, *Complainant,* and JERSEY CITY WATER SUPPLY COMPANY, *Defendant.*	On Petition, &c., Order to Show Cause.

This matter being opened to the Court by Albert C. Wall, of counsel with the petitioner, and the Court having considered the petition this day filed herein and the affidavits and exhibits thereto annexed:

IT IS, on this 7th day of June, 1918,

ORDERED that the defendant, JERSEY CITY WATER SUPPLY COMPANY, show cause before the Chancellor on the 23rd day of July, 1918, at the Chancery Chambers in the City of Newark, at 10:30 o'clock in the forenoon, why the prayer of the said petition should not be granted.

FURTHER ORDERED that a copy of the petition, affidavits and exhibits thereto annexed be served on the defendant, Jersey City Water Supply Company, by leaving the same at the office of the registered agent of said company in New Jersey. Said copies need not be certified.

FURTHER ORDERED that a copy of the affidavits and exhibits in reply, if any, be served by the said defendant on said Albert C. Wall at his office, No. 1 Exchange Place, Jersey City, New Jersey, not later than the 10th day of July, 1918. Copies of any replying affidavits to be served at said principal office of said company not later than the 20th day of July, 1918.

E. R. WALKER,
C.

Affidavit of Herbert D. Pease.

IN CHANCERY OF NEW JERSEY.

Between
THE MAYOR AND ALDERMEN OF JERSEY CITY,
Complainant,

and

JERSEY CITY WATER SUPPLY COMPANY,
Defendant.

On Petition and Order to Show Cause. Affidavit.

STATE OF NEW YORK,
County of New York. } ss.:

HERBERT D. PEASE, of full age, being duly sworn, deposes and says as follows:

1. I reside in Richmond Hill, New York. I am Director of the Department of Bacteriology of the Lederle Laboratories, 39 West 38th Street, New York City. The Lederle Laboratories are an incorporated company composed of professional sanitarians, chemists, bacteriologists and others engaged in making sanitary, chemical and bacteriological investigations.

I was graduated from the Medical Department of the University of Toronto in 1893, and was a post-graduate student and Fellow in Pathology in the Johns Hopkins University and Hospital in the years 1893, 1894 and 1895. I was resident pathologist of the Thomas Wilson Sanitarium for sick children near Baltimore, Md., in the summer of 1894, and made a special study of the causes of infantile diarrhoeas and dysenteries.

I was First Assistant Bacteriologist of the Bureau of Health of the City of Philadelphia, and had charge of several important investigations of the water supply of that City in the years 1895, 1896, 1897 and 1898.

I was Bacteriologist of the New York State Laboratory at Buffalo, New York in the years 1898-9-1900, undertaking medical researches.

I was Instructor in Bacteriology in the Sheffield Scientific School of Yale University in the year 1901.

I was Director of the Antitoxin Laboratory of the New York State Department of Health at Albany, New York, in the years from 1901 to 1909, and was Director of all the laboratory work of that department from 1906 to 1909, during which period I had charge of a complete investigation of all of the municipal water supplies of that State, and likewise cooperated in a study of all the important watersheds of the State.

My work also included investigations of all of the outbreaks of typhoid fever and other infectious diseases which occurred in that State in those years, and also numerous special sanitary investigations of oyster grounds, sewerage systems and sewage treatment works.

I was Sanitary Expert for the Board of Water Supply of the City of New York from in the year 1910 to 1916, and had sanitary supervision over the construction operations required in the building of the Catskill aqueduct and related operations. This work included studies of the sanitary quality of the proposed water supply. Many investigations of the effects of the chlorination of surface waters of various degrees of pollution were called for in this work.

In my professional work as medical investigator, bacteriologist and sanitarian, during the last ten years I have investigated many outbreaks of infectious diseases both in the field and in the laboratory. I have had charge of many sanitary and bacteriological investigations of water supplies and water purification processes and of sewerage systems and sewage treatment works, especially chlorination problems. In the course of these studies I have had occasion to study and investigate the various problems relating to the isolation and identification of bacteria of the bacillus coli group and closely related species, and also of the spore-forming bacilli, especially those commonly spoken of as the B. Welchii, and have studied the problems associated with the interpretation of results of tests for the presence of these groups of bacteria in water supplies, sewage, milk, oysters and other foods and beverages, also their distribution in nature and likewise in relation to human and animal infectious and intestinal diseases.

I have made studies and scientific investigations of a wide variety of medical problems, especially those having bacteriological aspects. I have had charge of very many studies and scientific investigations of the effects of physical agencies, such as heat, cold, and of a very wide variety of chemicals and chemical products upon living bacteria under many conditions and in numerous environments.

In the last year this work has included the study of germicidal properties of chlorine containing solutions used extensively for disinfection of infected wounds, and also of similar solutions and preparations intended for sanitary use and general disinfection.

I am a Fellow or member of the following scientific and technical societies and educational institutions:

Fellow, American Medical Association.

Fellow, New York Academy of Medicine.

New York State, and Albany County, Medical Societies.

Honorary member of the Medical Societies of the County of Rockland and of the County of Dutchess, New York State.

Associated Physicians of Long Island.

Society of Medical Jurisprudence, New York.

American Association of Pathologists and Bacteriologists.

Society of American Bacteriologists.

American Public Health Association, and also of its Sections as follows:

Recorder of Laboratory Section 1901-09.

Secretary Sanitary Engineering Section 1912-17.

Member of Committee on Standard Methods of Testing Disinfectants and Committee on Processes of Pasteurization of Milk.

2. I have read the petition of the Mayor and Aldermen of Jersey City, a municipal corporation of this State, filed on the seventh day of June, 1918, in the above entitled cause on its application for leave to file a bill of review, and I have also read the affidavits thereto annexed purporting to support the allegations therein contained.

3. In my opinion, what is designated in the petition as "new matter" is merely a recital of the *evolutionary and cumulative scientific developments,* largely explanatory in character, which go to the demonstration of the fundamental fact, that the hypochlorite treatment of water intended for potable purposes, *accomplishes substantial sterilization* of that water when *applied under appropriate conditions and in an efficient* manner.

It is true that the chlorination process cannot be left to the care of unsupervised and unskilled persons, nor that it can always be applied *de novo* and with full efficiency to waters of unknown composition, and those which have not been studied through various seasons of the year both chemically and bacteriologically, but this is likewise true of the application of any system whatever of water purification. It would appear to be warrantable to conclude from the statements as to mortality and morbidity rates in Jersey City made in the affidavits annexed to the petition that those in charge of the water supply for Jersey City had already mastered this situation. This is supported by the fact that no allegations were made of an outbreak of gastro enteritis occurring among the consumers of the Jersey City Water last winter under the same meteriological and natural conditions as are alleged to have contributed to the causation of an outbreak of this nature among the consumers of another chlorinated water in certain surrounding communities when the latter water had been added to from a new source subjected to the chlorination by, I am informed, a hastily installed apparatus.

4. Chlorine gas, or hyphchlorite, undoubtedly reacts chemically with certain forms of organic materials naturally present in water supplies, with consequent complete change in the characteristics of such organic materials. Other organic substances which may be added to a water supply, through sewage pollution, also undoubtedly react with chlorine, or with the constituent elements of chlorinated lime, resulting in the formation of loose combination between the chlorine or the constituents of the chlorinated lime and the organic matter; which combinations are capable of subsequent breaking up resulting in the liberation of the chlorine or the constituents of the chlorinated lime. Thus, in my opinion, it is equally true, *that*

much of the organic elements in sewage polluted waters are substantially destroyed in a chemical sense, by the chlorination treatment; and it is likewise true, that other organic constituents of the polluting material become bound to, and are definitely affected and rendered innocuous by the chlorine or the chlorination treatment.

5. Substantially all the experts in making the affidavits attached to the petition allege a new discovery, to the effect that the bacteria are "stunned" by the application of the chlorination process, and that they may recover from the effects of the same and continue their existence.

No small part of this belief appears to have been the result of investigations of Dr. Redfield, outlined by him in his report, on page 57, from which he draws the following conclusion: "* * * the indications are, that these fecal bacteria are stunned, and forced for a time to suspend their biological activities, which are later resumed."

This conclusion by Dr. Redfield appears to have been deduced as a result of his finding in some of the samples of water collected at various points in Jersey City and in drinking-water tanks upon railway cars in Jersey City, the occasional presence of bacteria of the B coli group in samples which were held for prolonged periods in the laboratory; whereas the previous examinations of those samples had failed to demonstrate the presence of any of the members of that group of bacteria.

The very small number of instances in which this result was noted, leads me to believe that the conclusion Dr. Redfield draws therefrom is unwarranted. It is an exceedingly common experience to obtain variability in results by submitting to the same methods of testing identical amounts of the same sample of water. It is, therefore, in my opinion, not in the least warrantable to conclude, that because on any given day a sample fails to show the presence of one of the members of the B coli group, and does so on another day, that any change whatever has taken place in the number or the state of activity of the B coli present in the said sample. This is particularly true when the numbers present in the sample are very few, as was substantially and almost invariably the case with the samples studied by Dr. Redfield. He himself states that his conclusions warrant further investigation, which he promises to undertake, indicating thereby a lack of thorough conviction on his part as to the full significance of his conclusions. In fact, in the quotation given from his report, he does not himself draw the hard and fast conclusion that the fecal bacteria are stunned by the chemical treatment, but he merely confines himself to the rather indirect statement that the indications point in that direction.

There is therefore nothing in the way of conclusive, or even strong, evidence, in my opinion, that the chlorination of waters containing bacteria of the bacillus coli group results in a stunning or incomplete devitalization or anaesthetising of the B coli present and their subsequent revival.

There is nothing new, however, in the proposition, that the action of various physical and chemical agencies upon living bacteria may not, under sound conditions of application of these forces to the germs to which they have been applied, result in the complete destruction of some of them a weakening of another portion of them, and a failure to affect the vitality of others. This result is to be commonly noted, not only when one is dealing with numbers of various types and kinds of bacteria, but also when the investigations are confined to cultures of single species or races of them.

It is unquestionably true, that certain groups of species of bacteria are much more readily affected by chemical germicidal agencies, than are others. It is well known, that disease-producing bacteria tend to lose their disease-producing powers the longer they sojourn outside the bodies of susceptible animals, and furthermore that any untoward condition or devitalizing treatments tend to rob these micro-organisms of their capacity to produce human infection.

It is not, therefore, necessary to require that complete destruction of pathogenic bacteria should take place in order that they may be rendered innocuous.

Dr. Redfield in his report claims that the cultural properties of the gas producing organisms of fecal origin of 80 per cent of the isolations in his investigations were changed by the chlorination treatment. This change took the form, in his opinion, of delayed fermentation and the reduction of the amount of gas formed. It is inconceivable that, if his views were warranted, these so-called stunned, devitalized or anaesthetised micro-organisms, even of fecal origin, have any sanitary significance, for in my opinion it is absolutely true, that any disease-producing micro-organisms, such as the typhoid bacillus, which may possibly have been present in the water in association with these harmless types of sewage bacteria, would likewise have been rendered entirely innocuous as regards consumers of the water.

6. It is claimed by the makers of the affidavits attacked to the petition, that the results of bacteriological investigations do not estimate purity, but that they merely determine the extent of contamination. It is difficult to conceive, either scientifically or practically, the existence of purity other than by the absence of contamination; therefore meth-

ods having as their primary object the demonstration of the absence of contamination, living in character and capable of producing disease in and of themselves, or of indicating the possible presence of other living forms possessing pathogenic properties are truly appropriate procedures for the determination of the purity of the product under examination.

If it is claimed that the impurities are non-living in type, their presence can, in my opinion, be reasonably well determined by chemical analyses, and yet the results of such are not presented in the affidavits annexed to the petition.

7. It is alleged in the petition, that the water delivered to Jersey City is unfit for use, in that it does not conform to the standards of purity adopted by the United States Public Health Service for waters to be used in interstate commerce. These standards, which are purely bacterial in character, require that the results of tests for the presence of the bacillus coli group, shall show not more than one positive result (in 10 c. c. inoculations) out of 5. The promulgation of this standard by the United States Public Health Service dated October fourteenth, 1914, immediately called forth a vigorous protest on the part of sanitary engineers, which protest was participated in by some of the very same experts (including George W. Fuller) who have sworn to the affidavits annexed to the petition charging that the Jersey City water is unfit for use, by reason of its failure to meet these requirements or standards. One of the members of the Commission appointed by the United States Public Health Service to make recommendations with respect to these standards, viz., Professor Winslow, stated to the deponent, that the standards were made stringent by reason of the fact that it was now perfectly possible to meet

them, by the use of chlorination applied to the usual sources of water supply employed by railroads for drinking purposes.

It is note-worthy that none of the reports of the bacteriologists making the affidavits annexed to the petition, appear to have followed the methods of expressing results recommended by this Commission in their quantitative tests of B coli. However, in but two instances, out of the eleven samples reported upon by Dr. North (page 21 of his affidavit) of examinations of water taken from the outlet of the conduit, namely, on December 10th and December 11th, were B. coli found in smaller volume of the water tested than 10 cc.; and in but two more instances were they even found in this larger amount, of the samples used for inoculation.

The results, therefore, of the small number of tests made by Dr. North indicate, as far as they go, full compliance with the requirements of the standards prescribed by the United States Public Health Service, in all but two instances out of eleven; and this during a winter month, when it is alleged that the hypochlorite is deficient in its germicidal efficiency.

The number of results of analyses available do not permit of the appropriate determinations as to compliance, or non-compliance, with the standards of the International Joint Commission on Boundary Waters, representing the United States and Canada.

8. In my opinion it is incompetent to take the average results of the b. coli tests of the waters of the Rockaway River as they enter the Boonton Reservoir (as was done by some of those making the affidavits annexed to the petition) and consider them as representing the results on the waters that are being treated by the chlorination process after they leave the reservoir, Such a presentation leaves

out of consideration the well-known purifying effects of sedimentation in the reservoir, the existence of which is generally recognized in the affidavits.

If the so-called International Commission Standards for water about to be purified for potable use are to be applied to the waters to be purified at points on the streams or lakes from which they are derived where the first natural or preliminary artificial purification processes begin to operate, then logically no pollution of any consequence must be permitted to enter any contributing stream or water course which would result in giving the water at that point a B. coli content over these standards. It is unbelievable that the International Commission had any such idea in mind. Standards to be applied to waters about to be purified should be applied to the water immediately before the application of the purification process under consideration. That in this case is the chlorianation process, and the waters should be those rination process, and the waters should be those it.

Furthermore, standards for average yearly results were presumably agreed upon for averaged conditions by those who recognized that at times conditions must of necessity be worse than at others, and they should not be used therefore for the purpose of judgment of condemnation on the worst conditions existing only occasionally. They should be applied only to averaged conditions.

9. One of the most valuable means of measuring the past sanitary history of a water supply, both qualitatively and quantitatively, and also for the determination of the extent to which natural purifying influences have been active, lies in the well-known and extensively used practice of sanitary chemical water analysis.

The results of such chemical analyses, taken in conjunction with those of bacteriological studies, including both the bacterial counts and the numerical determination of the bacteria of the bacillus coli group, afford most valuable information to experienced workers in the estimation of the degrees of both original contamination of a water supply and of the extent of the action of the natural purification processes upon the same.

While much has been said in the affidavits annexed to the petition in commendation of the value of bacteriological investigations, and especially bacterial standards of purity, and with almost equal frequency, in condemnation of the utilization of such means of passing sanitary judgment, nothing has been said in these affidavits as to the results of sanitary chemical analysis; which results, in my opinion, would unquestionably give most useful and valuable information as to the character and extent, not only of such pollutions as may have entered the Rockaway River and its tributariaes, but as to the results of the natural processes of purification unquestionably operating upon such pollutions as may have gained access to these waters. Thus they have, both in their statements of qualification and in the substances of their affidavits, vigorously set forth, that the results of the chlorination treatment, as measured by certain international and government standards, have fallen short, while with equal forcefulness they have condemned the passing of judgment upon purification processes solely through the employment of the results of bacteriological investigations.

In my opinion there is nothing of evidence worthy of serious consideration in the affidavits attached to the petition which would indicate that particles of fecal matter actually reach Jersey City through the water supply, although it is indirectly alleged that they do, and much argument is presented as to the difficulty of effectively chlorinating the interiors of such particles, and also as to their liability to break up en route and discharge their contents untreated into the water. In my opinion if such conditions existed they would be susceptible of scientific demonstration, and the obvious importance of them, if they existed, would have fully warranted the utmost efforts to expose them in a definite and specific manner in addition to argumentation on hypothetical possibilities.

10. Allegations appear in the affidavits attached to the petition claiming a retardation of the speed of action of the hypochlorite or of chlorine gas upon the bacteria in the water by the reduction of temperature. This and all elaborations of the argument there presented as to the formation of so-called hydrate of chlorine were all phenomena or possibilities that were well-known to competent scientists familiar with the principles of disinfecting action by physical and chemical agencies, and undoubtedly were, or should have been, recognized, and their effect, if any, demonstrated at the time of the presentation of the evidence which led to the decree.

11. A very obvious effort is made in the affidavits annexed to the petition to indicate that the spore-forming bacillus, commonly characterized as B. Welchii (bacillus, aerogenes capsulatus, or bacillus sporogenes) was either unknown in 1908-9, or that the information concerning its distribution and human relationships was meager. In my opinion, this is entirely erroneous. In the years 1893 and 1894, in the laboratory of Prof. Welch, at Johns Hopkins Hospital, I investigated the biological characteristics and animal relationships of this micro-organism, and the American, English

and German literature, many years prior to 1908 and 1909, contains extensive references to not only the biological characteristics thereof, but also to the distribution of this micro-organism in nature, and especially in relation to human and animal pollutions and very particularly to its disease-producing possibilities in human beings. Substantially little information has been added to the very extensive knowledge on this subject then existent, except that of a confirmatory character.

While it is true that this group or groups of spore-forming bacilli are, under extraordinary and very unusual conditions, capable of producing disease in human beings (that is, possessing pathogenic properties), it is likewise true, as has been admitted in many of the affidavits annexed to the petition that this micro-organism is found most widely distributed in nature, being particularly associated with human activities, and it is found existing with great frequency in the intestinal contents of humans and animals, thus indicating that, under ordinary and usual circumstances, a fact well-known for much more than a decade, these micro-organisms are usually without pathogenic properties for human beings. No statements are made, either in the petition or in the affidavits, presenting any facts or evidence alleging the existence of information that was not well-known to me in the years 1908-9 and prior thereto, concerning the character, distribution, and pathogenic properties of B. Welchii. The existence of these and other spore-forming bacteria, commonly associated with sewage pollution, must have been well-known to the experts who testified at the hearing of this case in the years 1908 and 1909. In fact, I am informed that the record will show that one of the exceptions to the Master's report confirmed by the final decree was in this language:

"For that the said Master has reported that he finds the plans and devices presented as an alternative remedy are an effective process which destroys in the water the germs, the presence of which is deemed to indicate danger, including the pathogenic germs, so that the water, after this treatment, attains a purity much beyond that attained in water supplies in other municipalities.

"Whereas, the said Master should have found that the plans and devices presented as an alternative remedy do not destroy the spore-forming pathogenic bacteria in this water, and that they do not affect, remove or lessen, to an appreciable extent, the polluting organic matter or filth in the water."

12. As set forth in the affidavits annexed to the petition, and including the report of Dr. W. H. Redfield, the watershed of the Rockaway River is so extensive and of such a character, that even if the sewage of Dover, Hibernia and Boonton were entirely eliminated from the river, regardless of the method of doing it, there would still remain so much pollution (much of it undoubtedly from human sources and therefore potentially dangerous to health) entering the river at numerous points, that if the waters thereof were not properly purified (preferably by sterilization by means of hypochlorite or chlorine, as is the water supply at the present time) the water supply could only be considered as one offering a potential menace to the health of the consumers thereof.

13. I have found nothing in the affidavits attached to the petition worthy of serious consideration, to lead me to the conclusion, or to indicate that a point has been reached in the alleged addition of hypochlorite to the water at the treatment

station at the Boonton Reservoir, beyond which any further addition would of necessity produce tastes and odors, due to the application of chlorine in the water as delivered.

The ability of the average untrained and inexperienced layman to distinguish between the odors commonly and frequently found in surface waters, from those possible of production through the hypochlorite treatment of water, is open to most serious doubt, and for this reason the testimony of untrained and inexperienced persons counts for very little; and I have expressed the opinion above given, because none of the affidavits of the experts annexed to the petition present any direct evidence as the result of described investigations tending toward a conclusion that this point had been reached.

14. No references appear in the affidavits annexed to the petition, to the well known purifying influence of sedimentation, sunlight, and their destructive action on animal and microscopic life in surface waters, and yet the same undoubtedly take place.

No evidence is presented that these purifying forces have not been able to accomplish all that they did accomplish in the years prior to 1908 and 1909, by reason of any alleged increase in the amount or characteristics of the pollution of the waters of the watershed and in the reservoir. It is true, that the affidavits allege a necessity on the part of the Jersey City authorities to increase the amount of chlorine or hypochlorite used in the chlorination of the waters of the Boonton Reservoir. No comparative results or tests of relative sterilizing efficiencies of the processes as applied at the Boonton Dam when the decree of the court was made, as compared with those more recently applied, are to be found in the affidavits annexed to the petition, and the necessity for this alleged increase in the amounts of chlorine used is not demonstrated in my opinion. There is therefore still greater doubt as to the alleged necessity for a still further increase in the near future.

Judging from the results of the meager number of samples taken from the point of delivery of the water in Jersey City, namely, the outlet of the conduit at the Summit Avenue Reservoirs, as submitted by Dr. North (see his affidavit, p. 21) I find nothing to indicate that the water being delivered at that point, on those occasions, was anything but reasonably pure and wholesome, nor do I find any direct evidence in the affidavits annexed to the petition to show that those results do not fairly represent the efficiencies obtainable and actually attained by the operation of the chlorination system at the Boonton Dam.

I am informed that the contract required that the water should be pure and wholesome at the point of delivery. Attached to the petition, and submitted in connection with the affidavit of Michael I. Fagen, Director of the Department of Streets and Public Improvements of Jersey City, is a report of Dr. W. H. Redfield of the Bureau of Chemistry, U. S. Department of Agriculture, giving the results of his bacteriological investigations of numerous samples of water, collected in various parts of Jersey City and especially at the Erie and the Central R. R. of New Jersey Stations, and from drinking water tanks on railroad cars in said stations. The results of these bacteriological tests of samples so taken are not of necessity or directly indicative of the quality of the water delivered to Jersey City at the outlet of the conduit at the Summit Avenue Reservoir. However, taking the results of all the tests which he made, from his investigations as to the total numbers of bacteria found on plain agar, incubated at body temperature (37 degrees C.), and also from his efforts to determine the numbers of bacteria of B. coli group and the identification of those found with the various sub-groups, there appears to be nothing in the same to indicate the presence in the water supply of Jersey City of anything but the most occasional and irregular and wholly casual presence of bacteria of the B coli types, recognized by the report of the Committee of Standard Methods of Water Analysis of the American Public Health Association (1917) as of fecal origin.

In view of the elaboration of work undertaken by Dr. Redfield upon samples collected under various conditions and on various dates, those results, far from warranting condemnation of the effectiveness of the chlorination treatment of the water supply delivered to Jersey City, would, in my opinion, constitute evidence strongly tending to corroborate an opinion, that the water supply of Jersey City was both pure and wholesome.

Herbert D. Pease.

Sworn to and subscribed before me, a Notary Public in and for the County and State of New York this 9th day of July, 1918. In witness whereof I have hereunto set my hand and official seal.

(L. S.) E. E. Haines,
Notary Public in and for the County and State of New York.

Affidavit of John H. Cook.

IN CHANCERY OF NEW JERSEY.

Between THE MAYOR AND ALDERMEN OF JERSEY CITY, *Complainant,* and JERSEY CITY WATER SUPPLY COMPANY, *Defendant.*	On Petition and Order to Show Cause. Affidavit.

STATE OF NEW JERSEY, County of Passaic. } ss.:

JOHN H. COOK, of full age, being duly sworn, deposes and says:

I reside in the City of Passaic and am engaged as a hydraulic engineer in the City of Paterson, and have been in the employ of the Jersey City Water Supply Company, the above named defendant, which is not now engaged in any active work.

The population of the various municipalities in the Rockaway watershed above the Boonton dam originally belonging to the Jersey City Water Supply Company and now belonging to Jersey City, as given by the New Jersey State Census of 1895, 1905 and 1915, and by the United States Census for the years 1900 and 1910, was as follows:

Year	Boonton	Dover	Wharton	Rockaway Boro.	Rockaway Township
1895	3276	5021	....	1334	4461
1900	3901	5938	2069	1483	4528
1905	3935	6353	2285	1585	5153
1910	4930	7468	2983	1902	4835
1915	5207	8971	2591	2224	3264

The total population of all these places as given by the 1905 census was 19,311, and as given by the 1915 census was 22,257, an increase of 2,946, or about 15.3%.

The population of Boonton has increased in the ten year period 1905 to 1915, from 3,935 to 5,207, an increase of 1,272 or 32%.

The population of Dover during the same period increased from 6,353 to 8,971, an increase of 2,-618, or 41%.

The population of Wharton during the same period increased from 2,285 to 2,591, an increase of 306 or 13%.

The population of Rockaway Borough during the same period increased from 1,585 to 2,224, an increase of 639 or about 40%.

The population of Rockaway Township decreased from 5,153 in 1905 to 3,264 in 1910, a decrease of 1,889 or 36%.

This last mentioned place (Rockaway Township) includes a large rural district outside of the Borough of Rockaway. The places which would exercise the greatest polluting influence upon the stream have, as indicated by the above figures, increased in population to a considerable extent during the said ten year period.

JOHN H. COOK.

Sworn and subscribed to before me this 9th day of July, A. D., 1918.

Richard Rossiter,

(L. S.) Commissioner of Deeds, N. J.

Affidavit of Edmund LeBreton Gardner

IN CHANCERY OF NEW JERSEY.

Between THE MAYOR AND ALDERMEN OF JERSEY CITY, *Complainant,* and JERSEY CITY WATER SUPPLY COMPANY, *Defendant.*	On Petition and Order to Show Cause. Affidavit.

STATE OF NEW JERSEY, }
County of Passaic. } ss.:

EDMUND LEBRETON GARDNER, of full age, being duly sworn according to law deposes and says:

1. I am the president of the Jersey City Water Supply Company, the above named defendant.

2. The original capital stock of the said Jersey City Water Supply Company was One Million Dollars ($1,000,000) and its bonded indebtedness Six Million Five Hundred Thousand Dollars ($6,-500,000).

3. The water works erected by the said Jersey City Water Supply Company for Jersey City were transferred by the Company to Jersey City on October 10th, 1911, the purchase money received by the Company in payment therefor amounting approximately to Seven Million Dollars ($7,000,-000).

4. In addition to that purchase money the said Jersey City Water Supply Company had previous to the transfer of the water plant to Jersey City received large sums of money from Jersey City

for water supplied to it, which moneys were used for operating purposes, for the payment of interest on the bonds, and the creation of a sinking fund in reduction of said bonds.

5. Out of the balance of the moneys so received by the said Jersey City Water Supply Company for water so sold, and with the moneys received by the said Company as the consideration for the transfer of the said water works, the said Jersey City Water Supply Company has paid off its entire bonded indebtedness and has reduced its capital stock to Ten Thousand Dollars ($10,000). It today possesses no tangible assets whatsoever.

EDMUND LeB. GARDNER.

Sworn to and subscribed before me this 9th day of July, 1918.

RICHARD ROSSITER,
(L. S.) Commissioner of Deeds, N. J.

Affidavit of Andrew J. Provost, Jr.

IN CHANCERY OF NEW JERSEY.

Between THE MAYOR AND ALDERMEN OF JERSEY CITY, *Complainant,* and JERSEY CITY WATER SUPPLY COMPANY, *Defendant.*	On Application for Leave to File Bill of Review. Affidavit.

STATE OF
County of } SS.:

ANDREW J. PROVOST, JR., of full age, being duly sworn, deposes and says as follows:

1. I reside in Richmond Hill, City of New York and am a Consulting Engineer and Sanitary Expert with offices at 39-41 West 36th Street, New York City. My work relates principally to the development of water supplies; and methods for the removal of their impurities; to the formulation of projects for sewerage and the problems connected with sewage treatment and disposal works; to the studies of epidemics and the more practical phases of public health work, including preventive medicine.

2. I am a graduate of the School of Mines, Columbia University and have for more than twenty-five years practiced exclusively on work related to water supply and sewerage.

For a short time after graduation in 1889, I travelled in Europe for the purpose of observing the art of water supply, engineering sewerage as then practiced in Europe.

3. I was employed by the City of Brooklyn for several years prior to 1898 in the design and construction of important sewerage projects and shortly after the formation of Greater New York in that year, I entered the employ of the City of New York in an advisory capacity to the Comptroller which position I held for about five years, during which period I had supervisory charge of all the important sewerage and water supply projects in the Boroughs of Brooklyn and Queens. From 1904 to 1906, I acted as consulting engineer to the President of the Borough of Brooklyn and formulated during that period important changes in the sewerage of the Borough.

