1907

REPORT

OF THE

State Sewerage Commission

TO THE

Legislature of 1908.

SOMERVILLE, N. J.:
THE UNIONIST-GAZETTE ASSOCIATION, STATE PRINTERS.
1908.

REPORT.

To the Legislature:

The State Sewerage Commission submits the following report showing its operations and expenditures during the past year, the ninth of its existence.

The expenditures of the Commission during the year are reported by its Treasurer, whose detailed report is submitted herewith. A detailed report of the work of the Commission has been prepared by its Secretary and is also submitted herewith.

During the fiscal year the Commission has met fifty-two times. Of these meetings forty-two were held in its office in Jersey City and ten in other parts of the State. It has had before it matters affecting more than one hundred municipalities located in twenty of the counties. It has received and investigated thirty complaints and protests. Sixty sanitary inspections have been made, of which fifty were made by the Commission or its members. The other ten include river inspections covering over thirty-two hundred miles of riparian frontage, including both sides of streams, and resulting in over five hundred reports of pollutions. Each of these cases involved some correspondence. Many of them required hearings, notices and reinspection. The Commission has given notice during the year to twenty-six municipalities or public corporations, fifteen private corporations and one hundred and twelve individuals to cease pollution. It has ordered four suits for injunctions to enforce its orders. It has given advice or opinions in sixty cases, of which twenty-five required the preparation of special engineering reports. It has done active work in supervising thirty disposal plants. It has held hearings in relation to forty-two subjects. It has considered thirty-eight plans for sewerage systems and disposal plants, of which twenty-two were approved, ten disapproved and five either were not properly before the Commission or have not yet been considered. The plans approved involve the expenditure of nearly two million dollars. Those disapproved in all cases but two were subsequently altered to meet the views of the Commission and the revised plans approved. In these cases much needless or useless expenditure was avoided.

The Commission has received requests for copies of its annual reports from most of the States and from many foreign countries. These requests come usually from engineers, sanitary officers, teachers of engineering, and libraries, especially those of colleges and engineering societies. A large number of the reports are distributed among the municipal officers of this State. Copies have been sent to every continent by request.

Many of the matters which have come before the Commission are of general importance and to these the Commission desires to direct especial attention.

SANITARY PROGRESS.

Although the Commission meets with difficulty in obtaining from some official bodies, as it has before reported, the most necessary sanitary action, it is glad to be able to report that its educational work during the preceding eight years has not been wasted, and that in many cases where it met with opposition a few years ago there has been a complete reversal of opinion. New cases have arisen, which show plainly the results of work in previous cases, and the examples of those who willingly or unwillingly have taken action advised by the Commission have led to good results with others.

It must necessarily be that the Commission is more familiar with sanitary problems than is the average citizen or official, and that its advice will seem revolutionary and perhaps unnecessary to those unfamiliar with this work. It is accustomed to this reception of its views, and it is pleased to note the gradual change due to the enlightenment of the people of the State along sanitary lines. Each year it is easier to accomplish results, because the ground work has been laid in the years before. In most cases, when the situation is properly appreciated, citizens and officials are as anxious to accomplish sanitary results as is the Commission. In a gradually decreasing percentage of cases, stubborn opposition is met with, but experience shows that diplomatic action and detailed explanations of the reasons of the action tend to make voluntary the improvements which at first must be made compulsory.

The Commission is also pleased to report that the provision of proper sewerage facilities is being made in sections which heretofore have been eyesores because the municipal authorities hesitated to spend the money necessary for sewerage. One of the first lessons in sanitation is that proper sewerage and sewage disposal are necessary and expensive. This lesson often takes entirely too long to penetrate into some municipalities. When it has been learned, an enlightened public spirit demands prompt provision of these necessities.

During the past year plans of work voluntarily undertaken by the City of Elizabeth to relieve the Elizabeth River have been adopted. Madison and Morristown, long condemned by this Commission for laxness in regard to sewerage, have turned over a new leaf and made quick strides toward most complete sewerage systems, with disposal plants designed according to the best engineering practice. Riverside has taken similar action, and East Rutherford is taking steps toward the same end. Work is progressing at Merchantville, where a new plant will soon be in operation. Bordentown is preparing for sanitary sewerage work. North Plainfield is spending time and money to plan for the best action and will soon be in shape to do actual work. In all of these and many other places, careful study is being given to these questions, and good engineering advice is sought.

ENGINEERING ADVICE.

The Commission received from the last Legislature an increase of its appropriation, in order that engineering advice might be given to parties with whom it had to deal, or from whom it required action. It is found that this is a very practical assistance in the work of the Commission, and one that is being recognized and approved throughout the State. It aids largely in obtaining the necessary co-operation of those in interest. It saves them much time and expense in studying as to what should be done, placing at their service at once competent engineering advice and the experience of the Commission. It is believed that no other method of expending money will produce so much result in the way of sanitation. Engineering reports have been prepared in relation to sewerage questions at Perth Amboy, Atlantic Highlands, Seabright, Rumson, Long Branch, Glen Gardner, Pleasure Bay, Brielle, Swedesboro, Roebling, Phillipsburg, Belvidere, Pluckamin, Bernardsville, Allentown, Vincenttown, Water Witch and other places, and similar advice is being arranged for in relation to Sea Girt, Flemington and Bordentown.

SEWAGE DISPOSAL.

The Commission meets with some questions arising from local opposition to the sites selected for sewage disposal plants. The Commission is satisfied that a sewage disposal plant is not a nuisance, and that it is not a danger to health. When managed with even ordinary care, it should be entirely inoffensive. Most of the opposition encountered to disposal plant locations has arisen from prejudice or ignorance of actual conditions. It is found that, after a short period of operation of the plants to which objection had been made, the opposition fades away. The Commission is compelled to deny that dangerous gases are emitted which will sap the vitality of all within a radius of a mile or two, or that the wind will bring up an army of bacteria, as of mosquitoes, to seek whom they may devour. The Commission has also been forced to deny that there will be a heavy reduction in the value of property for a square mile if a plant be built, or that disease or death can come from flowing sewage which is not imbibed. The Commission is also compelled to deny that "streams of water are God given natural sewers, designed by Omnipotence to bear away human wastes, and that man is wiser than his Maker in providing that filth shall filter through soil."

These matters may seem childish or even humorous to the trained sanitarian, but they are real bugaboos to the uninitiated, and many good citizens are led by a mistaken public spirit to protest against the wisest sanitary action on the assumption that it is unsanitary. Only examination of the sewage plants already in operation can show that the preconceived ideas of these people are erroneous, and in some cases the preconceived ideas are so strongly rooted that the mere suggestion that a disposal plant is near will act almost like an emetic. This Commission has been called upon to investigate a few complaints of nuisance at disposal plants for which it can assign no other explanation. In this regard, an improperly managed plant can do immensurable harm to sanitary progress. Sentimental objections to the location of sewage disposal plants are as real as objections with more substantial reasons, and where it was possible the Commission has made efforts to satisfy all concerned.

SEASIDE RESORTS.

The power of the Commission for the prevention of injury due to pollution of the waters of this State were increased by the last session of the Legislature, especially by the removal of a limitation on its jurisdiction which prevented action in relation to pollution of the Atlantic Ocean in so far as it effected the shore front. The result of this was to place the seaside resorts of Monmouth county under the jurisdiction of the Commission.

The Commission has noted the growing injury to the seaside resorts, due to the unclean practice of all these municipalities in the disposal of their wastes. It adds nothing to the attractiveness of our summer resorts to foul the ocean beach, their one beauty, with immense quantities of crude sewage. Certainly, the chief sufferers from this practice were the people who were responsible. The chief financial loss fell on those who were guilty, and they have been steadily paying the penalty in loss of patronage and consequent depreciation of values. But there is more at stake than the financial question. It is no credit to the State that the most attractive place on the Atlantic seaboard has been permitted to befoul itself. This State has progressed too far along lines of sanitation to permit the continuation of this nuisance.

The Commission had repeatedly advised the municipalities bordering on the Atlantic Ocean in Monmouth county that they were injuring their own reputation and that of the State. It had exhausted moral suasion as a method of reaching results. Meetings had been held at the resorts in conjunction with the local authorities, which were pleasant but fruitless. In some cases it seemed as though an injunction would be necessary, and the others would not act alone as it would do no good. For this reason, the new legislation was suggested.

Under its new authority, this Commission proceeded to take action to the extent of its power to prevent the pollution of the bathing beaches. If the orders issued by it during the summer of 1907 are obeyed, the summer of 1908 will see a clean beach from Sandy Hook to Point Pleasant. This statement is qualified because theCommission regrets to find that the largest and wealthiest of these municipalities seem inclined to compel it to seek the aid of the Court of Chancery in enforcing its orders, although they are in the best financial condition to obey them. These places excite wondering surprise at their persistent uncleanliness. It may be confidently expected that they will be the first to use their enforced cleanliness as an advertisement to attract the patronage they have heretofore repelled by disregard of sanitation.

The Commission notes with pleasure the enlightened views of the authorities and citizens of places like Allenhurst, Spring Lake and Seabright. They admitted the wrong, and pledged themselves to do better, provided that their shores were to be protected from the filth of their neighbors. Many of the smaller of the seaside resorts would have cleaned house long ago if their own cleanliness was all that was necessary. Unfortunately, this coast is so situated that no one borough can accomplish anything alone. State supervision was necessary, for the filth of any of the resorts will at some stage of tide and wind reach each of the others.

SHREWSBURY RIVER.

The Shrewsbury watershed is part of the Monmouth county summer resort section, being only separated from the ocean by a narrow sand bar. During the early part of the last fiscal year, a number of complaints of injury from pollution in this section reached the Commission. Some of these complaints were directly traced to the circular letter sent to shell fish growers by the Bureau of Shell Fisheries in 1906 as a result of action taken by this Commission in relation to the pollution of shell fish. This is noteworthy because it shows that the sanitary protection of their shell fish beds is considered important at least by some of the dealers.

During the last summer, the Commission has inspected the entire shore line of the Shrewsbury river and its tributaries. It has found that practically every house on the Shrewsbury river sewers into it. These cases were still under consideration at the end of the fiscal year, but the conclusion reached was that the Commission should take such action as would ensure the cleanliness of the river during the summer season of 1908. The Commission was pleased to find that many of the individuals concerned in these cases were ready and willing to prevent sewage contamination of the river, and in these cases action will be or already has been taken voluntarily. In a number of the cases, the direct action of the Commission does not seem necessary at this time, because the Borough of Seabright, which has been notified to cease polluting, has under consideration a new sewerage system to take care of its present sewage and that of its citizens who have private sewers.

In many cases along the Shrewsbury river, there are special difficulties met with in handling the sewage from individual houses, because of low elevation and high ground water, the soil being usually sand or sand and gravel with a substrata of clay. The Commission, after careful consideration, believes that in these cases shallow covered cesspools without artificial bottoms, and with dry laid or loose side walls, will permit of disposal by percolation, and it has recommended that this style of cesspool be used in conjunction with an ordinary tight cesspool or septic tank with a siphon connection, taking the liquid to the secondary cesspool from below the scum of the first. By this combination, the solids are left in the first cesspool for septic action, and do not clog the ground around the second cesspool and prevent the escape of the liquid.

NAVESINK RIVER.

In connection with the Shrewsbury inspection, the Commission caused a re-inspection to be made on the Navesink river and its tributaries. During the year 1900, the Commission inspected this territory as far east as the Oceanic bridge on the complaint of many of the riparian owners of injury to their property caused by pollution. As a result of this inspection, notices were sent to all found to be polluting the Navesink river that they must cease, and the Town of Red Bank was required to install a septic tank. On inspection this year, no cases of pollution were reported from the territory included in the former inspection by the Commission, and much appreciation of its action was expressed. Some of those who stopped polluting at that time have brought to the notice of the Commission the damage done them by pollution backed up the Navesink river from the Shrewsbury river by the flood tide.

OTHER MONMOUTH STREAMS.

The Commission has also inspected the various streams and lakes along the Monmouth county shores: the Manasquan and Shark rivers, and Deal, Silver, Como, Fletcher, Duck and Wesley Lakes. Little pollution was found along the lakes, but there was quite a little along the rivers. The action to be taken in these cases will be similar to that in the Shrewsbury district. In many of the cases, remedial action is already under way.

RARITAN RIVER.

The Commission inspected the Raritan watershed during the summer of 1907 and has served notices to cease pollution or secured voluntary action in many cases. This inspection includes the water supplies of Flemington, Somerville, Raritan and Bound Brook, which were found to be polluted to a considerable degree. The Commission has accomplished much in this watershed. Many individual sources of pollution have been or are being removed. All cases above water intakes are receiving swift action. The work below the sewers of Bound Brook, Somerville and Raritan is being allowed a longer time. These municipalities have been allowed four years in which to remove their pollution from the river.

In many of the individual cases, the Commission has given advice for the removal of pollution. It expects that by another year it will be able to report that the upper part of this watershed is in satisfactory condition.

In the lower part of the river, there is pollution from New Brunswick, Highland Park and Perth Amboy. It does not seem necessary yet to require the purification of the Perth Amboy sewage, although it may soon be proper. Action in relation to New Brunswick and Highland Park is under consideration and a time limit may soon be determined.

RAHWAY RIVER.

A sanitary inspection has also been made in the Rahway watershed, and notices have been given to all polluting above Rahway to cease. Below the Rahway water intake, there is little pollution, excepting that of Rahway and the Cranford outlet main. The stream, however, is small, and the pollution is so great in proportion that the river is an open sewer. Rahway has already been notified to purify its sewage, and Cranford soon will be.

OTHER INSPECTIONS.

In a number of other places, local inspections have been made because of complaints received by the Commission, the principal ones being at Woodstown on Salem creek, and at Medford on Haynes creek. Appropriate action has been taken in these cases, and in most of them satisfactory results have been obtained.

WATER SUPPLIES.

The cases of polluted water supplies at Flemington, Raritan, Somerville, Bound Brook and Rahway, as well as in other parts of the State, as at Trenton, Jersey City, Newark, Burlington and part of Gloucester supply, furnish serious questions. This Commission again records its opinion that a safe water supply cannot be obtained from a stream draining a populated district, and that such a supply, if used at all, should be carefully filtered. This Commission cannot undertake to achieve the impossible or to render such a supply safe. Although all reasonable care be taken, the use of land involves a pollution of drainage water. The only sure remedy is the purchase and devastation of an entire watershed, a proceeding in most cases obviously impossible. Yet until this is done, the proprietors of the soil have the right to use it, which involves the right of sewerage, a right as absolute as are any water rights.

DELAWARE RIVER.

During the year headway has been made in the Delaware watershed. There has been some progress made in Trenton and Bordentown. Riverside has adopted a plan of sewerage and disposal, the construction work of this system being only delayed until bonds can be sold. Washington, Belvidere and Blairstown are giving consideration to providing purification plants. The time limit given to several towns in this watershed has expired, and action will soon be taken to compel a cessation of pollution. Already the Attorney General has been requested to proceed against Phillipsburg.

In Pennsylvania, the State Health Department is by agreement taking action similar to that of this Commission. Progress toward the elimination of sewage on the Pennsylvania section of the Delaware watershed has been made in a number of cases. Easton has been required to purify its sewage by January 1, 1909. Bristol is building a sewerage system and disposal works. Allentown is preparing plans for the purification of its sewerage. East Mauch Chunk has had plans approved for a sewerage system and disposal plant, and other work has been accomplished, the details of which are not yet reported.

The work done by the sanitary officers of Pennsylvania and New Jersey will have a lasting effect for good in the Delaware watershed. There are yet to be considered cases of individual pollution, but consideration of these has been delayed for more pressing work, because their removal will cause little difference until the major sources of pollution are removed. The work is not being overlooked, and it is probable that inspections of the tributaries of the Delaware river will soon be made, similar to those made during the past year in the Raritan, Rahway and Shrewsbury watersheds.

This work is of great importance because of the contamination of water supplies drawn from the Delaware river below the sources of many pollutions. Trenton, Belvidere, Phillipsburg, Palmyra, Riverton, Burlington, Delanco, Riverside, Beverly, Edgewater Park, Kinkora, Roebling and Gloucester, in New Jersey, and Philadelphia, Chester, Bristol, Morrisville and Easton, in Pennsylvania are directly affected by these questions, as they use Delaware river water for potable purposes. The health of the citizens of all of these places is endangered by present pollution.

The amount of pollution of the Delaware river from New York State is not great, but it is of some importance at present, and the prevention of future contamination as population increases is of great importance. Following the action of New Jersey and Pennsylvania, the State Health Department of New York is preparing a complete report of all present pollution of the Delaware river in New York, and that Department, through the State Health Commissioner, Dr, E. H. Porter, has agreed to take such action as is within its power to protect the water supplies of New Jersey and Pennsylvania. This action is the more to be appreciated as it is of less direct benefit to New York than to the other two States affected, although it is valuable to New York in a great degree.

DISINFECTION EXPERIMENTS.

During the year, the Commission has conducted, in conjunction with Professor Earle B. Phelps. of the Boston Institute of Technology, some elaborate and interesting experimental work in the disinfection of sewage by chlorine.

The Commission has realized that the purification accomplished at Red Bank by a mere septic tank, while chemically sufficient for the nature of the location, did not accomplish the bacterial reduction which would be proper in view of the use of the waters for bathing and for shell fish beds. The only practical alternative heretofore has been the installation of sand filters. It seemed that there ought to be some less expensive and equally efficient method of destroying bacteria. There has been heretofore no practical germicide for use in sewage work. There are a number of places in the State situated similarly to Red Bank in regard to sewage disposal, and a practical method of disinfection of sewage without the costly installation of filters is of much value in this State. It ought not to be necessary for a town situated as is Red Bank to bring its effluent to a drinking water standard to avoid bacterial pollution.