Since 1906, I have been in private practice and President of Lederle and Provost, incorporated, Sanitary Experts and Hydraulic Engineers. I have been an engineering member of the New York Metropolitan Sewerage Commission, a scientific body created by the Legislature of the State of New York to examine into and report on the sanitary conditon of New York Harbor and its tributary waters and have been retained by the State as an expert in the litigation before the Federal Court brought by the State against the State of New Jersey and the Passaic Valley Sewerage Commission to restrain the discharge of objectionable sewage into the waters of New York State and for report on various projects for water supply and sewerage in various parts of New York State.

I have been employed by the City of New York as Sanitary Expert to the Board of Water Supply from 1910 to 1916, in connection with the construction of the Catskill Aqueduct and have also represented the City of New York before Legislative Committees for the purpose of safeguarding the sanitary quality of the City's water supply.

I have prepared plans and supervised the construction of improvements for water supply and sewerage for the City of New York in the Borough of Richmond and in Orange County, N. Y.

I have also acted in a consulting capacity for many municipalities, water companies, industrial plants, hospital and educational boards, etc. in the United States, South America and China. I am a member of the American Water Works Association, the New England Water Works Association, the American Society of Municipal Improvements, the American Society for Testing Materials, the American Public Health Association and other scientific societies. I have been a member of the Committee on the Sanitary Protection of Water Ways in the American Public Health Association.

4. I have read the affidavits accompanying the application presented by the Mayor and Aldermen of Jersey City to the Chancellor of the State of New Jersey against the Jersey City Water Company and fail to find in the opinions and beliefs therein set forth anything material or substantial relating to the practical problems of chlorinating the water delivered to Jersey City from the Boonton Reservoir that is new or that could not readily have been anticipated from the knowledge of the Art that obtained or was obtainable in 1909.

5. I am unable to concur in the opinion expressed by several of the affiants that the use of hypochlorite since 1909 has shown it is unreliable for the sterilization of water under conditions similar to those which exist in the Jersey City supply; on the contrary deponent is of the strong opinion that sterilization of water supplies by means of hypochlorites or other form of chorine has greatly advanced in its efficiency under skill-

ful technical operations and that the obtainable margin between effective sterilization and overdosing which will create objectionable tastes and odors is controllable and capable of being increased to entirely safe limits under expert supervision and control.

6. I am unable to concur in the opinions expressed by several of affiants that the extent of pollution which exists in the water shed of the Rockaway River is so great that it cannot be effectively removed by filtration, or by sterilization or by both. Compared with other water sheds furnishing a good quality of potable water this shed is not in deponent's opinion densely populated. From a table prepared and published in November, 1914, by George W. Fuller, it appears that the population of the Jersey City water shed is 157 persons per square mile and that the Cochituate shed of the Boston supply has 775 persons per square mile; the Sudbury shed of the Boston supply 294 persons per square mile; the Lynn shed Massachusetts, 710 persons per square mile; the Jones Falls shed of the Baltimore, Maryland, supply 154 persons per square mile; the shed of the Chester, Pa. supply 173 persons per square mile; the Croton shed of New York City 70 persons per square mile; and that none of these supplies are filtered except that at Chester, Pa.

It is deponent's belief that the supplies from the Massachusetts sheds therein referred to, with populations from 294 to 775 persons per square mile, are not even sterilized and that sedimentation in large storage reservoirs is the only means for the removal of impurities.

7. Deponent is informed and it is his belief that the greater part of the people in the United States obtain their water supplies from surface sources more or less contaminated with human discharges;

that approximately 20 million people therein regularly use such water after it has been subjected to filtration and sterilization and that an approximately equal number regularly use the water after sterilization alone or combined with sedimentation as is the case in Jersey City, Chicago, Detroit, Buffalo, Cleveland, New York City, Nashville, Seattle, Hartford, Lynchburg, Newark, Omaha, Sacramento, Milwaukee and other cities.

3. Deponent understands and believes the Mayor and Aldermen if successful in these proceedings intend to construct a trunk line sewer from various municipalities along the Rockaway River to a point below the Boonton Dam and to there construct and operate a sewage treatment works for the aeration of the sewage in the presence of activated sludge.

It is deponent's belief that this form of treatment is still entirely experimental and that sufficient information does not exist to warrant the assumption it can be depended upon to effectively purify the sewage to be treated including the trade wastes which will form a part thereof and that in the event of failure to so purify which deponent believes is entirely possible, contamination dangerous to public health will occur in the Rockaway River below the Boonton Dam and above the intake of the Montclair Water Company and the other companies without the benefits of sedimentation which now occur in the BoontonReservoir.

ANDREW J. PROVOST.

Sworn to and subscribed before me, a Notary Public in and for the County and State of New York this 9th day of July,1918, in witness whereof I have hereunto set my hand and affixed my official seal of office.

E. E. Haines,

(L. S.) Notary Public,

County and State of New York.

Reply Affidavit of George W. Fuller

IN CHANCERY OF NEW JERSEY.

Between THE MAYOR AND ALDERMEN OF JERSEY CITY, *Complainant,* and JERSEY CITY WATER SUPPLY COMPANY, *Defendant.*	On Petition and Order to Show Cause. Reply Affidavit of GEORGE W. FULLER.

STATE OF NEW YORK,)
County of New York.) ss.:

GEORGE W. FULLER, of full age, being duly sworn, deposes and says as follows:

1. I am the same George W. Fuller who made an affidavit herein in March, 1918.

2. In the affidavits filed in behalf of the defendant, especially that of Mr. Andrew J. Provost, Jr., the belief is indicated that approximately 20 million people in the United States are supplied regularly with water after it has been subjected to sterilization combined with sedimentation, as in the case of the Jersey City water supply. If this indication is to be construed to imply that such chlorinated supplies provide a pure and wholesome water, or a water which at all times is safe to drink, I desire to take positive exception to such statement, and I will specify my knowledge of the facts with respect to a number of cities used illustratively in the affidavit of Mr. Provost:

(A) The City of Milwaukee, Wis. for several years has made use of the chlorination process, but the results are far from satisfactory. I have investigated the subject at Milwaukee and found that the United States Government has forbidden the city water supply of Milwaukee to be used by inter-state carriers because the quality of the water does not meet the Government standard, substantially as stated in the Engineering Record of March 10, 1917, page 370. For more than four years Milwaukee has been engaged in designing and building extensive intercepting sewers and sewage treatment works at a cost of several millions of dollars with the specific object of protecting the city water supply. Within the past few weeks it has also made appropriations for the commencement of investigations directed to filtration of the water supply to supplement the protection to be obtained by sewage purification and water cholorination.

(B) Lynchburg, Va., has an impounded water supply which I have investigated on several recent occasions during the period when it was being chlorinated. I know it to be a fact that in the summer of 1917, the City commenced the construction of a filter plant for its water supply. It is my belief that that water filter plant has recently been put in service or is about to go in service.

(C) At Hartford, Conn., the Water Commissioners have consulted me on several occasions about its water supply, which has been chlorinated for several years, and I have made several reports during the past six months looking to the installation of a water filter plant, bids for a portion of which were invited during the spring of 1918.

(D) The cities of Omaha, Nebr. and Nashville, Tenn., make use of coagulation processes as well as chlorination. Their water treatment procedures show the further important difference between the treatment afforded the water of Jersey City in that the sedimentation reservoirs are of regular shape designed to receive from the river only such quantity of water as is actually used by the city, for a period sufficient to bring about its clarification in conjunction with clarifying reagents. The Omaha and Nashville basins, built outside the river bed, are not subject to the floods in the rivers from which they are filled by pumping, nor to currents in the reservoir, promoting a short-circuiting of the water from inlet to outlet, and thus causing a falling off in efficiency of the sedimentation processes, as is true in the case of the Boonton reservoir of the Jersey City water supply. It is to be recalled in this connection that not only is the Boonton reservoir formed by building a dam across the main stream bed, flooding the main valley and a large lateral valley, but also the shape of the reservoir is such, resembling a long-legged boot, with the inlet at the toe and the outlet at the heel, that heavy flood flows make it relatively easy to short-circuit the stream through the reservoir from inlet to outlet.

(E) The Cedar Grove reservoir of the City of Newark, N. J. as compared with the Jersey City reservoir at Boonton also has the advantages of the basins at Omaha and Nashville in that it is not subject to the disturbances, incident to its location on the main stream bed, its shape and locations of inlet and outlet, etc., which the Court held in 1908, the Boonton reservoir to exhibit at intervals, with a consequent abnormally low efficiency as a sedimentation mechanism.

(F) At Cleveland, Ohio, I have been retained as consulting engineer for one and one-half years in the matter of purifying the sewage of the city before it enters Lake Erie and pollutes the city water supply, which for several years has been chlorinated, and which within the past few months has also been subjected to filtration as regards a large portion of the water supply. Work is progressing toward not only purifying the sewage, but filtering all of the city water supply.

(G) At Chicago I have studied water supply and sewage disposal problems at intervals for 15 years. Here the sewage of the City is diverted from Lake Michigan through the Chicago drainage canal at a cost of some 40 million dollars with the primary object of protecting the purity of the city water supply from the lake.

(H) At Detroit, Mich. plans are now being prepared for a filtration plant for the city water supply and preliminary steps to the same end are under consideration at Buffalo, N. Y.

(I) New York City, where I have been consulting engineer on the City's water problems for over 12 years, adopted more than 20 years ago the policy of preventing sewage from entering the streams and reservoirs on the Croton watershed. And it has taken strongly the position that every effort should be made to guard against accidental pollution of its water supply through human wastes. This policy has been strongly set forth in the recent efforts by the City to prevent the erection of public institutions on the Croton watershed, such as the Mohansic State Hospital and the New York Training School for Boys at Yorktown. It has also contributed to the expense of a number of sewerage and sewage disposal plants for villages upon the Croton watershed. The new water supply from the Catskill mountains is now chlorinated and at intervals it is coagulated. Plans are being prepared for a filter plant for the Catskill supply.

(J) In brief, it may be said that the state of the art of water chlorination for the city supplies of this country by no means warrants the conclusion that this process of water treatment, independently of filtration, is capable of producing a pure and wholesome water at all times from surface supplies.

3. It is indicated in the affidavit of Mr. Provost that the watershed of the Rockaway river above Boonton is not as densely populated per square mile as some other cited watersheds alleged by him to be furnishing potable water of good quality without the aid of filtration. I desire to point out that the cited Jones Falls watershed of Baltimore has been completely abandoned, that the cited Cochituate supply of Boston is rarely if ever used, that the cited Sudbury supply with its numerous reservoirs on its watersheds sends water to the Boston district under all ordinary circumstances only from a limited number of the reservoirs. Furthermore, it is to be pointed out that all of these Boston reservoirs, as well as those on the Croton watersheds of New York City, are protected by rigorous steps to effect the purification of all sanitary wastes on the watersheds; and that the cities of Boston and New York have each

spent large sums of money to bring about purification not only of the sewage, but also of the storm waters falling upon inhabited areas before the flow reaches the impounding reservoirs. Again, the Sudbury and Croton reservoirs, as is true also of the Lynn (Mass.) reservoirs, are several in number, making it feasible to draw water for periods of considerable duration from first one and then another reservoir. This greatly aids the sedimentation process. In this respect they are quite unlike the arrangements of the Jersey City supply where, as explained above, there is only one reservoir, on the main stream itself, which is subjected to the disturbances of flood flows of the Rockaway river and to the action of winds and storms with peculiarly favorable conditions for by-passing or short-circuiting the water from inlet to outlet and during which period it is necessary to withdraw the water for use of the city, because there is no alternate reservoir to draw from.

4. As to the declaration of Dr. Pease that he finds nothing worthy of serious consideration leading him to conclude that conditions at the treatment plant at the Boonton reservoir are such that the addition of more hypochlorite to the water than has been added hitherto would produce tastes and odors in the water as delivered in Jersey City, I say that this is contrary to my knowledge of the facts. My knowledge is based upon personal examination on several occasions of the water at the Summit avenue gatehouse where I found it to contain quantities of chlorine noticeable to my taste and smell. I also noticed in April, 1917, objectionable taste and odor to the Jersey City water supply at the residence at 125 Manhattan avenue of Mr. Stephen Fallon, an affidavit from whom has been filed in behalf of

the complainants. Furthermore, if more scientific information than this is sought, reference may be made to a point in my affidavit of March, 1918, and seemingly overlooked, namely, that analyses of the water at the Summit avenue gatehouse in Jersey City, some of which have been made in my presence, show "residual chlorine" or excess of chlorine to be from 0.15 to 0.20 part per million. These are high figures, based on what my general experience shows that consumers will stand for, and they clearly approach the upper limits of the "danger zone" beyond which the dose cannot be increased without likelihood of wholesale complaints by water consumers, such as have frequently occurred at Cleveland, Milwaukee, South Milwaukee, and some other cities personally known to me.

5. It is indicated in the affidavit of Dr. Pease that in the affidavits annexed to the petition no consideration has been given to or no reference appears as to the well-known purifying influence of sedimentation such as occurs in reservoirs. There must be some misunderstanding about this. The Boonton reservoir during a very large portion of the year does serve to effect a large degree of purification to the waters slowly passing through it. This is shown in the 1908 decree and I believe it the view of all who have studied this proposition. It is doubtless true that there are many days in the year when there is no need of any chlorination process to supplement the purifying effects of the reservoir; but, as recited in the decree, there are times when the sedimentation functions of the reservoir are inadequate. These random occasions which no one can forecast are when there is need for treatment to supplement that of the impaired sedimentation process. The real practical question, as I look at it, is whether

sedimentation plus chlorination provides adequate purification, not as an academic proposition based on what these arrangements might do on an average or under conditions found elsewhere, but what they can be counted upon reliably to do under local conditions of the Jersey City Water Works, under conditions of operation based on ordinary intelligence and not that of profound expert knowledge, which cannot be made available when these periods of lapses in the performance of the reservoir occur at intervals, without warning. This statement has been made at some length in order to accentuate the thought in my mind as to the need of a margin of safety as regards chlorine dose, not with a view that this dose is necessarily required on this or that particular day, but whether it would be sufficient on the occasion of the next severe rainstorm, such as would put the purifying mechanism of the reservoir itself on a basis of reduced efficiency.

6. Concerning the statement that the formation of hydrated chlorine was a phenomenon or possibility well known to scientists in earlier years, that may be true on a hypothetical basis, irrespective of degree. But it is not true if degree be taken into account, because it is a fact that I did not know that this substance would produce yellow crystals sufficient in amount to stop up a perforated pipe of a diameter of more than one inch until January, 1918, when I was called to South Milwaukee as referee to decide whether objectionable tastes and smell in the local city water supply were due to chlorination of the water or to trade wastes discharged into Lake Michigan from a neighboring chemical plant. I have since learned of stoppages of the pipe due to crystals of hydrated chlorine at a number of other places, particularly in the devices used for applying

chlorine to the water supplies of Milwaukee and New York City.

7. It is not a fact that the chlorination process as applied at Boonton destroys "much of the organic elements in sewage-polluted waters" as is stated to be the opinion of Dr. Pease. On the contrary, the facts are that very little organic matter of sewage-polluted waters is so destroyed. This is of necessity so where the weight of available chlorine amounts to not more than about 4 to 7 pounds per million gallons or about 0.03 to 0.05 grain per gallon. These quantities of chlorine would not affect more than a very small per cent. of the organic matter found in such a water as that of the Boonton reservoir. This point is an excellent one for illustrating the oft-repeated statement of fact that the chlorination process involves the application of only relatively small quantities of chlorine before serious trouble from tastes and odors arises, and if the very small dose is made too small then the hygienic efficiency fails. With a reservoir stirred up by floods, winds and currents, it is an extremely difficult matter, if not practically impossible, to adjust the chlorine adequately at times when there is the greatest need for its use to supplement the treatment which the Rockaway river water receives in its passage throuh the Boonton reservoir.

8. I view the reservoir at Boonton as a part of the purification process for the flow of the Rockaway river just as I would rate a coagulation or sedimentation basin, used with a filter plant, as a part of the complete purification plant. This has always been my view on the projected program of the International Joint Commission. However, the standard of the latter is not always met by the water leaving the outlet of the Boonton reservoir. Safety to the water consumers in Jersey City

does not lie in the average composition of the water as the Court has said.

9. About the views I have expressed concerning the Government standard for bacterial tests, the U. S. Commission report states:

> "Compliance with the requirements herein recommended will insure a quality of water supply equal to that of municipal supplies which have been demonstrated by experience to be entirely safe and satisfactory, and will at the same time impose no great burden upon common carriers, since it is entirely practicable with moderate direct expense and pains to purify water to the degree required."

My comments stated in a paper before the Franklin Institute, November, 1914, were as follows:

> "A comment which may be made upon this report of the Treasury Commission is that, while the standard they set is proper under the conditions for which they place it,—that is, a single standard for the testing of large varieties of water from different unknown sources,—and will give practically a safe water under any such conditions, a somewhat more liberal standard might well be applied in the case of a municipal water supply where the source of the water is known and its possibilities of being subjected to pollution can be investigated on the ground. Under these latter conditions a higher B coli content may be well in accord with a good and wholesome water."

> "There is a feeling among some waterworks men that the recent standard proposed by the Federal Government for the quality of drinking water supplied to the

public by common carriers in inter-state commerce will cause annoyance and perhaps some serious trouble to municipal water supplies that are generally believed to be of safe and satisfactory quality. At any rate, the Treasury Department report above quoted from at length will unquestionably stir up a helpful agitation as to the reliability of bacteriological methods of analysis and accentuate the need of more care being exercised in the future than in the past."

G. W. FULLER.

Sworn and subscribed to at the city of New York, this 15th day of July, 1918, before me, the subscriber, a Notary Public in and for said County and State duly commissioned and sworn, as witness my hand and official seal.

(L. S.) MARIETTA SUIOPOLI.

Reply Affidavit of George A. Johnson.

IN CHANCERY OF NEW JERSEY.

Between The Mayor and Aldermen of Jersey City, *Complainant,* and Jersey City Water Supply Company, *Defendant.*	On Petition and Order to Show Cause. Reply Affidavit of George A. Johnson.

State of New York, }
County of New York. } ss.:

George A. Johnson, of full age, being duly sworn, deposes and says as follows:

1. I am the same George A. Johnson who made an affidavit herein in March, 1918.

2. Since making my former affidavit last March I have been commissioned Major in the Construction Division of the Army, and since then have been officer in charge of the section of that Division which has the direction of operation and maintenance of Water Supplies, sewerage systems, and purification plants in all the Army Camps and Cantonments.

3. I have read with care the affidavits filed in behalf of the defendant and take exception especially to those of Dr. Herbert D. Pease and Mr. Andrew J. Provost, Jr., for reasons that, in my opinion, their intent is to lead away from and befog the real question involved in the Application for leave to file a Bill of Review in the matter at issue, and because in many important essentials

they are not in accord with the facts as I know them.

4. The cardinal question, as I view it, is whether the effect of the limited and decidedly unreliable and ever changing purifying tendencies existing in the Boonton reservoir, supplemented by the effect of treatment of the water issuing therefrom with chlorine or its compounds, can definitely be counted upon to provide adequate purification at all times, and thus afford a continuous impregnable barrier to disease germs reaching the mouths of the inhabitants of Jersey City through the medium of the public water supply of that city. I am still firmly of the opinion that these agencies cannot be so depended upon.

5. In the affidavit of Mr. Provost comparison is made of the Rockaway River watersheds with other watersheds as to density of population resident thereon, indicating for the watershed tributary to Boonton Reservoir a resident population of 157 persons per square mile. The comparisons he draws are not fair to the question at issue, and the conclusions he arrives at as a result of his assumption as to population I dissent from strongly for the reason that as far back as 1912, when I made a sanitary survey of the Rockaway River watershed, I found the population resident thereon to be 207 persons per square mile. This finding was stated in an exhaustive report made by me to the Board of Street and Water Commissioners of Jersey City, dated December 7, 1912.

(A) The supply delivered to Boston and vicinity comes from a number of reservoirs and it is possible to make such selection from these as will permit the more inferior water to be retained and subjected to the natural purifying agencies in the reservoirs for a prolonged period. The same is true to a large extent of the New York City supply, and also of the Lynn, Mass., supply. In these cases community sewage is not permitted to enter the reservoirs without having been subjected to purifying treatment.

(B) Not one of these supplies is, therefore, comparable to that of Jersey City, where untreated sewage is positively known by me to find its way into the reservoir, and where inferior water cannot be held back for prolonged storage, and where as was recognized by the Court in 1908, the highly polluted water of the Rockaway River at times does not find its way to the gatehouse at Boonton dam in much too short a time effectively to receive the benefit which sufficiently protracted storage may afford.

(C) That water gathered on such inhabited watersheds is not to be relied upon as safe, even with such most careful preventive measures as are exercised in the cases of Boston and New York City, even also where chlorination is employed, the case of the Cochituate supply of Boston, now seldom used, and the case of the Croton supply of New York, plainly indicate. Plans for the filtration of the New York City supply are now being prepared, and I have also been informed by the Chief Engineer of the State Department of Health of Massauchusetts, Mr. X. H. Goodnough, that filtration of Boston's supply is anticipated in the reasonably near future.

6. Mr. Provost states his belief that approximately 20 million people in the United States are supplied regularly with water after sterilization combined with sedimentation, as in the case of the Jersey City supply. Without refutation, this may

be taken to imply that such treatment can be relied on to yield a pure and wholesome water. I take decided exception to this statement of Mr. Provost's, both as to fact as regards the comparison indicated and to the implication suggested.

(A) The process of treatment of water by sterilization combined with sedimentation, is not of equal effect in the instances cited by Mr. Provost as compared with the Boonton reservoir situation. Its adaptabily, even if it can be relied anywhere, is limited by such conditions as shape and size of reservoir, relative location of inlet and point of out-take, character and extent of pollution, climatic conditions, and others. I have personal knowledge of numerous large reservoirs, and *not one of them* is comparable with the Boonton reservoir as regards directness and swiftness of flow from inlet to point of taking in the case of the latter.

(B) The New York City supply is protected by many sewage treatment plants for communities upon the watersheds. The policy of preventing untreated sewerage from entering the reservoirs has been vigorously followed for many years. Even this exceptionally well guarded supply is deemed to need filtration, a need which was recognized years ago, when provision for filtration was included in the general scheme of providing an additional supply from the Catskill Mountains.

(C) At Chicago and Cleveland the immense purifying powers of Lake Michigan and Lake Erie have proven insufficient, and sewage diversion for the former and sewage treatment in the case of the latter city have been found necessary. At Milwaukee, chlorination alone has fallen flat as regards compliance of results with the Federal Standard of water purity for Interstate Carriers. Sewage treatment works are being built and filtration of the water supply is projected.

(D) Milwaukee, Detroit, Cleveland, Buffalo and Hartford are to my personal knowledge all working towards the installation of filtration works. Cleveland already is filtering part of its supply.

(E) The Omaha supply is not at all comparable to that of Jersey City, because effective sedimentation is assured, as to period of retention, by the manner in which the basins are constructed. Furthermore, the process of sedimentation is aided by the use of coagulants.

(F) The Cedar Grove reservoir of the Newark supply cannot be accepted as indicating the efficiency of reservoir purification at Boonton, because it is of such shape that the water does not take a short cut through the reservoir from inlet to outlet, as is the case at Boonton. Furthermore, the purifying effect of the 30 day's storage provided by this reservoir can be realized by temporarily discontinuing the use of this part of Newark's supply.

(G) At all of the places above mentioned the water supply conditions are materially different from those pertaining to Jersey City, or else the method of treatment by sedimentation and chlorination has not proven satisfactory. I cannot but regard this process as insufficient and unsafe for the treatment of any supply subject at all times to human contamination and as of extremely doubtful safety for the treatment of any ordinary surface supply.

7. Dr. Pease states that "much of the organic elements in sewage polluted water are substantially destroyed in a chemical sense by the chlorination treatment, and that other organic constituents of the polluting material become bound to, and are definitely affected and are rendered innocuous by the chlorine or the chlorination treatment." The extravagant absurdity of such a declaration is evident in face of the fact that the quantity of chlorine or hypochlorite of lime which can be added to water without imparting to it offensive tastes and odors of the chemicals themselves is so small that any chemical changes which may in consequence occur in the organic content of the untreated water are so slight as practically to be indeterminable by any and all of the known methods of chemical analysis.

8. Again I affirm that all of the many cities which use chlorination of their water supplies which have come under my observation, at one time or another, due to unavoidable overdosing or other reasons constituting inherent deficiencies in the chlorination process of water sterilization, have at one time or another experienced periods of varying duration where offensive tastes and odors of the treated water, due to the chlorine or hypochlorite added to it, have been the cause of serious complaint on the part of the water consumers.

9. Dr. Pease is inclined to belittle the important complicating fact that where disease producing bacteria are embedded in particles of suspended fecal matter such disease germs cannot be effectively destroyed by the chlorination treatment. He refers to this point as set forth in the affidavits

attached to the petition as an argumentation on hypothetical possibilities. Any sanitarian versed in the literature and experienced in the art of the science of water purification knows that nothing applicable in a practicable way to municipal water purification problems except filtration will remove absolutely all of the fine particles of suspended matter within which disease germs can find safe refuge from the destroying activities of chlorine compounds and other sterilizing agents; and that at any time such suspended particles washed into the water from inhabited watersheds, no matter how thoroughly they may become broken up, can well contain disease germs which will thus pass by the sterilizing treatment unscathed, later to enter the mouths of the water consumers and be liable to cause sickness and death in consequence.

GEORGE A. JOHNSON.

Sworn and subscribed to at the City of New York, this 19th day of July, 1918, before me, the subscriber, a Notary Public in and for said County and State duly commissioned and sworn, as witness my hand and official seal.

(L. S.) Marietta Sinopoli.

Affidavit of Charles E. North

IN CHANCERY OF NEW JERSEY.

Between THE MAYOR AND ALDERMEN OF JERSEY CITY, *Complainant,* and JERSEY CITY WATER SUPPLY COMPANY, *Defendant.*	On Petition for Leave to File Bill of Review. Affidavit.

STATE OF NEW YORK,
County of New York. } ss.:

CHARLES E. NORTH, of full age being duly sworn on his oath deposes and says:

I have read the affidavit of Dr. Herbert D. Pease presented on behalf of the defendant on the petition and order to show cause between the Mayor and Aldermen of Jersey City, complainant, and the Jersey City Water Supply Company, defendant, dated July 9, 1918.

Page 4, paragraph 4, deponent mentions mortality and morbidity rates as evidence of excellence of supervision of chlorination process by Jersey City authorities. Such a conclusion is unwarranted, for the reason that low mortality and morbidity rates in a city consuming water may only reflect the absence of epidemics in the population on the water shed.

Page 5, paragraph 1, deponent alleges absence of outbreak of epidemic of gastro enteritis in Jersey City as indication of excellence of supervision of water supply while surrounding communities were suffering from such an outbreak. This conclusion is unwarranted, for the reason that the upper part of the water shed from which Jersey City draws its water may not have received the same infectious organisms which were received by waters at lower levels of the shed delivered to the communities mentioned. The existence of the epidemic of gastro enteritis in these communities is evidence of the kind of outbreak to which Jersey City might be subjected under similar conditions.

Page 5, paragraph 2, deponent expresses the opinion "that much of the organic elements in sewage polluted waters are substantially destroyed in a chemical sense, by the chlorination treatment." This statement is unsupported by deponent by any experimental data, and, as a matter of fact, the numerous chemical tests of water which have been made by many chemists of chlorinated waters have failed to show any reduction in the quality of various chemical components as the result of chlorination. There is no evidence that chlorination does in any way reduce or destroy organic elements in polluted waters.

Page 6, paragraph 2, Deponent ignores the fact that numerous bacteriological tests performed by me showed the stunning effect of chlorine treatment on bacteria in addition to the tests presented by Dr. Redfield.

Page 6, paragraph 4, deponent attempts to cast discredit on conclusions of Dr. Redfield by suggesting variability in the results of testing identical amounts of the same sample of water, overlooking the fact that in the samples tested by Dr. Redfield the results were invariable, namely, preliminary tests which in every case showed the absence of B. coli were followed by subsequent tests on the same samples which in every case showed the presence of B. coli.

Page 7, paragraph 8, deponent in this paragraph practically admits the entire contention of Dr. Redfield, namely, that some bacteria are only stunned by the treatment with hypochlorite.

Page 8, paragraph 1, deponent alleges that even if stunned the organisms of fecal origin have lost their sanitary significance because they are rendered inocuous. The sanitary significance of B. coli and other bacteria of fecal origin in water is much broader than the mere fact that the organisms in themselves may be dangerous. The treatment may render them inocuous and yet in no way remove the pollutions of the water indicated by the presence of these bacteria. Killing the evidence or rendering the evidence inocuous certainly does not render water free from sewage pollution. To admit the contention of deponent regarding the sanitary significance of these organisms in the limited sense in which he uses that expression is to admit that sterilized sewage is potable water.