During the year 1906, the Commission considered this question in conjunction with the Hydrographic Division of the United States Geological Survey, with which Professor Phelps was then associated. A joint experiment was tried at Red Bank for a short time. In this it developed that while chlorine would kill bacteria, as had already been shown by many experiments, yet a much larger quantity of chlorine was needed to treat septic sewage than was the case in treating raw sewage. This was due to the chemical condition of the sewage as discharged from a septic tank.

During the present year, the Geological Survey could not participate in the further trial of chlorine for lack of appropriation, and the work was carried on by the Commission with the assistance and supervision of Professor Phelps, whose individual interest in the work led him to act jointly with the Commission in the experiment. The results have been highly satisfactory and the report of experts indicates that a practical and economical method of destroying bacteria in a sewage effluent has been demonstrated by this work. The chlorine was obtained from a solution of chloride of lime, and was applied in proportion to the flow of the sewage by a float regulator. It was found that a practically sterile effluent was obtained by a two hours detention of the sewage in transit through a tank after the chlorine solution was applied. By proper guagings and analyses, the percentage of chlorine to be applied was determined, so as to avoid the two dangers: escape of chlorine and escape of bacteria. The chlorine, in addition to its bactericidal work, liberated oxygen from the water in the formation of new compounds, which not only advanced the reduction of nitrogenous matter, but remained, in part in the effluent for further work of purification.

It also appears from the analyses that a greater quantity of chlorine was needed as the sewage became more concentrated. The consumption of part of the chlorine in purification work accounts for this. There was abundant opportunity to observe this feature, as the sewage of Red Bank is normally very dilute because of the infiltration of large quantities of ground water in its sewers, and an extremely dry season lowered the ground water until little, if any, entered the system. The Commission believes that this work will be of great service in this State and elsewhere.

ANALYSES.

The Commission has during the year caused analyses to be made of samples from some of the sewage disposal plants in the State, either where the plants were new or where special questions were under consideration. It has also had analyses made of the water supply from two watersheds in which inspections were being made by it. It was not considered wise to incur the expenditure necessary for a duplication of the elaborate analyses made last year, as those analyses in general furnished sufficiently accurate data for measuring the present working of the plants.

DISPOSAL PLANTS.

The Commission had caused an inspection of each of the disposal plants of the State to be made during the year, and it is basing new requirements upon the reports received. The supervision of disposal plants is an important part of the work of the Commission, and one in relation to which adequate work can hardly be done without devoting to it too large a proportion of the funds of the Commission. It is again to be reported that the Commission finds many cases of official neglect or incompetence in the management of sewage disposal plants. Excepting in a few isolated cases, the management of the plants is left in the hands of persons who are unfamiliar with the principle upon which the plants are designed to work and who either from inadvertence, neglect or pure ignorance, do or omit to do something that results in serious deterioration of the plant. It is difficult to remedy this condition unless it should be provided by law that no plant should be placed in charge of an attendant who was unsatisfactory to this Commission. Local politics enter into the appointment of these attendants, and, if a power removed from local influence intervened, politics might be eliminated to the good of all concerned.

INJUNCTION SUITS.

During the year, the Commission has for the first time applied to the Court of Chancery for aid in enforcing its powers. Three suits for injunction were brought and one will soon be begun.

In the case of the Consumers Gas and Fuel Company, of Atlantic City, complaint had been made of the discharge of waste tar and oil into Inside Thorofare. The Company ignored the action of this

Commission entirely. The Commission requested the aid of the court, and an injunction was granted. This was ignored, and contempt proceedings were instituted. At this stage, the Company took action and new arrangements were made whereby the nuisance was avoided, and at the present time conditions are satisfactory, excepting for the escape of a small amount of polluting matter which had been discharged on the grounds of the Company and escapes therefrom into the Thorofare.

In the case of the Borough of Wood-lynne, a sewer was constructed without the approval of the Commission. The borough authorities were notified that the sewage should be purified, but they paid no attention to the notice. A suit was started to enjoin the use of the sewer, which is still pending.

In the case of the John A. Roebling's Sons Company, a sewer was constructed without the approval of the Commission, at Roebling. The Company was notified that the sewage must be purified. No attention was paid to the notice. A suit was started to enjoin the use of the sewer. The Company thereupon filed plans of the sewer with the Commission and requested advice as to purification. Engineering advice was furnished to the Company by the Commission, and the Company has reported to the Commission that plans are being prepared by it in accordance with the suggestions of the Commission for the purification of the sewage.

In the case of the Town of Phillipsburg, a notice was given that the town should cease polluting the Delaware river prior to October 1, 1907. The time limited has expired and the notice has been ignored. The Commission has requested the Attorney General to institute proper proceedings to secure a compliance with the law.

The Commission anticipates that in a number of other cases similar action will be necessary, but it wishes to give every reasonable opportunity for proper action before asking for an injunction.

While it was not a party to the suit, the Commission finds that its work is hampered by a decision of the Court of Errors and Appeals in the case of the State Board of Health vs. Ihnken. In this case it was held that creamery wastes do not come within the jurisdiction conferred upon this Commission in relation to "sewage and other polluting matter." A chemical analysis of creamery wastes is practically identical with a chemical analysis of ordinary domestic sewage. The same wastes are always present in domestic sewage and furnish one of its ordinary components. It is practically impossible to distinguish the pollution caused by milk wastes from that caused by any other sewage, excepting by bacteriological analysis, which would disclose that bacilli coli were not present in the milk wastes. This difference is rapidly eliminated where the milk wastes are discharged into polluted waters, as is almost invariably the case, by the rapid infection of these wastes by bacteria of this class present in the water. Even were coli not present or disclosed by the analyses, dangers are to be apprehended from pollution by creamery wastes as from pollution by other sewage. This Commission does not believe that a different rule of law was intended to be applied to the jurisdiction over two kinds of sewage because at the point of their origin a difference could be determined in the family of bacteria present.

At the time of the promulgation of this decision, the Commission had before it under consideration about a dozen cases of pollution caused by creamery wastes in a drinking watershed which was seriously polluted. These cases are a menace to health because of the danger of infection of these wastes from outside causes, milk supplies not being exempt from disease germs, especially when mixed with polluted river water. Because of this decision, no action has been taken in these cases. The Commission finds itself hampered in its work because if one of the chief and ever present ingredients of sewage does not come within the meaning of the phrase "sewage or other polluting matter," then this Commission is in doubt as to what does come within its meaning. The Commission believes that the exact limits of its jurisdiction should be determined by new legislation.

STATE INSTITUTIONS.

During the year, questions have come before the Commission concerning some of the State institutions. An inspection by this Commission, as well as complaints from neighbors, called the attention of the Commission to the discharge of sewage from the State Camp, at Sea Girt, which not only causes an injury to the neighbors, but sets a bad example on the part of the State in one of the very waters the State is endeavoring to protect from this kind of pollution. This matter has been considered in conjunction with the proper military officials, and a plan of proper disposal is being devised. This work can only be done if an appropriation is made for the purpose, and this Commission respectfully suggests that the necessary money be appropriated by the Legislature.

During the year, the State Sanitorium at Glen Gardner has been opened and the sewage of that institution is being cared for by a disposal plant constructed with the approval of this Commission.

During the spring and summer, an epidemic of typhoid in the State Hospital, at Trenton, led the authorities of that institution to complain of the pollution of a spring used as a source of water supply by the hospital, by sewage leaking from a sewer laid by the City of Trenton. The investigation of this Commission justified the complaint, but it did not appear that the spring could be saved for use for potable purposes, its situation condemning it as a source of water supply.

There has been no progress made during the present year in providing proper sewage disposal for the State Reformatories at Rahway and Jamesburg. Money spent by the State for this purpose would be well spent.

SPECIAL WORK.

The Commission has given some special attention to the disposal of mill wastes during the year, and has caused to be prepared a special report on the wastes from gas plants, which is of much value from a scientific standpoint and is of practical value in dealing with questions which are presented in the work of the Commission.

The Commission has also noted with interest the general results of work relating to the reduction of sludge in septic tanks, and has secured some valuable data on this subject with special reference to the Plainfield disposal plant, where difficulty in this work has been encountered. The Commission has been enabled to publish this data through the courtesy of George W. Fuller, C. E.

The Commission desires to acknowledge the courteous treatment it has received from the Governor, the Legislature and the other State officials and municipal authorities with whom its work has brought it into contact.

All of which is respectfully submitted.

CHARLES W. FULLER, *Chairman,*
FREDERICK C. JACOBSON,
JOHN H. CAPSTICK,
HARRY M. HERBERT.
WILLIAM H. CHEW.

Report of the Treasurer.

Report of the Treasurer.

To the State Sewerage Commission:

I respectfully submit the following report of the receipts, disbursements and expenditures of the State Sewerage Commission for the fiscal year beginning November 1, 1906, and ending October 31, 1907.

The Legislature of 1906 appropriated for the rent and necessary expenses of the Commission, five thousand dollars, for the fiscal year. In addition to this, two thousand five hundred dollars was appropriated for the same purpose during the same year by the Legislature of 1907, making a total appropriation of seven thousand five hundred dollars.

The Treasurer has received from the State Treasurer and expended, with the approval of the Governor and of the State Sewerage Commission, six thousand nine hundred and thirty-three dollars and seventy-four cents ($6,933.74) leaving an unexpended balance of five hundred and sixty-six dollars and twenty-six cents ($566.26) returned to the State Treasurer on November 1, 1907. The Treasurer has on file vouchers for the moneys expended.

RECEIPTS.

Received from the State Treasurer on account of expenses of the Commission:

1906.	
November	$160 38
1907.	
January	535 26
March	227 94
April	348 22
May	431 74
June	320 57
July	746 20
August	619 36
September	467 45
October	3,076 62
Total	$6,934 74

EXPENDITURES.

1906.			
Nov. 26.	For expenses of State Sewerage Commission:		
	To Robert Barry, Agent, for rent from November 1 to December 31, 1906, 2 months	$70 00	
	The New York Continental Jewell Filtration Company, for regulator float and equipment	14 60	
	General Chemical Company, for chloride of lime	23 30	
	Samuel Powis, Jr., for typewriting	21 50	
	H. M. Herbert, for traveling expenses as Commissioner	7 38	
	Frederick C. Jacobson, for traveling expenses as Commissioner	23 60	
			$160 38
1907.			
Jan. 21.	For expenses of State Sewerage Commission:		
	To Robert Barry, Agent, for rent for months of January and February, 1907	$70 00	
	J. W. Harrison, for stationery	9 65	
	Charles Young, for typewriting from October 25, 1906, to January 21, 1907, and on annual report	114 95	
	Rachel G. Butler, for typewriting on annual report	37 36	
	A. J. Greene, for services and expenses in sanitary inspection of Shrewsbury River	119 69	
	H. M. Herbert, for expenses as Commissioner	24 98	
	J. E. Fleming, for expenses as Commissioner	2 50	
	F. C. Jacobson, for expenses of the Commission to Vineland, Millville, Bridgeton and Atlantic City, and expenses as Commissioner to Camden	90 30	
	The Paterson Chronicle Company, for copies of Paterson sewerage report	12 00	
	United Electric Company, for electric lights	5 88	
	Boyd MacLean, for expenses as Secretary, October 22, 1906, to January 21, 1907, for traveling expenses, postage, telephone, etc.	47 95	
			535 26

Mar. 18.	For expenses of State Sewerage Commission:		
	To Robert Barry, Agent, for rent for the months of March and April, 1907....	$70 00	
	The Engineering Record, for yearly subscription	3 00	
	The N. J. Upholstering Establishment, for repairing table	15 00	
	Charles Young, for typewriting from January 24 to March 18, 1907..........	27 00	
	H. M. Herbert, for traveling expenses, etc., as Commissioner	13 54	
	F. C. Jacobson, for traveling expenses, etc., as Commissioner	12 00	
	R. L. Reed, for services and expenses in inspecting Raritan River............	53 50	
	Boyd MacLean, for expenses as Secretary: postage, telephone, traveling expenses, etc.	33 90	
			227 94
April 8.	For expenses of State Sewerage Commission:		
	To George W. Fuller, for engineering report.	$25 00	
	G. E. Hill, for engineering services and expenses	236 01	
	R. L. Reed, for services and expenses inspecting Raritan River..............	74 97	
	H. M. Herbert, for traveling expenses, etc., as Commissioner..............	12 24	
			348 22
May 6.	For expenses of State Sewerage Commission:		
	To Robert Barry, Agent, for rent for month of May, 1907......................	$35 00	
	John H. Capstick, for expenses as Commissioner	3 50	
	F. C. Jacobson, for expenses as Commissioner	5 75	
	H. M. Herbert, for expenses as Commissioner	11 20	
	Henry E. Alyea, for collecting samples for analyses at Ridgewood, from March 8 to March 22, 1907..................	15 00	
	Charles Young, for typewriting from March 21 to May 4, 1907...........	63 50	
	Joseph P. McLean, for engineering services and expenses, April 9 and 10, 1907	57 50	
	United Electric Company, for electric lighting from December 18, 1906, to April 22, 1907......................	14 64	

	J. W. Harrison, for stationery from February 6 to March 29, 1907..........	23 69	
	R. L. Reed, for services and expenses for inspection of Raritan River, April 1 to May 1, 1907....................	153 11	
	Boyd MacLean, for expenses as Secretary: postage, telephone, traveling expenses, etc., from March 18 to May 6, 1907	48 85	
			431 74
June 10.	For expenses of State Sewerage Commission:		
	To Robert Barry, Agent, for rent for month of June, 1907......................	$35 00	
	R. L. Reed, for services and expenses inspecting Raritan River, from May 1 to May 31, 1907, inclusive..........	80 27	
	Frederick C. Jacobson, for traveling expenses as Commissioner: to Flemington May 11, 1907; to Washington, N. J., May 25, 1907, and for expenses of the Commission at Lakewood May 23 and 24, 1907......................	47 15	
	H. M. Herbert, for traveling expenses as Commissioner during the month of May, 1907	4 52	
	Charles Young, for typewriting, May 8 to June 1, 1907......	30 25	
	United Electric Company, for electric lighting, April 22 to May 21, 1907....	2 28	
	Boyd MacLean, for expenses as Secretary: telephone, express, railroad expenses and railroad mileage books...	91 10	
	W. F. Barnum, for services and expenses, serving notices at Bridgeton, Woodstown, Jersey City and West Hoboken	30 00	
			320 57
July 18.	For expenses of State Sewerage Commission:		
	To George W. Fuller, for engineering services and report on Perth Amboy....	$150 00	
	General Chemical Company, for chloride of lime	9 45	
	Herbert B. Baldwin, for chemical analyses and reports	275 00	
	Robert Barry, Agent, for rent for month of July, 1907......................	35 00	
	Hoffman Brothers, for printing..........	4 75	

William O'Brien, for plumbing for experimental work at Red Bank........	31 12	
J. W. Harrison, for stationery from May 6 to July 13, 1907................	23 80	
H. M. Herbert, for traveling expenses as Commissioner from June 10 to June 28, 1907	21 23	
F. C. Jacobson, for traveling expenses of Commission to Merchantville, and for traveling expenses as Commissioner to Somerville, Asbury Park and Morristown	20 80	
J. E. Fleming, for traveling expenses as Commissioner to Lakewood.........	2 00	
John H. Capstick, for traveling expenses as Commissioner to Somerville and Morristown	9 00	
Charles Young, for typewriting from June 10, 1907, to July 18, 1907.......	52 00	
R. L. Reed, for services and expenses inspecting the Raritan River from June 1 to June 30, 1907................	78 40	
Boyd MacLean, for expenses as Secretary: railroad, telephone, postage, etc., from June 10 to July 18, 1907...	33 65	
		746 20

Aug. 15. For expenses of State Sewerage Commission:

To Robert Barry, Agent, for rent for month of August, 1907....................	$35 00	
James Owen, for engineering services and expenses at Swedesboro and Vincenttown	65 35	
E. B. Phelps, for services and expenses investigating pollution at Trenton State Hospital	119 50	
General Chemical Company, for chloride of lime	19 53	
Pierre Black, for services and expenses inspecting Rahway River from July 22 to August 13, 1907..............	69 30	
R. L. Reed, for services and expenses inspecting Raritan River from July 1 to July 31, 1907....................	135 00	
Charles Young, for typewriting from July 19 to August 14, 1907..............	40 30	
H. M. Herbert, for traveling expenses as Commissioner from July 1 to July 31, 1907	44 64	

	F. C. Jacobson, for traveling expenses, etc., as Commissioner, from July 24 to August 15, 1907	42 52	
	Boyd MacLean, for expenses as Secretary: railroad, postage, telegraph, etc., from July 18 to August 15, 1907	50 22	
			619 36
Sept. 20.	For expenses of State Sewerage Commission:		
	To Robert Barry, Agent, for rent for month of September, 1907	$35 00	
	G. E. Hill, for engineering services and expenses	21 77	
	Hoffman Brothers, for printing	3 25	
	Pierre Black, for services and expenses inspecting the Shrewsbury and Shark Rivers, August 13 to September 7, 1907	144 70	
	R. L. Reed, for services and expenses inspecting the Raritan River from August 3 to 31, 1907	113 66	
	H. M. Herbert, for traveling expenses, etc., as Commissioner from August 1 to 29, 1907	22 59	
	J. H. Capstick, for traveling expenses, etc., as Commissioner	9 00	
	Charles Young, for typewriting from August 16 to September 20, 1907	52 00	
	General Chemical Company, for chloride of lime	19 18	
	Boyd MacLean, for traveling expenses as Secretary: postage, telephone, etc.	36 30	
			467 45
Oct. 24.	For expenses of State Sewerage Commission:		
	To Robert Barry, Agent, for rent for month of October, 1907	$35 00	
	George W. Fuller, for engineering services in relation to sewage disposal at Phillipsburg, Kinkora and Trenton State Hospital	400 00	
	Herbert B. Baldwin, for chemical analyses of samples of sewage and water, and expenses	160 00	
	R. N. Connolly, for bacteriological analyses of samples of sewage and water, and expenses	384 50	

G. E. Hill, for engineering services, reports and expenses at Belvidere, Brielle, Atlantic Highlands, Highlands, and Branchport	285 74	
Alexander Potter, for engineering services, reports and expenses at Seabright and Rumson	83 00	
Earle B. Phelps, for expenses in conducting the experimental disinfection of sewage at Red Bank, reports on sewage disposal plants in New Jersey, and inspections and reports at Long Branch and Somerville, and expenses	970 00	
Charles Young, for typewriting from September 21 to October 23, 1907	21 55	
J. W. Harrison, for stationery	80 10	
R. L. Reed, for services and expenses inspecting the Raritan River and serving notices during month of September, 1907	140 75	
Pierre Black, for services and expenses inspecting the Shrewsbury River and Manasquan Rivers during the month of September, 1907	70 80	
H. M. Herbert, for expenses as Commissioner during the month of September, 1907	6 74	
F. C. Jacobson, for railroad expenses as Commissioner to date	66 50	
Hoffman Brothers, for printing copies of sewerage law	40 00	
E. C. Hazard, for chloride of lime	15 11	
Allan Hazen, for services in preparing report on the disposal of wastes from gas plants	300 00	
Public Service Corporation, for electric lighting	2 28	
Boyd MacLean, for expenses as Secretary: postage, telephone, express, etc.	14 55	
		3,076 62
		$6,933 74

Respectfully submitted,

FREDERICK C. JACOBSON,

Treasurer.