Page 8, paragraph 6, deponent states: "It is difficult to conceive either scientifically or practically the existence of purity other than by the absence of contamination." I am wholly in accord with this statement, but deny that sterilization necessarily means the absence of contamination. It is only necessary to apply the processes of sterilization to any fluid, no matter how badly contaminated to recognize at once the futility of the bacterial test as furnishing any evidence of purity. Any contaminated substance may be sterilized so that the bacterial test will show negative results.

Page 9, paragraphs 1 and 2, deponent discusses standards of purity adopted by the United States Public Health Service for waters to be used in interstate commerce. He admits that these standards require not more than 1 positive result in 10 cc. inoculations out of 5, and in discussing the result of 11 examinations made by me, admits that in 2 of these tests positive results were found in less than 10 cc., and in 2 more instances positive results were found in 10 cc., making a total of 4 instances out of 11 in which positive results were found. This is obviously in excess of the standards required by the United States Public Health Service, according to his own statement the same being 1 positive result out of 5.

Page 10, paragraphs 3 and 4, bacteriological tests made by me on samples of water taken from the Rockaway River were intended to indicate the degree of sewage pollution of the Rockaway River and were not intended to indicate the effect of sedimentation in the Boonton Reservoir.

Page 11, paragraph 2, deponent seems to assume that standards of purity should be based on average yearly results and not on occasional worse conditions. This is a dangerous philosophy from a public health standpoint, since it is the occasional and worse condition which is invariably the cause of epidemics of disease. It is the occasional and the worse condition mentioned against which communities must be protected. For example, the washing of large quantities of surface pollutions into the Rockaway River at times of heavy rainfall, and the scouring out of the lower end of the Boonton Reservoir by complete displacement of the contained water by the flood waters of the Rockaway River, and the temporary overload on the hypochlorite plant, or break down of the same, would be a condition of exceptional danger not representing the average, and yet a condition most menacing to the health of the inhabitants of Jeresy City. It is this very condition against which the City should be protected by the installation of a trunk line sewer that would carry the sources of human pollution out of the water shed.

Page 11, paragraphs 3, 4 and 5, deponent discusses the value of chemical analysis of water. It is now well recognized among sanitarians that chemical analysis indicates only the past history of water and not the presence of recent pollutions. The chemical changes which take place in water after a short time may destroy the evidence of sewage pollution so that chemistry is unable to give a correct diagnosis. When not interfered with artificially by such a process as sterilization, the bacterial test is a far more important indicator of sewage pollution in water.

Page 12, paragraph 3, page 13, paragraph 1, deponent alleges that the retardation of the sped of action of chlorine gas on bacteria in water by the reduction of temperatures should have been known in 1909. The hypochlorite plant installed at the Boonton Dam in 1909 was the first of its kind in America. There was no experimental evidence at that time or for a number of years following which revealed to chemists and bacteriologists the fact that at temperatures near the freezing point the efficiency of chlorine gas in destroying bacteria was impaired or nullified. Experimental evidence of this fact has only recently been compiled, and, as a matter of fact, has not yet been published in scientific literature. The knowledge of the escape of bacteria in ice water from the chlorine treatment is new knowledge, and this evidence is new evidence.

Page 13, paragraphs 2 and 3; page 14, paragraph 1, while deponent was a student in Johns Hopkins University under Professor Welch, whose name has been given to the species of bacteria known as B. Welchii, and he is therefore familiar with the original work done by Dr. Welch in identifying this organism, it still remains true that bacteriologists for many years confused this organism with three or four other species of bacteria, and its significance pathogenically and from a sanitary standpoint has not been clearly recognized until lately. During the past three or four years more extensive experimental work and investigations, particularly by the bacteriologists of the Rockefeller Institute of Medical Research, quoted in my affidavit, have revealed clearly the place which this species of bacteria occupies in medicine and in sanitation, and have shown that it is an intestinal organism of human and animal origin, and that its presence in water is just as truly an indication of sewage pollution as is the presence of B. coli. While formerly called a soil organism, it is now known that its presence in the soil simply means that the soil has been polluted with the intestinal discharges of human beings or animals. Its presence in water means that the water has been polluted with the intestinal discharges of human beings or animals, therefore it must take its place beside the B. coli as an intestinal organism of equal sanitary significance. The fact that it forms spores, however, gives it a big significance in waters treated with chlorine. The fact that B. coli are easily destroyed by the chlorine treatment makes it impossible to use the test for B. coli as a test of the sanitary character of waters treated by hypochlorite or chlorine. On the other hand, the fact that the spores of B. Welchii are not destroyed by the chlorine treatment makes it possible by the use of the test for B. Welchii to determine the presence of sewage pollution of waters which have been subjected to the hypochlorite treatment. The presence of large numbers of B. Welchii in water show that the same has received serious sewage pollution.

It is noteworthy that every sample of water tested in Jersey City in the series submitted by me after treatment with hypochlorite showed the presence of B. Welchii.

CHARLES E. NORTH.

STATE OF NEW YORK, }
County of New York. } ss.:

On this 19th day of July, 1918, before me personally came CHARLES E. NORTH, to me known and known to me to be the individual described in and who executed the foregoing instrument, and he duly acknowledged to me that he executed the same.

LAURA E. SMITH,
Notary Public, Kings County, No. 256.
Certificate Filed in New York Co. No. 83.
(Seal) New York County Register's No. 9178.

Affidavit of Clyde Potts.

State of New Jersey, } ss.:
County of Hudson. }

Clyde Potts, of full age, being duly sworn, deposes and says as follows:

1. I am the same Clyde Potts who made an affidavit in this same case, dated May 13th, 1918.

2. I have read the answering affidavits of Messrs. Herbert D. Pease, Andrew J. Provost, John H. Cook, and Edmund LeB. Gardner. Exception is taken to paragraph 4, page 5 of the affidavit of Mr. Herbert D. Pease, as follows:

Mr. Pease states that chlorine gas or hypochlorites reacts chemically with certain forms of organic materials with the consequent complete change in the characterization of such organic materials. This is true only theoretically. It has no practical effect in the treatment of waters such as the Rockaway River water.

At the time of the hearing before the Master it was believed that the chlorine gas or hypochlorites did remove organic matter, and the Master so stated in his report. Since that time the practical application of chlorine or hypochlorites to water has demonstrated that they have no appreciable effect on the organic matter in the amounts which can be safely added to the water.

3. Exception is also taken to paragraph 14, page 16. Mr. Pease in speaking of the sedimentation in the reservoir makes the following statement:

> "No evidence is presented that these purifying forces have not been able to accomplish all that they did accomplish in the years prior to 1908 and 1909, by reason of any alleged increase in the amount or characteristics of the pollution of the waters of the watershed and in the reservoir."

Affidavit of Clyde Potts

The decision of the Vice-Chancellor in the original case specifically stated that the reservoir was a purifying mechanism except on certain occasions. This finding of the Vice-Chancellor applied to the reservoir with the pollution entering it as it existed prior to 1908. The moving affidavits for this rehearing, particularly those of Messrs. Vreeland, Caldwell, Griffin, Johnson, Fuller, North, Levy, and myself called particular attention to the increasing amounts of pollution which are reaching the Rockaway River at Dover. The increasing amount of pollution which is reaching the Rockaway River in Dover is so plainly evident to the eye that it is not necessary to make analyses of the water to show that the amount of pollution reaching the river now is much greater than it was prior to 1908. This increasing amount of pollution that now reaches the river aggravates the shortcomings of the reservoir as a settling device which Vice-Chancellor found existed prior to 1908. This aggravated condition gives poorer sedimentation in the reservoir than it did prior to 1908, and at certain times is so great that the hypochlorite system cannot be relied upon to render the water pure and wholesome even if the sterilizing device was capable of performing the functions which the experimenters of 1908 hoped that it would be. I know of my own experience from experiments which I made in 1909 at the Boonton reservoir that at times it can not be relied upon to give adequate sedimentation to the water. As the pollution increases on the water shed, as it has done in Dover during the past ten years, these times when it fails to act as a sedimentation basin constitute a grave menace to the health of the people in Jersey City and a menace which in my judgment the chlorine disinfection process is not capable of overcoming.

To offset this increasing pollution the City has been compelled to increase the dose of hypochlorites from eight pounds per million gallons in 1908 to twenty pounds at the present time. This increase in the use of bleach has now reached the limit. At times I have noticed an odor of chlorine in the various gate houses on the pipe line leading from Boonton to Jersey City.

4. Exception is taken to the affidavit of Mr. Provost mainly to his statement contained in paragraph 7, page 3, wherein he draws the inference that the people of Chicago, Detroit, Buffalo, Cleveland, New York City, Nashville, Seattle, Hartford, Lynchburg, Newark, Omaha, Sacramento, Milwaukee and other cities use a water supply which is sterilized after sedimentation and that consequently these supplies being satisfactory in the places he named a similar supply should be satisfactory to Jersey City. I know of my own experience that the water supply of Chicago Detroit, Buffalo and Cleveland are not considered satisfactory supplies by the authorities at those places and that steps are now under way to provide some adequate and safer treatment to the water than can be relied upon by sedimentation followed with sterilization. The City of Cleveland is preparing to spend several million dollars on sewage disposal for the purpose of removing the menace of sewage from its water supply, and in this respect could be compared to the situation existing on the Rockaway River, where the City of Jersey City is preparing to spend upwards of a million dollars to remove the sewage of Boonton, Dover and Rockaway from its supply.

The City of Newark, mentioned by Mr. Provost as being one of the cities that uses sedimentation followed by disinfection has adopted an altogether different policy from any that could be used on the

Rockaway River in the case in question. The Pequannoc River, from which Newark draws its supply, is comparatively sparsely settled and the City has spent between one and two million dollars in purchasing houses adjacent to the river and which were likely to pollute its supply, and in one or two cases have bought out entire villages and removed them from the watershed. This policy would not be applicable for Jersey City to adopt on account of the immense values in Dover, Rockaway and Boonton, but in lieu of such a policy the City contracted with its contractor to provide an intercepting sewer for the purpose of diverting the sewage from these places when the waterworks was completed.

In my judgment the cases of the cities cited by Mr. Provost tend to emphasize rather than otherwise the necessity for the construction of the intercepting sewer for the purpose of removing the sewage of Dover, Rockaway and Boonton from the Jersey City supply, and confirms the farsightedness of those officials of Jersey City who drew the original contract with Mr. Flynn requiring the construction of the sewers and sewage disposal works to prevent the contamination of the water supply.

CLYDE POTTS.

Sworn and Subscribed to
before me this 18th day
of July, 1918.

Eleanor Schenk.

(seal.)

Order.

IN CHANCERY OF NEW JERSEY.

Between
THE MAYOR AND ALDERMEN OF JERSEY CITY,
Complainant,

and

JERSEY CITY WATER SUPPLY COMPANY,
Defendant.

On Petition, Etc., Order.

This matter coming on to be heard in the presence of Albert C. Wall, Esquire, of counsel with the complainant, and Gilbert Collins, Esquire, and Humphreys and Sumner, of counsel with the defendant, upon an order entered herein on the seventh day of June, Nineteen Hundred and Eighteen, that the defendant show cause why under the leave reserved to the complainant to apply to this court for such further order or decree as might be necessary to carry into effect the decree made in this cause on June 4, 1908, and the like reservation in the decree made in this cause on November 15, 1910, this court should not open and modify the said decrees by providing that the complainant should receive the deduction from the contract price referred to in the seventh paragraph of said decree of June 4, 1908, or in the alternative, why the complainant should not be at liberty to file a bill of review or application in the nature of a bill of review for the purpose of having so much of the said decrees above mentioned as permitted the defendant, Jersey City Water Supply Company, to substitute the alternative plan and device referred to in said decrees in lieu of the sewers and sewage disposal works, intercepting sewers and drains in the decrees mentioned, reviewed, reversed and set aside, and adequate relief granted to the complainant against the defendant, or such persons and corporations as might be liable in the place and stead of said defendant; and the petition of the complainant, and affidavits thereto annexed, and the answering affidavits filed by the defendant to the said petition and complainant's affidavit in reply thereto having been read, and counsel having been heard, from all of which it appears that the complainant is not entitled to the relief sought by it in its said petition.

It is thereupon on this eighth day of October, 1918, on motion of Humphreys & Sumner, solicitors for the defendant, ordered that the said petition be dismissed with costs, without prejudice.

E. R. WALKER,
C.

Respectfully advised,
Frederick W. Stevens,
V. C.

IN CHANCERY OF NEW JERSEY.

Between
The Mayor and Aldermen of Jersey City,
Complainant,

and

Jersey City Water Supply Company,
Defendant.

It is on this eighth day of October, 1918, stipulated and agreed in behalf of the defendant that if an appeal be taken by the complainant from the order of the Chancellor made in this cause on the day of the date hereof, as advised by his Honor, Frederic W. Stevens, one of the Vice Chancellors of this Court, dismissing the petition of the complainant filed in this Court on June 7th, 1918, the defendant will make no claim on said appeal that said order so appealed from is not reviewable by the Court of Errors and Appeals, but on the contrary will admit, and hereby admits (so far as it has power to do so), that said order is an appealable order.

Humphreys & Sumner,
Solicitors of Defendant.

Opinion.

IN CHANCERY OF NEW JERSEY.

Between
THE MAYOR AND ALDERMAN OF JERSEY CITY,
Complainant,

and

THE JERSEY CITY WATER SUPPLY COMPANY,
Defendant.

On Bill.

Mr. Albert C. Wall, for applicant.

Mr. John B. Humphreys and Mr. Gilbert Collins, for defendant.

Stevens, V. C.

This is an application to file a bill of review.

On August 1, 1905, Jersey City filed its bill against Patrick H. Flynn and the Jersey City Water Supply Company praying that they might be decreed to convey to it the water works conducted by them upon payment of such part of the consideration as might be ascertained to be due. A decree directing a conveyance was made in accordance with the opinion reported in 4 Buch. 104 (affirmed with a slight modification 6 Buch. 607). There was a reference to the late Chancellor Magie, as master, and his findings were approved in 9 Buch. 212.

Pursuant to the decrees made, the works were transferred and delivered to Jersey City in 1911, and Jersey City paid so much of the contract price as was found to be then due. It has continued to operate and use the works ever since. It now applies for permission to file a bill of review on the ground of newly discovered evidence. This evidence is that since the trial, bacteriologists have discovered that a bacillus known as B. Welchii, if present in water in considerable numbers, is productive of intestinal disorders; that this bacillus has recently been found in the Jersey City water and that it is probable that being present now, it was present in 1911 when the works were delivered to Jersey City. The relief sought is a money decree for a sum representing the cost of intercepting sewers.

Th affidavits filed show that since 1911 conditions have changed for the worse, and that there is greater pollution in the Rockaway river now than there was then. The deterioration in the quality of the water appears to have been due to the gradual increase of population on the water shed and to the fact that the gravelly soil underlying Dover and perhaps other smaller towns has become so permeated with polluted matter that it is no longer capable of acting as a filter and that, consequently, the water used by the inhabitants and the contents of cesspools find their way into the river unpurified.

The principal question is whether assuming complainants affidavits to state the facts correctly, they show a breach of contract on the part of the contractor. His contract was "to construct a new system of water works for Jersey City and to supply said city therefrom with pure and wholesome water" * * * the water to be furnished to be "pure and wholesome for drinking and domestic purpose". In the opinion filed in *Jersey City* vs. *Flynn,* 4 Buch. 104 it was said: "Contracts must have a reasonable construction and must be read in the light of the surrounding circumstances. The evidence shows that before the contract in question was executed, the city authorities visited the watershed and actually saw what the conditions were. They knew that the river flowed through a thickly populated region and that some pollution at the points where the population was thickest was inevitable. I think it is quite plain that the contention of counsel for the city that because it is provided that the supply is to be free from pollution and because the river is a part of that supply, therefore the *river* must be free from pollution from its source to the point where it flows into the Boonton reservoir is untenable. In view of the evidence the city would be demanding an impossibility. I think the contract means, that the supply at the time it reaches Jersey City and is delivered into the reservoir or pipes there, must be free from pollution. For example, if after the water should leave the Boonton reservoir, but partially purified, it should be subjected to the action of a filter plant, established at any point along the route, and be there freed from pollution, I have no doubt the terms of the contract would be fully complied with."

Further on I say (p. 138) "There is one other remark that, in order to avoid misapprehension, I wish to make before considering the evidence. The company is not bound to provide against that which may arise in the future; in other words against future conditions. Jersey City will have to provide against them, as occasion may require. For example, if the present population of the watershed does not create a situation calling for the installation of a filter plant, the company is not obliged to furnish it, merely because when the population increases, such a plant may be a necessity".

These quotations indicate the rule to be applied on this application.

It was strenuously contended on behalf of the contractor that the newly discovered evidence must be evidence of fact and not of opinion; and that evidence of opinion based on discoveries made since the trial is more objectionable than ordinary opinion evidence. I should be unwilling now to hold that such opinion evidence might not, under some circumstances, be ground for a new trial. I do not think the point calls for decision. The fundamental question is whether the affidavits show that the contractor has failed to perform his contract. The tests, chemical and bacteriological, in use when the works were delivered indicated that the water was pure and wholesome, after subjection to the treatment approved by the late Chancellor Magie. But if it stood these tests then, and the test of actual user beside, it was pure and wholesome within the meaning of the contract. It is absurd to suppose that the parties contracted for such water only, as would stand the tests that might be applied by future generations, in the light of future discoveries. The contract was to be completely performed at a time designated. It was the standards of the time and not the standards of the future, that were to determine whether full performance had been made. The contract was not to furnish water free from every mineral and other impurity, but only from such impurities as were then regarded as detrimental to health. Water absolutely pure is to be had only in the laboratory. If the Court found, as it did, that the water was pure and wholesome, according to the tests then known, and if it adjudged performance on that basis, and if the contractor delivered the works on that basis, there is no ground for asserting that he did not discharge his contract obligations.

There is nothing in the proof to indicate that the water was not pure and wholesome according to the then opinion. The case was tried by able counsel with the greatest care and elaboration. It is not pretended that any witness speaking only with reference to the then scientific knowledge on the subject could have testified in such a way as to have changed the result. It is not impossible that bacteriologists, will, in the future, as counsel suggest, discover, in addition to the B. Welchii, other germs or impurities that communicate disease—impurities that may have to be eliminated, before in the estimation of the scientific opinion of coming times, the water is entirely fit to drink; but is the contract to remain open until the last discovery is made?

There is another objection to the relief sought which seems to me to be fatal. It is a well known rule that, in the language of Depue, C. J., in *Colton* v. *Depew,* 15 Dick. 454 "the statutes of limitation do not apply to Courts of Equity for the reason that the words of the statute apply only to particular legal remedies, but proceedings in equity to enforce a legal right are within the spirit and meaning of the statutes and have always been so considered".

Now what is the right sought in this case. Plainly, a *legal* right. Complainant does not ask that the decree be opened, in order that, it may return the plant. The right insisted on, is a right to a money decree, adjudging damages for breach of contract; the measure of damages being, it is said, the cost of the intercepting sewers, which it proposes to build. This cause of action, accrued at latest in 1911, when it took the works and paid the price, for it was then, if at all, that the breach occurred. The present petition was not filed until 1918. Had it sued at law for damages it would have been barred by limitation. It is true that *in* *form* this is an application to file a bill of review to enable complainant to put in additional evidence, but, in substance, the evidence when put in, will be used as the basis of a money decree,—a decree founded on a cause of action occurring after the original decree was made. No part of the prayer of the original bill would meet the case. A new prayer would be necessary and this prayer would be grounded on a new cause of action not commenced and sued within six years next after it accrued. The case is plainly one within the spirit and meaning of the statute, if not within its letter; and none the less so because it is presented under the *form* of a bill of review. The end sought is and is only damages;—damages that would have been the subject of a legal action, but for the presence of the decree.

There are no equities that stand in the way of applying the statute. If there be any, they are rather with the defendant, who, after affirmance of the decree by the Court of Errors, distributed the price or the greater part of it, among its creditors and stockholders.

The application is denied, but as the denial is, no doubt, appealable, no injustice will be done, if the views here expressed are erroneous. The test of the right to appeal is whether the party be aggrieved, and Jersey City is certainly aggrieved if it has a legal right to recover damages in this Court and an opportunity to vindicate that right is denied. *Day* v. *Allaire*, 4 Stew. 303; *Reed* v. *Patterson*, 17 Stew. 211.

New Jersey Court of Errors and Appeals

THE MAYOR AND ALDERMAN OF JERSEY CITY, *Complainant-Appellant,* vs. JERSEY CITY WATER SUPPLY COMPANY, *Defendant-Appellee.*	On application for leave to file Bill of Review.

BRIEF FOR JERSEY CITY.

Statement of Case.

Appeal from an order of the Chancellor advised by V. C. Stevens, dismissing application to file.

This is an application for leave to file a bill to review that portion of the decree made November 15th, 1910, in a cause between the same parties, which permitted the defendant to substitute an alternative plan, viz: a chlorination plant in lieu of sewers and sewage disposal works, to which the City had been held to be entitled under the provisions of a decree of the Court of Chancery made June 4th, 1908, in what is referred to hereinafter as the Main Case. The course of the former litigation is set out in the petition printed on page 3 *et seq.* of the case.

In brief the situation was that the City contracted for the construction of water works and was so circumstanced that it was compelled to accept the works notwithstanding they were not completed in accordance with the contract. It desired to pay for the works but the contractor could not deliver the works because the same had not been constructed as required by the contract and the bill of complaint prayed that the court ascertain what part of the water works system the contractor could convey to the City and what part of the consideration of $7,595,000 should be paid by the City to the contractor.

The court found that the works as a mechanism for the purification of the supply were not at all times adequate and reliable. It directed the contractor to convey and granted certain abatements of the contract price for various defects.

The Seventh Abatement was as follows:

> "Seventh: There shall also be deducted from the contract price the cost of establishing intercepting sewers and drains and sewage disposal works capable of substantially preventing the contamination of the Rockaway River above the Boonton Reservoir from the sewage of the City of Dover, the City of Boonton, and the Village of Hibernia, which cost shall be hereafter determined by the Court. In lieu of and as a substitute for all or any of the sewers and sewage disposal works above referred to in this paragraph, the defendant company may, within ninety days from the date hereof, present other plans or devices for maintaining the purity of the water delivered by the company to the City throughout the year under present conditions, and estimates of the cost of the works now necessary therefor; and both parties may present evidence touching the efficiency of such plans or devices to produce the necessary results, and the cost thereof; and the defendant company may, pending the taking of testimony, with the leave of the court, upon notice, present amendments and modifications of such plans and devices."

This language was construed by the Court of Errors in *Mayor and Alderman of Jersey City* v. *Jersey City Water Supply Company* in 76 Eq., 607-8 as follows:

> "As we read this provision of the decree, the second part of it is in modification of the first part, the purpose disclosed by it being to relieve the water supply company from the deduction from the purchase price, of the cost of establishing sewers, drains and sewage disposal works for the prevention of the contamination of the Rockaway River above the Boonton Reservoir, provided the company is able to exhibit a less expensive plan or device for preventing such contamination *and which will insure that result;* and, if the company shall succeed in doing so, then permitting the cost of the works necessary for the installation of such plan or device, instead of the cost of constructing sewers, drains and sewage disposal works, to be deducted from the contract price. So read, the decree seems to us to be manifestly fair and just to both parties and to afford no ground for criticism."

The decree also provided for a reference to Ex-Chancellor Magie as Special Master to rel port on the cost of the sewers and disposal works, etc., necessary to substantially prevent the contamination of the Rockaway River from the sewage of Dover, Hibernia and Boonton and also to investigate other plans and devices as alternative remedies presented by the defendant for delivering water to the City in a pure and wholesome condition throughout the year under then present conditions, and upon the cost of the necessary works. The exact language of the provision for a reference is set out on page 9 of the case.

On September 3rd, 1908, the defendant presented plans for maintaining the substitute for the sewers and sewage disposal works above referred to. The matter was heard before the Special Master and on May 10th, 1910, the Special Master reported that the defendant had presented an alternative plan for delivering the water in a pure and wholesome condition throughout the year; that the device was first put in operation on the 26th of September, 1908. It was a novelty. The nature of the chlorination device as set forth in the Master's report is described on page 9 of the case.

He found that the device was capable of rendering the water delivered to Jersey City pure and wholesome for the purposes for which it was intended; was effective in removing from the water those dangerous germs which were deemed by the decree to possibly exist therein at certain times.

The City filed exceptions to the Master's report which are set forth on pages 12, 13 of the case.

On November 15th, 1910, decree confirming the Master's report and approving the substitute was made. See page 13 of case.

An appeal was taken and this court affirmed the decree. Throughout the affidavits on the present application the proceedings, including the decree of June 4th, 1908, are referred to as the Main Case and the proceedings before the Master following which the substitute device was ordered, ~~substitute for sewers and sewage disposal works.~~ are referred to as the Reference.

The decree in the Main Case contained this reservation:

> "And leave is hereby reserved to either party to apply to the court, at the foot of this decree, for any such further order or decree as may be necessary to carry this decree into effect."

And the decree after the Reference contained this reservation:

"and leave is hereby reserved to either party to apply to the Court in manner and form as such leave was reserved in the said decree of June 4th, 1908."

On October 11th, 1911, the water plant was turned over to the City and the consideration paid.

THE CHLORINATION DEVICE WAS NOT AN ADEQUATE SUBSTITUTE FOR SEWERS AND SEWAGE DISPOSAL WORKS.

This court by its opinion as set forth above had construed the language of the decree of June 4th, 1908, and declared what result the substitute device must accomplish in order to be an adequate The present application sets forth newly discovered evidence showing that the substitute device was inadequate and was in no sense a substitute within the definition of this court.

The newly discovered evidence is set forth in the affidavits of the petitioner and shows the different heads of newly discovered evidence from which V. C. Stevens in his opinion on this application chose one.

(a) Low temperatures nullify the effect and action of hypochlorite. This fact has only been recognized in the past year.

(b) Bacteria are stunned and not killed by the hypochlorite process which was substituted for sewers and sewage disposal works. This fact was not known to petitioner in 1908-9 or to any of the experts or witnesses obtainable at that time.

(c) The sterilizing process does not destroy B. Welchii and the spore-forming bacteria. B. Welchii is now known to be not only an indicator of sewage contamination, but the actual cause of peritonitis, intestinal putrefaction, auto-intoxication and many other diseases—a fact only partially and dimly recognized in 1908-9.

(d) At or subsequent to 1909, pipes and overflow drains through which polluting wastes from cesspools flowed directly into the Rockaway River and its tributaries, were disconnected in the belief that the sewage ultimately reaching the river would be purified by flow through soil from its point of origin. Since 1909 it has been found that the conditions as to such pollution of the river have become markedly worse due to the fact that the soil, particularly in the densely populated part of the City of Dover, has become saturated with polluting matter and is no longer capable of purifying the sanitary wastes to any substantial extent before they reach the river. The result is, and although it was not recognized in 1909, the conditions made it inevitable then that the polluted wastes of a large portion of Dover enter the Rockaway River and its tributaries directly and unpurified exactly as matter comes through a filter which is not functioning.

(e) The limitations of hypochlorite treatment existent in 1908-9 have become increasingly manifest by actual experience in dealing with what is really an emergency device and not a reliable method for the treatment of water which at times is highly polluted and is subjected previously only to sedimentation and which undergoes rapid fluctuation as to its composition—all of which was true of the water entering the Boonton Reservoir in 1908-9 and has been true since.

(f) The water entering the Boonton Reservoir is too foul for treatment by filtration or any other known method of purification, and this condition has come about as the inevitable result of the factors existent at the time the Court decreed that the chlorination device was an adequate substitute for sewers.

(g) In order to prevent pollution of the Rockaway River and its tributaries, sewers and sewage disposal works are necessary and were necessary in 1909. In recognition of this, on February 4th, 1918, the City of Jersey City made application to the State Department of Health for approval of plans for the construction of a trunk sewer and sewage treatment works to prevent pollution of the Rockaway River by polluting materials from various municipalities, including Dover, situate on the watershed of the Rockaway River above the Jersey City Reservoir at Boonton, and the State Department of Health on May 7th, 1918, approved the general scheme for the construction of a trunk sewer and sewage treatment works as a sanitary measure and described the limits of territory for which such system of drains and sewers shall be constructed. Within the territory so described is all the territory within the corporate limits of the Borough of Wharton, the Town of Dover, the Borough of Rockaway, &c.

(h) The bacterial test is far less reliable than it was considered to be in 1908 and 1909. Its applicability is limited to fewer conditions than was thought to be the fact in that period. It is a test for contamination, not a test for purity. It rests on the theory that because the bacillus known as B.Coli is always found when the germ of typhoid is present, which last has not been segregated in water, the presence of B.Coli is a danger signal; but when the fact is established, as it is in this case, that pollutions enter the water and were bound so to do by conditions existing in 1908-9, it is idle to blink such a fact and rest on the results of inquiry as to whether or no bacterial tests evidence pollution. The bacterial test is merely corroborative if a survey of the watershed demonstrates the entry of pollution in unreasonable quantities, as is the case in this case. No corroboration by means of bacterial tests is necessary. In 1908-9 too much reliance was placed by the experts on both side sof the cause on the finality of the bacterial test for B. Coli. It was not then recognized, as it is now by water experts, that the bacterial test is chiefly of value where other methods of investigation are not available. There is no bacterial test which will determine whether a water is pure and wholesome.

(i) The operation of hypochlorite is to artificially interfere with the character of the water entering the Boonton Reservoir and by destroying large portions of certain bacteria to conceal serious sewage pollutions. The pollutions themselves are not destroyed by the sterilizing process but only the evidence of the pollution. This fact was only partially recognized in 1908 and 1909.

(j) There is no known method of determining how much hypochlorite or bleach should be added to the water to attain the results which it was believed in 1908-9 were attained by the hypochlorite process. If there were any ascertainable standard and if the hypochlorite were effective, then the amount added to the water should of necessity be sufficient to kill all bacteria of a harmful nature; but no such freedom of operation is possible because the dose frequently creates such objectionable tastes and odors in the water in Jersey City that consumers are unable to use it. These facts were not realized in 1908 and 1909 because it was erroneously supposed that the margin between the amount of bleach necessary to kill dangerous bacteria and the amount of bleach which would create objectionable tastes and odors was so great that the question would not become a practical one. This was and is an error.

(k) The water delivered to Jersey City is not pure and wholesome and was not in 1908-9, and the device substituted for intercepting sewers did not effect the delivery to Jersey City consumers of pure and wholesome water in accordance with the rights of the City as declared in the decrees of this Court in the litigation adverted to above.

(l) The conditions in the Rockaway Watershed existent in 1908 and 1909 and existent since were and are prejudicial to the public health of the citizens of Jersey City.

The relief prayed was:

1: That under the leave reserved to petitioner to apply for such further order or decree as might be necessary to carry into effect the dcree above referred to of June 4th, 1908, and the like reservation in the decree of November 15th, 1910, above referred to, the Court open and modify the said decrees by providing that petitioner should receive the deduction from the contract price referred to in the Seventh Paragraph of the decree of June 4th, 1908; or, in the alternative—

2: That petitioner be at liberty to file a bill of review or application in the nature of a bill of review, for the purpose of having so much of the said decrees above mentioned as permitted the Jersey City Water Supply Company to substitute the alternative plan and device hereinbefore referred to in lieu of said sewers and said sewage disposal works, intercepting sewers and drains in the decrees mentioned, reviewed, reversed and set aside and adequate relief granted to petitioner against the defendant, or such persons and corporations as might liable in the place and stead of said defendant; and your petitioner prayed leave to use upon this application the files of the Court.

3: For such further or other relief as may be equitable.

Order to show cause on the petition and affidavits and exhibits was made on the 7th day of June, 1918. The defendant submitted the affidavits of Pease, Cook, Gardner and Provost in reply.

Of these affidavits that of Cook (Case, p. 242) was devoted to the statement of the populations of municipalities on the Rockaway River Watershed. He made his comparisons not between the time when the decree of 1910 was promulgated and 1915, but between 1905 and 1915.

The affidavit of Gardner (Case, p. 224) President of the defendant company, gave particulars concerning the capital stock, bonded indrebtedness of the company and the disposition of the moneys received from the sale of the plant.

The affidavit of Pease, a bacteriologist (Case, p. 224), is taken up mostly with criticisms of the affidavits of petitioner. It does not appear that he has any first hand knowledge of the shed or of the physical situation. Apparently he has never been in any of the municipalities in the shed or seen the Rockaway River. He says that in his opinion what is designated as new matter in the petition, is a recital of evolutionary and cumulative scientific developmetns largely explanatory in character which go to the demonstration of the fundamental fact that the hypochlorite treatment of water intended for potable purposes accomplishes substantial sterilization of that water when applied under appropriate conditions and in an efficient manner. Excluding his criticisms of the affidavits, q. v., he says that *much* of the organic elements in sewage polluted waters is substantially destroyed in a chemical sense by the chlorination, and other organic constituents rendered innocuous. That there is nothing in the way of conclusive or even strong evidence in his opinion that chlorination results in a stunning or incomplete devitalization of B.Coli present in waters and their subsequent revival, and it is not necessary to require that complete destruction of pathogenic bacteria should take place in order that they be rendered innocuous. He says also that the effects of reduction of temperature "undoubtedly were or should have been recognized and their effect if any demonstrated at the time of the presentation of the evidence which led to the decree;" that it is true that spore-forming bacilli are under extraordinary and very unusual conditions capable of producing disease, but as these bacilli are widely distributed they must be usually without pathogenic properties. He says that he knew all about them in 1908 and 1909. That the affidavits of the petitioner show that the watershed of the Rockaway River is of such a character that "even if the sewage of Dover, Hibernia and Boonton were entirely eliminated from the river there would still remain sewage pollution (much of it undoubtedly from human sources and therefore potentially dangerous to health) entering the river at numerous points; that if the waters thereof were not properly purified (preferably by sterilization by means of hypochlorite or chlorine, as is the water supply at the present time) the water supply could only be considered as one offering a potential menace to the health of the consumers thereof."

The affidavit of Provost, the only other expert for the defendant (Case, p. 246) is the result of an examination made by him of a table prepared by George W. Fuller, one of the affiants of the petitioner and one of the persons responsible for the first installation of the hypochlorite plant for the treatment of potable water.

Provost also says it is his belief that certain Massachusetts supplies are not even sterilized. Sedimentation is the only means relied on for the removal of impurities; also that he is informed and believes that the greater part of the people of the United States obtain their water supplies from surface sources more or less contaminated by human discharges; that approximately twenty millions of people use water after it has been subjected to filtration and sterilization, and approximately twenty million after sterilization alone or combined with sedimentation, as is the case in Jersey City and a number of other cities; but see Fuller's reply affidavit in which he shows first-hand knowledge of the cities in question. (Case, pp. 251-255.)

Provost also says that he believes that Jersey City if succesful in these proceedings, intends to construct a trunk line sewer from various municipalities along the Rockaway River to a point below the Boonton Dam, and to operate a sewage treatment works for the aeration of the sewage; says that such treatment is experimental.

(Note)—He evidently believes that the right to file a bill of review is equivalent to a decree in favor of the City. Apparently this expert, in common with the only other expert produced on behalf of the defendant, had never visited the Rockaway River and knew none of those things which would be acquired by an investigation of the physical situation.

The City filed a reply affidavit of Fuller (Case, p. 251) in which he takes up and answers fully the points covered by Messrs. Pease and Provost.

The City also filed a reply affidavit by Johnson (Case, p. 262) in which he covers the matters touched on by the experts for the defendant. See also reply affidavits of North (Case, p. 269) and Potts (Case, p. 276).

We have not attempted to set out the points of Petitioner's affidavits in full because they are in such form that an analysis would become repetition.

The defendant, in open court at the time of the argument, offered to stipulate that it would make no claim in this appeal that the order appealed from was not reviewable by this court, but would formally admit that said order was an appealable order (See Stipulation, Case, p. 282).

The matter was argued before Vice Chancellor Stevens on October 8th, 1918. The Vice Chancellor dismissed the petition without prejudice. See order, page 280 of Case. The matter was brought before this court by appeal filed October 16th, 1918 (Case, pp. 1, 2).

The Questions involved are

1: Whether leave should be given to the City to question by bill of review the adequacy of the chlorination plant at the time it was turned over to the City to insure a result equal to that of sewers, etc.

2: Whether by virtue of the reservations in the decrees and the facts disclosed by the affidavits, the City should not be permitted to file an application in the nature of a bill of review asserting the inadequacy of the chlorination plant as a substitute for sewers and sewage disposal works for which the chlorination plant was ordered as an alternative device.

BRIEF OF THE ARGUMENT.

POINT I.

The Court will not try the merits of the case on a petition of this kind. All that is necessary is for the petitioner to lay a sufficient foundation for a bill of review.

In *Quick* v. *Lilly*, 3 N. J. Eq. 255, 257, the Chancellor said:

"The new matter must be such as if un-"answered in point of fact, would either "clearly entitle the plaintiff to a decree, or "would raise a case of so much nicety and "difficulty, as to be a fit subject of judgment "in a cause: *Norris* v. *Le Neve,* 3 Atk. 26; "*Ord* v. *Noel,* 6 Mad. 131; 1 Hoff. Ch. Prac. "570."

And on page 258—

"But this is not the time to inquire whether "the petitioner can prove all the facts set out "in this petition. He there states the facts "and matters which he expects and believes "he will be able to prove, and verifies the pe-"tition by his own oath. If they are such as "to lay a sufficient foundation for a bill of "review, it is all that is required. The merits "of the case cannot be tried on the petition. "In this case the petitioner has laid such "foundation."

In *Traphagen* v. *Voorhees,* 45 N. J. Eq. p. 41, the Court, on page 44 refers to the language of some of the English cases, stating that the evidence must be of a fact "materially pressing upon the decree."

In *Quick* v. *Lilly* above, the language of *Ord* v. *Noel,* 6 Mad. 127, is evidently referred to, viz. that the case must be one of so much nicety and difficulty as to be the fit subject of a judgment in a cause.

POINT II.

The application should be granted on the ground of newly discovered evidence concerning the inadequacy of the sterilization plant to perform the office of sewers and sewage disposal works.

The law on the subject of bills for review is clear.

In *Norris* v. *Le Neve,* 3 Atk. 25, decided in 1743, it was stated that Lord Bacon's Rule in respect to bills of review had never been departed from since the making of them.

In *Traphagen* v. *Voorhees,* 45 N. J. Eq. 41, Vice-Chancellor Van Fleet quoted Lord Bacon's First Ordinance and dealt with the cases which defined the kind of newly discovered evidence which will induce a court to grant leave to file a bill of review. The headnote of that case is:

> "To get leave to file a bill of review on the "ground of newly-discovered evidence, the "applicant must show (1) that he has new "competent evidence, so material as to con-"vince the court that its decree is erroneous, "or to raise a question of so much difficulty "as to be the fit subject of a judgment in the "cause; (2) the new matter must be set forth "in such form that the court may see that it "is admissible; (3) new oral evidence, if "weighty enough, will be sufficient; (4) evi-"dence simply tending to impeach the char-"acter or impairing the credibility of wit-"nesses will not be sufficient; (5) the appli-"cant must show, by a statement of facts or "circumstances, that the nature, situation or "condition of the new matter was such that he "could not, by the use of reasonable diligence, "have discovered it in time to have made use "of it on the final hearing; (6) the court will "not be governed by the opinion of the appli-"cant on this point, but he must lay the facts "before the court, so that it may form its own "judgment."

In *Watkinson* v. *Watkinson,* 68 N. J. Eq. 632, the practice in filing bills of this character is laid down, and it is held that although there is no express statutory limitation as to the filing of bills of review the analogous limitation of the right of appeal should govern, *except* in the case of new or newly discovered matter, and points out that under the cases its limitation is 20 years in case of newly discovered evidence.

Lytton v. *Lytton*, 4 Bro. C. C. 442.

The evidence submitted meets the tests of our cases.

Petitioner's evidence is of two general classes: First, that which is new both in kind and degree, not touched upon in the previous litigation. Instances of this are the paralysis of the sterilization process by cold weather; the stunning of the bacteria and their subsequent return to vigor; saturation of the soil at Dover, whereby what was considered a protection has been transformed into a menace, etc.

The other class of newly discovered evidence is where the difference is in degree of understanding concerning the limitation of the process. There is a very real difference between evidence where one is dealing with a situation which has been crystallized and fixed, as for example, where the question to which the newly discovered evidence is directed is whether a certain document was forged. It was forged or not. It was accomplished which ever way it was. It was definitely finished. But when the inquiry is prognostic and not diagnostic; when the question is whether a certain process admittedly experimental will perpetually accomplish a certain result in partially ascertained conditions, necessarily the *degree* of knowledge possessed by experts and obtainable as evidence, becomes of the highest importance.

It has been held by the House of Lords that a new trial should be granted where scientific and novel questions of fact are involved, which are not yet fully solved but are still within the region of *bona fide* controversy, especially if the matter is one of great public interest, as in our case.

The Managers of the Metropolitan Asylum District vs. *Hill et al.* (1882) 47 Law Times Rep. n. s. 29 (House of Lords) (cited by Farwell, J., in *Atty. Gen.* v. *Nottingham Corp.*, 1904, 1 Chanc. 673, 682).

To the same effect, though lacking the element of great public interest:

Anschutz v. *Louisville Ry. Co.*, 152 Ky. 741; 154 S. W. 13; 45 L. R. A. n. s. 87, 91 (1913).

The Managers of the Metropolitan Asylum District vs. *Hill et al.* (1882), Vol. 47, (n. s.) Law Times Reports, 29 (Eng. House of Lords); also English Ruling Cases, Vol. 16, p. 556.

This was an action by the three plaintiffs (respondents) severally owners and occupiers of certain dwelling houses and lands in the parish of Hempstead, county of Middlesex, against defendants (appellants), for an alleged nuisance, created and caused by defendants in the erection and maintenance by them under statutory authority of the Hempstead Smallpox Hospital on land belonging to defendants, in said parish and adjoining said houses and lands of plaintiffs, in which action plaintiffs claimed damages for injuries sustained by them from said nuisance, and also an injunction to restrain the defendants from using their said lands and the buildings thereon as a hospital for smallpox, or any other infectious or contagious disease.

On a trial before Pollock B. and a special jury (reported 40 L. T. Rep. n. s. 491) both sides called expert witnesses on the issue whether the existence of said hospital was a source of danger to the neighborhood. The jury brought in a special verdict in answer to questions submitted to them by the court and found said hospital a nuisance *per se,* and that it was not erected and maintained with proper care and skill. Judgment was given for plaintiffs and injunction granted to restrain defendants, their servants or agents, from carrying on the asylum so as to be a nuisance to all or any of the plaintiffs. Defendants obtained in the Queen's Bench Division (Cockburn, L. C. J. and Mellor, J.), a rule for a new trial on the ground that the verdict was against the weight of evidence, which was afterwards made absolute.

On cross appeals the Court of Appeal (Bramwell, Brett, and Cotton, L. J. J.) affirmed judgment of Pollock on the point that the statute was no excuse to the defendants, and affirmed the judgment of the Queen's Bench Division as to a new trial, but with a condition as to payment of costs (42 Law Times Rep. n. s. 212).

Defendants appealed to House of Lords against imposition of costs as a right to a new trial, and on the question of statute being a justification.

Held; House of Lords; New trial granted without condition of paying costs.

Lord Chancellor Selbourne said, p. 30, "I consider it important to observe that the jury had not, in this case, to find a verdict on a common question of fact, depending upon the memory or credit of witnesses, who, if they remember accurately and speak truly must be capable of understanding what they have seen and heard. Nor was the question one of scientific knowledge, ascertained and verifiable by experiment, as to which any expert properly qualified could speak with the same certainty as concerning things which are the direct objects of sense. It was a problem of *medical science not yet fully solved, but still within the region of bona fide controversy.* I think it would be a *fallacy to apply to a case of that* *kind the ordinary reasoning,* according to which the verdict of the jury on a question of fact ought not to be disturbed when there has been evidence on both sides unless the preponderance of evidence against the verdict is strong and clear. If indeed nothing were at stake beyond the right of the plaintiffs to receive a certain sum of money by way of damages for a particular trespass, the maxim, '*Interest rei publicae ut sit finis litium*', might be in point, even in a case of this problematical kind, as (in patent cases especially) may sometimes be liable to happen. But when much more than this is at stake. It may well be that a single verdict, which appears to the court to be founded on an inconclusive and unsatisfactory state of evidence, ought not to stand even though an opposite verdict might also have been open to a similar objection. The court which has to determine whether a new trial should be granted ought to weigh the importance of the question with, and the consequences depending on its proper decision with strict impartiality." (Italics ours.)

Lord O'Hagan, after stating that the judges below, both in Queen's Bench Division and in the Court of Appeals, were unanimous in favor of a new trial, said, p. 31, "But even if there had been nothing else in the case (than conflicting medical evidence and statistical evidence) and nothing in the verdict attracting distinct judicial dissatisfaction, I should have been disposed to say that a new investigation is desirable. *The matters at issue were of great novelty and vast public importance.* The verdict and the injunction which necessarily followed it may affect deeply the health and safety of the community at large, and render very difficult, at least, if not impossible, the legal establishment of any hospital in any populated district for the reception of patients labouring under smallpox or perhaps other contagious diseases. . . . I do not say that the proof adduced might not have been so conclusive and the verdict so clearly right as to dissuade your Lordships from putting the parties to the great expense and vexation of another trial, perhaps even more lengthy and more costly than the last. But it seems to me there is here in the balance of the evidence, and in *the suggested imperfection and possibly misleading operation of the statistics,* which may have determined the judgement of the jury, enough to make us pause before we pronounce a ruling fraught with results so very serious—to be final and irreversible." (Italics ours.)

Lord Blackburn, p. 33, "I think that in this case a new trial ought to be granted. It is not easy, probably it is impossible, to lay down any precise rule as to when a new trial shall be granted or refused as against the evidence, and I shall not attempt to do so. The power to do so is intrusted to the courts for the purpose of securing that, as far as is practically possible, justice should be done. And the mode in which it is exercised, and the principles on which the courts act in doing so seldom got into the reports, whilst there was no appeal on such questions. . . . And I think, though as I have already said it would be difficult to find reported authorities for it, that the importance of the consequences of the verdict is always an important element in coming to a decision on such a question. . . . *I think that a further and very important element to be taken into account is, whether the question in issue is one of novelty, such that the litigant could not reasonably be expected to grapple with it and understand it all at once, and this is what weighs most with me.* I think that the respondents obtained their verdict, pricipally if not entirely, by the effect of their statistics, by which they undertook to show that the proportion of smallpox cases in the immediate vicinity of the hospital whilst it was open was much greater in proportion to the population than in other districts similar in character, but not near a hospital. Both sides called the evidence of experts . . . . practically the best if not the only mode of getting at the results of the extensive experience of professional men. If the facts did show that, not once or twice but during the whole course of these two epidemics, there was more disease in the neighborhood of the hospital than in other localities where everything was similar, except that there was no hospital there, I think the conclusion that the hospital was the cause of that excess of disease is one which the jury might draw. But I cannot think that there has been such an investigation into these statistics as to satisfactorily establish the foundation for this inference. It may be that *further investigation* will confirm the findng of the jury; it may be it will disprove it. All that I now say is that I think there has not been such an investigation as to be satisfactory ground for deciding such a novel and important question, and, therefore that there should be a new trial." (Italics ours.)

Lord Watson, p. 34, "I also am of opinion that there ought to be a new trial in this case. . . . Whether that or a similar hospital must even with the best of management, necessarily occasion nuisance to its neighborhood is a question which concerns many besides the present litigants. . . . These appear to me to be considerations which ought not to be disregarded in considering whether there ought to be a new trial in the present case. In determining whether there shall be a new trial, the real function of the court is to see that no injustice is done, and it is my opinion that, in a case like the present, the court is entitled, if not bound, to look beyond the interests of the litigants. . . . *In a case like the present of novelty and difficulty, and involving extensive inquiry into local facts and statistics, I do not think it can be imputed as matter of blame to either party that the evidence was not so complete as to afford materials for a satisfactory verdict.*" (Italics ours.)

NOTE to *Metropolitan Asylum District* vs. *Hill*.

Plaintiffs at original trial offered evidence regarding conditions prevailing at two other smallpox hospitals of defendants, but Pollock B. thought it inadmissable and practically at his request defendant's counsel objected to the reception of this evdence and it was rejected. Now defendants want to get in evidence relating to said hospitals to bear out their expert testimony.

Held—Admissable—See discussion on this point in the opinions.

The above case is strong on the point of the difference in the rule to be applied to evidence when the element of novelty is present. The chlorination device was a distinct novelty. It was designed and supervised by Messrs. Johnson and Fuller and their partners. It was operated by Johnson after it was first put in operation. He made the first recommendation of the use of hypochlorite of lime for the continuous sterilization of a water supply. See Paragraphs 7 and 8 of Johnson's affidavit, Case, pages 23,24.

Anshutz vs. *Louisville Railroad Co.*, 45 L. R. A. n. s., 87 (1913).

In April, 1910, Mrs. Anshutz, the plaintiff, being a young married woman who was at the time enciente, was severely injured by defendant's car. In September, 1910, a baby was born to her. In April, 1911, she was operated on in the presence of several physicians and surgeons. Before the case came on for trial in December, 1911, upon motion of defendant, the court appointed a surgeon to examine the plaintiff as to the nature and extent of her injuries. At the trial all the physicians and surgeons who were present at the operaton testified that there was removed from her body both fallopian tubes, the whole of the left ovary and part of the right ovary. They also testified that since the operation a tumor had developed in the abdomen of the plaintiff which would necessitate another serious operation. All the physicians and surgeons, including the one appointed by the court, testified that the plainiff was now barren. * * * Verdict for plaintiff for $7,000.00. * * * On June 3, 1912, Mrs. Anshutz gave birth to another child, and twenty-five days thereafter the Louisville Railroad Co filed this action for a new trial on the ground that the large verdict had been given Mrs. Anshutz because of the uncontroverted testimony as to her barrenness, which has since been proved false.

> Held—New Trial Ordered.—Turner, J.—"May a party be granted a new trial after judgment against him, where he subsequently discovers clear and unmistakable physical evidence that the vital and uncontradicted testimony, upon which the judgment against him was based, was untrue? * * * Yes. No reflection is intended upon the physicians and surgeons who testified. Either there was some strange and unaccountable mistake, or one of those freakish things in nature has happened which are so rare as that they are said by scientific people to be impossible."

(The facts of this case in and of themselves are conclusive evidence that there was no element of fraud in this case.)

In the main case and the hearing before Chancellor Magie, Messrs. Fuller & Johnson, Chief sponsors, inventors and constructors of the sterilization plant, honestly lent the force of their great attainments to the proposition that the sterilization plant was an adequate substitute for sewers and sewage disposal works. No one who reads their testimony in the previous litigation can doubt the reality of their convictions. These same men, with equal honesty, now assert the inadequacy of the sterilization plant as a substitute, and they point out the various reasons which indicate why they and others who agreed with them in 1909 were mistaken. In other words, the facts discovered since their testimony, knowledge of which was not procurable at the time they gave their evidence, stand revealed before them in the light of experience, and they assert the fact as a fuller experience now indicates the fact to be.

What we say is that since 1909, newly discovered evidence of the character classed by the New Jersey decisions as suitable for a foundation for a bill of review, has come to light. We make no claim that the mere assertion of a witness that he has changed his mind after the conclusion of litigation is a proper foundation for a bill of review. It may be entirely without significance; but if, after having testified concerning certain natural phenomena, an expert witness is confronted by experience with phenomena from which he is bound to conclude that his first testimony was wrong, and if a court on examining his reasons reaches the conclusion that the results of his later observation and experience lay a sufficient foundation for a bill of review, the court is interested not at all in the question of his change of mind but only whether there is valid reason for believing that his present conclusion is true.

Where testimony of witnesses on which the finding was based is founded on and derives credit from particular circumstances, and those circumstances are afterwards clearly falsified by affidavit, a new trial will be granted.

Lister vs. *Mundell,* 1 Bosanquet & Puller's Rep., 427 (Eng. 1799);

Trubody vs. *Brain,* 9 Price's Rep., 77 (1821);

Warham vs. *Selfrige & Co.,* 30 T. L. R., 344 (C. A.) (1914).

Mistake has been frequently held sufficient.

In *Richardson* v. *Fisher,* 7 Moore, 546; 1 Bing. 145, the court granted a new trial on an affidavit of a material witness that he had made a mistake in giving his testimony. This case was cited in *Tomlin, Adsm. Den. ex den Cox,* 19 N. J. Law, 76.

"On affidavit from a material witness that "he had made a mistake in giving his testi- "mony, the court granted a new trial.

"A new trial had been moved for in this "case, partly on the ground that the verdict "was contrary to evidence, but chiefly on an "affidavit from a material witness that he "had made a serious mistake in giving his "testimony.

"Vaughan, Serjt. showed cause against the "rule.

"*Per Curiam*: If there were nothing else in "this case, there must be a new trial on the "important affidavit that the witness has "made a mistake. Rule absolute."

(Reported in 1 Bing. 145; in 8 Engl. C. L. R. 273; also Vol. 130 English Reports (Reprint) at p. 59)

In *Lister* v. *Mundell,* 1 Bos. & P. 427, it was held if the testimony of witnesses on which a verdict has proceeded is founded on and derives its credit from particular circumstances and those circumstances are afterwards clearly falsified by affidavit, the court will grant a new trial. Cited in 34 N. J. L. 307, and 50 N. J. L. 501.

Dudley (*Lord*) v. *Robins,* 3 Car. & P. 26. The plaintiff appeared was non suited because an agreement appeared by the defendant's evidence to contain more than the proper number of words for the stamp it bore, but it afterwards turned out that the witness called at the trial had miscounted the number of words. The court granted a new trial on affidavit of that fact.

In *Truebody* v. *Brain,* 9 Price, 77, the plaintiff's attorney swore to a conversation with a witness for the defendant, who had denied ever speaking to him, and upon a verdict being found for the plaintiff, the judge committed the witness for perjury; the atorney having afterwards stated to the judge that he might have been mistaken, the court granted a new trial and directed the costs of the former trial to be paid by the atorney.

In the argument before Vice Chancellor Stevens great stress was laid by the defendant on the contention that the evidence set forth in the affidavits on behalf of the City was not evidence in existence at the time of the decree of 1910 and therefore was not a proper foundation for a bill of review.

By assuming that evidence and proof were the same thing, defendant sought, without the aid of authority of any kind, to establish the position that the natural laws governing the operation of the chlorination device, because they were not understood at the time of the former hearing, did not constitute evidence existent at the time so as to be available now as newly discovered evidence.

The idea was expressed with crisp felicity in *Lane Fox* v. *Kensington & Knightbridge Electric Lighting Co.* (1892) Chy. Div. Vol. 3, 424, a patent case in which Justice Lindley on Pages 428-429, says:

When Volta discovered the effect of an electric current on a frog's leg, he made a great discovery but no patentable invention. Again, a man who discovers that a known machine can produce effects which no one before him knew could be produced by it, may make a wonderful discovery . . . "*he has added nothing but konwledge to what previously existed.*"

The *Anschutz* case, *supra,* is an apt illustration of the fallacy of defendant's reasoning, for there the condition of the woman furnished *evidence* which was wrongly interpreted to the effect that she was barren, while the birth of the child subsequently was *proof* that she was not.

When we turn to the definitions of evidence, we find they are characterized by great breadth. They lend no aid to any such contention. For example:

Blackstone, Book 3, p. 367:

"Evidence signifies that which makes clear "or ascertains the truth of the very fact or "point in issue either on the one side or the "other."

Best on Evidence, Pars. 11 and 33:

"Evidence thus understood has been well "defined—any matter of fact the effect, ten-"dency or design of which is to produce in the "mind a persuasion, affirmative or disaffirm-"ative of the existence of some other matter "of fact."

Greenleaf on Evidence, Par. 1:

"The word evidence in legal acceptation includes all the means by which any alleged mat-"ter of fact, the truth of which is submitted "to investigation, is established or dis-"proved."

Professor Thayer, 3 Harvard Law Review, 143, says:

> "Evidence then is any matter of fact which "is furnished to a legal tribunal—otherwise than by reasoning or a reference to what is "noticed without proof—as the basis of in-"ference in ascertaining some other matter of "fact."

Defendant's affiant, Herbert D. Pease, says in Paragraph 11 of his affidavit (Case, p. 236), that he knew all about B. Welchii in 1893 and 1894. Apparently he does not disagree in any respect with the petitioner's affidavits so far as this subject is concerned except when they state the new evidence connectd with these organisms which are merely evolutionary (Paragraph 3 of his affidavit). Consequently if Jersey City had been fortunate enough to know of the attainments of Mr. Pease in this direction at the time of the hearing, it could have procured him to testify.

In like manner in Paragraph 10 of the Pease affidavit, he says that the retardation of the action of chlorine upon bacteria in cold water were all phenomena or possibilities that were well known to competent scientists familiar with the principle, and "were or should have been recognized" at the time of the hearing; but Jersey City, in a very extensive employment of experts at the hearing, many of them men of the highest standing, was not fortunate enough to obtain the services of any of the scientists to which Pease refers, and the present testimony of many competent experts is that they did not know until recently and particularly after the epidemic in Montclair and vicinity, that extreme cold would nullify the effect of hypochlorine.

In other words, this fact was not discovered, that is revealed, to persons whom Jersey City in the exercise of diligence, should have brought forward to testify.

Thecurtain had not been lifted so that the experts obtainable by Jersey City could see behind it. The affidavit of Mr. Pease overlooks the fact that the evolution is in the later discovery, not the thing itself. The evolution to which he refers has to do with how much the curtain has been drawn aside, but there has been no evolution so far as chlorine is concerned. The action of chlorine was the same seven years ago as it is now. But apart from the affidavit of Mr. Pease, which defendant makes a part of its argument, defendant gives altogether too narrow a definition to the word "evidence."