Report of the Secretary.

Report of the Secretary.

To the State Sewerage Commission:

I have the honor to submit the following report of the work of the State Sewerage Commission during the year commencing November 1, 1906.

At the annual meeting of the Commission held May 7, 1907, Mr. Charles W. Fuller was re-elected Chairman, and Dr. Frederick C. Jacobson re-elected Treasurer of the Commission for the ensuing year.

Mr. James E. Fleming resigned as a member of the Commission on August 7, 1907.

At a meeting held August 8, 1907, the Commission adopted the following resolution in relation to the retirement of Mr. Fleming from its membership:

"*Resolved,* That the State Sewerage Commission record formally its appreciation of the faithful and efficient services rendered to this State by James E. Fleming as a member of this Commission during the past three years, and the sincere regret of the members of the Commission at the severing of most pleasant relations by his resignation, and that the Commission express to him its sympathy because of the continued illness which compelled his retirement from the work which he has so bravely carried on at such a painful disadvantage.

Resolved, That the Secretary be directed to transmit a copy of the foregoing resolution to the Honorable James E. Fleming."

In September, 1907, the Governor appointed Mr. William H. Chew, of Salem, a member of the Commission, to succeed Mr. James E. Fleming.

According to its custom, the Commission has met weekly at its office in Jersey City and has held special meetings at other places for the convenience of parties having business with it.

At a meeting of the Commission held May 6, 1907, the Commission changed the time of its regular weekly meetings from Monday afternoon to Thursday afternoon of each week at two o'clock, at which times its meetings have been held since that date.

A detailed statement of the work done by the Commission during the past year is hereinafter set forth.

ALLENTOWN.

At a meeting of the Commission held July 18,1907, a communication was received from E. E. Hutchinson, of Allentown, requesting advice as to the proper measures to be taken to provide sewerage facilities for the Borough of Allentown.

The Secretary was directed to employ G. E. Hill, C. E., to make an inspection of the Borough of Allentown and advise with the parties in interest and report to the Commission in regard to the proper action to be taken to provide a sewerage system for the borough.

At a meeting of the Commission held July 25, 1907, the following report was received from G. E. Hill, C. E.

July 22nd, 1907.

To the Honorable the State Sewerage Commission of New Jersey:

GENTLEMEN—On July 20th, in accordance with your instructions, I visited Allentown, New Jersey, and conferred with Mr. Charles A. Spaulding concerning the questions of local sewerage and sewage disposal already submitted to you with a request for advice.

Allentown, which lies in the extreme western corner of Monmouth County, is an incorporated Borough with a population of about seven hundred and fifty. It stands on water bearing sand and gravel. Even in the higher parts of the town ground-water can be found within five feet of the surface. The area is drained by two streams:

(1) Indian Run, on the western edge of the town, a small stream, dammed once within the Borough limits and emptying into Doctor's Creek.

(2) Doctor's Creek, a tributary of Crosswick's Creek, which empties into the Delaware River at Bordentown. Doctor's Creek, a stream of considerable size, is dammed twice above the town and once below it, less than a mile away. Yardville, four miles away on Crosswick's Creek, is the nearest community lying below Allentown on the same watershed.

The Borough owns its water system, supplying surface water, filtered, to about seventy-five houses. There is no sewerage system.

The town is a typical rural residential community. The only factory is a cannery, employing forty to fifty people, running eight weeks in the year, canning pumpkins, tomatoes, etc.

About two miles of streets and roads lie within the borough limits. The main street of the town is to be straightened, recurbed and resurfaced; and a county road, entering it at right angles about seven hundred feet from

Doctor's creek, is now being rebuilt. The general fall toward the drainage valleys is good, and sewerage will not be difficult. The main sewer, which the borough wishes to put in now, before the roads are rebuilt, will run on the main street toward Doctor's creek. On the bank of this creek, a meadow of about two acres has been suggested as a disposal site, and preliminary acquisitive measures have begun. The site is suitable; but whatever disposal works are erected there will have to be specially protected against flood invasion, for occasionally—possibly two or three times a year—the creek overflows the tract, sometimes covering it with two feet of water.

Replying to Mr. Spaulding's specific questions, I told him that, in my judgement, efficient disposal works could be constructed on the site suggested, and that the proposed main sewer would have ample capacity and fall; I also suggested tarred gaskets and tar-cement joints well caulked as special measures for the exclusion of tree roots in certain localities.

Mr. Spaulding requested me to convey to you his appreciation of your courtesy and your help.

Respectfully submitted,

G. EVERETT HILL.

At private expense a tile storm drain was laid for a short distance to remove surface and cellar water from the main street of the borough.

At a meeting of the Commission held October 31, 1907, a communication was received from Henry A. Ford, of Allentown, making inquiry as to the propriety of the construction of cesspools in the borough. The Secretary was directed to reply that this was a matter to be regulated by the local health authorities.

ANALYSES.

During the fiscal year for which this report is made, chemical and bacteriological analyses of samples from various sewage disposal plants and water supplies were made for the Commission by Mr. Herbert B. Baldwin and Dr. R. N. Connolly, respectively. Their reports of this work follow.

Chemist's Report.

Chemist's Report.

The Honorable the State Sewerage Commission of New Jersey:

GENTLEMEN—I herewith submit my report of the chemical work performed during 1907. There is also included an examination of the disposal plant at Lakehurst which was made last December after the yearly report was written.

Compared with 1906 this year's work has been quite limited in volume and in brief is as follows: The examination of the Lakehurst plant, above referred to, and also the plants at Flemington, Plainfield, Ridgewood, Vineland and Newton. In addition there were several analyses made of samples of water taken from the public supplies of Somerville and Bound Brook.

All of the sewage analyses were made in the same manner as last year, e. g. on filtered and unfiltered samples, in order to get the values for suspended matter. The analytical methods used were outlined in last year's report and the results are tabulated in the same way as then but some additional columns have been included to allow of the ready comparison of some of the percentage of purification figures for the two years. I have referred in former reports to the unreliability of figures of this character for measuring the efficiency of a disposal plant and I have incorporated them in this table with considerable hesitancy. Most of the percentages of removal given, however, I believe approximately represent the work of the plants, but where these figures were likely to be largely misleading they have been omitted.

LAKEHURST.

The Lakehurst plant was doing poorly at the time of the examination, a fact which might be partly accounted for by a recent removal of some of the sand. The high dissolved oxygen content of the septic effluent is probably due to its flow of two thirds of a mile through a pipe partly filled with air. The final effluent shows no nitrification, has a bad odor and is unstable. The percentages of purification resulting from the analyses of these samples are given in the table but evidently indicate a much better condition than exists. This is due in this case to the abnormal strength of the sample of raw sewage.

An important feature of the year's work was the winter examination of the Flemington, Plainfield, Ridgewood and Vineland plants. These were selected as being representative of the systems in use in New Jersey and it was desired to make comparisons between their operations under warm and cool weather conditions. The collection of the composite samples from each of these plants extended over a period of two weeks, snow and ice being present much of the time.

The most noticeable features of difference between the summer and winter results were the increased stability and amount of dissolved oxygen in the latter, a condition which might naturally be expected as a result of the lower temperature. It should be explained, however, that most of the putrescibility tests were carried on indoors at a temperature approximating fairly warm weather. Generally, the other results are not sufficiently different from those of the warm period to admit of drawing any positive conclusions relative to the working at different temperatures. It cannot be said, nevertheless, that the winter results are worse than those of summer, but there may be times, as at Flemington, when ice so interferes as to allow the escape of unpurified sewage.

PLAINFIELD.

As usual, by far the most satisfactory results were obtained from the Plainfield works. This is doubtless due both to the care exercised in collecting the composite samples and the constant and intelligent supervision of the running of the plant. The sampling was done five times daily in the two weeks' period.

In each of the successive steps of the purification these works are doing excellent and progressively regular work and the final effluent, although slightly turbid, as would be expected from a contact filter, is well nitrated and of good stability, although, of course, not equal to that from a good sand filter.

One difficulty with the Plainfield plant has been the too rapid accumulation of sludge in the septic tank. These samples were taken just after a change designed to remedy the trouble had been made and the analyses indicate that the alteration was effective, as the tank removed but fifty per cent. of the suspended solids as against seventy-five per cent last summer. The percentages of removal are apparently good indices of work done in the different steps on each occasion and are given in full for both summer and winter examinations.

RIDGEWOOD.

An extract from my previous report on the winter examination of the Ridgewood plant will suffice to show the conditions there. "The situation at Ridgewood has not improved and the results are difficult to compare and interpret. The second contact or wave beds are not in use and the primary beds strain the sewage continuously without holding it for a definite period. The septic tank has been declared too large and a smaller one is to be built, but whether this be done or not the plant cannot be expected to give satisfactory results when operated as at present.

"The effluent contains much less nitrogen as nitrates and dissolved oxygen than the raw sewage and has a pronounced disagreeable odor.

"The beds were covered with snow and ice at the beginning of the test."

FLEMINGTON.

The winter working of the Fleming.on plant was not quite as satisfactory as its operation in warmer weather, although the quality of the effluent is as good or better. There was evidence that at times a portion of the sewage flowed over the banks without purification.

VINELAND.

At Vineland the samples were collected during a period of unusually cold weather for that section, the mean temperature for the two weeks being 33 degrees F with a minimum of 26 degrees. The filters were covered with ice and snow and it was said to be the most severe winter they had experienced with the plant. A reconstruction of the filters was contemplated and one of the east beds had already been rebuilt.

The average results were not widely different from those obtained during the summer, but the working of the system was erratic and the stability of the effluent was on some days little better than that of the raw sewage, which, however, was unusually high owing to its large oxygen dissolved content. Sand filters should yield a much better effluent than obtains here and doubtless the poor condition of the beds had more to do with its quality than the low temperature.

NEWTON.

The Newton plant, examined for the first time this year, consists of a catch basin, a septic tank, an automatic dosing device for distributing the septic effluent to the filters and five sand filters arranged in two groups of respectively two and three beds each. The following is taken from my report on the examination of these works:

"The analytical data indicate a very satisfactory condition of operation. The raw sewage is rather 'fresh' and contains considerable oxygen and nitrates. The latter disappears in the septic tank and the former nearly so. The septic effluent is good and practically contains no suspended matter which will not pass through filter paper. The sand effluents are perfectly clear and odorless and contain no suspended matter; they are in fact better than the brook water which they enter . . . . which contains six times as much free ammonia and more than twice as much organic nitrogen. The effluents were perfectly stable according to the putrescibility tests. . . . . A curious feature of these effluents was the increase in total solids which was considerably higher than in the raw sewage. This must be due to lime and other soluble mineral matter taken up in the beds."

"The sample of raw sewage as collected contained too little suspended matter. This should be remembered in considering the amount of purification, as the percentages would have been still higher had the crude sewage been stronger."

TABLE OF ANALYSES OF COMPOSITE SAMPLES OF SEWAGE.

Results Expressed in Parts per Million Except where Otherwise Stated.

Location of plant and date of samples. (The sample analyzed was a mixture of several samples taken daily between the dates given.)	SOURCE OF SAMPLE.	Turbidity.	Sediment.	Total Solids.	Volatile Solids.	Total Suspended Solids.	Per cent. Removed.—1906.	Per cent. Removed.—1907.	Volatile Suspended Solids.	NITROGEN AS Free Ammonia.	NITROGEN AS Total Organic.	NITROGEN AS Per cent. Removal.—1906.	NITROGEN AS Per cent. Removal.—1907.
Lakehurst— Dec. 1st to Dec. 14, 1906.......	Raw sewage	320	120	1042	886	478	....	....	454	17.5	28.0	....	....
	Septic effluent	80	20	322	188	22	95	....	12	27.0	17.0	39	....
	Sand filter effluent	40	00	340	180	00	....	....	0.0	35.0	9.5	66	....
Flemington— March 1st to 13th, 1907..........	Raw sewage	200	120	424	154	138	....	....	48	6.0	7.5	....	....
	Sand filter effluent	15	5	188	58	00	....	100	00	2.2	4.0	....	47
Plainfield— Feb. 17 to March 12th, 1907......	Raw sewage	100	40	416	214	60	....	....	28.0	14.0	20.0	....	....
	Septic effluent	55	20	354	140	30	75	50	24.0	17.0	15.0	17	25
	1st contact effluent	30	10	312	110	15	87	75	7.0	9.5	5.5	59	73
	2nd contact effluent	10	00	289	50	5	97	92	2.0	4.5	3.5	61	83
Ridgewood— March 9th to 22nd, 1907........	Raw sewage	140	60	360	142	90	....	....	42	11.0	14.5	....	....
	Septic effluent	55	20	264	96	13	....	....	9	12.5	12.5	....	....
	Contact bed effluent	40	10	260	75	2	....	....	0	12.0	4.0	....	....
Vineland— Feb. 27th to March 13th, 1907..	Raw sewage	140	60	348	212	44	....	....	34	29	11.0	....	....
	Settling basin effluent	70	10	238	112	20	56	55	10	21	10.0	15	9
	West sand filter effluent	35	5	169	43	9	....	....	4	18	4.8	72	56
	East sand filter effluent........	40	5	179	48	17	....	....	4	17	4.0	70	64
Newton— Oct. 16th to 23rd, 1907...........	Raw sewage	65	20	385	133	13	....	....	10	7.2	12.00	....	....
	Septic effluent	60	15	356	100	1	....	....	....	7.0	8.00	....	33
	1st and 2nd sand filter effluent..	2	0	430	80	0	....	100	0	0.1	.44	....	96
	3rd, 4th & 5th sand filter effluent	2	0	423	73	0	....	100	0	0.1	.75	....	94

TABLE OF ANALYSES OF COMPOSITE SAMPLES OF SEWAGE—Continued.

Results Expressed in Parts per Million Except where Otherwise Stated.

Location of plant and date of samples. (The sample analyzed was a mixture of several samples taken daily between the dates given.)	SOURCE OF SAMPLE.	NITROGEN AS Dissolved Organic.	NITROGEN AS Suspended Organic.	NITROGEN AS Nitrates.	Total Oxygen Consumed.	Per cent. Removed.—1906.	Per cent. Removed.—1907.	Dissolved Oxygen Consumed.	Suspended Oxygen Consumed.	Chlorine.	Oxygen Dissolved.	Per cent. of Saturation.	Temperature, Degrees Fah.	Putrescibility. (Days.)
Lakehurst— Dec. 1st to Dec. 14, 1906	Raw sewage	26.0	2.0	0.0	190	......	......	120	70	49	0.6	6.0	63	....
	Septic effluent	14.0	3.0	0.0	38	80	......	26	12	48	3.0	27.0	51	....
	Sand filter effluent	9.5	0.0	0.0	24	87	......	.....	.....	48	1.0	8.2	46	1.7
Flemington— March 1st to 13th, 1907	Raw sewage	7.0	0.5	0.20	26.0	......	......	20.0	6.0	37	5.4	34	41	....
	Sand filter effluent	4.0	0.0	3.80	7.2	......	72	7.2	0.0	22	8.3	45	34	14x
Plainfield— Feb. 17 to March 12th, 1907	Raw sewage	17.0	3.0	.35	40.0	......	......	34.0	6.0	41	1.40	10.7	46	....
	Septic effluent	13.0	2.0	.00	25.0	34	38	20.0	5.0	40	.05	.37	46.5	....
	1st contact effluent	5.0	0.5	.35	11.2	59	72	10.8	0.4	39	.25	1.85	45.5	2.5
	2nd contact effluent	....	......	2.20	5.6	63	86	5.6	0.0	38	4.40	29.1	45	7.1
Ridgewood— March 9th to 22nd, 1907	Raw sewage	10.0	4.5	.90	20	......	......	11	9.0	44	5.8	37.1	43	....
	Septic effluent	10.5	2.5	.45	15	......	......	11	4.0	45	1.7	11.0	43.5	....
	Contact bed effluent	4.0	0.0	.10	16	......	......	16	0.0	40	2.4	17.8	47	3.9
Vineland— Feb. 27th to March 13th, 1907	Raw sewage	9.0	2.0	.00	62	......	......	55.0	7.0	38	4.0	30.2	46	3.9
	Settling basin effluent	9.5	0.5	.00	21	24	66	19.0	2.0	32	3.0	18.5	40	5.5
	West sand filter effluent	4.8	0.0	.20	10.8	60	83	10.4	0.4	32	2.0	12.3	40	9.4
	East sand filter effluent	4.0	0.0	.25	10.4	55	83	10.0	0.4	35	2.7	16.6	40	11.6
Newton— Oct. 16th to 23rd, 1907	Raw sewage	11.0	1.0	1.2	25.0	......	......	21	4.0	70	3.7	36.0	58	1.1
	Septic effluent	7.5	0.5	0.0	16.5	......	34	16	0.5	70	1.0	9.7	57	.29
	1st and 2nd sand filter effluent	0.0	0.0	5.1	2.4	......	94	2.4	0.0	65	9.6	94.0	54	14x
	3rd, 4th & 5th sand filter effluent	0.0	0.0	5.1	2.2	......	95	2.2	0.0	65	9.6	95.0	55	14x

Four samples of water from the public supplies of Somerville and Raritan were taken on August 21st, 1907, and the analyses are as follows:

No. 1. From the Raritan river at the intake of the pump house.

No. 2. From the standpipe after addition of Sulphate of Aluminum and before filtration.

No. 3. From the filter house immediately after filtration.

No. 4. From a tap at the Ten Eyck Hotel on Main Street.

(Parts per Million.)

	(1)	(2)	(3)	(4)
Temperature	77	77	77	
Turbidity	15	15	none	trace
Color	25	5	5	5
Nitrogen as Free Ammonia	.03	.03	.002	none
Nitrogen as Albumenoid Ammonia	.138	.134	.048	.036
Nitrogen as Nitrites	.010	.010	.004	none
Nitrogen as Nitrates	.130	.130	.300	.250
Chlorine	4.0	4.0	4.0	4.0
Temporary Hardness (Alkalinity)	73.00	73.00	73.00	73.00
Total Solids	115.0	120.0	111.0	107.0
Loss on Ignition	33.0	25.0	25.0	25.0
Fixed Mineral Residue	82.0	95.0	86.0	82.0

This water contains distinct evidence of pollution at the intake. The river was low at the time and the water quite turbid. This turbidity was still about the same after the coagulant had been added. After filtration the water was perfectly clear, had hardly a measurable amount of color and was, chemically, in a satisfactory condition. The sample from the hotel faucet in the center of town was even a little better than that from the filter house, although there was a trace of turbidity. The Aluminum Sulphate added as a coagulant is probably used in larger amount than necessary, as some of it exists in the filtered water.

There were also four samples of water from the Bound Brook supply analyzed. This is mostly obtained from two small reservoirs fed by the mountain streams known as the "West Branch" and "East Branch." A portion of the supply is from driven wells, which were not being used when the samples were taken.

A sample was taken from the "West Branch" and one from the reservoir which it feeds; a third from the "East Branch" reservoir and a fourth from a faucet in Hamilton Street. The analytical data follows:

(Parts per Million.)

	West Branch	West Branch Reservoir	East Branch Reservoir	Hamilton St. Sample
Temperature	57	56	57	
Turbidity	2	5	5	3
Nitrogen as Free Ammonia	none	.020	.006	.002
Nitrogen as Albumenoid Ammonia	.046	.050	.056	.050
Nitrogen as Nitrites	.005	.010	.009	.004
Nitrogen as Nitrates	trace	trace	.080	.070
Chlorine	4.0	4.0	4.0	4.5
Temporary Hardness (Alkalinity)	33.0	37.0	36.0	34.0
Total Solids	78.0	83.0	87.0	85.0
Loss on Ignition	16.0	26.0	25.0	28.0
Fixed Mineral Solids	62.0	57.0	62.0	57.0

In reporting on the quality of a water supply of this character a full knowledge of the watershed and local conditions affecting the reservoirs is essential for the best interpretation of the analyses. The data indicate a soft water of fair quality, but not entirely free from pollution.

There was no very marked difference in quality between the four samples, but, comparatively, that from the "West Branch" is better than either of the reservoir samples, and the Hamilton Street sample a little better than any of the others.

With surface supplies of such small storage capacity there is almost sure to be much turbidity in time of flood.

Very respectfully,

HERBERT B. BALDWIN.

Bacteriologist's Report.

Bacteriologist's Report.

NEWARK, N. J., Nov. 9, 1907.

To the Honorable the State Sewerage Commission of New Jersey:

GENTLEMEN—Herewith is respectfully submitted a report of the bacteriological examinations made for your honorable body during 1907.

These examinations were made for the purpose of investigating the bacteriological character of sewage from a number of disposal plants at various stages during the process of purification. Samples of drinking water were also examined from three localities where the Commission had reasons for investigating the character of the water.

The examinations were made with the special object of determining the absence or presence of sewage pollution, and, consequently, our chief aim was to find out if colon bacilli were present, and, if so, to what extent.

It has been our experience that the most uniform results have generally been obtained in these tests when the culture material used was slightly alkaline—not more than 0.5 per cent. to Squibb's litmus—and when using glucose media for our fermentation tests we have had the best results from 2 per cent. peptone bouillon to which 2 per cent. glucose had been added.

With these exceptions our methods did not vary materially from those suggested by the Committee on Standard Methods of the American Public Health Association, and as the above media have been employed in all of our work for the Commission, the results obtained in the examinations of former years are to a certain extent comparable with those obtained this year, as well as with each other.

Upon this assumption the following table has been prepared to show the results obtained this year and compare them with those of former examinations from the same disposal plants:

SEWAGE DISPOSAL PLANT AT VINELAND, N. J.

Average Bacterial Reduction between Crude Sewage and Final Effluent:

1905—97%
1906—92%
1907—93%

The samples obtained from this plant in 1907 were taken during cold weather when the beds were covered with snow.

SEWAGE DISPOSAL PLANT AT PLAINFIELD, N. J.

Average Bacterial Reduction between Crude Sewage and Final Effluent:

1905—94%
1906—83%
1907—84%

SEWAGE DISPOSAL PLANT AT RIDGEWOOD, N. J.

Average Bacterial Reduction between Crude Sewage and Final Effluent:

1905—80%
1906—73%
1907—50%

SEWAGE DISPOSAL PLANT AT FLEMINGTON, N. J.

Average Bacterial Reduction between Crude Sewage and Final Effluent:

1906—38%
1907—43%

SEWAGE DISPOSAL PLANT AT NEWTON, N. J.

Average Bacterial Reduction between Crude Sewage and Final Effluent:

1907—83%

The details obtained by examination of samples from the various plants are given in the following tables, and in order to prevent the assumption that only presumptive tests were used to identify the colon bacillus, it may be wise to state that wherever the marginal note—"B. Coli found"—occurs in these tables, it is to be understood that from the culture indicated a non-motile or sluggishly motile bacillus was isolated, which fermented glucose (producing gas consisting of at least 25 per cent. CO_2.), did not liquify gelatine, produced a decidedly acid reaction in culture medium and grew in a very characteristic manner on blood serum "Loeffler Medium," producing irregular shaped, yellowish, waxy colonies.

This combination of characters in a bacillus places it, to my mind, in the colon group, and on more than presumptive evidence.

All of the sewage disposal plants from which samples were taken for analysis during 1907 had been examined before, excepting the Clinton Street disposal plant at Newton. There are two plants located at Newton, the other one being the Sparta Street plant. There was practically no sewage passing through it at the times of our visits, and therefore no samples were taken.

The Clinton Street plant consists of a small sedimentation chamber, a septic tank, a dosing chamber, five sand filters and a sludge bed.

The first series of samples were taken on October 16, 1907. The plant appeared to be well kept, and very little odor was noticed excepting where the effluent from the septic tank was exposed. The final effluent from the filter beds seemed to be almost transparent and odorless. The examination, however, gave some results which are at variance with the appearance. For instance, the effluent from filter beds Nos. 1 and 2, which were draining, showed a very high degree of bacterial reduction, averaging in two samples taken an hour apart 15,300 and 9,000 bacteria per cubic centimeter respectively, indicating a difference between the crude sewage entering the plant at the same time of 96 per cent. bacterial reduction in one case and 97 per cent. in the other.

The final effluent obtained from filter beds Nos. 3, 4 and 5, which were just being emptied when we arrived at the plant, showed in two samples also taken an hour apart 240,300 and 115,000 bacteria per cubic centimeter respectively, indicating a difference between the crude sewage entering the plant at the same time and the effluent from this set of beds of 55 per cent. and 71 per cent. The wide variations between the sets of beds and also in the same set of beds at different times suggests that the purification is not uniform.

The first portion of the final effluent may not come up to the maximum standard of purity that we should expect from a plant having septic treatment and sand filtration. Accidental disturbance of the plant may account for the variation.

Because the results of the first examination were not what would be expected from this plant, both because of its design and because of the appearance and chemical analysis of the effluent, a second series of samples was taken on November 21, 1907. It was unforunate that on the day on which it was necessary to take these samples and during the previous night, there was a heavy continuous rain. Judging from the results obtained from the crude sewage and effluent, the sewage must have been greatly diluted.

The final effluent samples in this series were obtained when both filter beds were draining, and they did not vary so much in the number of bacteria contained as the samples examined in the first series. The colon bacilli, however, appeared to be very much more numerous in the effluent from the set of beds Nos. 3, 4 and 5.

An examination at the same time of the water taken from Paulins Creek would indicate that this water contains colon bacilli in about the same amount as the crude sewage.

It will be seen from the accompanying tables that the crude sewage showed a comparatively low number of bacteria, while the effluent from the septic tank showed an increase in the samples which were not diluted by rain water of seven or eight fold. This may be accounted for by the fact that the distance between the town and the disposal plant is comparatively short, and the crude sewage arrives at the plant in a fresh state. Suspended matter, therefore, is not broken up, and consequently the figures may not be representative of the actual condition of the crude sewage. Perhaps we should take the relation between the septic tank effluent and the final effluent to obtain the percentage of bacterial reduction, which would indicate a much higher degree of purification. This, however, does not explain the variations in the final effluent itself.

BACTERIOLOGICAL EXAMINATION OF SEWAGE FROM VINELAND, N. J.					Amount of Sample Causing Fermentation in 5 C.C. Glucose Bouillon.									
1907.	Time.	ORIGIN OF SAMPLE.	APPEARANCE.	Bacteria Per C.C.	1-2 C.C.	1-5 C.C.	1-10 C.C.	1-20 C.C.	1-100 C.C.	1-1,000 C.C.	1-10,000 C.C.	1-100,000 C.C.	1-1,000,000 C.C.	B. Coli Found
1st	Series													
Feb. 27	10.35 A. M.	Crude sewage from manhole near settling beds	Turbid	2,370,000	x	x	x	x	x	x	x	x	—	In 1-100,000 C.C.
Feb. 27	10.45 A. M.	Effluent from settling beds	Slightly turbid	275,000	x	x	x	x	x	x	x	x	—	In 1-100,000 C.C.
Feb. 27	10.55 A. M.	Final effluent from (3) west beds	Slightly turbid	89,500	x	x	x	x	x	—	—	—	—	In 1-100 C.C.
Feb. 27	11.00 A. M.	Final effluent from East beds	Slightly turbid	238,500	x	x	x	x	x	—	—	—	—	In 1-100 C.C.

Bacterial reduction between crude sewage and final effluent from (3) west beds 96 per cent.
Bacterial reduction between crude sewage and final effluent from east beds 89 per cent.

2nd	Series													
Feb. 27	11.40 A. M.	Crude sewage from manhole near settling beds	Turbid	3,900,000	x	x	x	x	x	x	x	x	x	In 1-100,000 C.C.
Feb. 27	11.20 A. M.	Effluent from settling beds	Slightly turbid	261,000	x	x	x	x	x	x	x	x	—	In 1-100,000 C.C.
Feb. 27	11.25 A. M.	Final effluent from (3) west beds	Slightly turbid	11,500	x	x	x	x	x	x	—	—	—	In 1-1,000 C.C.
Feb. 27	11.30 A. M.	Final effluent from east beds	Slightly turbid	389,000	x	x	x	x	x	x	—	—	—	In 1-1,000 C.C.

The sign (x) means fermentation produced.
The sign (—) means no fermentation produced.

Bacterial reduction between crude sewage and final effluent from (3) west beds 99 per cent.
Bacterial reduction between crude sewage and final effluent from east beds 90 per cent.
Samples reached laboratory at 5.00 P. M.
Temperature below 40 degrees F. Weather cold and ground covered with snow.

BACTERIOLOGICAL EXAMINATION OF SEWAGE FROM PLAINFIELD, N. J.					Amount of Sample Causing Fermentation in 5 C.C. Glucose Bouillon.									
1907.	Time.	ORIGIN OF SAMPLE.	APPEARANCE.	Bacteria Per C.C.	1-2 C.C.	1-5 C.C.	1-10 C.C.	1-20 C.C.	1-100 C.C.	1-1,000 C.C.	1-10,000 C.C.	1-100,000 C.C.	1-1,000,000 C.C.	B. Coli Found
1st Series														
Mch. 13	10.00 A. M.	Crude sewage	Turbid	2,660,000	x	x	x	x	x	x	x	x	—	In 1-100,000 C.C.
Mch. 13	10.00 A. M.	Effluent from septic tanks	Turbid	5,270.000	x	x	x	x	x	x	x	—	—	In 1-10,000 C.C.
Mch. 13	10.00 A. M.	Effluent from 1st contact beds	Slightly turbid	2,090,000	x	x	x	x	x	x	x	x	—	In 1-100,000 C.C.
Mch. 13	10.00 A. M.	Final effluent from 2nd contact beds	Clear	420,000	x	x	x	x	x	x	x	—	—	In 1-10,000 C.C.
Bacterial reduction between crude sewage and final effluent—84 per cent.														
2nd Series														
Mch. 13	10.30 A. M.	Crude sewage	Turbid	3,130,000	x	x	x	x	x	x	x	—	—	In 1-10,000 C.C.
Mch. 13	10.30 A. M.	Effluent from septic tanks	Slightly turbid	6,320,000	x	x	x	x	x	x	x	x	—	In 1-100,000 C.C.
Mch. 13	10.30 A. M.	Effluent from 1st contact beds	Slightly turbid	1,750,000	x	x	x	x	x	x	x	x	—	In 1-100,000 C.C.
Mch. 13	10.30 A. M.	Final effluent from 2nd contact beds	Clear	480,000	x	x	x	x	x	x	x	—	—	In 1-10,000 C.C.

Bacterial reduction between crude sewage and final effluent—84 per cent.
Samples reached laboratory at 3.00 P. M.
Weather wet and ground covered with melting snow.

The sign (x) means fermentation produced.
The sign (—) means no fermentation produced.

BACTERIOLOGICAL EXAMINATION OF SEWAGE FROM RIDGEWOOD, N. J.			APPEARANCE.	Bacteria Per C.C.	Amount of Sample Causing Fermentation in 5 C.C. Glucose Bouillon.									B. Coli Found
1907.	Time.	ORIGIN OF SAMPLE.			1-2 C.C.	1-5 C.C.	1-10 C.C.	1-20 C.C.	1-100 C.C.	1-1,000 C.C.	1-10,000 C.C.	1-100,000 C.C.	1-1,000,000 C.C.	
1st	series													
Mch. 22	1.45 P. M.	Crude sewage	Slightly turbid	407,000	x	x	x	x	x	x	x	—	—	In 10,000 C.C.
Mch. 22	2.00 P. M.	Effluent from septic tank	Slightly turbid	885,000	x	x	x	x	x	x	x	—	—	In 10,000 C.C.
Mch. 22	2.10 P. M.	Final effluent	Clear	247,000	x	x	x	x	x	x	x	—	—	In 10,000 C.C.
Bacterial reduction between crude sewage and final effluent—39 per cent.														
2nd	Series													
Mch. 22	2.40 P. M.	Crude sewage	Slightly turbid	606,500	x	x	x	x	x	x	x	—	—	In 10,000 C.C.
Mch. 22	2.25 P. M.	Effluent from septic tank	Slightly turbid	741,000	x	x	x	x	x	x	x	—	—	In 10,000 C.C.
Mch. 22	2.25 P. M.	Final effluent	Clear	232,500	x	x	x	x	x	x	x	—	—	In 10,000 C.C.

Bacterial reduction between crude sewage and final effluent—61 percent.
Samples reached the laboratory at 5 P. M.

The sign (x) means fermentation produced.
The sign (—) means no fermentation produced.

BACTERIOLOGICAL EXAMINATION OF SEWAGE FROM FLEMINGTON, N. J.

1907.	Time.	ORIGIN OF SAMPLE.	APPEARANCE	Bacteria Per C.C.	Amount of Sample Causing Fermentation in 5 C.C. Glucose Bouillon. 1-2 C.C.	1-5 C.C.	1-10 C.C.	1-20 C.C.	1-100 C.C.	1-1,000 C.C.	1-10,000 C.C.	1-100,000 C.C.	1-1,000,000 C.C.	B. Coli Found
1st	Series													
Apr. 18	9.05 A. M.	Crude sewage	Turbid	1,725,000	x	x	x	x	x	x	x	—	—	In 1-10,000 C.C.
Apr. 18	9.15 A. M.	Final effluent from beds	Turbid	760,000	x	x	x	x	x	x	—	—	—	In 1-1,000 C.C.
Bacterial reduction between crude sewage and final effluent—55 per cent.														
2nd	Series													
Apr. 18	10.30 A. M.	Crude sewage	Turbid	1,130,000	x	x	x	x	x	x	x	x	—	In 1-100,000 C.C.
Apr. 18	10.40 A. M.	Final effluent from beds	Turbid	760,000	x	x	x	x	x	x	—	—	—	In 1-1,000 C.C.

Bacterial reduction between crude sewage and final effluent—32 per cent.
Samples reached laboratory at 2.30 P. M.
Samples kept below 50 degrees F.

The sign (x) means fermentation produced.
The sign (—) means no fermentation produced.

BACTERIOLOGICAL EXAMINATION OF SEWAGE FROM CLINTON ST. DISPOSAL PLANT, NEWTON, N. J.