Or by way of illustration, suppose in 1491 the question being investigated in a court in England was whether any continent lay to the westward, and on the best proofs obtainable the court had decided that there was no continent to the westward; and suppose Columbus in 1493 had sworn to a moving affidavit on an application for leave to file a bill of review—how seriously would the court view the contention that although the western hemisphere had been in existence, the evidence of the existence of the western hemisphere was not in existence in 1491? Would not the court say that every bit of timber that floated from the shores of the western hemisphere was evidence of the existence of land there? That every discoloration of the ocean's currents that came from the soil that is now America, was evidence of its existence, and so on *ad infinitum*. Undoubtedly the western hemisphere gave off evidence of its existence for centuries before the meaning of that evidence was recognized. Nothing but knowledge was added to an existing fact.

And so it is with any fact scientific or otherwise. When Chancellor Magie, relying upon the best proof obtainable at the time, concluded that the chlorine burned up the organic matter in the water, the fact existent at that time was that it only destroyed a minute amount—too small to measure, as now shown in the reply affidavits of Fuller and Johnson.

POINT III.

That the Court by the reservations in the decrees wished to make it clear that any alternative device must achieve as good a result as would be achieved by the sewers and sewage disposal works provided for under the contract, and that if it did not relief would be granted..

The reservation was:

> "And leave is hereby reserved to either party to apply to the court, at the foot of nis decree, for any such further order or decree as may be necessary to carry this decree into effect."

We do not contend that this reservation made the decree tentative or took away its character as a final decree, for Daniell says (6th Edit. Amer. 997) a decree with a reservation is still a final decree. The effect of the reservation is to permit persons having an interest under it to apply to the court, treating such interest in a summary way without the necessity of again seeking the court's decree, citing *Kendall* v. *Marsters,* 2 DeG., F. & J. 200. That case says the usual form of such reservations is, "Any of the parties are to be at liberty to apply to the court as they shall be advised."

In the case at bar, is a reservation substituting another **decree** to carry into effect the purpose of the decree, viz: to give Jersey City a 100% substitute for sewers and sewage disposal works. That was the principle of the decree.

In *Eureka Fire Hose* vs. *Eureka Rubber Mfg. Co.,* 72 Eq., 555-558, Vice-Chancellor Emery dealt with a reservation for directions, in a decree as follows:

> "That either party have leave to apply to "this court at the foot of this decree for fur-"ther directions, if it should appear to be "necessary in order to effectuate this decree "or to protect the rights of either party there-"under."

and the Court held that under a general leave reserved for further directions, an alteration of the decree made on the original hearing cannot be made, nor a decree inconsistent with it. Citing 2 Dan. Ch. Pr. (6th Ed.), 1370, 1371, and pointing out that the leave reserved in that case was, however, special, and extended only to directions for enforcing or protecting the rights granted by the doecree, not to a modification of those rights.

By comparing the reservation in the Eureka case with the reservation in the case at bar, it appears that in the Jersey City case the reservation is not limited merely to DIRECTIONS for the purpose of effectuating the decree, but reserves leave "to apply to the Court at the foot of this decree for any such further order or decree as may be necessary to carry this decree into effect." The present case is an instance of a reservation large enough to permit of a modification of the mechanism for asserting the rights of the City under the decree. In other words, the practical situation was as if the court said—"You scientific gentlemen apparently agree that this expirement of chlorination admittedly developed during the progress of this law suit will achieve results identical to the results obtainable from sewers and sewage disposal works, and if that be the case there is no equity which demands that the Water Company should be called upon to furnish at much greater expense the sewers and sewage disposal works, which after all can only accomplish the same result, particularly as the city is asking a specific performance with deductions, but the whole thing is a novelty. It may be that you are wrong, in which case Jersey City would have received an inadequate substitute incapable of producing the results to which it is entitled. We will therefore arrange it so that the end of this decree may be attained."

The character of the decree is shown in the recital," and the Court being also of the opinion and adjudging that Patrick H. Flynn and the Jersey City Water Supply Company have not complied with those provisions of the said contract which stipulate that the supply of water delivered to Jersey City shall at all times be free from pollution; it appearing that the works, as a mechanism for the purification of the supply, are not at all times adequate and reliable," etc. (p. 4160, main case).

With the advantage of the retrospect, what abler disposition could be made of the controversy for the purpose of conserving the apparent rights of each party as well as protecting their contractual relations and preventing either from overreaching the other. It is a most picturesque instance of the triumph of common sense over the cock-sure predictions of experts of high standing as to the efficiency of devices which we now know fell short of their confident hopes.

Obviously, the matter is one where resort must be had to the language of the reservation and the known circumstances under which the decree was made.

Defendant contends that the reservations in the decrees cannot help the City for they were merely for the purpose of carrying the decrees into effect.

This is a mere play on words. We have already shown what the results to be attained by the decrees was as that result was set forth by Vice-Chancellor Stevens and later defined by the Court of Errors. The fair meaning of the decrees has been sufficiently set forth in the petition and in this brief, and a construction by which the Water Company should be brought into court and the City allowed to question whether the company should keep the difference in value between that which the court said the City was entitled to and that which the City received, is altogether consistent with the decrees.

Under this reservation it is obvious that the right to the city to relief in case of the inadequacy of the chlorination plant as a substitute does not require that such an application should meet the requirements of the law in dealing with newly discovered evidence.

POINT IV.

The fundamental question is whether the affidavits fairly indicate that chlorination was not at the time it was ordered by the court a 100% substitute for sewers and sewage disposal works at that time.

The opinion says:

The fundamental question is whether the affidavits show that the contractor has failed to perfrom his contract.

We respectfully contend that the fundamental question is rather as we have stated it above because—

1: We are not dealing with the contract. We are dealing with the decree. The contract has been merged in the decree. The decree, as construed by the court, meant to give the value of sewers or an alternative device equally effective. The alternative device was not equally effective. The evidence diligently presented was insufficient because of the novelty of the device. The court decided on the evidence before it. We now ask leave to present newly discovered evidence so important as to warrant the belief that if the court had heard it, it would not have permitted the substitute device.

2: The opinion treats the question as if the whole case were sought to be opened, as if there were no decree. It goes back of the decree of 1908 whereas the City starts with that decree and points to it as the definition of its rights.

POINT V.

The question of tests or standards of purity had no relation to the physical right of the City to sewers or an equally efficient alternative device.

Under the Decree of 1908, the City was held entitled to the price representative of actual sewers, and any test of the purity or wholesomeness of the water was to be directed to a water protected by intercepting sewers. The right to sewers was not to be determined by tests, but the purity and wholesomeness of the water after it had been protected by sewers was to be determined by test.

The City authorities, when they visited the shed upon signing the contract, had in mind the experience of the City in being forced to abandon the plant at Bellville because of the pollution of the Passaic. They knew that danger and they arranged for sewers.

Any standard of purity implied in the contract was for a water from which the sewage of Dover, Boonton and Rockaway had been excluded.

The opinion in the Main Case in 4 Buch. 104, says:

> "There can be no doubt under the evidence
> "that such works (*i. e.* sewage disposal works)
> "were to be constructed."

The standard was defined by the Court of Errors itself. It was to be a device capable of insuring the result of preventing contamination equal in all respects to the result which would be attained by sewers, drains and sewage disposal works for the prevention of the contamination of the Rockaway River above the Boonton Reservoir. (76 Eq. 608)

It is true that it has been determined in the main case that the purity of the water is to be ascertained at the point of delivery in Jersey City and not at its point of entrance into the reservoir at Boonton; but under the Court of Errors decision quoted above, the task that was set for the chlorination device was to furnish a result equal to the result of sewers and sewage disposal works located as stated in the opinion.

As by the chlorination device, independent of any intervening distance between the City and the reservoir, the consumers in Jersey City do not receive a water equal to the water they would have received if they had the sewers instead of the substitute, the Water Company has obtained an abatement at the cost of $20,000. for sewers and works which would have cost some hundreds of thousands of dollars and pocketed a profit of the difference because the Court wished to deal equitably with the Water Company and not force it to unnecessary expenditure for means of accomplishing the same results which cheaper devices would obtain. Now that it appears that the chlorination device was not at the time it was ordered an adequate substitute, never has been since and never will be, we ask leave to lay the newly discovered facts before the court.

Naturally the City could not enlarge the contract to cover periods of time after the plant came into its possession. The opinion in the main case was quite clear as to this; but can there be any doubt that when the pipes and drains carrying sewage into the Rockaway River were cut off and the filtrative powers of the soil at Dover temporarily prevented such sewage from reaching the Rockaway, the inevitable saturation of the soil and the consequent destruction of its powers of filtration represented a present condition at the time the substitute was ordered, and it is certainly a cogent bit of evidence existent at the time. That the cutting off of the drains from Dover into the Rockaway was an important matter, in the view of the Vice Chancellor, is shown by what he said on Page 175 of his opinion:

> "While the trial was progressing the dili-
> "gence of the City's witnesses led to the dis-
> "covery of several cesspools and polluted
> "drains which discharged their contents into
> "the river. Where the proof was clear, the
> "evil was corrected by the agents of the
> "Water Company. Much of the evidence has
> "for this reason become unimportant except
> "insofar as it shows the extreme difficulty of
> "adequately protecting the river as it flows
> "through Dover under existing conditions."

If the inevitable saturation had been realized or pointed out, can any one doubt that it would have been considered important?

But assuming that we are wrong in the contention that sewers were the City's right and tests and standards of purity were only to be applied to a water when so protected, we make no claim that the contract was to remain open until the last discovery is made, as the opinion puts it. The decree does not remain open. It was a final decree with reservations. (Treated elsewhere herein.)

If the conclusion was reached by the use of what everyone considered a yardstick but which was really not a yard long, can the court not do justice? The City never agreed to any particular standards or tests and should not be forever barred if it appears, through the honest mistake of experts, that an incorrect standard was used.

The standards themselves, as the affidavits show, are still within the region of bona fide controversy, to quote the language of the House of Lords case —*Metropolitan* v. *Hill, supra.*

The City's case is no different in principle from any other where a mistake has been made and newly discovered evidence of the mistake has come to light.

POINT VI.

The limitation governing bills of review in case of newly discovered evidence is twenty years.

Lytton v. *Lytton,* 4 Bro. C. C., 442.

See also *Scarisbrick* v. *Lord Skelmersdale,* 4 Y. & C. Ex. 78, page 106; Vol. 160, English Reports Reprint, top of page 940.

Edwards v. *Carrol,* 5 Bro. P. C., 466.

A decree of the Court of Chancery, by Section 44 of the Chancery Act of 1902, has the force, operation and effect of a judgment at law in the Supreme Court, and all decrees and orders of the Court of Chancery whereby any sum of money shall be ordered to be paid by one person to another shall have the force, operation and effect of a judgment at law in the Supreme Court.

The Statute of Limitations applicable to judgments is twenty years. The rights of the parties in the former litigation, were merged in the decree of June 4th, 1908, under the maxim of transit in rem judicatm, the maxim under which a contract upon which a judgment is obtained is said to pass in rem judicatam.

An instance frequently cited is *Drake* v. *Mitchell,* 3 East., 258-259.

In *Hudson Trust Company* v. *Boyd,* 80 N. J. Eq., 267, Chancellor Walker says:

> "In fact when merged into a decree the debt "which before was one by specialty becomes "one of record."

quoted in *Sandford* v. *Wellborn,* 85 N. J. Eq., 577-582.

A man starts an action to foreclose a mortgage on the day before the bond is barred by the Statute of Limitations. But the decree is good for twenty years from the date of the decree. So here.

When Jersey City performed the decrees, no new action came into existence by reason of the failure of the defendant to give the City what the decree, as construed by this court, said the City was entitled to.

The opinion on this application says:

Now what is the right sought in this case. Plainly, a *legal* right. Complainant does not ask that the decree be opened, in order that, it may return the plant. The right insisted on, is a right to a money decree, adjudging damages for breach of contract; the measure of damages being, it is said, the cost of the intercepting sewers, which it proposes to build.

We do not so contend. Our position as to the sewers the City now purposes to build, is that they have nothing whatsoever to do with the defendant. They are mentioned in the papers merely as further evidence in favor of the City's contention that they are necessary because the State Board of Health has ordered them. Clearly, as we contend, that we did not get the equivalent of sewers, &s., in 1911, we could not ask for more than the cost of the sewers then.

Nor, as it seems to us, are we seeking to enforce a legal right. As shown above, the contract was merged in the decree and did not exist thereafter. Consequently there was no breach of a contract in October, 1911, when the City took over the plant. The real grievance of the City came into being when the decree permitted chlorination instead of sewers. The 7th abatement in the decree (Case, p. 4, line 39) abated the cost of sewers, &c., costing say~~s~~ several hundreds of thousands of dollars and permitted an alternative device in lieu thereof which cost about $20,000.

We now seek the difference representative of the difference in efficiency. ~~This court said the alternative device must insure the result of sewers, &c., say several hundreds of thousands of dol- the alternative device, a new action?~~ The 7th abatement was within the prayer of the old bill of complaint; consequently the correction of that part of it which dealt with the alternative device also is.

POINT VII.

The adequacy of chlorination is a live question now being litigated in another suit and in a situation of such doubt the city should not be prevented from challenging its adequacy by a bill of review in this cause.

The East Jersey Water Company and a number of municipalities have filed a Bill of Complaint to enjoin Jersey City from building an intercepting sewer to divert the sewage from Boonton and Dover and other towns from the reservoir and discharge the effluent into the Rockaway River below the Boonton Dam.

One of the issues in that cause is the adequacy of the chlorination plant, and the assertion is made that the chlorination plant was approved by the Court of Chancery and the decree was affirmed by the Court of Errors, to the effect that the chlorination was an effective process.

It would certainly be unfortunate in the administration of justice if, as is likely to be the case, the court should determine in that suit that the clorination was not an adequate process, and should now deny this application.

The practical situation, as shown by the East Jersey case, is that the decree upholding the chlorination process is being used as a judicial endorsement of a mechanical process which the affidavits of petitioner on this application show was mistakenly supposed to accomplish results of which it was incapable.

When the earlier investigation took place, Jersey City could only peer into the future and reason from insufficient data; but now the affidavits show the device is no longer a novelty and its limitations are understood. This application is made on those many limitations and insufficiencies. It is not rested on the single fact that B. Welchii is now known to be a much more dangerous germ than it was thought to be at the time of the reference before ex-Chancellor Magie, as Special Master.

POINT VIII.

Leave to file a bill of review to determine the extent to which the alternative device permitted under the 7th abatement was not in lieu of sewers, &c., mentioned in that abatement, should be granted.

Respectfully submitted,

JOHN MILTON,
ALBERT C. WALL,
Of Counsel with Petitioner-Appellant.

New Jersey Court of Errors and Appeals

(Case No. 76, Nov. T. 1918)

The Mayor and Aldermen of Jersey City, *Complainant-Appellant,* *vs.* Jersey City Water Supply Company, *Defendant-Appellee.*	On Appeal from Chancery.

REPLY BRIEF FOR JERSEY CITY.

Petitioner's evidence, as disclosed by the affidavits, is not cumulative.

In the *Dundee* case, cited by defendant, the Court said:

"The real point in controversy at the trial
"was the genuineness of the signature to the
"disputed receipt. This was the pivot of the
"case. If genuine, there was a strong pre-
"sumption raised that the payment had been
"made as alleged by the defendants. If not
"genuine, there was no evidence in the case
"from which such payment could be justly
"inferred. From the testimony submitted
"to them at the trial, the jury came to the
"conclusion that the receipt in question was
"not signed by the plaintiff and rendered a
"verdict in his favor, disallowing the alleged
"payment of May 9th, 1859. This verdict we
"are now asked by the defendants to set aside
"on the ground that since the trial of the

"cause they have discovered that William "Burns, Jr., was present and saw the disputed payment of $500. made by Col. Allen "to the plaintiff on the 9th day of May, 1859, "and that Mr. Burns * * * under that "date made a memorandum in his diary of "such payment. This is the material part of "the alleged newly discovered testimony and "all that need be considered in connection "with the present application."

Held, not cumulative, applying the definition set out by defendants in their brief.

The liberality with which the *Dundee* case has been applied in deciding what is cumulative evidence is shown by the following cases:

In *Kursheedt et al.* v. *Standard Bleachery Co. et al.*, 77 N. J. L., 99, it appeared that the plaintiff had given great quantities of lawn to the defendant to be bleached. The plaintiff claimed that there was a one per cent. stretch to the lawn to which he was entitled under the contract. The defendant claimed there was no stretch. Verdict and judgment for the defendant.

Plaintiff moved for a new trial on the ground of newly discovered evidence. The Court, on page 100 and 101, says:

"Coming now to the new evidence, taken "under the rule, we observe that it is of three "kinds: First, that relating to the count or "the number of threads to the inch in the "lawns bleached for the plaintiff by the defendants. Second, that relating to the "'Northrup Loom.' Third, direct evidence "given by certain former employes of the defendants as to the stretch or 'overs' which "was obtained at the works of the Standard "Bleachery and what was done with it. It is "unnecessary to state with greater particu"larity this evidence. It is sufficient to say "that much if not all of its has, in fact, been "discovered since the former trial; that by "the use of reasonable diligence it could not "have been then obtained; that it is material "to the issue and goes to the merits of the "case and is not cumulative. Under these "circumstances the motion for a new trial "ought not to be denied. *Dundee Mfg. Co.* v. "*Van Riper,* 4 Vroom, 152. Let the rule "to show cause be made absolute."

In *Ellis* v. *Martin Auto Co.,* 77 N. J. L., 339, it appears that plaintiff left his car at the garage of the defendant. Action in replevin was instituted and the defendant gave bonds and held the car. Defendant claimed that he had made general repairs to the car at the direction of the plaintiff. Witnesses called by defendant testified that the car was badly in need of repairs when left at the garage; and that the repairs made were rendered necessary by its condition and not by any negligence on the part of defendant. Plaintiff testified that he purchased the car in April 1907 and used same continuously until June 1907 when he left it with defendant to have a tire retreaded, and that same was in good condition. He stated that he had purchased the car in April 1907 of the Manhattan Storage Co. of N. Y. Verdict and judgment for plaintiff. On rule to show cause, newly discovered evidence is set up. The Court, on page 341, says:

"The newly discovered evidence is to the "effect that in fact the car was bought by "the plaintiff on June 14th, 1907, (but four "days before it was left at the garage) and "that it had never been in his possession be-"fore that time; that it was then four years "old and was sold as it stood on the floor, "without demonstration and without guar-"antee, and that its value was much less than "that stated by the plaintiff on trial. With "respect to this evidence, it is sufficient to "say that it has in fact been discovered since "the former trial; that by the use of reason- "able diligence it could not have been then "obtained; that much if not all of it is ma- "terial to the issue and goes to the merit of "the case and is not cumulative. Under these "circumstances the motion for a new trial "ought not to be denied. *Dundee Mfg. Co.* v. "*Van Riper,* 4 Vroom, 152; *Kurcheedt* v. "*Standard Bleachery,* 77 N. J. L., 99. Let "the rule to show cause be made absolute."

In *Hoban* v. *Sanford,* 64 L. 426, cited by defendant under this point, the main controversy was over the sufficiency of strength of a certain rope and this in turn depended upon whether a rope of sufficient length had been used. To prove the length of the rope, evidence was introduced showing the distance between a creek and an engine. At the two trials of the case various witnesses, including the plaintiff, testified and no one swore that the rope was more than 80 feet long. Plaintiff asked for a new trial on the ground of newly discovered evidence and that various witnesses would then testify that they were positive that the distance was more than 200 feet. The court pointed out that no workman of the many at work there at the time of the accident testified on either trial to any such location as the plaintiff contended for upon the evidence on the rule. "Every witness, including the plaintiff, resworn upon a new trial, would in order to establish such a position refute his own evidence in this respect and tell a different story. The court decided that new evidence was merely cumulative. The court also decided that if the evidence had all been placed before the jury, it could not have changed the result. The so-called new evidence dealt merely with the question of distance and the court said:

> "The distance was a fact material to the "determination of the issue of whether a "sufficient rope or ropes had been provided."

It is perfectly clear from the way the Court dealt with the facts in that case, that if confronted with the facts in the application at bar, no principle enunciated in the *Hoban* case would class the facts here as merely cumulative. It should be remembered in this connection that the petitioner's application is based on two grounds—the reservations in the decrees and newly discovered evidence. The petitioner did not seek to ticket all the voluminous evidence (set forth in the petition) as belonging inevitably to one class or the other, for viewing the case from the standpoint of the reservations, every fact was proper whether new or old; whereas from the standpoint of newly discovered evidence, the facts are to be tested by the rules dealing with such evidence.

It is true that the Fourth Exception to the Master's report claimed that the sterilization device did not destroy spore-forming pathogenic bacteria in the water, and if all the petitioner's affidavits show as to this class of bacteria really amounts to what has already been testified to, the evidence is cumulative and should be discarded.

But do they show it? Dr. North's affidavit, Paragraph 11, subdivisions c, d and e, show that these bacteria were formerly classed as soil bacteria but that recent studies have shown that they exist only in soils contaminated with the discharges of human beings or of warm blooded animals. As a consequence the presence of these bacteria indicates contamination with intestinal discharges; that this was not really known in 1908 and its position as an indicator of sewage contamination had not been established. Its importance as an indicator of contamination has now secured a recognition which it was impossible to establish in 1908. Actually the cause of a long list of serious, infectious diseases,—(see Paragraphs 18 and 19 of Mr. Fuller's affidavit; Case, 49, 50; North, p. 96).

It seems to us unnecessary to answer the argument that all evidence is cumulative which lies between that which is perfectly understood and that which is partially recognized. In other words, that if a word of testimony was uttered in the old case suggesting the pathogenic danger of B. Welchii, no fact could be brought forward thereafter which enforced the conclusion that B. Welchii were dangerous things to drink.

It is not strange that these affidavits show that experience has punctured the hopes of 1908. That instead of a cure-all process, the sterilization process is now recognized as purely accessory to filtration, sewers or the like. Consequently, it will not do to dismiss as cumulative evidence which was touched on in the old case, and generally at that time recognized to be a factor, let us assume, important to the extent of 20%, but now recognized to be important to the extent of 80%. In other words, a real difference in degree of scientific knowledge, is, so far as the rights of the City are concerned, new knowledge.

We know that the word electricity is derived from the Greek word for amber. Fundamentally it is true that the force by which amber picks up dust particles is the same as the force which takes an express train under the Hudson River. It is only a difference in degree which has enabled modern man to achieve present development, but for all practical purposes the difference in degree is as important as if it were a difference in kind. It is a very different thing for an expert to suggest hypothetically a difficulty which he feels will be encountered in dealing with a new process, and for the same man after his opinion has been stabilized by actual experience and sufficiently complete data for a long enough period, to announce the results of actual observation and experience.

Opinion evidence is no different from other evidence except as to its admissibility. Once its admissibility is determined the sole remaining question is its weight.

There is no difference in a scientific fact from any other fact. No indication is in the treatises on evidence or in the cases that facts of science are subject to special treatment except that it is recognized that matters lying in the knowledge of experts alone must be proved by experts whose opinions the law will consider when those opinions are brought forward in accordance with the rules of admissibility.

Nor is there any case cited here that newly discovered evidence must be of any particular kind. On applications for leave to file bills of review, one will search in vain for any limitation of the classification of newly discovered evidence. The burden of showing that opinion evidence and expert evidence will not be classed as newly discovered evidence, is on him who asserts such a novelty.

The cause in which the substitute device was ordered was decided on just such evidence. It could be decided on no other, and it was largely decided on opinions as to what would happen in the future. This application is on evidence as to what has happened, and curiously enough two of the strongest witnesses for the bleaching device on the former trial now point out the errors in their opinions as corrected by their experience.

Johnson and Fuller, two of the leading experts in favor of the device, now say that they have been obliged to reach different conclusions in the light of more accurate knowledge.

The only argument which the defendant interposes to their testimony is an attack on its sincerity; but that may be dismissed because that argument is addressed to the weight of the testimony. The sole argument against opinion evidence on this application is that the evidence was not in existence at the time of the former hearing because it was not then available as proof. One of the defendant's affidavits, that of Pease, appears to say that it was then available as proof, which would dispose of the contention; but leaving out the Pease affidavit, defendant's contention rests on the assertion that *evidence* and *proof* are the same. This is not borne out by any definition of evidence or by any case cited. It is unsound on the face of it. Proof is the set of rules which govern the admissibility of a fact in evidence. Wigmore says:

> "When an offered fact satisfies all the rules "of these groups (that is the rules of admissibility), being forbidden by none, it is said "to be admissible. That is the jury many "consider it as part of the evidential material "which is to persuade them to the conclusion "reported in their verdict."
>
> Rule 13, Paragraph 38, Wigmore's Pocket Code.

So the offered facts in this case were always facts although not available as proof at the hearing—a condition that always exists in a meritorious application for a bill of review, for if the facts were available in the sense that it was negligence on the part of the City not to ascertain them, the court would not permit the filing of the bill.

But the evidence here is not all opinion evidence. Much of it is rather expert evidence—that is, the witnesses who testified are experienced in this particular watershed besides being experienced in their particular science.

Folkes v. *Chadd*, 3 Dougl. 157; decided by Lord

Mansfield is frequently stated to be the principal case on the admissibility of matter of opinion.

The question there was whether a bank which had been erected for the purpose of preventing the overflowing of the sea, had caused the choking up of a harbor; and Lord Mansfield held that the opinions of scientific men as to the effect of such an embankment upon the harbor are admissible evidence and evidence might also be given that other harbors similarly situated where there are no embankments, have begun to be choked and filled up. He says:

> "It is objected that Mr. Smeaton is going to speak, not as to facts, but as to opinion. That opinion, however, is deduced from facts which none can dispute. The situation of the bank, the course of tides and of wind, and the shifting of sand * * *. In matters of science no other witnesses can be called. An instance frequently occurs in actions for unskilfully navigating ships. * * *
>
> I cannot believe that where the question is whether a defect arises from a natural or artificial cause, the opinions of men of science are not to be received."

The defendant cites no case which upholds the theory that the evidence of the short-comings of the chlorination device was non-existent at the time it was ordered.

Water Supply & Storage Co. v. *Larimer & Weld Irrigation Co.*, 46 L. R. A. 329, referred to on page 42 of defendant's brief, was a Colorado case. In that case appellant contended that under the latest approved formula for ascertaining the carrying capacity of water in ditches and canals, the computation as originally made by the court was erroneous and that the specified quantity should be much less. The court said:

"It must be remembered that the present "action is not for the purpose of reforming "the decree upon the ground of mistake or "fraud *or any other recognized ground,* but "that it is in the nature of a collateral at- "tack upon the decrees after the statutory "time for their reformation or review in the "court of original jurisdiction, upon the same "or additional testimony, has long gone by "and when the right of appeal is also lost by "lapse of time."

The case does not deal with the question of newly discovered evidence. The court continued:

"But if we should adopt appellant's views "and hold that under these decrees the car- "rying capacity of the canal was still open "to adjudication, and that the court in the "present action might determine the same, "the evidence before us would not at this "late period justify the reduction asked. "From the testimony of Prof. Carpenter it "would appear that the latest approved and "most trustworthy test for ascertaining the "carrying capacity of streams and canals is "that known as Ganguillet and Kutter's "* * *. It is in evidence, however, that in "accordance with a formula that was in gen- "eral use in this state at the time the decrees "were rendered, the computation as deter- "mined by the decree was substantially cor- "rect; and it further appears that no two "computations are ever the same even with "the same formula."

On page 328 the court said:

"Involved in appellant's argument is the "assumption that if we use this new test the "calculation as made by the district court is "erroneous * * *. At any rate it is not "'made clearly to appear by this record that "'a different result would necessarily follow "'if this new formula should be used. * * * "'The claim is not that the court erred in "'making the computation from the formula "'which it used, but on the contrary the mis- "'take complained of consists in the use of a "'wrong formula and in not selecting the one "'which, as is said, has since been discovered "'and found to be more accurate. * * * We "'conclude the discussion of this branch of the "'case by remarking that counsel's entire at- "'tack upon this decree is an attempt only "'partly disguised, under the pretense of cor- "'recting a mistake therein, at this late day "'to reopen and readjudicate the relative "'rights of ditch owners whose predecessors "'in interest were parties to the proceedings "'in which the decree determining these rights "'was rendered, and therein consists the fun- "'damental error in much of their argument. "'* * * So here, this ditch decree cannot be "'reopened to correct an alleged mistake made "'in the calculation of the quantity of water "'appropriated, based upon a formula which "'the evidence then established to be the most "'correct in general use because, as the result "'of later investigation, another test has been "'discovered said to give more accurate re- "'sults; and if this Kutter formula was then "'known, and not used by the court, we must "'presume that it was the finding and judg- "'ment of the court that the one that was used "'was more accurate. In either case the de- "'cree cannot be disturbed."