1907.	Time.	ORIGIN OF SAMPLE.	APPEARANCE.	Bacteria Per C.C.	1-2 C.C.	1-5 C.C.	1-10 C.C.	1-20 C.C.	1-100 C.C.	1-1,000 C.C.	1-10,000 C.C.	1-100,000 C.C.	1-1,000,000 C.C.	B. Coli Found
					Amount of Sample Causing Fermentation in 5 C.C. Glucose Bouillon.									
1st	Series													
Oct. 16	11.15 A. M.	Crude sewage	Turbid	446,300	x	x	x	x	x	x	x	x	—	In 1-100,000 C.C.
Oct. 16	11.15 A. M.	Effluent from septic tank	Slightly turbid	3,451,300	x	x	x	x	x	x	x	x	x	In 1-1,000,000 C.C.
Oct. 16	11.30 A. M.	Final effluent from beds Nos. 1 and 2 (beds draining)	Clear	15,300	x	x	x	x	x	—	—	—	—	In 1-100 C.C.
Oct. 16	11.30 A. M.	Final effluent from beds Nos. 3, 4 and 5 (beds discharging)	Clear	241,300	x	x	x	x	x	x	—	—	—	In 1-1,000 C.C.

Bacterial reduction between crude sewage and final effluent from beds Nos. 1 and 2—96 per cent.
Bacterial reduction between crude sewage and final effluent from beds Nos. 3, 4 and 5—45 per cent.

1907.	Time.	ORIGIN OF SAMPLE.	APPEARANCE.	Bacteria Per C.C.	1-2 C.C.	1-5 C.C.	1-10 C.C.	1-20 C.C.	1-100 C.C.	1-1,000 C.C.	1-10,000 C.C.	1-100,000 C.C.	1-1,000,000 C.C.	B. Coli Found
2nd	Series													
Oct. 16	12.30 P. M.	Crude sewage	Turbid	410,000	x	x	x	x	x	x	x	—	—	In 1-10,000 C.C.
Oct. 16	12.30 P. M.	Effluent from septic tank	Slightly turbid	2,935,000	x	x	x	x	x	x	x	x	—	In 1-100,000 C.C.
Oct. 16	12.30 P. M.	Final effluent from beds Nos. 1 and 2 (beds draining)	Clear	9,000	x	x	x	x	x	—	—	—	—	In 1-100 C.C.
Oct. 16	12.30 P. M.	Final effluent from beds Nos. 3, 4 and 5 (beds discharging)	Clear	115,000	x	x	x	x	x	x	—	—	—	In 1-1,000 C.C.

Bacterial reduction between crude sewage and final effluent from beds Nos. 1 and 2—97 per cent.
Bacterial reduction between crude sewage and final effluent from beds Nos. 3, 4 and 5—71 per cent.
Samples reached laboratory at 4.30 P. M.

The sign (x) means fermentation produced.
The sign (—) means no fermentation produced.

BACTERIOLOGICAL EXAMINATION OF SEWAGE FROM CLIINTON ST. DISPOSAL PLANT, NEWTON, N. J.					Amount of Sample Causing Fermentation in 5 C.C. Glucose Bouillon.									
1907.	Time.	ORIGIN OF SAMPLE.	APPEARANCE.	Bacteria Per C.C.	1-2 C.C.	1-5 C.C.	1-10 C.C.	1-20 C.C.	1-100 C.C.	1-1,000 C.C.	1-10,000 C.C.	1-100,000 C.C.	1-1,000,000 C.C.	B. Coli Found
3rd	Series													
Nov. 21	11.30 A. M.	Crude sewage	Turbid	345,000	x	x	x	x	x	x	—	—	—	In 1-1,000 C.C.
Nov. 21	11.30 A. M.	Effluent from septic tank	Turbid	295,000	x	x	x	x	x	x	—	—	—	In 1-1,000 C.C.
Nov. 21	11.30 A. M.	Final effluent filter bed No. 1 at drain pipe	Clear	10,000	x	x	x	—	—	—	—	—	—	In 1-10 C.C.
Nov. 21	11.30 A. M.	Final effluent filter beds Nos. 1 and 2 at brook	Clear	10,000	x	x	x	—	—	—	—	—	—	In 1-10 C.C.
Nov. 21	11.30 A. M.	Final effluent filter bed No. 5 at drain pipe	Clear	20,000	x	x	x	—	—	—	—	—	—	In 1-10 C.C.
Nov. 21	11.30 A. M.	Final effluent filter beds Nos. 5 and 4 at drain pipe	Clear	10,000	x	x	x	x	x	—	—	—	—	In 1-100 C.C.
Nov. 21	11.30 A. M.	Final effluent filter beds Nos. 5, 4 and 3 at drain pipe	Clear	20,000	x	x	x	x	x	x	—	—	—	In 1-1,000 C.C.
Nov. 21	11.30 A. M.	Final effluent filter beds Nos. 5, 4 and 3 at brook	Clear	20,000	x	x	x	x	—	—	—	—	—	In 1-20 C.C.
Nov. 21	11.30 A. M.	Water from Paulin's Creek above discharge from beds	Turbid	85,000	x	x	x	x	x	x	—	—	—	In 1-1,000 C.C.

The sign (x) means fermentation produced.
The sign (—) means no fermentation produced.

Samples reached laboratory at 5 P. M.
Bacterial reduction between crude sewage and final effluent from beds Nos. 1 and 2—97 per cent.
Bacterial reduction between crude sewage and final effluent from beds Nos. 5, 4 and 3—94 per cent.
Recent rain had probably affected the normal conditions at this plant.

BACTERIOLOGICAL EXAMINATION OF WATER FROM STATE HOSPITAL AT TRENTON, N. J.

1907.	ORIGIN OF SAMPLE.	Bacteria Per C.C.	Amount of Sample Causing Fermentation in 5 C.C. Glucose Bouillon. 1-100.	1-20.	1-10.	1-5.	1-2.	1 C.C.	5 C.C.	B. Coli Found
July 29	Water from spring near overflow pipe...........................	35,700	x	x	x	x	x	x	x	In 1-100 C.C.
July 29	Water from Artesian Well No. 1..	40	—	—	—	—	—	—	—	
July 29	Water from Artesian Well No. 3..	60	—	—	—	—	—	—	—	

The sign (x) means fermentation produced.
The sign (—) means no fermentation produced.

BACTERIOLOGICAL EXAMINATION
OF DRINKING WATER FURNISHED BY THE SOMERVILLE WATER COMPANY.

1907.	Time.	ORIGIN OF SAMPLE.	Bacteria Per C.C.	Amount of Sample Causing Fermentation in 5 C.C. Glucose Bouillon. 1-100.	1-20.	1-10.	1-5.	1-2.	1 C.C.	5 C.C.	B. Coli Found
Aug. 14	10.50 A. M.	Unfiltered water from Sluiceway near Intake	1,560	x	x	x	x	x	x	x	In 1-100 C.C.
Aug. 14	10.55 A. M.	Unfiltered water after coagulant had been added	1,220	x	x	x	x	x	x	x	In 1-100 C.C.
Aug. 14	11.00 A. M.	Filtered water from tap in filter house........................	155	—	—	—	—	x	x	x	In 1-2 C.C.
Aug. 14	10.55 A. M.	Filtered water from tap in pump house........................	176	—	—	—	—	x	x	x	In 1-2 C.C.

Samples reached laboratory at 1.00 P. M.
Bacterial reduction about 89 per cent.

The sign (x) means fermentation produced.
The sign (—) means no fermentation produced.

BACTERIOLOGICAL EXAMINATION OF DRINKING WATER FURNISHED BY THE BOUND BROOK WATER CO. TO BOUND BROOK, N. J.				Amount of Sample Causing Fermentation in 5 C.C. Glucose Bouillon.						
1907.	Time.	ORIGIN OF SAMPLE.	Bacteria Per C.C.	1-20.	1-10.	1-5.	1-2.	1 C.C.	5 C.C.	B. Coli Found
Oct. 12	3.05 P. M.	Water from stream feeding west branch or new reservoir.	2,310	—	—	x	x	x	x	In 1-5 C.C.
Oct. 12	3.15 P. M.	Water from west branch or new reservoir at Spillway....	1,320	—	x	x	x	x	x	In 1-10 C.C.
Oct. 12	3.35 P. M.	Water from east branch or old reservoir at upper dam..	2,940	—	x	x	x	x	x	In 1-10 C.C.
Oct. 12	4.10 P. M.	Water from faucet No. 11 Hamilton St., Bound Brook	930	—	—	x	x	x	x	In 1-5. C.C.

Samples reached laboratory at 6.15 P. M.

The sign (x) means fermentation produced.
The sign (—) means no fermentation produced.

The preceding three tables give the results obtained by bacteriological examination of water used for drinking purposes. The origin of the samples and date of examination are given in the tables.

In these examinations the same methods were followed as in the sewage samples, with the exception that in the sewage we endeavor to determine the minimum amount of each sample that would show B. Coli; while in the water samples we try to determine the maximum amount of the water that did not contain this germ.

In our experience with bacteriological examination of samples of effluent from sewage purification plants, it has been shown that it is possible to so reduce the colon bacilli that they are not demonstrable in amounts of the sample which contain less than 1-100 of a cubic centimeter, if the cultures are made within a few hours and the samples have been kept at a temperature of 40 degrees F., or below, between the time the sample is obtained and the cultures made. It, therefore, seems to me that it should be the aim of those who construct or have charge of sewage disposal plants where the effluent, even in a remote way, finds its way into the water used for drinking purposes, that 1-100 of a cubic centimeter should be the minimum limit in which B. Coli could be demonstrated in the final effluent.

Regarding the presence of B. Coli in water used for drinking purposes, we have learned to look with suspicion upon water which contains this bacillus in quantities of 1-5 of a cubic centimeter or less, even though the source of the water is apparently above suspicion. This applies to surface waters such as are usually collected in sparsely inhabited watersheds, where there is a greater possibility of colon pollution from animals than from man.

In deep well water the presence of B. Coli to any extent should positively condemn the supply.

The examination of the water supply of the State Hospital at Trenton was incidental to the investigation being made by the Commission as to the sources of pollution of the drinking water used at the hospital.

The examination of the samples taken from the water supply of the Somerville Water Company was made in connection with the investigation by the Commission in relation to the pollution of the Raritan River. I visited the plant of the Water Company on August 14, 1907, and met with representatives of the company. The Water Company plant consists of two batteries of filters, one horizontal and one vertical, a pump house and a standpipe, and I was informed that the plant has a capacity of somewhat over one million gallons per day. The water is taken from a sluice-way, which is fed from the canal, and is constructed in such a manner that only at very high flow in the river can any of the river water find its way into the intake.

The company supplies water for Raritan and Somerville. Next adjoining this plant is the property of Mr. James B. Duke, on which is located a pump house and a set of filters, having more than double the capacity of those of the Water Company. This supply is taken from the same sluice-way, above the Somerville intake.

The water taken by the company is forced into the standpipe, where it rises to a height of more than ninety feet, during which time some precipitation takes place, which removes the larger particles of foreign matter. After passing from the standpipe, a coagulent is added, and the water is then passed through the filters and thence to the consumer.

In the sluice-way, the water has a decidedly greenish tinge caused by algae, but after passing through the filters, it was clear and transparent. The bacteriological examination, however, of this series of samples would indicate that only about 89 per cent. of the bacteria were removed by the precipitation, coagulation and filtration to which the water is subjected.

I was informed that at the time the samples were taken the filtered water would probably not be at its best condition because it was just before the filters had been washed, but it seems to me that it is when at its worst rather than when at its best that such water should be examined, as it has very little chance of purifying itself after leaving the filters.

While the percentage of bacterial reduction in the water is not as great as expected, yet the total number of germs in the filtered product is so small that many places which have a presumably pure natural water supply have a greater number of bacteria per cubic centimeter in the water as delivered to the consumer.

The examination of samples of water from the plant of the Bound Brook Water Company was also made in connection with the investigation into sources of pollution of the Raritan River and its tributaries. The samples were obtained on October 12, 1907. This water supply is obtained from mountain streams, the water from which enters two small reservoirs called respectively West Branch or New

Reservoir and East Branch or Old Reservoir. This source of supply is supplemented by a series of artesian wells, which are only used when the streams do not furnish sufficient water. The wells were not being drawn from when our samples were obtained. The bacteriological examination shows that the water from the stream flowing to the West Branch or New Reservoir contains a comparatively large number of bacteria and some colon bacilli before it enters the reservoir. The samples taken from this reservoir showed that an average increase of about 25 per cent. of bacteria takes place in the reservoir, and the colon bacilli also become more numerous, if we may judge by this series of samples.

The water from the East Branch or Old Reservoir contained even more bacteria per cubic centimeter than that obtained from the New Reservoir and colon bacilli were found in about the same amount.

The water in both reservoirs had a faint but distinct greenish tinge due to the presence of algae.

The sample obtained from the faucet at Bound Brook, after the water had passed through about two miles of pipes from the reservoirs, showed a decided decrease in the bacteria of all kinds; yet it was possible to demonstrate colon bacilli in one-fifth of a cubic centimeter, even at a time when there were no unusual weather conditions and the water should have been in its best condition.

The reservoirs are situated in a remote and well protected region where there is little chance for them to receive contamination of a dangerous character from the immediate vicinity. They are, however, too small to permit the stored water to remain long enough to allow precipitation of suspended matter brought to them by the streams to take place, and no provision so far as I could discover has been made to allow muddy or turbid water which comes down the streams during heavy rains to flow away except through the reservoirs.

I have been informed that some complaints have been made by the consumers of the water that its color and taste at times have not been satisfactory, but I have been unable to learn of any ill effect following the use of the water, for which the water could be held responsible.

The development of algae in the reservoirs and the influence of heavy rains on the streams might account for the taste and color complained of.

Inquirty failed to show that there is any source of dangerous pollution on the streams, or their tributaries that feed the reservoirs, but the presence of colon bacilli in the water of the stream shows that it is receiving the drainage of some locality where the discharges of human beings or animals find access to the stream.

Very respectfully,

RICHARD N. CONNOLLY, M. D.,

Bacteriologist.

ATLANTIC CITY.

At a meeting of the Commission held August 20, 1906, the Commission notified the Atlantic City Sewerage Company that its application for permission to construct a temporary sewer in Annapolis Avenue, to discharge into Inside Thorofare, did not meet with the approval of the Commission.

At a meeting of the Commission held November 19, 1906, F. H. Snow, C. E., consulting engineer for the company, requested advice as to the provision of sewerage facilities in the neighborhood of Annapolis Avenue, Atlantic City.

The Commission met at Atlantic City December 1, 1906, and inspected this territory.

At a meeting of the Commission held December 31, 1906, two communications were received from Mr. Snow, stating that it was beyond the ability of the company for the next few years to undertake the construction of the sewers for the southern district of Atlantic City, including the Annapolis Avenue section, according to the general plan of sewers for the city approved by the Commission, because of the small population of that district and the consequent inadequate revenue to be derived from these sewers, and because the amount of money available ought to be expended to improve the sewerage conditions in the main section of the city, where the territory was built up and immediate improvements were demanded; that as a practical measure, he believed that the small amount of sewage from the southern section of the city should be permitted to be discharged into Inside Thorofare for the next few years or until there was complaint or a nuisance were caused thereby, and that if the State should permit such a temporary disposition of the sewage, it should be contingent on the discontinuance of such discharge when complaint was made or there was a nuisance created; that in his opinion it would be quite a number of years before an actual nuisance would be established; that if sewers were not provided in this section, cesspools would have to be built, involving considerable expense for the removal of their contents, and that it was probable that their contents would be dumped into the Thorofare, either within or without the city, and if not under legal sanction, surreptitiously; that he had advised the company not to assume any risk in the southern section of the city and to refuse to build the sewers unless the company were prepared to undertake the expense of carrying out the permanent plan to deliver the sewage from this district into the main interceptor within a very short time; that if this advice to the company were ignored, it would run the risk of local agitation against an alleged nuisance by reason of the temporary discharge into the Thorofare; that he was prepared to advise the Commission that the temporary discharge into the Thorofare was the best solution of the question at Annapolis Avenue if there was a strong demand for sewers there; that the company wished to help build up the outlying sections of the city and was willing to make temporary expenditures to help its growth, knowing that sewers built on temporary grades would later need to be rebuilt, and that it considered this policy wise because the temporary expenditures would soon pay for themselves, and that when the district developed sufficiently, the income would warrant the expenditure of rebuilding the sewers; that to build the sewers designed for the southern district would probably involve an expenditure of fifty-five thousand dollars, if the work were done by contract.

At a meeting of the Commission held March 11, 1907, the Secretary was directed to notify the Atlantic City Sewerage Company that the Commission would approve of plans when properly submitted providing for the temporary discharge of sewage from the section of Atlantic City in the neighborhood of Annapolis Avenue into Inside Thorofare at the foot of Dover Avenue, provided that such discharge be continued not longer than eighteen months, and that in the meantime other provision for the disposition of the sewage in that vicinity be made.

At a meeting of the Commission held April 8, 1907, plans providing for sewers in Annapolis, Dover and Winchester Avenues, Atlantic City, to discharge at the foot of Dover Avenue into Inside Thorofare, were submitted to the Commission by F. H. Snow, C. E., on behalf of the Atlantic City Sewerage Company.

At the same meeting, the following resolution was adopted:

"*Resolved,* That the plans submitted by the Atlantic City Sewerage Company for the construction of sewers in Annapolis, Dover and Winchester avenues in Atlantic City, to discharge without treatment into Inside Thorofare at the foot of Dover avenue, be approved, provided that such discharge be continued not longer than eighteen months, and that in the meantime the provision of other sewerage facilities in that vicinity be made."

At a meeting of the Commission held June 27, 1907, Commissioner Herbert reported that he had visited Dover Avenue, Atlantic City, on June 23, 1907, and found that the sewers for which plans had been approved by the Commission were being constructed.

During the year 1907, the Atlantic City Sewerage Company has continued the improving, changing and enlarging of sewers in streets that were previously sewered, but in which inadequate service was afforded. Enlarged sewers were also laid in streets which were to be paved. This work was done in conformity with an agreement between the City Council of Atlantic City and the Sewerage Company, whereby the company agreed to expend the money necessary to rebuild its entire system in consideration of being permitted to increase its charges for sewerage service. The work was done with the approval of the local board of health and in accordance with the general plans for a sewerage system for the city which were approved by the Commission. These plans were prepared by F. Herbert Snow, consulting engineer, who reported on the work to the Commission on behalf of the company.