This last quotation shows that the case does not deal with newly discovered evidence, and the other quotation shows that the proceeding was not in good faith; that it was not according to the practice of the court. There would be analogy in the situation if instead of pointing out in the case at bar the newly discovered evidence of the continuous inadequacy of the chlorination plant, the City had filed a petition simply setting forth the fact that the water received by the consumers did not comply with the requirements of the U. S. Treasury Standards of 1914 without showing what the truth was.

That the Colorado case is entirely irrelevant is shown by the fact that the formula of Ganguillet and Kutter was in existence, as the opinion intimates, at the time of the original trial. This is further established by the following:

The earliest date mentioned in the report of the case is April, 1882. The opinion was delivered in 1897, and Rudolf Hering (the partner of Mr. Fuller, one of the affiants in the case at bar) read a paper before the American Society of Civil Engineers on October 16th, 1878, reported in the transactions of the American Society of Civil Engineers (Vol. VIII, Dec. 1879, Page 1), in which he makes the statement that the formula was developed in 1869. The title of the paper was "The Flow of Water in Small Channels, after Ganguillet & Kutter, with Kutter's Diagram modified, &c."

The equities are in favor of the City.

The fact that the company has distributed among its stockholders and creditors the moneys it received from the sale of the plant, is a matter of which it will have full advantage if this court permit a bill of review to be filed.

How has the defendant been hurt? It was enabled to avoid its obligation to furnish sewers and sewage disposal works by installing a device which cost only $20,000. Naturally, as the decree dealt with present conditions at the time it was made, defendant would never have any greater obligation than the cost of sewers and sewage disposal works at the time of the former decree. The only way in which the defendant has been hurt is that the truth has come out.

Until the necessity of sewers and sewage disposal works was brought home to Jersey City, until in fact the need became so pressing that it set about constructing sewers itself, full knowledge of the situation did not come. Is it not a picturesque fact that a number of the important cities in the country, as shown by the reply affidavits of Messrs. Fuller and Johnson, cities which had followed the lead of Jersey City with reference to the chlorination device, should have needed about the same time to come around to its abandonment? We refer to Milwaukee, Lynchburg, Hartford, Chicago, Detroit, &c.

The doctrine of laches does not rest on the invocation of the word "laches." Facts must lie behind such a contention which make it unjust that the court should permit the matter to be stirred, as for example, the probable destruction of evidence. The case at bar indicates the very opposite of that.

The petitioner is a municipal corporation representative of the public, with its governmental policies subject to swift political changes. Diligence did not require that it should have knowledge which should be in advance of the opinions of leading experts.

In *Tooker* v. *Sugar Refining Co.*, 80 N. J. E. 305-320, Vice Chancellor Stevens, in dealing with a delay of eleven years by stockholders of a private company in bringing an action to cancel stock issued without consideration, held that such a delay did not prevent the granting of relief where stockholders had no knowledge of the facts during the interval and the stock was still owned by the original owner and his children and his position had not been changed to his detriment in the meantime. Vice Chancellor Stevens said:

> "Their being on their part no knowledge "and on the part of Havemeyer no change of "position to his detriment, there can be no "laches and therefore no estoppel. Is then "lapse of time a bar? Havemeyer and his "estate so far from being worse off to-day "because of his ownership of the stock, are "better off. He has received dividends in the "meantime to the amount of $2,500,000. and "has paid out nothing. There is no inequity "therefore in holding that the stock, void in "its origin, has continued void for a period of "eleven years, and is now void in the hands "of the original holder and his children. "Nothing is better settled that that mere "lapse of time does not apply as a bar in a "matter exclusively cognizable in equity un-"less the time be much longer than that, says "Pomeroy, &c."

The question of whether stock has been issued without consideration is a far simpler question than that presented here and the fact that some of petitioner's witnesses, who were also witnesses for the defendant at the former hearing, began to discover the inadequacy of the chlorination treatment a few years after their testimony and publicly announced the result of their observations, is proof rather of their credibility as impartial scientific observers; than of any laches on the part of the petitioner. Petitioner had the right to rely on the court's findings based on the best evidence obtainable at the time until the fact was sufficiently established to warrant this application; and the fact that petitioner took over the plant in reliance on the decrees but without knowledge of the evidence now pointed to as newly discovered, does not affect the question. In fact, it has been held that the performance of the decree is a prerequisite of an application of this kind.

Ricker v. *Powell,* 100 U. S. 104;
Davis v. *Speiden,* 104 U. S. 83.

Respectfully submitted,

JOHN MILTON,
ALBERT C. WALL,
of Counsel with Petitioner-Appellant. 10

New Jersey Court of Errors and Appeals

Between THE MAYOR AND ALDERMEN OF JERSEY CITY, Complainant-Appellant, and THE JERSEY CITY WATER SUPPLY COMPANY, Defendant-Respondent.	On appeal from order of Court of Chancery refusing Jersey City leave to file bill of review.

BRIEF FOR RESPONDENT, THE WATER COMPANY.

The appellant, who was the complainant in the cause below, applied in the Court below for two separate kinds of relief in the alternative:

(1) That under leave reserved to the complainant to apply to said Court for such further order or decree as might be necessary to carry into effect a decree in this cause of June 4, 1908, and a like reservation in a decree of November 15, 1910, said Court might open and modify the said decrees by providing that the petitioner should receive a certain deduction from the contract price referred to in the seventh paragraph of the decree of June 4, 1908, or (in the alternative)

(2) That the complainant should be at liberty to file a bill of review or application in the nature of a bill of review for the purpose of having so much of said decrees as permitted the Jersey City Water Supply Company to substitute an alternative plan and device in lieu of sewers and sewage disposal works, etc., reviewed, reversed and set aside and adequate relief granted to the complainant against the defendant, etc.,

The petition also contained a prayer for such further or other relief as might be equitable.

The Court of Chancery after hearing the argument by its order dated October 8, 1918, dismissed the petition with costs—and Jersey City appeals from that order.

We shall first of all deal with the application for leave to file the bill of review.

There are a few details with reference to the suit in which the decrees sought to be reviewed were entered which it is advisable to state without need to refer to the various portions of the voluminous record in the main case establishing them.

In 1904 the Water Company, notwithstanding the protest of the City, turned on water for the new supply. The City claimed that the works were not completed. November 15, 1904, the Company notified the City that the works were completed, and in use, and ready for the City to purchase the same if desired. April 12, 1905, the Company commenced action against the City for the price of water supplied, claiming $115,744.80. The City pleaded to the declaration, and the Company demurred to several of the pleas. A second suit was commenced by the Company against the City to recover $105,732 for additional water supplied to the City, and the City filed its pleas in that action. Thereupon the City harassed with actions at law, and in the midst of uncertainties, filed its bill of complaint in the Court of Chancery, contending that the Company had not completed the works in accordance with the contract, but that the City in equity was the owner of the works to the extent that they had been completed, and that the City was entitled to the possession of the works. The City stated that it desired to pay therefor, but was not liable to pay the full sum named in the contract, $7,595,000, because the Company could not convey the whole of the works to the City; also because the Company was not the owner of the lands overflowed by the reservoir; and because it had not acquired the rights of the Morris Canal & Banking Company for the diversion of water supply in a certain territory; and because the Company had not acquired the rights of riparian owners on the Rockaway River, and its branches, and had not obtained the consents of certain riparian owners below the reservoir; and because the Company could not convey and deliver to the City a completed operating plant free from pollution; and because the Company could not convey the works as provided by the contract. The City tendered itself ready and willing to pay to the Company such part of the sum named in the contract as the Court should determine under the circumstances set forth in the bill of complaint it ought to pay therefor. The City asked for a decree that the Company convey to the City the water works or so much thereof as they were able to convey upon payment by the City of such part of said consideration as might be ascertained; and the City asked that the Company be enjoined from prosecuting the actions at law above referred to.

The Vice-Chancellor, who heard the application for the preliminary injunction, granted the same, and restrained the prosecution of the actions at law. Thereupon the litigation proceeded and after the taking of some thousands of pages of testimony the matter became ripe for decision by the Vice-Chancellor before whom the testimony was taken, and his opinion was filed May 1, 1908. Reported in Vol. 74 of the New Jersey Equity Reports, page 104, *et seq.* This opinion covers one hundred closely printed pages, and in it the Vice-Chancellor set down his conclusions and showed how he reached them. The final decree on this opinion was entered June 4, 1908. The seventh paragraph of that decree is as follows:

> "There shall be deducted from the contract price the cost of establishing intercepting sewers and drains and sewage disposal works, capable of substantially preventing the contamination of the Rockaway River above the Boonton Reservoir from the sewage of the City of Dover, the City of Boonton and the Village of Hibernia; which cost shall be hereafter determined by the Court.
>
> "In lieu of and as a substitute for all or any of the sewers and sewage disposal works above referred to in this paragraph, the defendant company may, within ninety days from the date hereof, present other plans or devices for maintaining the purity of the water delivered by the company to the City throughout the year, under present conditions, and estimates of the cost of the works now necessary therefor; and both parties may

> present evidence touching the efficiency of such plans or devices to produce the necessary results, and the cost thereof; and the defendant company may, pending the taking of testimony, with the leave of the court, upon notice, present amendments and modifications of such plans and devices."

The decree had this further provision:

> "And it is further ordered, adjudged and decreed that it be referred to the Honorable William J. Magie, one of the Special Masters of this court, to ascertain and report upon the cost of sewers and of sewage disposal works, and of intercepting sewers or drains necessary to substantially prevent the contamination of the waters of the Rockaway River from the sewage of Dover, Hibernia and Boonton, and also to investigate and report upon other plans and devices as alternative remedies presented by the defendant company for delivering water to the City in a pure and wholesome condition through the year, under present conditions; and upon the cost of the works now necessary therefor."

And the decree further provided:

> "And the master may use in his inquiry the evidence already offered in the cause, and may receive further evidence on the matters herein referred to him and shall report thereon to this court with all convenient speed."

And it further provided:

> "And leave is hereby reserved to either party to apply to the Court at the foot of

> this decree for such further order or decree as may be nécessary to carry this decree into effect, or to prevent forfeiture arising out of the inability of the City to raise and pay the purchase price within the time fixed by the decree by reason of litigation not instituted at the instance or request of said City based upon any of the resolutions or proceedings taken by said City or any of its Board or officers to raise and pay the purchase money."

In July, 1908, the City appealed this decree to this Honorable Court complaining that the seventh paragraph, as above quoted, was erroneous, and not in accordance with equity. The Water Company also appealed, but from other parts of the decree.

September 3rd, 1908, the Water Company filed "Plans and Devices of the Jersey City Water Company for Maintaining the Purity of Water," acting under the seventh paragraph of the decree as above quoted.

This Court in an opinion filed February 28th, 1910 (reported in 76 *N. J. Eq.*, p. 607), affirmed the decree with some modifications. In dealing with the appeal of the City from the seventh paragraph of the decree this Court held as follows:

> "Some criticism has been made upon the form of the decree. In providing what sums shall be deducted from the contract price on account of the failure to construct the water supply plant in complete accordance with the plans and specifications, the mandate of the decree is as follows:
>
> " 'There shall also be deducted from the contract price the cost of establishing intercepting sewers and drains and sewage dis-

posal works, capable of substantially preventing the contamination of the Rockaway River, above the Boonton reservoir, from the sewage of the City of Dover, the City of Boonton and the village of Hibernia; which cost shall hereafter be determined by the court.

" 'In lieu of and as a substitute for all or any of the sewers and sewage disposal works above referred to in this paragraph, the defendant company may, within ninety days from the date hereof, present other plans or devices for maintaining the purity of the water delivered by the company to the City throughout the year, under present conditions, and estimates of the cost of the works now necessary therefor; and both parties may present evidence touching the efficiency of such plans or devices to produce the necessary results, and the cost thereof; and the defendant company may, pending the taking of the testimony, with the leave of the court, upon notice, present amendments and modifications of such plans and devices.'

"As we read this provision of the decree, the second part of it is in modification of the first part, the purpose disclosed by it being to relieve the water supply company from the deduction from the purchase price, of the cost of establishing sewers, drains and sewage disposal works for the prevention of the contamination of the Rockaway River above the Boonton reservoir, provided the company is able to exhibit a less expensive plan or device for preventing such contamination, and which will insure that result, and, if the company shall succeed in doing so, then permitting the cost of the works

> necessary for the installation of such plan or device, instead of the cost of constructing sewers, drains and sewage disposal works, to be deducted from the contract price. So read the decree seems to us to be manifestly fair and just to both parties, and to afford no ground for criticism."

While the appeal was proceeding in this Court, Special Master Magie conducted a hearing in which testimony covering some thousands of printed pages was taken. The first hearing was held September 28th, 1908, and the Special Master's report was filed May 9th, 1910. The Special Master reported that the device was then in operation and was effective and capable of rendering the water to Jersey City pure and wholesome for the purposes for which it was intended. The City filed exceptions to the Special Master's report. The Vice-Chancellor's decision on the exceptions, which was filed July 20th, 1910, is, in part, as follows:

> "The Master reports that the device for removing dangerous germs now in operation is effective and capable of rendering the water delivered to Jersey City pure and wholesome for the purposes for which it was intended. I see no reason to dissent from his view.
>
> "The City contends that the annual cost of operating and maintaining this device should be capitalized and the capitalized sum deducted from the contract price. The contention rests upon the eighth section of the original contract which provides that the operation of sewers and sewage disposal works constructed or arranged for by the contractor shall not be a charge upon or ex-

pense to Jersey City. It is conceded that the device in question is not referred to in this or any other section of the contract, but it is argued that as the Company is relieved from building, maintaining and operating sewers and disposal works, it should be subjected to the cost, not only of installing the device, which it has done, but of maintaining and operating it. The first section of the contract provides that 'if such works and supply are purchased by Jersey City they shall be delivered to Jersey City, *as a completed operating plant free from pollution as aforesaid.*' The general obligation is to furnish a plant; not the money wherewith to operate it. I think that if the cost of operating it or of keeping the water pure is to be borne, in any measure, by the Water Company, it must be because of some express provision in the contract to that effect. If the Company provides a plant capable, if properly operated, of furnishing pure and wholesome water, it fulfills its contractual obligation. If the City would compel it to do more, it must show that it has, in its contract, agreed to do the very thing demanded. The plant will not deliver pure and wholesome water automatically. Chemists, bacteriologists and inspectors will have to be constantly employed; the banks of the river will have to be policed; land along the sources of the stream will have to be acquired; floods and droughts will have to be guarded against; repairs will have to be made and a steady flow of the water constantly maintained—all at the expense of the City. The cost of operating the device in question falls into the same category.

"I thought that a fence around the reservoir was because of its location, a proper part of a completed plant, but the Court of Appeals, because it was not expressly required by the terms of the contract, held otherwise. Here the court is asked to go farther. It is sought to compel the Company to furnish, not what might be thought to be a proper part of a completed plant, but a sum of money to defray the costs of a part of its operation, in the absence of any contract on its part to pay such costs."

Final decree, which was filed November 16th, 1910, was entered in the Court of Chancery on the exceptions to the Master's Report. This decree, so far as it is pertinent to a consideration of the present appeal, is as follows:

"This matter coming on to be heard in the presence of Mr. James B. Vrendenburgh, of counsel with complainant, and Mr. William H. Corbin, of counsel with defendant, Jersey City Water Supply Company, on exceptions of complainant to the report of Hon. William J. Magie, Special Master, upon the matters referred to him in the decree entered herein on the fourth day of June, A. D. Nineteen hundred and eight, and upon application of said defendant to settle the other matters reserved in said final decree as corrected by the decree on remittitur herein, dated on the ninth day of April, 1910; and it appearing by said Report bearing date the ninth day of May, A. D. 1910, that the plan and device presented to the court by the Jersey City Water Supply Company as alternative remedies for delivering the supply to the Mayor and Aldermen of Jersey City in a pure and wholesome condition throughout the year under present conditions, is an effective process for that purpose, the said process being described by the Master in his said report substantially as follows: the addition to the water as it is discharged from the reservoir at Boonton into the pipe leading to Jersey City, of a minute quantity of bleach or chloride of lime through the use of tanks in which the solution of bleach is made by stirring; the power being obtained by the water in the reservoir; the said solution when pumped into another tank being discharged through an aperture, which may be increased or diminished in size, into the water flowing in the pipe; and the Master finds that said device is an effective process which destroys in the water the germs, the presence of which is deemed to indicate danger, including the pathogenic germs, so that the water, after this treatment attains a purity much beyond that attained in water supplies of other municipalities; and that the said device has already been installed in the Boonton dam at the expense of the said Water Company, the cost thereof being the sum of Twenty thousand five hundred and forty-five dollars and sixty-four cents ($20,-545.64); and that the same has been in continuous and successful operation since September 26th, 1908. * * * that the said Master's report, except so much thereof as relates to the cost of sewers and sewage disposal works, be in all things approved, ratified and confirmed; and, that the said alternative plan and device hereinbefore referred to and put in use by the defendant is approved as a substitute for the sewers and sewage disposal works, intercepting sewers and drains in the said decree suggested, except as hereinafter mentioned, and no deduction or abatement of the purchase price, except as hereinafter mentioned, shall be made because of the lack of any such sewers, works or drains, or because of any defect in the works as a mechanism for the purification of the supply."

Said decree confirming report contained this provision:

"And leave is hereby reserved to either party to apply to the Court in manner and form as such leave was reserved in the said decree of June 4, 1908."

November 15, 1910, the City appealed from parts of the decree. One of the grounds of the appeal was stated to be because the part of the decree approving the alternative plan was erroneous, and the City appealed from

"that part of the said decree which approves the alternative plan and device in said decree referred to and put in use by the defendant as a substitute for the sewers and sewage disposal works, intercepting sewers and drains in the said decree suggested, except as in said decree mentioned, and adjudges that no deduction or abatement of the purchase price except as in said decree mentioned should be made because of the lack of any such sewers, works or drains or because of any defect in the works of the mechanism for the purification of the supply."

December 6, 1910, the Water Company also appealed to this Honorable Court from parts of the decree.

July 11, 1911, this Court affirmed the decree upon the opinion delivered by the Vice-Chancellor in the Court of Chancery. (Reported in 79 *N. J. Eq.*, 212.) The new water works were transferred to Jersey City on October 10th, 1911.

With this statement of the material facts in the case read in connection with the statement of the same facts contained in the appellant's petition, let us for a moment, and before examining the application from a legal viewpoint, consider exactly the precise thing which this application seeks to have done.

Here is a chancery suit commenced on April 12, 1905, the prosecution of which in all its branches, appeals, etc., lasted until August, 1911, when it was fully and finally closed and determined, and in which, after reading the testimony of numerous expert witnesses on both sides of the question involved, it was determined first by the Court of Chancery and afterwards by this Court, that the chlorination device for removing dangerous germs *then* in operation was effective, and capable of rendering the water delivered to Jersey City pure and wholesome for the purposes for which it was intended, and was a fit substitute for the sewage disposal works referred to in the decrees—such findings being, of course, based on the evidence of experts whose knowledge was necessarily limited by the boundary line beyond which human knowledge did not extend at that time; the courts, of course, could not project their vision into the future and determine a case in 1908—the determination of which depended on expert testimony limited by the knowledge the experts then possessed—by knowledge which such experts might possess ten years afterwards; that is to say, to-day. Neither courts of law nor courts of equity can be expected to do impossible things. But as we understand the present application, it does not in so many words say that the Chancellor decided this case wrongly according to the light he had imparted to him by the experts at the time he decided it, or that this Court, when the case was first before it, decided the case wrongly, or that the Special Master (the late Chancellor Magie) decided the case wrongly according to the light imparted to him through the testimony of the experts at the time he decided the case, or that the Chancellor decided wrongly in confirming the Master's report, or this Court decided wrongly when it affirmed the second decree—no such claim as that could be made in view of the fact that the findings, the correctness of which are now criticized, are those of our Court of Errors and Appeals, the Court in this State of last resort in all causes, and however much anybody may choose to differ from those findings they are nevertheless to-day the law of this State and absolutely binding as between the complainant and the defendant.

What the petitioner seeks to accomplish is to have this long, tedious litigation, which was thrashed out in all its parts and finally determined more than seven years ago, resurrected from its present place of repose in the archives at Trenton, and reheard and redecided nearly seven years after the City has paid the Water Company the consideration decreed to be paid for the water supply, and nearly seven years after the water plant has been turned over by the Water Company to the City.

Now, then, what impelling cause exists for bringing to life this long disposed of litigation? Simply that some of the experts who testified in favor of the Water Company at the original hearings, and testified that the chlorination device was a fit substitute for sewers and sewage disposal works now come forward and say: "We have changed our opinions." If this be ground for a bill of review, then any decree or judgment can be opened years after its deliverance where witnesses can be found ready to come forward and say: "We have since changed our views." Suppose this case should be reopened and reheard and the Water Company should be compelled to stand the cost of an intercepting sewer and disposal plant, and ten years hence these same witnesses were to come forward and say: "We have again changed our opinions—we find that our scientific research went off into a wrong channel when we testified ten years ago condemning the chlorination device—scientific research has since returned to its old true channel, the channel in which it was running when we testified in the first instance—to-day we know the chlorination device possesses all the qualities we claimed for it when the case was first heard," and suppose the Water Company on this second change of opinion on the part of the witnesses should apply for leave to file a second bill of review—wherein would the position of the Water Company be different then from the position of the City at the present time? It would be an extraordinary circumstance if decrees finally settled and affirmed by this Court of last resort, as these decrees have been, could, by any system of legal or equitable procedure, be reopened seven years after their deliverance upon the plea that the change of opinion of an expert witness is in the nature of newly discovered evidence. We shall deal with that claim in a later portion of this brief. At present we are attempting merely to point out in a general way the startling character of the present application, violating as (if granted) it would do two fundamental maxims, *"Interest reipublicae ut sit finis litium"* and *"Nemo debet bis vexari pro una et eadem causa."*

Passing now in the first place from a discussion of the general features of the application for leave to review these decrees, we proceed to state, as briefly as the subject will permit, the points which we mainly rely on in resisting this application.

POINT I.

The purity of the water to be obtained by the substituted device (the chlorination device) provided for in the decrees was purity according to the standards in existence at the time the decree was made, not purity according to present standards based upon the latest scientific knowledge.

The relevant provisions of the contract between Jersey City and Flynn are set forth in the opinion of the Vice-Chancellor in 74 *N. J. Eq.,* p. 135, as follows:

> "The contractor agrees to construct a new system of water works for Jersey City and to supply said City therefrom with pure and wholesome water in strict conformity with said specifications and his proposal under plan No. 1. * * * Such works shall be constructed and maintained by the contractor that the water delivered therefrom shall

be pure and wholesome and free from pollution deleterious for drinking and domestic purposes, during the time that Jersey City shall take water by the million gallons. If such works *and supply* are purchased by Jersey City they shall be delivered to Jersey City as a completed operating plant free from pollution as aforesaid."

The Vice-Chancellor stated (p. 135):

"The specifications provide as follows:

" 'The water to be furnished must be pure and wholesome for drinking and domestic purposes.' "

The Vice-Chancellor further stated (p. 136):

"Contracts must have reasonable construction and must be read in the light of the surrounding circumstances. The evidence shows that before the contract in question was executed, the city authorities visited the watershed and actually saw what the conditions were. They knew that the river flowed through a thickly populated region and that some pollution at the points where the population was thickest was inevitable. I think it is quite plain that the contention of counsel for the city that because it is provided that the supply is to be free from pollution and because the river is a part of that supply, therefore, the *river* must be free from pollution, from its source to the point where it flows into the Boonton reservoir, is untenable. In view of the evidence, the city would be demanding an impossibility. I think the contract means that the supply, at the time it reaches Jersey City

> and is delivered into the reservoir or pipes there, must be free from pollution. For example, if after the water should leave the Boonton reservoir but partially purified, it should be subjected to the action of a filter plant, established at any point along the route, and be there free from pollution, I have no doubt the terms of the contract would be fully complied with."

We have here a legal construction of the contract that the purity of the water is to be determined at the point of delivery in Jersey City and not at its point of entrance into the reservoir at Boonton. This construction of the contract was approved by this Court, 76 *N. J. Eq.*, p. 607. This was, of course, a matter of law and not a question of fact.

The Vice-Chancellor further stated (74 *N. J. Eq.*, p. 174):

> "There is this provision in the contract:
>
> " 'Eighth.—It is further understood and agreed that all sewers and sewage disposal works constructed or arranged for the contractor to *prevent* pollution or to carry off pollution existing in the watershed shall, under said specification and plans, be so constructed and arranged for by him that in the event of the purchase of the water supply and plant by Jersey City under any of the options aforesaid, the operation and maintenance of such sewers and sewage disposal works for the purposes aforesaid shall not be a charge upon or expense to Jersey City.'
>
> "This clause is so worded that there is no express agreement to build sewage disposal

> works, but under the provisions of the first paragraph, which provide that the contractor shall so construct and maintain the works that the water delivered therefrom shall be pure and wholesome and that if such works and supply are purchased they shall be delivered to the city 'as a completed operating plant free from pollution as aforesaid,' I think it is clear that the company must construct disposal works if they are necessary to insure the purity of the water supply. It cannot be said of them, as it can be of a filter plant, that they were not within the contemplation of the parties. They are expressly mentioned in the contract itself as works that may have to be built."

The construction of this provision of the contract as matter of law was also approved by this Court (76 *N. J. Eq.*, p. 607).

After reviewing the evidence relating to the conditions as to the pollution of the river at Dover, the Vice-Chancellor said (p. 180):

> "I think that the weight of the evidence is that the river, as it passes through Dover, is very considerably polluted; that freshets may increase the danger, and that a properly constructed disposal works, properly managed, would be a considerable safeguard. * * * If I had thought that the evidence did not support that view, I should have been forced to the conclusion that a filter plant should be provided in order to satisfy the paramount contract obligation to furnish pure and wholesome water."

The final decree advised by the Vice-Chancellor based upon his findings contained the provision:

> "Seventh: There shall also be deducted from the contract price the cost of establishing intercepting sewers and drains and sewage disposal works capable of substantially preventing the contamination of the Rockaway River, etc.,"

followed by this provision that

> "In lieu of, and as a substitute for all or any of the sewers and sewage disposal works above referred to in this paragraph, the defendant may * * * present other plans or devices for maintaining the purity of the water delivered by the Company to the City throughout the year *under present conditions* (italics ours) * * *, and both parties may present evidence touching the efficiency of such plans or devices to produce the necessary results."

And it was referred to a Special Master to report upon the cost of sewers and sewage disposal works and of intercepting sewers or drains necessary to substantially prevent the contamination of the waters of the Rockaway River from the sewage of Dover, Hibernia and Boonton, and also to investigate and report upon other plans and devices as alternative remedies presented by the defendant company for delivering water to the City in a pure and wholesome condition throughout the year *under present conditions.*

As a matter of law, therefore, it has finally been determined by this Court that the contractor was bound to supply sewage disposal works to prevent the pollution of the Rockaway River, providing such works were necessary in order that the water as it actually reached Jersey City should be pure and wholesome, but that the contractor was not confined even to sewage disposal works, but that if the evidence had warranted it he might even have been compelled to construct a filter plant (74 *N. J. Eq.*, p. 181), "in order to satisfy the paramount contract obligation to furnish pure and wholesome water."

In other words, the contractor was not limited to any particular method of obtaining the desired result, and for that reason the decree provided that in lieu of sewage disposal works the contractor might offer other devices for maintaining the purity of the water.

The question then was by the terms of the decree as the contract had been construed, whether or not the device offered would maintain the purity of the water as it was delivered within the limits of Jersey City, and not as it entered the reservoir, and not even its purity in the reservoir itself.

The contract itself contained no standard by which the purity and wholesomeness of the water was to be determined. As a matter of law, therefore, that standard must have been the common standard by which purity of water was determined at the time of the execution of the contract. What was generally considered pure and wholesome water at the date of the contract must have been the standard by which the water to be supplied by the contractor was to have been determined. *The standard then in existence was necessarily based upon the scientific knowledge of that time.*

As stated by the Vice-Chancellor (74 *Eq.*, p. 133):

> "* * * The science of bacteriology, originating in the wonderful discoveries of Pasteur and Koch, dates its origin from a period within the last thirty years."

If, therefore, the contract had been made thirty years previous to its actual date, the standard to determine what was then pure and wholesome water could not have been based upon the science of bacteriology, there being then no such science, and the existence of bacteria then being unknown.

But at the time when this contract was actually made, science had reached a point at which the purity of water was determined by tests showing the presence or absence of bacteria. Consequently, the question of fact determined by the Vice-Chancellor related to the presence of bacteria in the water as it reached Jersey City, and he found from the evidence of the experts who were examined before him and the Special Master that the water as it reached Jersey City did contain a greater number of bacteria than according to the scientific standard of that time was permissible if the water were to be considered pure and wholesome. He accordingly determined that the contractor was bound either to build the sewage disposal works or to offer some other plan in lieu thereof.