ATLANTIC HIGHLANDS.

At a meeting of the Commission held August 15, 1907, Commissioners Herbert and Jacobson reported that on August 10, 1907, they had inspected the outlet of the sewerage system of the Borough of Atlantic Highlands, and found that sewage was being discharged into lower New York Bay, causing injury to inhabitants of this State in their health, comfort and property, and recommending that the authorities of the Borough of Atlantic Highlands be notified to show cause why they should not be notified to cease polluting the waters of New York Bay.

At the same meeting, the Secretary was directed to notify the authorities of the Borough of Atlantic Highlands to show cause at a meeting of the Commission to be held August 29, 1907, why they should not be notified to cease polluting the waters of New York Bay.

At a meeting of the Commission held August 29, 1907, in response to this notice, there appeared before the Commission John L. Sweeney, Borough Attorney of Atlantic Highlands. He stated that there was some nuisance caused by the discharge of sewage from Atlantic Highlands; that it probably injured the borough, and that discussion had already been had in the borough with respect to remedying the nuisance; that he thought the borough could remedy the nuisance by purifying the sewage by July 1, 1908, and requested that it be given at least until that time in which to comply with any order to cease polluting the waters of New York Bay which the Commission might make.

Mr. Sweeney also submitted a statement prepared by the Borough Council and signed by the Mayor and Borough Clerk, requesting that no action be taken against the borough at this time on account of its financial condition and because the pollution from Atlantic Highlands was only a small part of that going into New York Bay.

At the same meeting, the following resolution was unanimously adopted:

"*Whereas,* The State Sewerage Commission has found that the waters of New York bay are being polluted to the injury of inhabitants of this State in their health, comfort and property: therefore be it

"*Resolved,* That under the authority conferred upon the State Sewerage Commission by section 5 of chapter 72 of the laws of 1900 and the supplements and amendments thereto, it hereby gives notice that prior to the first day of July, nineteen hundred and eight, the Borough of Atlantic Highlands must cease to pollute the waters of New York bay, and make such disposition of its sewage or other polluting matter as shall be approved by this Commission."

The Secretary was directed to have a notice in writing served in accordance with the foregoing resolution.

At the same meeting, the Secretary was directed to employ an engineer to report to the Commission what action should be taken by the Borough of Atlantic Highlands in relation to the disposal of its sewage. G. E. Hill, C. E., was employed for this purpose. His report is as follows:

October 31st, 1907.

To the Honorable the State Sewerage Commission of New Jersey:

GENTLEMEN—On October 18th I visited Atlantic Highlands, under your orders, to investigate its method of sewage disposal, and make recommendation for improving the disposal facilities.

The Borough of Atlantic Highlands lies on the south shore of the lower New York bay, behind and about three miles west of the Sandy Hook peninsula. It has a winter population of 1800 and a summer population ranging from 7000 to 8000. A large part of the borough lies on a hillside of considerable elevation and sharp grade, but between the foot of this hill and the bay stretches a flat area, irregular in outline and low. Part of it is swampy. This is traversed by a tortuous drainage channel—a typical salt-marsh stream—called Manymind creek, which empties into the bay close to the outfall sewer. The elevation of the lowest part of the town is but three feet above normal high tide, and this district is subject to flood invasion at times of unusual tides.

From the shore the bottom of the bay slopes very gradually for 2200 feet to the end of the pier of the Central Railroad of New Jersey. Here the depth at low water is about twelve feet; but even this is an artificial depth, dredged to permit the docking of the Sandy Hook boats, which draw eleven feet of water. The pier is really an aggregation of piers. At the end of the easternmost, which is about 400 feet shorter than the pier occupied by the railroad tracks and used as a dock by the steamers, stands a station of the New York Yacht Club. East of the pier, running from shore as far as the Yacht Club station, lies a string of sand shoals; and a curved breakwater of piles minimizes the motion of the shallow water behind.

The bay is a pocket with no true current. The channel of the Shrewsbury, which really has little freshwater flow, lies close to the shore of Sandy Hook; and the channel of the Raritan runs far west and north of Atlantic Highlands. For weeks at a time there is no motion of the shoal water at Atlantic Highlands, save the rise and fall of the tide. Under these conditions suspended solids heavier than water sink rapidly to the bottom, and the presence of sewage deposits thus formed is plainly demonstrated by the fouling of the water when the bottom is stirred by the screws of the steamers as they arrive or depart at low tide.

The nearest oyster plantings lie in the Shrewsbury river, three miles to the east, and at Keyport, nine miles away to the west. Some uncultivated oysters are dredged between these plantings, and clams are dug from the flats along the entire shore.

The built-up portion of the borough is fully sewered. There are no factories, and the sewage consists of domestic wastes only. The entire flow is collected by a single 12-inch main sewer, which ended, originally, in shallow water near the shore. Sewage floated back to the beach, however, in such quantity that the outlet pipe was extended 400 feet. It now discharges under the eastern pier, some distance short of the Yacht Club station, and still about 700 feet short of the end of the railroad pier. At low tide there is but three feet of depth at the outlet; at high tide nearly nine feet. The sand shoals and the breakwater tend to pocket the sewage and prevent egress or even wide diffusion. The discharge is continuous, so that there is no advantage in the seaward flow of the ebb tide that is not offset by the shoreward flow of the flood tide. My examination of the outlet was made at low tide. The escape of sewage could be plainly seen and the fouling of the water could be traced to a considerable distance. The shore showed no trace of sewage contamination, but this may—or may not—have been due to the fact that the prevailing wind for several days had been from the southwest.

There is no doubt whatever that existing conditions are unsatisfactory. Their continuance cannot fail to prove an untimate detriment to the borough itself, apart from all considerations of danger or offence to others.

The suspended matters of the sewage can, and should be kept out of the bay. This result may be attained, without difficulty or undue cost, by cutting the outlet sewer a short distance back from the shore line, and inserting a septic tank, built with two or more independent compartments, so that there may be ample accommodation for the heavy flow of summer, without undue detention of the small flow of winter. The construction of this tank would relieve the bay of its *obvious* burden of pollution, but the water washing ashore would still be more or less contaminated, possibly infected, and, in the absence of a sweeping current, this contamination would be constant during calm weather.

Secondary treatment is unquestionably advisable if the outlet be allowed to remain in its present location. The outfall sewer lies so low, of necessity, that the introduction of any efficient form of bacterial filter would involve pumping of the sewage. It is possible, however, to sterilize the septic tank effluent chemically, removing the danger of specific infection, without pumping. This treatment will involve the purchase and transportation of chemicals and frequent loading and inspection of the feeding device. The weak point in this system of treatment lies in the multiplicity of operations dependent upon human fallibility.

I recommend the delivery of the septic effluent, at the end of the railroad pier, about 2200 feet from the shore. There *is* some current at this point, with a general trend toward the sea. If the outlet be extended thus, and the improvement be not found all-sufficient, the septic tank effluent may be sterilized during the summer and fall of each year, and discharged without treatment during the winter.

Respectfully submitted,

G. EVERETT HILL.

BOWNE.

At a meeting of the Commission held May 6, 1907, a communication was received from Dr. J. H. Conover, of Flemington, complaining of pollution at Bowne caused by a break in the pipe of the Standard Oil Company.

The Secretary was directed to acknowledge receipt of the complaint and to communicate with the company requesting that the break complained of be repaired.

Upon communicating with the company, it was learned that the break complained of had already been repaired by the company.

BRIDGETON.

At a meeting of the Commission held October 15, 1906, the authorities of the City of Bridgeton were directed to show cause why they should not be notified to cease polluting the waters of Cohansey Creek, at a meeting of the Commission to be held October 22, 1906.

At a meeting of the Commission held October 22, 1906, James

Boyd Potter, City Solicitor of Bridgeton, consulted with the Commission in response to the notice to show cause why the city should not be notified to cease polluting Cohansey Creek.

At a meeting of the Commission held November 12, 1906, the Secretary was directed to have a bacteriological analysis made of samples of water and of oysters taken from Cohansey Creek.

At a meeting of the Commission held November 26, 1906, reports of bacteriological analysis of oysters and samples of water taken from Cohansey Creek were received from Dr. R. N. Connolly. These reports were printed in the last annual report of this Commission.

The Commission met at Bridgeton on November 30, 1906, and consulted with the city authorities in relation to the pollution of Cohansey Creek.

At a meeting of the Commission held April 15, 1907, the following resolution was adopted:

"*Whereas,* The State Sewerage Commission has found that the waters of Cohansey creek are being polluted to the injury of inhabitants of this State in their health, comfort and property: therefore be it

Resolved, That under the authority conferred upon the State Sewerage Commission by section 5 of chapter 72 of the laws of 1900, the State Sewerage Commission hereby gives notice that prior to the first day of May, nineteen hundred and eight, the City of Bridgeton must cease to pollute the waters of Cohansey creek, and make such disposition of its sewage or other polluting matter as shall be approved by this Commission."

The Secretary was directed to have a notice in writing served in accordance with the foregoing resolution.

BURLINGTON.

At a meeting of the Commission held December 17, 1906, a renewed complaint was received from the Board of Health of the City of Burlington that repairs to the sewers of the Burlington Sewer Company had not been effective, and that sewage was still being permitted to escape into the city ditch. An answer was also received from the Burlington Sewer Company, stating that repairs were being made by it; that some leakage still continued, but not constant nor in large volume, because it was not desired to disturb the main sewer at that time of year.

At a meeting of the Commission held April 1, 1907, a communication was received from M. W. Newcand, M. D., sanitary inspector of the Board of Health of the City of Burlington, complaining that the Burlington Sewer Company has failed to repair a break in its main sewer.

At the same meeting Commissioners Herbert and Jacobson were appointed a committee to investigate the complaint against the Burlington Sewer Company.

At a meeting of the Commission held April 22, 1907, Messrs. Herbert and Jacobson reported that as a committee to investigate the complaint of the Board of Health of the City of Burlington against the Burlington Sewer Company, they had visited the City of Burlington on April 3, 1907, and had conferred with representatives of the City of Burlington and of the Burlington Sewer Company; that the representatives of the Board of Health stated that there was a break in the main outlet sewer pipe, from which sewage ran into the city ditch and thence into the Back Bay, and that in times of high water this flowed back over a large part of the city, causing a nuisance; that the septic tank and filter beds were not properly cared for, and that the odor from them could at times be detected in parts of the city; that the septic tank overflowed on the filter beds; that pumping was carried on irregularly and inefficiently; that the daily flow of sewage was from six hundred thousand to eight hundred thousand gallons, a large portion of it being due to infiltration of ground water, caused by the poor construction of the joints in the mains.

The representatives of the Burlington Sewer Company stated that they had used their best endeavors to stop the leak in the main sewer and had succeeded in doing so except at one joint where they had as yet been unable to remedy the trouble owing to quicksand through which the sewer passed; that the pump well was about twelve by eighteen feet, and that the pumping was never discontinued long enough to overflow the well; that there were about eight hundred and fifty connections with the sewerage system; that the average daily flow was about five hundred and fifty thousand gallons; that the filter beds had been placed in good condition last fall, but that according to custom no work had been done on them during the winter and they were consequently not in such good condition at the present time.

The committee visited the plant and found that between the city ditch and the pump house, the sewer had been uncovered for about thirty feet, the excavation being about five feet in width and the top of the pipe being about three feet below the original surface of the ground; that the excavation was separated from the city ditch by an earthen dyke, the top of which was at the same elevation as the ground surface; that the excavation showed that the pipe was laid through live quicksand; that the pipe had recently been encased in concrete, but that there was apparently a break in the bottom of the pipe at one joint; that the exposed bottom and sides of the trench were strongly impregnated with sewage, and that water was standing in the trench to about one-third the depth of the pipe; that when pumping was stopped for about twenty minutes, the sewage rose rapidly in the trench, showing considerable leakage from the pipe; that this was reduced again when pumping was resumed; that the septic tank was active, but that owing to two overflow pipes placed in the top of the tank, the scum was broken and carried off; that the filter beds were covered with a stubble of grass and weeds; that the effluent from the tank, instead of spreading over the surface of the beds, was flowing through channels to holes in the beds from whence it found its way by subterranean channels to the city ditch, and that only a few of the underdrains were working. The committee recommended that the Burlington Sewer Company be required to pump continually until the break in the main sewer was repaired and the leakage into the city ditch stopped; to permanently close the two overflow pipes in the septic tank; to cause the filter beds to be plowed and harrowed and leveled to grade; to cause the underdrains to be examined at several points, and if they should be found to be clogged, to have them relaid at an increased depth, and to cause them to be covered with at least three inches of cinders or coarse gravel.

This report of the committee was adopted by the Commission, and the Secretary was directed to notify the Burlington Sewer Company that the Commission required that the repairs and improvements recommended in the report of the committee be made.

At a meeting of the Commission held June 20, 1907, Commissioner Herbert reported that he had inspected the sewage disposal plant of the Burlington Sewer Company on June 18, 1907, and found that nothing had been done to repair the leak in the main outlet pipe; that the sewage was being pumped only during the day and that at night it escaped from the broken pipe into the city ditch; that a number of underdrains has been relaid and appeared to be doing good work, with the exception of two or three in the northerly bed, in which bed there was a pool of sewage which was running through two subterraneous channels to the city ditch; that a small dyke had been thrown up on the lower edge of the southern bed, and that several of the holes in the bed observed at the last inspection had been filled, but that the beds had not been plowed and leveled, and that they were covered with a rank growth of grass and weeds, the sewage flowing in rivulets insteads of spreading over the surface of the beds; that the septic tank was covered with scum except about ten square feet; that this was due to the stopping of the two overflow pipes, but that this had only been done by a temporary arrangement instead of being permanently closed; that he recommended that these pipes be either permanently closed with cement or extended so that the inlets would be three feet below the surface of the sewage in the tank, and that the Commission require the Burlington Sewer Company to immediately repair the broken main and renovate the filter beds.

The Secretary was directed to notify the Burlington Sewer Company that the Commission required that within ten days it comply with the requirements heretofore made for the improvement of the plant, and that unless this were done, the Commission would take such action as the law provides to secure a compliance with the requirements, or to prevent the operation of the sewage disposal plant.

The Secretary was directed to also notify the Burlington Board of Health of the action taken by the Commission.

CAMDEN.

At a meeting of the Commission held December 31, 1906, plans for a combined sewer to drain part of the City of Camden and to discharge without treatment of the sewage into the basin of Newton Creek, were submitted to the commission by E. G. C. Bleakley, City Counsel, and L. E. Farnham, City Engineer.

At the same meeting, Commissioners Jacobson and Herbert were appointed a committee for the purpose of making an investigation in relation to the application for approval of these plans.

At a meeting of the Commission held January 7, 1907, this committee reported that it had inspected the proposed place of discharge into Newton Creek of the sewer for which plans had been submitted by the City of Camden, and that in the judgment of the committee the discharge of sewage as proposed would be injurious and create a nuisance; that it recommended that the Commission should not approve of such discharge; and that it could find no objection to the discharge of storm water into Newton creek from the City of Camden:

At the same meeting the following resolution was adopted by the Commission:

"Resolved, That this Commission notify the City of Camden that it is prepared to approve of plans for the discharge of storm water into Newton creek from the City of Camden, but that it considers that it would be inproper for it to approve of any plans providing for the discharge of crude sewage into Newton creek."

At a meeting of the Commission held February 11, 1907, a communication was received from L. E. Farnham, City Engineer of Camden, inquiring what conditions would be imposed upon the City of Camden for the construction of a storm water sewer to discharge into Newton creek. The Secretary was directed to reply that the Commission would approve of plans for the discharge of storm water into Newton creek without other conditions than that sewage or other polluting matter should not be discharged through such sewer.

At a meeting of the Commission held November 21, 1907, a report was received from L. E. Farnham, City Engineer, in response to inquiry, that a storm water sewer had been constructed by the City in Seventh street, to discharge into Newton creek; that instructions had been issued for the construction of this sewer under the supposition that the plans had been actually approved by the commission, and that it was constructed in accordance with the information received from the Commission that a storm water drain to discharge into Newton creek would meet with its approval.

COLLINGSWOOD.

At a meeting of the Commission held December 31, 1906, Commissioners Jacobson and Herbert were appointed a committee for the purpose of inspecting the sewage disposal plant of the Collingswood Sewerage Company, at Collingswood.

At a meeting of the Commission held January 7, 1907, this committee reported that it had inspected the plant of the Collingswood Sewerage Company and found three primary beds in operation and one resting, and that the sewage was being pumped daily but not on Sunday, the result being that every Sunday the sewage backed up and changed the level in the septic tank, thus interfering with its action; and that the tidal sluice gate at the outlet of the system was not in proper repair and permitted some tide water to back up on the lower beds of the plant, interfering with their action; that it recommended that the Collingswood Sewerage Company be notified to provide for the regular pumping of the sewage at its plant on Sundays as well as week days, and also to have the sluice gate at the outlet of the plant repaired so that it would prevent the backing up of the tide water into the plant.

At the same meeting, the following resolution was adopted:

"*Resolved,* That this Commission notify the Collingswood Sewerage Company that it must provide for the regular pumping of its sewage on every day of the week, and that it must have repairs made to the sluice gate at the outlet of its sewage disposal plant which would be effective to prevent the entrance of tide water into the plant."

At a meeting of the Commission held January 21, 1907, a communication was received from Richard T. Collings, president of the Collingswood Sewerage Company, stating that he had received the notice of the Commission in relation to repairing the sluice gate and pumping regulary at the plant of the Collingswood Sewerage Company, and that he had referred the same to the directors of the company.

DELAWARE RIVER.

During the year 1906, a special investigation of the pollution of the Delaware river was made by the Commission, as a result of which notices to cease polluting that river were given by the Commission to a number of municipalities and corporations during the early part of the fiscal year ending October 31, 1907. The action of the Commission in these cases was included in the report of the Commission to the Legislature of 1907, it being connected with the special report of the Delaware river investigations.

Notices to cease polluting the Delaware river and its tributaries were given as follows:

To Millville, at once.
To Swedesboro, at once.
To Belvidere, by October 1, 1907.
To Phillipsburg, by October 1, 1907.
To Washington, by October 1, 1907.
To Blairstown, by October 1, 1907.

To Blair Presbyterian Academy, by October 1, 1907.
To Delaware and Raritan Canal Company, by January 1, 1908.
To Florence Thread Company, by January 1, 1908.
To Riverside Metal Company, by January 1, 1908.
To Philadelphia Watch Company, by January 1, 1908.
To William Taubel, by January 1, 1908.
To Bridgeton, by May 1, 1908.
To Woodbury, at once.
To Wood-lynne, at once.
To J. A. Roebling's Sons' Company, at once.
To Wenonah, at once.
To Bettlewood Land Company, at once.
To Trenton, by January 1, 1911.
To Bordentown, by January 1, 1911.
To Mt. Holly, by January 1, 1911.

In these cases, action has been taken by a few. The Commission is preparing to apply for injunction in seven cases and has had suit started in two cases. The necessary action to enforce these notices is planned but does not come within the fiscal year for which this report is made. In nine of the cases the time limit has not yet expired. Where action has been taken it is reported under proper headings in this report.

In the States of Pennsylvania and New York, in pursuance of the agreement made by the State Sewerage Commission with the Health Departments of these states, action has been taken by these Departments during the past year in relation to the pollution of the Delaware river.

The following communication was received from the State Health Department of New York under date of November 25, 1907, in relation to the work done in the Delaware valley during the past year:

"In reply to your communication of recent date asking for report from this Department on work in relation to the prevention of pollution of the Delaware river in this State, I beg to say that during the summer just past, we made a careful investigation covering the entire watershed, showing all sources of pollution within the State, and the report covering said watershed is being completed by one of our sanitary engineers.

Owing to the large amount of work before us, some of which has been very pressing, it has been impossible up to the present time to complete this report. This will be done, however, at the earliest opportunity and as soon as it is completed it will afford me pleasure to send you a copy of the same.

Very respectfully,

EUGENE H. PORTER,
Commissioner of Health."

In response to inquires made to the State Department of Health of Pennsylvania in regard to the work done by it in relation to the pollution of the Delaware river during the year 1907, a communication was received from Dr. Samuel G. Dixon, State Health Commissioner, under date of November 15, 1907, stating that a sewerage system and sewage disposal plant had been adopted at Bristol and approved by the State Department of Health and was in process of construction; that the City of Allentown was engaged in settling the problem of sewerage and sewage disposal at that place; that the Borough of East Mauch Chunck had submitted plans for a sewerage system and sewage disposal works, which had been approved by the State Department of Health; and that a detailed report of this and other work done in the Delaware valley would be prepared during January, 1908, by the Chief Engineer of the Department, of which report a copy would be furnished to the State Sewerage Commission of New Jersey.

In relation to the City of Easton, Chief Engineer F. Herbert Snow, of the State Department of Health, in reply to inquiries by the Commission, wrote to the Commission stating that on April 10, 1906, a permit was issued by the State Commissioner of Health to the City of Easton, requiring it before July 1, 1907, to prepare plans for a sewage disposal works and granting temporary permission to run crude sewage from additional sewers into the river until January 1, 1909.

Mr. Snow further notified the Commission that he was informed by the Mayor of Easton that the City had employed an engineer, and that plans for a new sewerage system and disposal works had been prepared, and that the matter was about to be taken up by the City Council.

The State Department of Health of Pennsylvania has also transmitted to the State Sewerage Commission the following copies of reports and permits issued by the State Health Commissioner of Pennsylvania to Easton, Bristol, East Mauch Chunk and the New Jersey Zinc Company, of Palmerton. These are submitted herewith in full. The Department also reported that together with local health authorities it had removed various minor sources of pollution in the Delaware watershed, but that a report of these cases could not be compiled until the report of the Department which was in course of preparation should be completed.

COPY OF PERMIT ISSUED BY THE COMMISSIONER OF HEALTH OF PENNSYLVANIA TO THE CITY OF EASTON, NORTHAMPTON COUNTY, PENNSYLVANIA.

This application was made by the City of Easton and is for permission to extend its sewerage system and to discharge the sewage therefrom into the waters of the State.

The City of Easton is situated on the eastern boundary of the State at the confluence of the Delaware and Lehigh rivers. Opposite it on the east bank of the Delaware river in the State of New Jersey is the town of Phillipsburg.

The Lehigh river watershed contains a population of about two hundred and thirty thousand people distributed in three cities, twenty-nine boroughs and sixty-five townships. Wherever there are sewers in any of these places they discharge directly into the stream.

The Lehigh river is used as a source of filtered water supply for South and West Bethlehem, Fountain Hill, Northampton Heights and East Allentown.

The south side of Easton is also supplied partly from a well on the banks of the Lehigh river.

The Delaware river watershed above Easton and Phillipsburg contains a population of about one hundred and eighty thousand people distributed in one hundred and nineteen townships, thirty boroughs and villages.

Easton proper and a part of Palmer township is supplied by unfiltered Delaware river water taken from a crib located in the bed of the river opposite High street, College Hill.

Below Easton, beginning at Trenton, New Jersey, there are a number of places in Pennsylvania and New Jersey which derive their water supply from the Delaware river.

It has been unanimously determined that the interests of the public health require the discontinuance of the discharge of sewage into the Delaware river at Easton, as well as the discontinuance of the discharge of sewage into the river, of any place in the river valley above said water supplies.

Easton Center lies between the Lehigh river and Bushkill creek. It includes both the business section and also a residence section. It is here that the sanitary sewers are found.

In one thousand eight hundred and eighty-nine the city began the construction of a combined sewer system. Since then not all of the sewers built have been of this system. In the Northampton street basin, which comprises over one-third of the whole sewer district, the sanitary sewers are separate from the storm water drains.

About one half of the city sewer system at present is on the combined plan. The combined sewers have three main outlets, two of which are into the Delaware river and one into the Lehigh river above the dam near the bridge.

The first outlet into the Delaware river is above the bridge and Northampton street. It is a three by four brick sewer. It passes up Front street and Bushkill street to Pearl street. At this point the combined sewer ends. But it receives the flow of the sanitary sewers of the Northampton street basin which flow is discharged into the combined sewer by an eighteen inch pipe. Paralleling the sanitary sewers in the Northampton street basin are storm drains which have a separate outlet into Bushkill creek at a point a short distance below the dam on said creek near Locust street. This drain is an arched culvert and receives the flow of a five foot circular and a thirty inch storm drain.

It is in this district that the proposed extentions both of the sanitary sewers and storm drains are to be largely made.

The separate system was built to prevent pollution of Bushkill creek. That is why sanitary sewers were constructed in the Northampton street basin and the sewage discharged therefrom into the combined system emptying into the Delaware river. If the separate system had not been adopted the sewage would have been discharged into Bushkill creek near Locust, and thence from this point to the river, a distance of over two-thirds of a mile, a nuisance would have existed.

It is proposed to extend or build sanitary sewers and storm drains.

The addition to the sanitary sewers comprise simple extentions of the existing sanitary system which has an eighteen inch outlet into the combined system and hence into the Delaware river near the bridge. The proposed extentions will not include over fifty possible connections. While an approval of these extentions would be consistent from the standpoint of amount of pollution to be added to the river, it would not be consistent with the previous determination herein of the necessity for a diminution of the sewage discharge into the river. To accomplish this diminution, one of two things must be done, namely, the interception of the flow of the existing sewer outlets into the river during times of dry flow, and the overflowing into the rivers at said outlets of the surplus over and above what the intercepting sewer would be designed to carry during times of rain; or the absolute separation of all storm water conduits and sewage conduits.

By either plan the sewage would be conducted to some place and there be treated. However, the fluctuations in flow which would be bound to accompany the adoption of the former plan would carry with it two serious objections to the plan. First, it would not prevent sewage pollution during storms. Second, it would materially increase the first cost of the sewage disposal plant and the cost of operation.

The only objection to the latter plan of a separate conduit system for sewage for the entire town would be the expense. But this cost would not perhaps be prohibitive, taking all things into consideration. Fortunately, in Easton, the combined sewers can be paralleled by separate sewers at an estimated cost of one hundred thousand dollars. At this price, it would be better for the city, both from the standpoint of efficiency and economy to adopt the separate system. It is unanimously concluded therefore, that this policy should prevail at once, and that the city should proceed to re-design the sewer system in conformity with a plan for the collection of all of the sewage separate from storm water at some remote point, and its treatment there by an approved and modern process.

Permission is hereby given for the building of the following storm drains:

A five foot circular storm drain in Philadelphia street.

A four foot circular storm drain in Delaware street.

A four foot circular storm water drain from Delaware river to Lafayette street.

Storm water drains in Northampton, Ninth, Twelfth, Thirteenth, Spruce and Lehigh streets, all as shown on the plan accompanying petition and on the condition that nothing in the nature of sewage shall be discharged into them.

Permission is also granted for the building of the following sanitary sewers; sanitary sewers in Northampton street, a sanitary sewer in Ninth street, Twelfth, Lehigh and Spruce streets, all as shown on plan accompanying application under the following conditions:

First, that soon after the said sewers are built, a plan and profile of each shall be made and filed with the Commissioner of Health.

Second, that the sewage from these additions and from the sewers into which said additions are to discharge and from all of the sewers in the city may continue to discharge into the Delaware and Lehigh rivers and the Bushkill creek until January first, one thousand nine hundred and nine, when this permission for said discharge will end.

Third, that on or before July first, one thousand nine hundred and seven, plans for a new sanitary sewer system paralleling the present combined system, and plans of an intercepting system of sanitary sewers for the collection of all of the sewage of all of the territory of the city shall be prepared and submitted to the Commissioner of Health for his approval.

Fourth, that on or before July first, one thousand nine hundred and seven, plans of sewage disposal works for the treatment of the sewage of the City of Easton shall be prepared and submitted to the Commissioner of Health for his approval.

Fifth, that no pathological material from any laboratory shall be permitted to discharge into the system. The proper authorities shall cause these wastes to be incinerated on the premises.

Harrisburg, Pa., April 10th, 1906.

COPY OF PERMIT ISSUED BY THE STATE COMMISSIONER OF HEALTH OF PENNSYLVANIA TO THE BOROUGH OF BRISTOL, BUCKS COUNTY.

This application was made by the Borough of Bristol and is for permission to construct a system of sewerage and sewage disposal works and to discharge the effluent therefrom into the Delaware river within the limits of Bristol township.

It appears that on June fifteenth, one thousand nine hundred and six, a complaint was duly made to the State Department of Health by residents and taxpayers of the borough calling attention to the unsanitary conditions of the surface drainage in many parts of the town and the contamination of water in the wells on many properties, and asking for an inspection and prompt remedy.

On June twenty-second, one thousand nine hundred and six, the Bristol Water Company entered a formal complaint with the Commissioner of Health relative to the contamination of the source of water supply of the borough and requested that prompt measures to abate the menaces be taken.

With respect to the pollution of wells, on investigation it was ascertained that there were about one thousand six hundred and fifty dwellings in Bristol of which eight hundred or thereabouts were supplied with water by the Bristol Water Company, and that the remaining dwellings relied upon dug or drilled wells on individual premises, many of which wells were in close proximity to cesspools and privies.

The present population in the municipality is in the neighborhood of eight thousand. It was estimated that not over one-third of this number are served by sewers. The fifty odd cesspools receiving both sewage and wash water were reported as requiring occasional emptying because the sewage did not percolate away into the ground fast enough. Now, as well as at the time of the inspection, dry privy vaults are very numerous and in many of the dwellings, not provided with a sewer, slops and wash water are drained by facilities which terminate in street gutters in those instances where the discharge cannot readily be effected into a natural water course. The borough site is unusually level, of porous gravel formation, the grades of the streets and yards have but a slight inclination, and consequently household drainage thrown out on the surface percolates into the ground more readily than if the inclination were steep. Therefore, organic pollution of the soil is liable to remain in the vicinity where deposited. Under these circumstances, there is danger in drinking water drawn from the ground, especially from shallow wells in proximity to privies and cesspools. At the time of the inspection it was ascertained that the students of the High and Common School (the school buildings being located on the same lot) were in the habit of drinking water taken from a well whose location is within a few feet of the cesspool receiving the sewage of the two institutions, and also within a few feet of an old well on the grounds of the Pythian Hall Building, from which building the sewage was being discharged into the old well. Immediately back of and less than one hundred feet distant from the school well, there is a cemetery. Under these conditions, the health of those drinking the said school well water would be constantly menaced.

It was concluded that the complaint against the use of well water in the town was well founded, and that all such water should be boiled before being used for drinking or culinary purposes.

With respect to the Water Company's complaint, it appeared upon investigation that there were public and private sewers, privies and industrial plants, from which polluting material was discharged into the Delaware river in the immediate vicinity of the water works intake, or into tributaries of the river under conditions which menace the said supply. It also appeared that throughout the borough, wherever possible, either sewage was conducted to the nearest water course or privies were placed on the banks overhanging the streams, and that wash water and slops were emptied into the water courses. The inferior quality of the water furnished by the Water Company may have been one reason for the preference on the part of many of the towns people for the ground water.

For years the Bristol Water Company had furnished to its consumers crude Delaware river water polluted by sewage and industrial wastes of the borough and of other municipalities above Bristol in the Delaware river valley. The citizens knew of this pollution and in consequence were deterred from liberally patronizing said Water Company. Hence the use of ground water taken from wells on individual premises was promoted.

The process of purifying water by mechanical filtration has been perfected so that water like that of the Delaware river may be treated and rendered safe for domestic uses. With the approval and by the advice of the State Department of Health, the Bristol Water Company installed such a plant during the summer of 1906. Because such a safeguard does not afford absolute assurance, especially where the source is subject to gross sewage pollution, the interests of the public health demand as pure a source of supply as can be obtained, and it was concluded that the Water Company's complaint was well taken.

The Borough of Bristol is located on the north bank of the Delaware river fourteen miles below Trenton, and about eight miles above the intake of the Torresdale filter plant of the City of Philadelphia's water works system. The tides extend back as far as Trenton. At Bristol the rise and fall is between five and six feet. The ebb tide has an average period of seven hours duration, and the flood tide five hours. A float thrown into the river will go up-stream on the ebb tide several miles, so it is said. It is evident that with an average velocity of two and one-half miles per hour on the flood and three miles per hour on the ebb, that sewage emptied into the Delaware river any where in the vicinity of Bristol would be very liable to pass and repass the water works intake, which is located in the central part of the borough at the foot of Walnut street at a point where strong currents exist in the river.

The borough is bounded on the east by Adams Hollow creek, on the north by the Mill pond, Adams Hollow creek and Otter creek, and on the west by Otter creek and the basin. Midway through the town, east and west, is the old Delaware Lehigh canal still in use. It terminates in a basin which has a lock outlet into the river. Thus the borough is surrounded by natural water courses. The main line of the Pennsylvania railroad passes through the town paralleling the canal. The industries are located between the railroad and the canal, or on the banks of the canal. The resident section and business center is between the railroad and the river. Along the river front about every dwelling or building sewers into the river. The business highway is named Mill street, and the buildings and dwellings on it and adjacent streets are sewered into the basin.

The buildings in the vicinity of Adams Hollow creek are generally sewered into it. The industrial plants between the canal and the railroad discharge their wastes and sewage into a natural water course which is partly covered up in a box drain four feet wide and eighteen inches deep, and partly open and located in Canal street. The lower part of this natural water course, from Canal street to Beaver street, and across Beaver street, partly through private land has been improved by the substitution of a 24-inch pipe in place of the open ditch. The flow of this stream is conducted under the canal and finally reaches the marshes and Otter creek. Into this natural water course the liquid wastes and sewage from the worsted mills of W. S. Grundy and Company are discharged. Wool in the fleece is taken and scoured here and settling basins are provided to intercept the solid portion and to permit the liquid to overflow into the stream. The sewage wastes from the Bristol Iron and Steel Company's plant, from the Edward T. Steel Company's worsted mill, Pierce and Williams saw mill, T. B. Karkin's foundry, Kayser and Allman wall paper mill, and from the Thomas L. Leedlam and Company's carpet mill are also discharged into this natural water course. The uncovered portion of it is an open sewer. At the time of the investigation stranded particles of organic matter were to be seen along the sides thereof; the liquid had a dark color, had stained the sides and besides being disagreeable in appearance, emitted strong putrefactive odors. At that time, the stream was sluggish in flow, and altogether a nuisance, and such as ought not to be tolerated as soon as a general sewerage system and means for purifying the sewage shall have been afforded.

The William Henderson carpet mills sewage flows into the canal. The Corona Kid Manufacturing Company employ about nine hundred hands. The sewage from this plant which is in the northeastern corner of the town, goes into the Adams Hollow creek. At this manufactory hides which have been tanned are received and enamelled. The process requires the extraction of all oils in the leather. The residue from the extraction process is discharged into the creek. There is a tank about twenty feet square which is said to be partially emptied twice weekly. In the Third ward, which is in the district north of the canal in the western part of the borough near Otter creek, there are no public sewers or private sewers except those from houses located on the banks of the creek or the millrace. Elsewhere in the district there are privy vaults and the slops and wash water go into the street gutters.

On June 28, 1906, the Commissioner of Health determined it to be for the general interests of the public health, that all individuals, private corporations and companies and the municipality discharging sewage, or any of the waste products or excrementitious discharges from the bodies of human beings or animals, into any stream, spring or body of surface or ground water in the borough of Bristol, or adjacent thereto, within the boundaries of the State, shall discontinue such discharge and a written notice was given to this effect to every such individual, corporation or company known to be discharging sewage into the streams within the borough limits. Further, the notice stated that some more sanitary way of disposal of the sewage must be devised whereby the sewage may be treated satisfactorily before it goes into the river. A public election has since been held and a bond issue authorized for the construction of a general sewerage system.