If, as there seems to be no doubt, the criterion by which the purity and wholesomeness of water for drinking and domestic purposes was determined at the time of the execution of the contract was the presence or absence of bacteria to not exceeding a certain number per cubic centimeter, and if that number were then ascertainable by the only tests then available, then it certainly could not now be maintained that although the contractor may have supplied pure and wholesome water in accordance with that standard, and as discoverable by those tests, he had not complied with the terms of the contract because scientific knowledge concerning the purity and wholesomeness of water has now, seven years afterwards, increased, and because there exists to-day another standard by which the purity and wholesomeness of water must be determined, and that although water may not contain more than the permissible number of bacteria capable of discovery according to the standard of seven years ago, nevertheless the water is impaired and unwholesome for drinking and domestic purposes for other reasons now known to science.

The present position of Jersey City appears to be that although the water supply was rendered pure and wholesome by the chlorination device in accordance with the standard of purity and wholesomeness then known to science, it is not pure and wholesome according to the present standard based upon an advance in scientific knowledge, and that it is now discovered that the water contains unwholesome qualities not fully eradicated by the chlorine treatment. According to this contention, the contractor, at the time of the performance of the contract, was bound to provide for contingencies not known to exist at that time. It further follows that whether or not the contractor has complied with the terms of his contract to supply pure and wholesome water, can never be definitely determined so long as the science of bacteriology and kindred sciences are progressive, for the reason that what may be to-day considered water suitable for drinking purposes may not be so considered twenty years hence because of future scientific discoveries.

In confirming the Master's report the Vice-Chancellor stated (79 *N. J. Eq.*, p. 214) :

> "The Master reports that the device for removing dangerous germs now in operation is effective and capable of rendering the water delivered to Jersey City pure and wholesome for the purposes for which it was intended. I see no reason to dissent from his view."

This necessarily related to what were considered by science dangerous germs at that time, and it was the presence or absence of such germs, which according to the standard then in existence, rendered the water pure and wholesome or impure and unwholesome, and as the contract itself contained no express standard by which the purity and wholesomeness of the water could be determined, that standard as a matter of law must necessarily have been the standard then in existence.

The provision in the decree in regard to a substitute for disposal works provided for plans or devices for maintaining the purity of the water throughout the year *under present conditions* and estimates of the cost of the works *now* necessary therefor. The legal effect of the language of the decree" * * * for maintaining the purity of the water" was the same as if the words "according to present standards of purity" had been inserted.

Underlying and running through the entire argument of counsel for Jersey City there appears to be an implied assumption (not expressly stated, but in fact denied) that the determination of the Court that the chlorination device was a proper substitute for the sewers and drains mentioned in the contract was intended by the Court to be tentative only; that the device was merely to be accepted, subject to trial, and that, if it should finally be found not to be as effective as it had been represented to be, after experimenting with the device, and after the contractor had furnished the device to the City, the contractor might, without any additional compensation, still be required to furnish the sewers and drains or to refund to the City the cost of the sewers and drains out of the purchase price for the water works, which the decree directed the City to pay. But such an implied assumption is altogether baseless.

The final result of the suit was that the City was required to take the works and pay the contract price for the same (with certain exceptions not germane to the argument).

So far as the final outcome of the litigation in its substance and effect is concerned, it was simply a money decree against the City in favor of the contractor for the definite amount of the contract price. In its nature it was precisely the same as would have been a judgment final in an action at law for the contract price in favor of the contractor.

The terms of the decree having been fully performed by the respective parties, the water works having been conveyed to the City (including the chlorination device in the conveyance), and the City having paid in full the amount decreed, the decree is now in precisely the same situation as would be a judgment at law which had been fully paid and satisfied.

The City is in the same situation as it would be in had it paid a judgment at law and then attempted to open the judgment upon the ground that it had been erroneously rendered for too great an amount.

The City, having satisfied this decree by paying to the defendant the amount required by its terms, now contends in this proceeding that the provision in the decree, that no deduction should be allowed because of the lack of sewers and drains, was erroneous, and seeks to open the decree in order that it may be afforded an opportunity to prove its contention. In effect it seeks to recover back the amount of what it claims to have been an overpayment in satisfying a money decree against itself, on the ground that it was not allowed a deduction, which it claims it can now prove, by means of alleged newly discovered evidence that it should have been allowed.

Such having been the nature of the litigation and its result, it is apparent that there is not the slightest ground for a contention that there was anything of a tentative character in the Court's final determination of the suit. The determination was as positive as language could make it, to the effect that Jersey City should pay a sum certain for the water works, which were to be conveyed to it by the defendant company, with the express provision that there should be no deduction because of the lack of sewers and drains, the question of whether or not such sewers and drains were required by the terms of the contract having been the principal subject-matter of contention in the suit.

The Court reached its determination (of such positive finality in its nature) by three steps: first, it construed the contract, as matter of law, to mean that the contractor was not limited to any particular means, such as sewers and drains, in order to provide the required supply of pure and wholesome water, but that he might use any other effective means of attaining that result; second, the Court found and determined, as matter of fact, that the chlorination device did accomplish that result; and, finally, again as matter of law, it held that the contractor had fully performed the contract in supplying that device; *ergo,* the decree in favor of the contractor for the full contract price, without any deduction.

Is it conceivable that if the Court had intended by its decision simply to provide that the chlorination device should be accepted tentatively, in lieu of sewers, until after a sufficient time it could be determined whether or not the device actually did all that had been claimed for it; and that, in case after such trial it was finally determined not to be an effective substitute for sewers, the contractor should then be required to furnish the sewers, or to refund their cost to the City, the able counsel who represented the City should not have embodied such intention of the Court in the terms of the decree in such clear and unmistakable language that there could not have been any misunderstanding of its meaning, instead of having left that intention to be drawn from the attempted far-fetched construction of the ordinary provision in the decree reserving leave to either party to apply for any such further order or decree as might be necessary to carry the decree into effect?

Is it conceivable that if it had been contemplated that under any possible future contingency the contractor might be required to build the sewers, or to refund their cost to the City, the decree should not have contained some provision requiring the defendant company, which the decree provided was to receive the full contract price, to furnish some kind of security for either building the sewer or refunding its cost, upon the happening of the contingency so contemplated?

It would seem that there is only one possible intelligent answer to either of these questions, namely, that it is not conceivable that the decree should have been drawn in its actual terms, if the intention had been such as that now claimed by counsel for Jersey City.

Counsel says that the standard by which the purity of the water was to be determined was fixed by this Court of last resort itself. It was to be a device capable of insuring the result of preventing contamination equal in all respects to the result which would be attained by sewers, drains and sewage disposal works for the prevention of the contamination of the Rockaway River above the Boonton Reservoir.

Granting that to be the case, it is no answer whatever to the proposition that the standard of purity, whatever that standard was, and by whatever court defined, was necessarily a standard then in existence and known to science. The very question of what constituted contamination of the Rockaway River could only have been answered in 1907 by the scientific knowledge of that day. The criterion by which the contamination of a stream was then determined was the presence or absence of bacteria not in excess of a certain number per cubic centimeter. In accordance with that standard, by which the case was originally determined by this Court, it was held that the Rockaway River was contaminated to such an extent that it did injuriously affect the purity of the water as it reached Jersey City. Consequently the Court held in the first instance that the sewers and drains mentioned in the contract should have been furnished by the contractor and that their cost should therefore be deducted from the contract price. But the Court immediately modified that determination by allowing a substitution for such sewers, and it approved the chlorination device (in turn approved by this Court) upon the evidence that sewers to care only for the sewage of Dover, Boonton and the other localities in question could not materially diminish the contamination of the water of the Rockaway River, inasmuch as pollution from other sources, such as surface drainage, reaching the river would cause substantially as great contamination as without the sewers; so that the bacterial count of the river water at its entrance into the reservoir would probably not be materially diminished by the sewers; whereas the substitute device would act on such of the bacteria as passed through the reservoir and entered the pipes of the intake.

As this Honorable Court expressly approved this determination approving the device, and adopted the findings of the Court of Chancery in that respect, the language of the opinion upon which counsel now relies may have been somewhat inept.. It is certain that the device expressly approved by this Court, which was situated below the reservoir dam, and which could therefore only act upon the water as it reached that point, after passing through and leaving the reservoir, could have no effect, and could not have been understood by the Court to have any effect upon the contamination of the water of the river before it reached the reservoir.

However, this consideration in nowise affects the question of what was the standard of purity by which the case was governed. Whether it was intended by the terms of the contract that the water supply to be furnished was to be pure and wholesome as it entered the reservoir at the mouth of the Rockaway River, or as it actually reached Jersey City, is immaterial upon the question of standards. It is true that this Court has decided that the purity is to be determined at Jersey City and not at Boonton; but regardless of the place where the sample is obtained, the test must necessarily have been made in 1907, according to the scientific standard then in existence, or more properly, in existence at the time of the execution of the contract.

Counsel says the task that was set for the chlorination device was to furnish a result equal to the result of sewers and sewage disposal works located as stated in the opinion of the Court of Errors.

Assuming this to be a correct exposition of the matter, nevertheless the question of whether or not the chlorination device furnished a result equal to the result of sewers depended upon some fixed standard of purity, by which both systems might be judged, and that standard necessarily was the standard then in existence.

Assuming (without conceding) that counsel's argument that a newly discovered scientific fact is nevertheless a fact in existence in past time, that whatever is scientifically true to-day must necessarily have been true for all past time, and that consequently a newly discovered scientific fact should come within the ordinary rules governing other newly discovered evidence, the newly discovered scientific facts (assuming them to be such), upon which Jersey City now relies, are facts by which the standard of purity and wholesomeness of the water for drinking and domestic purposes is made very much more stringent than the standard in existence at the time Mr. Flynn entered into a contract with the City to furnish it with a supply of pure and wholesome water. The standard at that time was the presence or absence in the water of b. coli (not in excess of a certain number). The City now claims that since the contract was made science has discovered a b. Welchii, whose presence in the water is deleterious, and that Mr. Flynn should have made arrangements to keep b. Welchii out of his supply. Likewise other things have been discovered in water, which caused an epidemic in Montclair last winter, and Mr. Flynn should also have provided against those things.

Counsel is attempting to impose the water standards of 1918 upon the terms of a contract made over fifteen years previously (about 1902), at a time when such standards were much less stringent.

That the contractor (The Jersey City Water Supply Company) in agreeing to give Jersey City pure and wholesome water did not contract with reference to tests not in existence at the time the contract was entered into or at the time the original decree was made is apparent from the express terms of the contract itself as set forth in *Jersey City* v. *Flynn*, 74 *N. J. Eq.*, 104.

Quotation from page 111 of *Jersey City* v. *Flynn:*

> "The agreement of February 28th, 1899, provides that the specification prepared by the city, on which the bidding took place and the accepted proposal, are to be regarded as a part of it.
>
> "The specification declares that the Mayor and Aldermen of Jersey City will receive proposals for a supply of pure and whole-

some water under the following plans: (Then follows the plan.) At the sacrifice of brevity it will be necessary to set forth such of its provisions as throw light upon the point at issue. They are the following:

* * * * * *

"'Bidders must also state a price for which the City can buy and own the water works, etc.; * * * *said purchase to take effect on completion and acceptance of the works* if the City shall give notice of its intention to purchase within one year after date of contract.' (Words underlined in italics.)

* * * * * *

(p. 112) "On this specification and proposal the contract was drawn. After binding the contractor to construct the works in strict conformity with the above specification and proposal it continues:

"'Such works shall be constructed and *maintained* by the contractor that the water delivered therefrom shall be pure and wholesome and free from pollution deleterious for drinking and domestic purposes *during the time that Jersey City shall take water by the million gallons.* If such works and supply are purchased by Jersey City they shall be delivered to said City as a completed operating plant free from pollution as aforesaid.' (Words underlined in italics.)

* * * * * *

"Its fifth section reads as follows:

"'The said contractor hereby covenants and agrees that he will, upon the receipt of notice as provided in the specification, *and the payment of the purchase price,*

> sell and convey said water supply with the appurtenances upon any of the following options.'

"Then follow the options mentioned in the specifications.

"The sixth and ninth sections also bear upon the present inquiry.

> (p. 113) " 'Sixth. It is understood and agreed in case the city shall give notice within one year from the date of this contract of its *intention* to purchase said water supply and water works under said specifications when the water works are completed and accepted, that then the city shall have such reasonable time to test said works and the water supply *after* completion and *before the acceptance thereof for purchase* as Jersey City may deem necessary and reasonable for that purpose, provided such tests shall not extend beyond a period of four years and eleven months from the date of this contract.' (Words underlined are in italics in the report.)

*　*　*　*　*　*

"It seems to me that these clauses, read consecutively, show a very clear and definite scheme, a scheme that may be stated in the words of the specification:

> " 'If a contract (*i. e.*, a contract for the supply of water by the million gallons and containing an option) is entered into, it will run for twenty-five years from the date of the contract, unless sooner terminated by a *purchase* of the water works by the city as herein provided for.'

"What is the meaning of the word 'purchase'? Is it used inaccurately as synonymous with agreement to purchase, or is it used in its proper signification of actual acquisition of full title for a valuable consideration? The contract itself gives the answer. It reads, in clause 5: The contractor hereby covenants that he will, 'upon the receipt of notice' (*i. e.,* notice of the popular vote of acceptance) 'and the payment of the purchase price, sell and convey said water supply with the appurtenances to Jersey City.'

"And in clause 6:

"'In case the city shall give notice within one year from the date of this contract of its *intention* to purchase, when the water works are *completed* and *accepted,* then the city shall have such reasonable time to test said works and water supply *after completion and before acceptance thereof for purchase* as Jersey City may deem necessary and reasonable for that purpose, provided such test shall not extend beyond a period of four years and eleven months from the date of this contract.' (Words underlined in italics.)

"This clause only follows and amplifies similar language in the specification, 'said purchase to *take effect* on completion and acceptance of the works if the city shall give notice of its intention to purchase within one year after the date of the contract' (p. 113).

(p. 114) "Here, then, is an express declaration that the notice is not to be treated as a present purchase, but as a notice of *intention* to purchase at a future time after completion and after test. The contract is to be performed in two years and one-half after its date, but the test may be made at any time within four years and eleven months. In other words, two years and five months may intervene between the completion and the test that is to precede the purchase. But during all this interval Jersey City must take the water by the million gallons, for here again the contract provides as follows:

> 'Second. Jersey City agrees to take the water aforesaid and use the same for its water supply *when said works are completed* in accordance with the specification and plan No. 1, as soon as said contractor is ready to deliver pure and wholesome water from such supply.
>
> 'Third. Jersey City agrees to pay for such water when delivered as follows.'

"Then follows the price per million gallons on a graduated scale. It is hard to imagine how language could have been more explicit. Counsel for the city, when pressed to say what would be the city's obligation in case it actually took and used the water during the interval of two years and five months, made two suggestions—first, that the city was not obliged to pay anything; that the test that the city had the right to make was the receipt and use of the water, and that such test might be extended over the entire period, and second, that the express provisions of the contract were suspended during the two years and five months, and that the city was only obliged to pay as much as the water was reasonably worth, the assumption, without proof, being that it was reasonably worth less than the price fixed.

"Neither of these suggestions finds any support in the language of the contract. They are directly opposed to the express stipulation that the city agrees to take and use the water as soon as the contractor is ready to deliver it and to pay for it according to the schedule prices.

"Nothing is more obvious or more reasonable than the scheme as thus defined. Jersey City could no longer use its old supply. It wanted a new one. It was for its advantage not to assume the cost of construction until it had given the works a trial, until it was demonstrated that the plan and supply were good—in other words, the risk was thrown upon the contractor. Is it conceivable that he, under these circumstances, would be willing not only to construct works costing over seven millions of dollars, from which he bound himself not to deliver water to anyone except Jersey City, but also to supply either gratis or without fixing any price, for a period of two years and five months, water worth over $800,000? The Jersey City officials had no such idea, in the first instance, for they paid, without objection, for two quarters, at the schedule rate (114-115).

* * * * * *

(p. 116) "Looking, therefore, at the original agreement alone, it is quite plain that the city was required to pay for the water by the million gallons at the schedule rates, until it actually took the title and paid the price.

"But the works were not completed within the time agreed upon, and supplemental agreements were made. * * * By contract of March 31st, 1902, the time for the completion of the works was extended to Dec. 25th, 1903, and the time for the testing of the works was extended to October 1st, 1905. * * * It contains this provision:

'It is further agreed that the limit of the time for the testing of the works and water supply and the payment therefor by the city after completion and before the acceptance thereof for purchase shall be extended, if desired by Jersey City, to a period not beyond October 1st, 1905.'

"Here again we see that the distinction between the time allowed for completing the works and the acceptance thereof for purchase is sharply indicated. That the contractor was bound to begin to furnish the water immediately upon completing the works appears from the following clause:

'The mayor and Aldermen of Jersey City do hereby agree that the time to complete the work and furnish the water specified in said contract of Feb. 28th, 1899, shall be and hereby is extended until Dec. 25th, 1903.'

* * * * * *

"The next question is whether the position of the parties in reference to payments was altered by the filing of the bill (p. 117). The water, as I have said, was turned on on May 23rd, 1904. The bill was filed Aug. 1st, 1905, that is, *before* the time for testing and acceptance (Oct. 1st, 1905) had expired.

"The bill does not contain an offer to pay the whole price, but only such part of it as may be decreed to be due. It does not aver a willingness to pay any definite sum, and it does not charge that any particular sum is justly payable. It has never tendered any part of the price. This being so, can the mere filing of the bill be regarded as the equivalent of a completion of the contract? The question seems to answer itself. The mere filing of the bill is, certainly, not the equivalent of a tender of the price. It bears more resemblance to an application to this court to postpone payment until such time as this court may determine how much is justly due. The allegation is as follows:

> 'The voters of Jersey City having voted to purchase said water works, and the water works having thereafter been constructed for your orator under said contract, your orator became and is the owner thereof in equity and entitled to the possession thereof. Your orator is compelled for the reasons aforesaid to accept said water works, notwithstanding they are not completed in accordance with said contract. It desires to pay therefor, but it should not be compelled to pay to the defendants said sum of $7,595,000 for the following reasons.'

"Then follow the reasons. The prayer is that this court may ascertain

> 'how much and what part of said water works system the said defendants can con-

vey to your orator; and what part of the said consideration of $7,595,000 should be paid by your orator,'

and that Flynn and the water company 'may be ordered by decree of this court to convey to your orator said water works or so much thereof as they are able to convey upon payment by your orator of such part of said consideration as may be so ascertained.'

"The position of the city is, therefore, this: 'I am not willing to take the works as you have constructed them and pay the contract price. I am willing to accept and take them as far as constructed for such part of the contract price as the court shall (p. 118) decide that I ought to pay.' It had the legislative authority to raise money by an issue of bonds, bearing interest at five per cent., which, however, it is not authorized to sell below par. P. L. 1895, p. 768. Its water board has not as yet authorized an issue. Defendants' counsel say they cannot be sold. Whether they can or cannot, it is admitted that there has never, actually, been in the treasury money available for the payment.

"If the city had, before suit, tendered the purchase money, or so much as was really due, or, if after bill filed, it had paid the money into court, its position with reference to the question now under consideration would have been very different. But it has not. I do not see how, under these circumstances, the mere filing of the bill could be said to have altered the contract rights of the parties and to have conferred upon the city that right to the possession which the contract only gave upon payment or tender.

*   *   *   *   *   *

(p. 119) "The case in hand is much more complicated than that just cited. The complainant's failure to perform consists in not having tendered so much of the price as was really payable.

(p. 120) "Its excuse is that it did not know how much to tender. But it has not only neglected to pay the price; it has advanced several claims that it has not made good by proof—claims, therefore, that the defendant was not bound to submit to. On the other hand, the defendant has insisted that it was entitled to the full purchase price. It has never indicated that it would take less. But the court finds that it was entitled to considerably less. The exact sum payable has, therefore, remained a matter of doubt until decree.

"The matter may be viewed in another way. The water was turned on in May, 1904. The city had, therefore, a year and a half in which to make the final test and to determine for itself the sum which it thought itself at liberty to deduct for deficient performance, and it might have tendered the sum which it considered to have been due at its peril. It did not take that course. It chose, rather, to make its tests during the progress of the cause, and to let the court decide whether those tests showed complete performance by the water company, and what, in equity, it was bound to pay. Having thus sought, as far as it could, to postpone performance until decree; hav-

> ing thus refused to take the responsibility of tendering the money actually due, or of paying it into court, it is hardly in a position to say that it should have the same benefit that it would have had had it performed by the time prescribed by the contract" (p. 120).

From the above quotation it appears that the contract contained express provisions in regard to the time during which tests of the water were to be made, and it necessarily follows from what we have already said that those tests were to be such as were known to science at the time they were to be made. As stated by the Vice-Chancellor (p. 120), the City *"chose to make its tests during the progress of the cause, and to let the Court decide whether those tests showed complete performance by the Water Company,"* and the Court decided that the tests established the fact that the chlorination device did furnish a supply of pure and wholesome water, and decreed therefore that the City should pay the full contract price without any deduction because of the absence of sewers. The decree of the Court of Chancery was affirmed by the Court of Errors and Appeals, and if new tests are now to be introduced into the case, it would amount to a negation of the findings both by the Court of Chancery and the Court of Errors and Appeals that the purity of the water was to be determined by the tests made during the progress of the cause.

It follows from the foregoing, we respectfully submit, that the evidence upon which Jersey City now bases its application for leave to file a bill to review the former decree is evidence which, being *non-existent at the time, could not have been introduced at the hearings of the cause, and that such evidence is absolutely irrelevant to the particular question with which it purports to deal, viz., that involved in the suit, because the question involved in the suit was whether the chlorination device, which was approved of by the decrees, rendered the supply of water to Jersey City pure and wholesome, so far as human intelligence could determine that question at that time, and not so far as human intelligence might determine that question ten, fifty or one hundred years afterwards.*

There is one case which comes very near to determining, in fact which we think actually determines against Jersey City, the point which it raises.

We refer to *Water Supply & Storage Company* v. *Larimer & Weld Irrigation Co.*, 46 *L. R. A.*, at page 329 (1897), quotation:

> "The science of irrigation has greatly developed; among the discoveries made is the fact that the carrying capacity of ditches can now be more accurately determined than formerly. In view of these considerations, counsel ask us, arbitrarily, as we think, to correct these early mistakes; their client and its grantors not having availed themselves of the relief which could be awarded under the statute, had a review been seasonably asked or an appeal taken. As an illustration that courts avail themselves of the latest developments of science, we are admonished that the science of operating a railroad is of constant growth and expansion, and that in actions sounding in damages for personal injuries, involving the correlative duties of master and servant, the court constantly takes no-

tice of these advances, and so modifies and expands old rules to conform to new processes and to meet new conditions. So we are asked in the decision of this controversy, in determining whether the district court erred in computing the capacity of the Larimer & Weld canal, to apply to that question a test or formula that is said to have come into general use since the district court had occasion to determine what was a proper test. The illustration from railroading was unfortunate for the appellant, for, as is well said by counsel for appellees, while courts do avail themselves of new processes and new discoveries in all branches of science, and apply them to new cases as they arise, they do not, in a direct proceeding, open up solemn judgments, rendered upon competent and proper testimony, for the purpose of setting aside a calculation or a deduction therein made by the trial court, based upon legitimate testimony, and substitute therefor a different conclusion, merely because subsequent discoveries in some science or art would seem to require it. In a new case, upon the same facts, or in the former case, had such later facts then been in evidence, the question is entirely different. So, here, this ditch decree cannot be reopened to correct an alleged mistake, made in the calculation of the quantity of water appropriated, based upon a formula, which the evidence then established to be the most correct in general use, because, as the result of later investigations, another test has been discovered, said to give more accurate results."

The question in that case was concerning the carrying capacity of water ditches, and it was held expressly that the question should be determined "in accordance with a formula in general use in this State at the time the decree was rendered." The appellant had endeavored, in a proceeding to open the decrees, to show by the testimony of a Professor Carpenter that "the latest approved and most trustworthy test for ascertaining the carrying capacity of streams and canals is that known as Ganguillet and Kutter's."

The exact point was *not* that the formula of Ganguillet and Kutter had been discovered since the decrees, but it was claimed that scientific investigations, made since the decree, had proved that their formula was more accurate and trustworthy than the formulae in general use at the time of the decrees, and by which the case had been determined.

The Court, however, held that whether or not that particular formula had been considered at the time of the decree, the case had been correctly decided by using the formulae then in general use.

In short, that case is direct authority for our proposition that when a contract is being enforced, which by its terms requires the contractor to attain a certain standard or meet a certain test, unless the exact nature of the standard or test is expressly set forth in the terms of the contract, the standard or test must necessarily be that in common use at the time of the execution of the contract. Otherwise it would be impossible for the contractor to know what standard or test he would be required to meet.

POINT II.

Opinion evidence of the character disclosed by the papers is not within the rule as to newly discovered evidence on bill to review.

The new evidence which the complainant seeks to introduce into the case as newly discovered is the evidence of experts to the effect that in their *present* opinion, as distinguished from the opinion they entertained when some of them gave their evidence at the original hearing, the chlorination device is not effective. These experts claim to base their reasons for their present opinions as distinguished from their past opinions upon alleged scientific discoveries made since the decree.

It is our insistence that if a change in the opinion of an expert witness can be regarded as newly discovered evidence sufficient to constitute a ground for leave to file a bill of review, litigations would be endless, and the maxim "It concerns the State that there be an end to lawsuits" would be without effect.

Every lawsuit, whether an action at law or a suit in equity, is for the purpose of settling a dispute which has arisen between parties. In every such suit the complaining party alleges a failure of duty which he claims to have been owed to him by the defendant. Such failure may be regarding a matter arising *ex delicto,* whether an alleged act of omission or commission, or regarding a matter arising *ex contractu.* In the first case, the matter *ex delicto* must relate to some duty imposed by the law to govern the relations of the parties. For instance, the duty to exercise reasonable care, or the duty not to commit a trespass. In the second case, if the matter arose *ex contractu,* then the duty has been created by the parties themselves by an express agreement, or the facts of the case must be such that the law implies the existence of an agreement between them. In the case at bar there was an express agreement between the parties, whereby one agreed to furnish the other with a supply of pure and wholesome water. In determining any such dispute arising either *ex delicto* or *ex contractu* the Court is bound to determine what was the duty owed by the one party to the other, and that determination must necessarily relate to the time when the duty arose. In a matter *ex delicto* the case would be governed by the duty owed by the defendant at the time of his alleged breach of duty. If the case were one of alleged negligence to exercise reasonable care, it would be determined by the rule relating to the subject at the time of the alleged act of negligence; and that rule would depend upon what an ordinarily prudent man should have known at the time regarding the effects of his alleged conduct. If such a case were determined in favor of the defendant upon the ground that he could not reasonably have foreseen the effects which actually occurred, the case could never be reopened and retried and determined against him by showing that subsequent scientific discovery proved that the result of his conduct was bound to be what it had been, and that he had been consequently negligent. The chief, if not only difference between a failure of duty arising *ex delicto* and one arising *ex contractu,* is that in the one the duty is imposed by law, and in the other (except in the case of an implied contract), the duty is self-imposed by agreement between the parties, but in either case the nature and extent of the duty must be governed by the extent of human knowledge at the time the duty arose or was created. In the case of a contract the reciprocal duties between the parties created by their agreement must be determined by what was their common intent, as expressed in the agreement, and that intent must necessarily be within the limits of human knowledge at the time the agreement is made. If the agreement relates to the quality of a thing, or the efficiency of a device, in the absence of an express provision as to the manner in which such quality or efficiency is to be determined, it must necessarily be intended that it shall be determined by the common understanding regarding such matters at the time of the performance of the agreement. If a dispute arises out of the agreement which is taken into a court for its decision, and it is alleged that the defendant has failed to perform his contract because of his failure to furnish the thing of the required quality or efficiency, and it is a question requiring the assistance of experts to determine, their evidence must necessarily relate to the state of science at the time of the performance of the contract, because it could not possibly be considered in construing the contract that the parties, at the time they entered into it, had in mind matters beyond human knowledge. Therefore, in determining what duty was owed by one party to the other arising out of a contract, it would be as unjust as it would be in determining a duty arising *ex delicto* to decide the case by knowledge arising out of scientific discovery made several years after the trial of the case. All conduct and every obligation must be judged by what the party could have known at the time the act complained of was committed or the obligation was incurred. To penalize a party for conduct, the result of which could not be foreseen because of the state of undeveloped scientific knowledge at the time of the trial, would be no less unjust than to hold him liable to perform under a contract something more than either party contemplated would be required by the test or standard in existence at the time of making the contract based upon the scientific knowledge of that time.

Opinion is variant in character, and as time progresses and scientific knowledge grows, the opinions of experts on any specific subject will necessarily be subject to constant changes. We respectfully submit that it would be a very dangerous precedent to create to say that a change in the opinion of these experts after all these years is newly discovered evidence within the rule as to newly discovered evidence on bill to review. Such a decision would be to lay down an entirely new precedent, because no case can be found in England or America where such effect has been given to a change in the opinion of an expert witness or of expert witnesses.

The nearest case we have been able to find, having any bearing on the subject, is the case of *Munday* v. *Landry*, 51 *La. Ann.*, 303.

Headnote: Affidavits of witnesses for defendants and counter-affidavits of witnesses for plaintiff regarding the extent of injury suffered in a case of assault and battery do not present grounds to set aside the verdict and remand the case.

Quotation:

> "It appears that defendant contended in the District Court that plaintiff had not sustained any injury; that he remained at home secluded and feigned to be sick in order to ex-

cite public sympathy and make better the opportunity for recovering damages. Three experts were appointed on defendant's motion to examine into his physical condition—the examination was read to the jury. Plaintiff's testimony was taken at his residence. * * * The mental and physical health of plaintiff presented an issue, it is contended, and the reports of the experts, defendants assert, must have influenced the minds of the jury prejudicially to the defendants. That they were prejudiced by it because, (defendants insist) it was erroneous to the extent that it was stated that plaintiff suffered with a fracture of the occipital bone causing a compression of the brain. Lately two of the experts, for reasons stated, have arrived at a different conclusion, and now certify substantially that they of late (since the trial) from personal observation have had the opportunity to discover the error complained of; that the plaintiff's physical health is apparently better than it has been for years, and that it is very doubtful that any injury was ever inflicted on his brain. * * * The jury found a verdict for plaintiff in the sum of $1500. From the verdict * * * defendant appealed. The court refused to grant a new trial, holding that the maxim 'It concerns the state that there be an end to lawsuits' applies."

The opinion of an expert witness does not necessarily prove the fact he deposes to. In *Winans* v. *N. Y. & Erie R. R. Co.*, 21 *How.* (*U. S.*), 101, the Court, in defining the nature of expert evidence, used this language:

> "Experts may be examined to explain terms of art and the state of the art at any given time. * * * A judge may obtain information from them, if he desires it, on matters which he does not clearly comprehend, *but cannot be compelled to receive* their opinions as matter of evidence. Experience has shown that opposite opinions of persons professing to be experts may be obtained to any amount."

We further submit that the evidence in question is such as if introduced in the case would not necessarily, or even probably, in view of the opposing affidavits, result in any change in the decree, and for that reason also it is insufficient ground upon which to base an application for leave to file a bill of review.

POINT III.

Though all criticisms applied by us to this so-called newly discovered evidence should fall to the ground, such evidence would, nevertheless, be valueless for the purpose for which it is intended, because it is essentially cumulative in character.

In *Dundee Manufacturing Company ads. Van Riper*, 33 *N. J. Law*, 152-156, the Court said:

> "As to what is cumulative evidence Savage, *C. J.*, in the case already cited from 10 *Wend.*, says:
>
> " 'According to my understanding of cumulative evidence, it means additional evi-

dence to support the same point, and which is of the same character with evidence already produced.'

"Adopting this definition, which, I think, an admirable one, at once terse, comprehensive, and accurate, it is clear that the evidence upon which a new trial is sought in this case, is in no proper sense cumulative."

In *Hoban* v. *Sanford*, 64 *N. J. L.*, 426, the fourth headnote reads:

> "If the newly-discovered evidence is of the same general character and cumulative of that produced on the trial, and merely additional or corroborative of such evidence, and merely multiplying the number of witnesses on the one side or the other, a new trial will not be granted."

Quotation, page 438:

> "This evidence merely adds to the evidence on the two trials. * * * It is additional evidence of the same general character. It merely corroborates one contention or the other assumed by the parties in this case. * * * it merely multiplies the witnesses to a fact before investigated, and only adds a few other circumstances of a general character, and it is a well settled rule that a new trial will not be granted when the new evidence relied upon is merely cumulative of that introduced at the former trial."

See also:

Den v. *Geigor*, 9 *N. J. L.*, p. 225

It is not our intention to seek to have this application disposed of on a mere comparison of affidavits, though the cumulative character of the testimony sought to be introduced is made absolutely manifest by Dr. Pease's affidavit and that of Andrew J. Provost.

The fourth exception to the Master's report expressly claimed that the Master should have found that the plans and devices presented as an alternative remedy did not destroy the spore-forming pathogenic bacteria in the water, and that they did not affect, remove or lessen to an appreciable extent the polluting organic matter or filth in the water (p. 12, lines 27-35). That is precisely the very question then passed upon which it is now desired to have passed upon a second time in the light of alleged evolutionary improved scientific knowledge.

The same may be said of the sixth exception to the Master's report, which reads as follows:

> "Because the Master reported that this device is capable of rendering the water delivered to Jersey City pure and wholesome for the purposes for which it is intended, and is effective in removing from the water those dangerous germs which were deemed by the decree to possibly exist therein, at certain times.
>
> "Whereas, the Master should have reported that this device is not capable of rendering the water delivered to complainant pure and wholesome. That the sewers, when built, would absolutely prevent the sewage which entered them from contaminating this water, while these alternative plans and devices only assume to kill in this sewage those pathogenic bacteria which were known to be

water-borne at the date of the execution of the contract" (p. 12, line 35).

We offer the following few additional illustrations as to the cumulative character of the evidence sought to be introduced by the complainant.

Paragraph 16 of the petition, Subdivision (a) (p. 16), states that the limitations of hypochlorite treatment existent in 1908-1909 have become *increasingly* manifest by actual experience in dealing with what is really an emergency device. The use of the word "increasingly" in this paragraph would indicate that the limitations of the treatment were manifest to some degree in 1908-1909, as, of course, is apparent from the record and the claim made by Jersey City at the hearings. That this manifestation has since increased is, therefore, purely cumulative evidence.

At page 18 of the petition, Subdivision (h), it is claimed that the pollutions themselves are not destroyed by the sterilization process, but only the evidence of the pollution, and that that fact was only partially recognized in 1908 and 1909. If it was then partially recognized, any evidence now tending to corroborate that partial recognition would be purely cumulative.

Subdivision (k), page 19, of the petition, claims that the sterilization process does not destroy B. Welchii and the spore-forming bacteria; that B. Welchii is now known to be not only an indicator of sewage contamination, but the actual cause of peritonitis, intestinal putrefaction, auto-intoxication and many other diseases—*a fact only partially and dimly recognized in 1908 to 1909.* If the fact was partially recognized in 1908 to 1909, its fuller recognition to-day is merely cumulative.

POINT IV.

The appellant's right to a bill of review, which, if successful, would involve a money decree in its favor, is barred by the Statute of Limitations.

This conclusion is clearly enunciated in the opinion filed by the Vice-Chancellor in the cause below, and we can add but little to the subject.

In *Hovenden* v. *Lord Annersley,* 2 *Sch. & Lef.,* Lord Redesdale held that

> "courts of equity, though not within the words of the statute of limitations (which apply to particular legal remedies) are within the spirit and meaning of them. Courts of equity act not by analogy, but in obedience to the statute of limitations."

The same Judge, in his treatise on the subject (*Mitford's Equity Pleading,* p. 53), which is the fountain head of nearly all our modern text in equity pleading, divides bills into three classes: (1) original bills, (2) bills not original and (3) bills in the nature of original bills, but occasioned by a former bill, and bills of review are classified as of the third class.

The rule in the English courts, however, was that when twenty years had elapsed from the time of pronouncing a decree which had been signed and enrolled a bill of review could not be brought unless the plaintiff was under disability.

The American cases, however, limit the time within which a bill of review must be brought to the same period which limits writs of error at law, at least so far as concerns bills of review for error apparent on the face of a decree.

We have been unable to find any clear-cut decision as to the period within which bills of review may be filed on the ground of newly discovered evidence.

Story, in his book on equitable pleadings, says, with reference to this subject, as follows:

> "We have already seen that a bill of review for error apparent on the face of a decree must be brought within the same period which limits writs of error at law. The question may arise whether the like limitation applies to bills of review upon newly discovered facts and evidence. *There can be no doubt that it would be a good bar that the bill of review is not brought within the period limited for writs of error after the discovery of the new facts or evidence.* (Italics ours.) But the point intended to be stated is whether any bill of review would lie after the lapse of that period from the time of making the decree, although the bill of review is brought within the prescribed period after the discovery of the new facts or evidence. *There does not seem to be any decision settling the point;* (italics ours); and as the allowance of a bill of review for newly discovered evidence is discretionary with the court, it is scarcely probable that it will arise in judgment, as the lapse of time will always have great weight with the court in refusing the application in connection with the other circumstances."
>
> *Story's Equity Pleading,* 10th Edition, Sec. 419.

The same point was before the Supreme Court of the United States in *Thomas* v. *Harvie*, 10 *Wheat.*, 146-151, but the Court left it undecided.

It would, therefore, seem that it is discretionary with the Court of Chancery, and we supopse also with the Court of Errors and Appeals, to determine whether in any given case where leave is asked to file a bill of review on the ground of newly discovered evidence, the Statute of Limitations shall strictly apply or not.

The New Jersey cases seem to be in accord with this view.

> *Watkinson* v. *Watkinson* (*N. J. Court of E. & A.*, Nov. Term, 1904), 68 *N. J. Eq.*, 632.
>
> Head Note 3: "Although there is no express statutory limitation as to the filing of bills of review, the analogous limitation of the right of appeal should govern, and a bill of review cannot be filed after the lapse of three years from the final decree, *except in case of new or newly discovered matter.*"

This was a bill of review filed by the defendant in a divorce suit to set aside a decree of divorce.

Pitney, *V. C.*, advised a decree setting aside the decree in the original suit. His action was reversed by the Court of Errors.

Quotation from page 641:

> "The record in this case shows that the petition for leave to file a bill of review was not filed until nearly four years after the entering of the final decree in the suit for

divorce, and the question to be determined is whether the laches and delay of the respondent in asserting her rights is a bar to this suit.

"The rule in the English courts is that when twenty years have elapsed from the time of pronouncing a decree which has been signed and enrolled, a bill of review cannot be brought unless the plaintiff was under disability. 2 *Dan. Ch. Pr.,* 1580; *Mitf. Pl.,* 105; *Lytton* v. *Lytton,* 4 *Bro. Ch. C.,* 441; *Delaraine* v. *Brown,* 3 *Bro. Ch. C.,* 633.

"And in the supreme court of the United States, in the case of *Thomas* v. *Harvie's Heirs,* 10 *Wheat.,* 146, Justice Washington, in commenting upon the question of the limitation of the right to file a bill of review, said: 'It must be admitted that bills of review are not strictly within any act of limitations prescribed by congress, but it is unquestionable that courts of equity, acting upon the principle that laches and neglect ought to be discountenanced, and that in cases of stale demands its aid ought not to be afforded, have always interposed some limitation to suits brought in those courts.' And this case explicitly declares the rule, never since departed from in that court, as follows: 'There is no statute expressly limiting bills of review, but the courts of the United States are governed in this particular by the analogous limitation of the right of appeal, and therefore a bill of review cannot be filed after the lapse of five years from the final decree.' Applying this rule to the practice in our state, after the lapse of three years leave would not be granted to file a bill of review.

"There is, however, one exception to the general rule in England, as noticed by Mitford, and that is the discretionary power of the court in the case of newly discovered evidence, and this exception Judge Washington recognizes in *Thomas* v. *Harvie, supra*, saying: 'Whether a bill of review, founded upon matter discovered since the decree, is in like manner barred by the lapse of five years after such decree, is a question which need not be decided in the present case, since we are all of opinion that it is in the discretion of the court to grant leave to file a bill of review for that cause.'

"My examination of the authorities leads me to the conclusion that the law as above laid down in the Supreme Court of the United States has been almost uniformly followed in this country.

"The time of appeal having expired when this application for leave to file a bill of review was made, the petitioner was barred, unless her case could be brought strictly within the exception of newly discovered evidence, or of some special equity that would give the court the discretionary power to make the order."

Note: The period of three years for taking appeal allowed by the statute, as stated in the quotation above, was contained in P. L. 1902, p. 545. This period has now been reduced by P. L. 1907, p. 452, to one year.

Forman v. *Executors of Edmund Brewer* (N. J. Court of Errors and Appeals, Nov. Term, 1900), 62 *N. J. Eq.*, 748.

Quotation, page 750:

> "The common statute of limitations, and the analogous bars and presumptions in equity and at law are regarded for all purposes of the pending litigation as having ceased to operate against a claim from the tiem when it was submitted to the jurisdiction of the court" (citing authorities).

We submit that the effect of this decision as applied to the case at bar, is as follows:

The City's present claim to be reimbursed for the amount of what it claims the sewers will cost is a money demand which first arose (if it arose at all) some time prior to the time it filed its original bill for the specific performance of the contract; that is, some time prior to August 1st, 1905 (74 *N. J. Eq.,* 108). This is a period of thirteen years. Assuming the claim to be a purely monetary one, the ordinary statutory period of limitation would have expired some time prior to August 1st, 1911, namely, within six years.

Applying the rule in the *Forman* case, if there had been no litigation the claim would now be barred, but as we understand the rule laid down in the *Forman* case, the statute ceased to operate against the claim from the time when it was submitted to the Court of Chancery. But we submit that the litigation having been terminated by the final decree in 1911, and pursuant to that decree the water plant having been turned over to the City October 11th, 1911, the Statute of Limitations began to run again from the date of the final decree in 1911 as against the present monetary demand, and that the statutory period of six years has again run against the claim, and that this Honorable Court should so hold, even though such an application of the Statute of Limitations to the demand is deemed to be discretionary on its part and not mandatory.

And if, as Judge Story says (in the quotation from his book in equity pleading above given), "there can be no doubt that it would be a good bar that the bill of review is not brought within the period limited for writs of error (or for appeals as the practice of New Jersey is) *after the discovery of the new facts or evidence*"—then the bar exists in the present case, because clearly the change of opinion on the part of the experts, or at all events on the part of some of them, which is erroneously termed by the complainant "newly discovered evidence," took place *more than one year ago*, and as appeals must now be brought within one year, the bar has thus become complete, even though it be not deemed complete for any other reason.

The maxim *"Nullum tempus occurrit regi"* has no application so as to permit Jersey City to escape the application of the Statute of Limitations—and this for the following reason set forth in Dillon in his work on municipal corporations:

> "The doctrine is well understood that to the sovereign power, the maxim *'Nullum tempus occurrit regi'* applies, and that the United States and the several states are not without express words bound by statutes of limitations. Although municipal corporations are public agencies, exercising on behalf of the state public duties, yet they also exercise and acquire what the courts have called rights in a private and proprietary capacity rather than in a public and govern-

mental capacity, and such corporations are not exempt from the operation of limitation statutes in cases wherein arise questions involving property or contracts which do not pertain to the authority of the state which is exercised through them, but pertain to the private and contractual rights of the municipal corporations, and such statutes run in favor of and against these corporations with respect to these private and proprietary rights and obligations in the same manner and to the same extent as against natural persons."

Dillon Municipal Corporations, 5th Edition, Vol. 3, Sec. 1188, and cases there cited.

Counsel, however, claim that the Flynn contract became merged in the decree, and that, therefore, the statutory period of limitation applicable is twenty years, and not six years. This, we submit, is due to a confusion of thought on the subject. If this was a proceeding to enforce the decree, the statutory period would be twenty years. But, as clearly pointed out by the Vice-Chancellor in his terse and lucid opinion, the present application, while, in form, one to file a bill of review to enable complainant to put in additional evidence, is, in substance, one to obtain leave to put in evidence, which, when put in, will be used as the basis of a money decree—a decree founded on a cause of action arising out of a supposed error in the original decree and occurring after the original decree was made. As the Vice-Chancellor says:

"No part of the prayer of the original bill would meet the case. A new prayer would be necessary, and this prayer would be grounded on a new cause of action not commenced and sued within six years next after it accrued."

POINT V.

The points above relied upon by the defendant in opposition to the petitioner's application for leave to file a bill of review are all supported and fortified by the affidavits filed on both sides of this application.

As stated in a previous part of this brief, it is not our intention to seek to have this appeal disposed of on a mere comparison of affidavits. In fact, our first impulse was not to trouble filing any affidavits in reply, and those we did file were simply for the purpose of showing:

(1) That the facts alleged in the affidavits filed for the complainants are disputed facts.

(2) That all that is designated in the petition as "new matter" is not, in fact, new matter.

(3) That the expert witnesses possessed at the time of the hearing the same kind of knowledge that they now say they have recently discovered—or, if properly qualified, they should have then possessed it.

(4) That the supposed newly-discovered evidence is cumulative in character.

(5) That the application should be denied involving (as it does) a money demand barred by the Statute of Limitations.

(6) That the conditions confronting Jersey City by reason of increase in population in

Rockaway Township are somewhat different from the conditions which confronted it when the sufficiency of the chlorination plant was passed upon by the Court.

(7) That, as a matter of fact, Jersey City's present water supply is excellent.

The affidavits of Herbert D. Pease and Andrew J. Provost may be treated as part of our present brief. Wherein they are argumentative they simply set forth the arguments upon which these expert witnesses base their conclusions. Nothing would be gained by repeating these arguments or conclusions here. They speak for themselves. It will be observed, however, from the affidavit of Herbert D. Pease, paragraph 7 (p. 232), that "it is alleged in the petition that the water delivered to Jersey City is unfit for use in that it does not conform to the standards of purity adopted by the United States Public Health Service for waters to be used in interstate commerce," and that these standards were not promulgated until October 14, 1914. It is not easy to understand how the defendant, Jersey City Water Supply Company, could have complied in 1910 with standards which were not promulgated until 1914, but this is the kind of vice which runs through all the evidence upon which this application is based.

It remains simply to state that there is nothing in the affidavits presented by Jersey City to indicate that it has taken any steps whatsoever to protect itself against unlawful pollution of the Rockaway Rive by Boonton, Dover and the other municipalities and individuals who are polluting it, although it is afforded every opportunity to do so by Chapter 35 of the Laws of 1897 (P. L. 1897, p. 99).

We pass now to the other prayer for relief contained in the appellant's petition, which we dispose of under

POINT VI.

Neither the leave reserved to the petitioner to apply to this Court for such further order or decree as might be necessary to carry into effect the decree in this cause of June 4, 1908, nor the like reservation in the decree of November 15, 1910, can entitle the petitioner to obtain the modification of those decrees which it asks for in its petition. Even if the petitioner were entitled to the relief it seeks (which we have shown not to be the case), it could only obtain such relief by obtaining permission to file a bill to review the decrees. No such relief could, under any circumstances, be granted under mere leave to apply for further directions.

The form of the reservations contained in the decrees will be found in an earlier point of this brief and at page 6 of the case, lines 15 *et seq.*, and page 13, lines 36 *et seq.*

Of course, if we have succeeded in demonstrating that the petitioner possesses no equity whatsoever to have the decrees modified, then it is unnecessary to discuss whether if it possessed such an equity it could have enforced it in the manner now under discussion, or whether its only remedy would have been by bill of review.

The provision in the decree of June 4, 1908, reserving to either party leave to apply to the Court at the foot of the decree, was expressly limited to two things, one with which we are not concerned, viz., to prevent forfeiture, etc.; the other, for such further order or decree as may be necessary *to carry this decree into effect*. The reservation in the decree of November 15th, 1910, adopts precisely the same language.

The clear intent of this language is to reserve leave to apply for further directions *in order to carry out the actual terms of the decree,* not, certainly, for leave to apply for an order modifying those terms—that is to say, in fact, for a new decree reversing the finding of the decree in which the reservation was contained.

At page 10 of the petition the petitioner is made to say:

> "It appears, therefore, that in the course of the litigation above referred to the law of the case in respect of the chlorination device which the Water Company was permitted to substitute for sewers, drains and sewage disposal works, called for a device designed to insure the prevention of the contamination of the Rockaway River above the Boonton Reservoir, and that in order to safeguard that result * * * it was provided by this Court that leave was reserved to the City to apply to the Court for such further decree," etc., etc. (p. 14, lines 30 *et seq.*).

Of course, this is an erroneous statement of what the law of the case was. The chlorination device was not (under the Court's ruling) designed to insure the prevention of the contamination of the

Rockaway River above the Boonton dam, but to insure against the contamination of the water as it entered Jersey City's water pipes. Counsel have completely overlooked the fact that Jersey City voluntarily exercised its option to purchase the plant—paid for it and took title to it—and there must surely be some confusion of thought in arguing that the Court, in reserving leave to apply for further directions, intended to keep a watchful eye on Jersey City's own water works, and, from time to time, if occasion arose, compel the Jersey City Water Supply Company, who had no further interest in the plant, to take care of the pollution, and, if necessary, build intercepting sewers. Counsel confuse what might have been the situation if the Jersey City Water Supply Company had continued to own and operate the works for the benefit of Jersey City with the situation which, in fact, arose when Jersey City exercised its option, took over the plant and operated the plant itself.

In *Daniels Chancery Practice,* Sixth American Edition, Vol. 2, p. 996, we find the following quotation, which seems to have some bearing upon the subject now under discussion:

> "Although the general rule of the Court is to make a complete decree upon all the points connected with the case, it frequently happens that the parties are so circumstanced that a decision upon all the points connected with their interest cannot be pronounced till a future period. All that the Court usually does, under such circumstances, is to order the interest of the fund to be paid to the person entitled to the dividends during his life, and to declare that, upon his death, the parties interested in the fund are to be at liberty to apply to the Court as they may be

> advised. *The same sort of liberty is also given in any other case in which it may seem requisite; and the effect of it is not to alter the final nature of the decree. A decree, with such a liberty reserved, is still a final decree, and, when signed and enrolled, may be pleaded in bar to another suit for the same matter.* The effect of the reservation is to permit persons having an interest under it to apply to the Court touching such interests in a summary way without the necessity of again setting the cause down."

Counsel for Jersey City relies on *Eureka Fire Hose Company* v. *Eureka Rubber Manufacturing Company*, 72 *N. J. Eq.*, 555, in support of his point

> "that the court by the reservations in the decrees wished to make it clear that any alternative device must achieve as good a result as would be achieved by the sewers and sewage disposal works provided for under the contract, and that if it did not relief would be granted."

We, however, cite that case as bearing out our contention that the reservation of "leave to apply to the court at the foot of the decree for such further order or decree as may be necessary to carry this decree into effect" expressly limits the scope of the "further order or decree" to carrying out the actual terms of the decree containing the reservation, and does not extend that scope to modifying, or, still less, reversing the findings of the decree containing the reservation.

As stated in the case cited by counsel:

> "It is well settled that under a *general* leave (italics ours) reserved for further di-

> rections, an alteration of the decree made on the original hearing cannot be made, nor a decree inconsistent with it."

But in that case (the *Eureka* case) the leave reserved was not a general leave reserved for further directions, but was (as in the case at bar) a special leave expressly extending "only to directions for enforcing or protecting the rights granted by the decree, not to a modification of those rights."

The final decree, entered in this cause November 16, 1910, and approved by the Court of Errors and Appeals July 11, 1911, recited that

> "the plan and device presented to the court by the Jersey City Water Supply Company as alternative remedies for delivering the supply to the Mayor and Aldermen of Jersey City in a pure and wholesome condition throughout the year under present conditions is an effective process for that purpose * * * *",

and decreed

> "that the said alternative plan and device hereinbefore referred to and put in use by the defendant, is approved as a substitute for the sewers and sewage disposal works, intercepting sewers and drains in said decree suggested * * *, and no deduction or abatement of the purchase price * * * shall be made because of the lack of any such sewers, works or drains or because of any defect in the works as a mechanism for the purification of the supply."

To have an order or decree made now determining that the chlorination device is insufficient, and that a deduction or abatement of the purchase price shall be made equivalent to the expense of building an intercepting sewer, would be to expressly reverse the decree aftr the same has been affirmed by the Court of Errors and Appeals; after the works have been taken over by Jersey City and paid for by Jersey City to the Jersey City Water Supply Company, and after the Jersey City Water Supply Company has distributed all its assets among its bondholders and stockholders.

But counsel says that

> "by comparing the reservation in the Eureka case with the reservation in the case at bar, it appears that in the Jersey City case the reservation is not limited merely to directions for the purpose of effectuating the decree, but reserves leave to apply to the court at the foot of the decree for any such further order or decree as may be necessary *to carry the decree into effect.*" (Italics ours.)

What the precise distinction may be between *"effectuate"* and *"carry into effect"* we are unable to see. Our interpretation of these two terms is that a reservation limited merely to directions *"for the purpose of effectuating a decree"* is precisely in every respect the same thing as a reservation limited merely to directions for the purpose of *"'carrying the decree into effect."*

Neither do we understand counsel's contention that while a reservation for the purpose of effectuating a decree permits of no modification or change of that decree, nevertheless a reservation for the purpose of *carrying a decree into effect* is tantamount to saying:

"You scientific gentlemen apparently agree that this experiment of chlorination, admittedly developed during the progress of this lawsuit, will achieve results identical to the results obtainable from sewers and sewage disposal works, and if that be the case there is no equity which demands that the Water Company should be called upon to furnish at much greater expense the sewers and sewage disposal, which, after all, can only accomplish the same result, particularly as the City is asking a specific performance with deductions; but the whole thing is a novelty. It may be that you are wrong, in which case Jersey City would have received an inadequate substitute incapable of producing the results to which he is entitled. We will, therefore, arrange it so that the end of this decree may be attained."

It is difficult to trace the connection between counsel's premises and conclusion as formulated in the above proposition.

Counsel claims in one part of his brief that the decree was not based upon diagnostic but upon prognostic evidence, the inference being that some rule of equity exists that where evidence is *prognostic* in character the conclusion based upon it can always be changed by inserting a reservation for further directions in the decree, and then afterwards offering evidence to show that retrospect demonstrates that the prognosis was wrong. We, however, submit that no such rule exists.

In citing the case of *Quick* v. *Lilly,* 3 *N. J. Eq.*, 255, in support of Point I of their brief, counsel omit to mention this language of the Chancellor:

"The question now is whether the petition shall be granted. The rule in cases of this kind is that the evidence discovered must not only be new, but material; and the meaning given to the word material is of the highest importance."

We have already shown that the evidence sought to be introduced is not only not new, but is purely cumulative in character, and it is *immaterial* also, because the question to be tried in the case was whether the chlorination device, which was approved of by the decrees, rendered the supply of water to Jersey City pure and wholesome, so far as human intelligence could determine that question at that time, and not so far as human intelligence might determine that question years afterwards.

Counsel further insists that the Court will not, in considering an application for leave to file a bill of review, do more than see if there is an arguable question and grant the order for leave and determine the whole case on the final hearing. The injustice of such a course of procedure as applied to the case at bar would be to cause the Water Supply Company to embark in an enormously expensive litigation when, if we are right in our contention, it is clear there exists no ground at all for review.

No case will be found where leave was granted to file the bill for review where there did not exist some disputes of fact which the Court could not solve *in limine* as against the applying party. In the case at bar, however, the question of granting or refusing this application is one of law, because our contention is that the complainant's affidavits, though taken as true, do not present any proper ground of relief.

In discussing Point II of their brief counsel lay great stress on the decision of the House of Lords in the case of *The Managers of the Metropolitan Asylum District* v. *Hill et al.*, 47 *L. T. Rep.*, *N. S.*, 29. That case, however, was not an application for a bill of review on the ground of newly discovered evidence, but was an application (before judgment final) for a new trial, on the ground that the verdict was against the weight of the evidence; and Lord Selbourne said in the case, "If, indeed, nothing were at stake beyond the right of the plaintiffs to receive a certain sum of money by way of damages for a particular trespass, the maxim '*interest rei publicae ut sit finis litium*' might be in point, even in a case of this problematical kind as (in patent cases especially) may sometimes be liable to happen." *The whole case hinged upon public policy.* If a new trial had not been granted in that case, and if the verdict of the twelve laymen composing the jury, based upon inconclusive scientific evidence—for of such character the Appellate Court found the evidence to be—had been allowd to stand, and judgment final to be entered thereon, the case would have become a governing authority of the English Courts for the proposition that a small pox hospital was *per se* a nuisance, so that no such institution might thereafter have been established in any populated part of Great Britain. Naturally, and very properly, the Appellate Court scrutinized with great care the character of the evidence upon which the verdict had been based, and as the result of such scrutiny decided that the evidence had been altogether inconclusive either in support of or against the proposition that such institutions are necessarily nuisances, or that the particular institution in question was in fact a nuisance. Whereas the only result of a refusal of leave to Jersey City to file a bill of review in the present case would be to prevent it from recovering an alleged money demand from the Water Supply Company, which we claim (and the Chancellor has held) is barred by the Statute of Limitations.

Counsel also rely (p. 23 of their brief) on the case of *Anschutz* v. *Louisville Ry. Co.*, 152 *Ky.*, 741. That was a very extreme case, in which the subsequent birth of a child demonstrated that the plaintiff woman was not barren, as the medical experts had sworn she was—whereas in the case at bar no *demonstration* exists, or is attempted, to show the lack of purity of the water supply of Jersey City, *as it reached that City,* and as it was furnished to the City by the Water Supply Company at the time the City purchased the water works in 1911; there is simply a claim made (contradicted by the Water Supply Company) that the water supply will not *to-day* stand the tests as to purity which recent scientific opinion may now deem necessary.

We respectfully submit that for all the above reasons the order of the Court of Chancery denying the application should be affirmed.

John B. Humphreys,
William A. Sumner,
Gilbert Collins,
Of Counsel with the Respondent.