The borough purposes to install a strictly sanitary sewer system for the entire municipal limits, and to collect the sewage by gravity in a pump-well to be located on the marshes near the banks of the Delaware river below the borough in Bristol township, from whence the sewage is to be lifted into sewage disposal works to be erected at the same place.

All storm water is to be excluded from the system, the sewers are to range in size from eight to twenty-four inches in diameter and to comprise all told thirteen and six-tenths miles.

Two automatic flush tanks are provided in the system, the sewers being proportioned for self cleansing with the intention that hand flushing shall be accomplished at manholes when necessary. Manholes are to be located at all dead ends, summits, intersections and changes of line and grade. All sewer lines are to be absolutely straight between manholes. Iron covers at said manholes are to be perforated for ventilation. The specifications require the use of vitrified pipe and the construction of tight cement joints. The sewers are not to be underdrained.

Because of the topography, minimum grades are provided for the sewers. For instance, quite a number of the eight-inch sewers will have grades of three tenths per cent. As such grades, unless the flow in the sewer be very considerable, there will be accumulations of deposits which will require to be forcibly removed. All of the sewers in the district north of the canal are to form part of a system to be served by a twenty-inch main which is to pass under the canal and the railroad near Mill street to a drop manhole at the head of the canal basin. Into this drop manhole an eighteen-inch sewer main is also to discharge which main is to serve all the districts of the borough south of the canal. From the said drop, the outfall sewer to the pump well it to be twenty-four inches in diameter and one thousand three hundred and fifty feet long. The specifications provide that iron pipes shall be used where a sewer runs under or through water ways or under a railroad or wherever it is deemed necessary by the engineer. The joints of all iron pipes are to be of lead properly caulked. If this form of construction be rigidly adhered to, the outfall sewer and the twenty-inch main as far as Mill street and the eighteen-inch main as far as the foot of Pond street, will be of iron.

It is in the low part of the borough about the waterways that ground water will be encountered in the sewer trenches more than it is likely to be encountered elsewhere. It is estimated that one-eighth of the entire length of the sewer system will be in territory where the ground water will be permanently higher than the sewer. So in this district special care must be adopted to render the sewers tight, else the leakage into them might easily amount to several times more daily than the volume of house sewage to be discharged into the system.

The borough purposes to build at once slightly less than ten miles of the sewer system. A ten-inch line will be laid in Beaver Dam Road to the Summit near the Corona Kid Works, a ten-inch will be laid up Canal Street by all of the industrial plants herein before enumerated, and in fact, the occupied portions of the town will, under the proposed system, be immediately afforded sewerage facilities. The local authorities with commendable zeal have made an earnest effort to afford a practical remedy suggested by the Commissioner of Health in the notification of June twenty-eight, one thousand nine hundred and six.

The borough also purposes to build at once sewage disposal works comprising a pumping plant, septic tanks, contact beds and sand filters. Its full capacity is designed to be six hundred thousand gallons daily. The locality selected seems to be the only available site. Nowhere in the borough is there land for the purpose, but on the marshes west of Otter Creek there is a tract of land a little higher than the marsh dyked off by the proprietor to prevent flooding of his crops. Here in the corner near the river and the creek, at a point about one thousand six hundred feet radius from Mill Street and the railroad and the farmer's residence in the township, it is proposed to erect a plant.

The elevation of the mean high water of the river is one hundred and three, local datum, corresponding to three feet above the Sandy Hook base. The highest freshet recorded attained an elevation of one hundred and ten and two-tenths feet. The top of the dyke is at an elevation of one hundred eight and one-half so that should an extraordinary freshet again occur, the land within the dyke would be flooded.

The pump well is to be built of masonry and to be ten feet in diameter and five feet to the bottom below the flow line. This flow line will be at the level of the invert of the twenty-four inch outfall sewer whose elevation is to be ninety-four and sixty-six hundredths or eight feet below mean high water. However, said flow line will fluctuate and may be permitted to rise in the well to about elevation one hundred and three before any street main in the sewer system of the town would be seriously backflooded thereby. The top of the pump well is to be carried up above the freshet flow line and the pumping machinery is also to be protected.

In the pump house the machinery and piping is to be in duplicate. There are to be two fifteen-horse power gas engines and two centrifugal pumps and two suction and force main pipes so arranged that pumping operations may be continuous, admitting of repairs to the duplicate parts or apparatus not in use at the time. The capacity of each single unit will be ample for any demands to be put upon it.

The rate of pumpage will be adjusted to the rate of flow of sewage from the town. No overflow pipe to the stream from the well is to be provided.

Sewage from the pumps after being screened at the well is to be delivered to the open septic tanks whose flow line is to be elevation one hundred and twelve whose walls are to be carried up to elevation one hundred and thirteen and to be built of concrete. In fact, all of the tanks, beds and filters are to be placed in structures having concrete bottoms and sides and to be built water tight and open at the top with one exception, namely, that the drying area for sludge drainage is to be composed of sand two feet deep resting on natural earth formation. This area is to be fifty feet long and twenty-five feet wide and to be drained by a fifteen inch pipe to the river.

The septic tanks are four in number arranged side by side each sixty feet long, nineteen feet wide and six feet deep from the flow line. The sewage is to be delivered into each tank just below the surface by means of two openings through the end wall along which there is a distributing trough from which, at will, by opening the sluices, sewage may be admitted to any one or all of the septic tanks. Extending across the inlet end of each tank and three feet therefrom is to be a baffle board suspended from the surface to mid-depth of the sewage, which is to serve as an equalizer of the currents. The outlet from the tanks is a six foot weir in the wall at the center, over which the sewage is to flow from the end opposite to the inlet of each tank into a collecting trough extending across the entire length of the ends of the four septic tanks by means of which sewage from any one or all of the tanks may be collected and conducted either to the settling basins or directly to the contact beds. Underneath this trough and between the walls supporting it is an open space designed to serve for the drainage of the septic tanks or the settling basins, and connecting with an eighteen inch pipe to the sludge drying area.

On the opposite side of this conduit from the septic tanks are the two settling basins, each thirty-one and a half feet long by twenty-two feet wide and six feet deep, divided by a wall containing a trough at the top, extending to the filter beds. By means of sluice gates which may be inserted in the trough, the septic tank effluent may be directed to either one of the settling basins, entering them and leaving by means of weirs so placed that by a division wall to be built across each basin nearly its whole length, the liquid must pass longitudinally a distance of at least sixty-three feet in its course through the basin.

The contact beds are four in number, each one hundred feet long by fifty feet wide and to be filled with three feet of filtering material, crushed rock, the lower layer being twelve inches thick of two to three inch stone, the intermediate layer twenty-one inches thick of one to two inch stone and the top layer three inches thick of one-quarter to one-half inch stone, all resting on semi-circular six inch tile underdrains, spaced two feet on centres. By means of partition walls, each filter is divided into equal compartments fifty feet square and so arranged that but one compartment in each filter need be used if necessary.

In the centre about which are grouped the four contact beds, there are located the controlling chambers and house for the installation of the Merritt automatic airlock sluiceways for the purpose of automatically distributing and collecting the sewage in its passage through the plant from the septic tanks or settling basins to the sand filters.

This apparatus will distribute the sewage into the surface of a fifty foot compartment and when the bed is filled three feet deep to elevation one hundred and ten and a half, it automatically shuts off this bed and turns the sewage into the next fifty foot compartment adjacent to the house, and so on, completing the cycle of the four compartments grouped around the controlling chambers. The intention of the designer is that these four smaller beds shall be dosed twice daily. When the flow of sewage exceeds the volume (three hundred thousand gallons daily) required to fill these four fifty foot contact beds twice daily, then the intention is to bring into commission the outside series of contact bed compartments. The second compartment of any contact bed is to be dosed on the fill and draw plan, the underdrains serving as distributors and collectors. Through the partition wall at the bottom there are to be two pipes fitted with gates connecting the underdrain system of the first compartment with that of the second compartment, so that on the opening of the gates sewage will rise to an equal height on both beds. When both compartments of all four beds are in use the plant will be operated at the maximum capacity designed, or six hundred thousand gallons per twenty-four hours, equivalent to a rate of filtration in the contact beds of one million two hundred thousand gallons per acre daily, or thereabouts.

Each one of the four contact beds is to be connected with its corresponding sand filter. So there will be four sand filters, each fifty feet square, having three and one-half feet depths of sand, the surface of which is to be elevation one hundred and seven and the top of the enclosing walls elevation one hundred and eight. The sand is to rest on a concrete floor, also the tile underdrains, they being six inch semi-circular, spaced four feet on centres and extending across the entire width of the filter, each line passing through the wall at the bottom into a concrete collecting trough the bottom of which is to be at an elevation of one hundred and three, which is mean high water mark. The sand filters are placed side by side, adjacent to the contact beds and between the contact beds and the dyke paralleling the river. The effluent from the sand beds will be conducted by means of an eighteen inch terra cotta pipe to the river. The plans do not show it in detail and no mention is made of a valve on this or the fifteen inch pipe to the river from the sludge filter.

In the centre of each sand filter there is to be a circular ring, inside diameter three feet, outside diameter eight feet, built of concrete, in which the effluent from the contact beds is to be delivered and thence distributed over the surface of the sand, the ring being placed at or slightly below the filter surface. The rate of filtration when operated at the full capacity of the plant will be two million four hundred thousand gallons per acre each twenty-four hours. Bacteriological purification is not anticipated by this finishing process or in the treatment of the sewage by the entire filter plant. The sand filters will act more as rapid strainers and will probably fill up rapidly and require constant attention. The usefulness of the sand filters will depend largely upon the intelligence and skill with which the entire plant is operated. Whenever the river rises above the mean high water mark, the sand filters will be put out of commission and in the event of a flood carrying large quantities of sediment the backflooding of the underdrainage system by silty water might seriously damage the filter and put the town to considerable expense for a remedy. Flood gates should be placed on all drains or openings through the dyke into the creek or river and an arrangement should be made so that the output from the plant could be pumped into the stream at times when a gravity discharge is impossible.

It is anticipated that the sewers will be generally availed of and that on completion of the system the daily flow of the sewage will be in the neighborhood of six hundred thousand gallons. No account has been made in the design of the disposal works for the immediate addition to the sewer system of the industrial wastes. What the total volume of such waste is, is unknown to the borough expert and to the State Department of Health. Undoubtedly some of these wastes may be unsuitable without preliminary treatment at the plant for admission to the sewers. It is the customary policy in Pennsylvania for municipalities to provide outlets for industrial pollutions so far as such pollutions may be handled in the public sewer system. The borough of Bristol should thoughtfully consider what changes if any may be necessary in the proposed sewer system and disposal works to provide for the handling of such portions of the liquid wastes from the industrial plants as it is desirable to take into the sewer system. It might be better policy for the Corona Kid Company to pump its sewage and other wastes over the summit into the borough sewer than to attempt a change in disposal in any other way. Investigations might show that for the industrial uses alterations in the proposed sewer plans should be made. Also that, in event of the collection of both domestic and manufacturing sewage that the proposed sewage disposal plant would be inadequate in capacity to successfully treat the sewage. In such a case extensions and changes in the plant would be required at an earlier date than otherwise, but every installation of this character is tentative in its design. The proposed plans are so arranged that more units may be added as desired. At best the disposal works will not attain the highest standard of bacteriological efficiency. A clear, odorless and nonputrescible effluent, however, should be produced. The matter of enlarging the plant to meet requirements is a question of fact to be settled at the time the first installation becomes outgrown. The present plans make a reasonable provision for growth so far as domestic sewage of the town is involved. If house connections with the sewers are not general and rapid, then the plant proposed may prove adequate for the treatment of both domestic and manufacturing sewage, and possibly so anyway.

There can be no question about the necessity for a sewer system to take both kinds of waste and there can be no question about the necessity for a very careful high class maintenance of the proposed disposal works. The site is too near the town to permit lax methods to obtain. A failure at the plant would constitute a nuisance easily manifest a greater distance than that between Mill street and the septic tanks. The interests centered in the use of the river water above and below the proposed outlet for the sewage effluent demand that the proposed sewage disposal plant shall be efficiently operated.

In view of all the circumstances, it has been unanimously agreed by the Governor, Attorney General and Commissioner of Health that the interests of the public health demand that approval be given and it is hereby and herein given to the plans and a permit issued for the construction of the proposed sewerage system and sewage disposal works, under the following conditions and stipulations:

First, that all storm and roof water shall be excluded from the system and that no existing public or private sewers shall be connected or permitted to connect with the proposed sewer system if found to be in a leaky condition or a conduit for roof, street, cellar or other water except sewage proper, and not then unless approval be given in writing by the borough's expert in charge of the design and construction of the sewerage system. And, further, that at the close of each season's work, the borough shall prepare a plan and profile of the sewers laid during the year and file the same, together with such other information as may be required, with the State Commissioner of Health.

Second. The local authorities shall make or cause to be made at least once monthly, an inspection of the sewers at every manhole, and a flushing by hand or otherwise, and removal of stoppages on all lines requiring it, and a record shall be kept thereof and a copy submitted to the State Department of Health whenever such copy may be called for.

Third. The borough shall construct the outfall sewer and the twenty-inch main as far as Mill street and the eighteen-inch main to the foot of Pond street of cast iron with lead joints; extra care shall be taken at the manholes and at the pump well to render these structures water tight and because a water tight sewer system is almost vital to the success of the entire improvement, it is stipulated that the entire works shall be constructed under the direction and supervision of the experts who have planned the works or by others eqally competent to execute the design.

Fourth. For the purpose of requiring all estates now sewering into any stream or body of water to discontinue such discharge and to connect with the public sewer, the borough shall provide an ordinance therefor and put it into execution as soon as the sewerage system herein approved is ready for use.

Fifth. The borough shall reconsider the question of admission of trade wastes to the sewer system, determine through its experts the quantity and quality of the wastes from each particular plant and what rules and regulations may be necessary for the municipality to enforce regarding the admission of such wastes to the sewer system. to the end that pollution of the streams shall cease, and a report thereof submitted to the State Department of Health for advice and approval, which report shall be filed in time to permit of any necessary modifications in work proposed to be done this year.

Sixth. The walls at the pump well shall be carried up to above the highest flood level ever recorded. Flood gates shall be placed on all drains and outlets from the plant to the river or creek, the drain from the sludge sand filter shall discharge into the pump well instead of the river as now planned and arrangements shall be made whereby the filtrate, when prevented by high water in the river from passing by gravity into the stream, may be pumped over the dyke to its proper destination.

Seventh. The borough is advised to secure at least five acres of ground at the disposal works and to arrange for the reconstruction of dykes about the plant to an elevation higher than that of any recorded flood, unless the borough shall submit sufficient reasons why protective embankments should not be provided.

Eighth. The controlling apparatus is, according to the design, a very important part of the disposal works. Because any mechanism may suffer accident or fail at times to work, provisions shall be made whereby the passage of sewage through the various filter beds may be controlled by hand conveniently in event of accident or repairs to the automatic mechanism and because the plant is to be continuously operated, the borough shall employ constant attendants of a class capable of understanding the principles of sewage purification and the responsibilities involved in assuming the duties of care and operation of such a plant.

Ninth. Such reports of the operation of the disposal works shall be made to the Department of Health on blank forms to be furnished by the State, as the Commissioner of Health may require, and if at any time, in the opinion of the Commissioner of Health the system of sewerage and sewage disposal works, or any part thereof, is inadequate for or prejudicial to the public health, then such remedial measures shall be adopted as the Department of Health may approve or advise.

Tenth. No pathological material from any laboratory shall be permitted to discharge into the sewer system. The proper authorities shall cause these wastes to be incinerated on the premises.

The borough is advised to cause an abandonment of dug and drilled wells in the borough, or in cases where wells are continued in use, to require the boiling of the water consumed for domestic purposes. Special attention is also called to the need of high class work at the disposal works and also in the construction of the sewer system. The economy of keeping the sewers tight by proper construction which involves ample inspection of each joint in the sewer line is emphasized.

Harrisburg, Pa., June 26th, 1907.

COPY OF PERMIT ISSUED BY THE STATE COMMISSIONER OF HEALTH OF PENNSYLVANIA TO THE BOROUGH OF EAST MAUCH CHUNK, CARBON COUNTY.

This application was made by the borough of East Mauch Chunk and is for permission to install a system of sewerage and sewage disposal works and to discharge the effluent therefrom into the Lehigh River within the limits of said borough.

It appears that the boroughs of Mauch Chunk and East Mauch Chunk are located on either side of the Lehigh River where it breaks through the Mahoning Mountains. Mauch Chunk is famous for being the place at which "Stone Coal" was discovered in one thousand eight hundred and four, and from whence the first regular shipment of anthracite coal was made in one thousand eight hundred and twenty to Philadelphia by the Lehigh Coal and Navigation Company. The canal began at Mauch Chunk and gave the place a position of importance in the opening up of the anthracite coal regions of the Lehigh basin. Here also was constructed in one thousand eight hundred and twenty-seven the second railway in the United States. By it loaded cars descended by gravity from the mines of Mount Pisgah to the canal and were hauled up by mules. The canal is still in active operation. The dam across the Lehigh River is in the upper part of both boroughs and the canal extends down stream from it along the East bank in East Mauch Chunk borough.

The mountain ranges here are nearly due east and west across the course of the river which, while tortuous, is in a generally southerly direction. The southerly boundary of Mauch Chunk borough lies at the summit of the Mauch Chunk Mountain Range. This range east of the river in East Mauch Chunk is known as Pocono Mountains. The northerly boundary of the borough is Sharp Mountain, also known as Pisgah Mountain. The next ridge northerly is known as Broad Mountain. In the valley between Broad and Pisgah Mountain from the west flows Nesquehoning Creek. This stream receives large quantities of mine drainage and in consequence is extremely acid. It enters the river about a mile and a half above the dam at EastMauch Chunk.

Coming down from the west in the valley between Pisgah Mountain and Mauch Chunk Mountain is Mauch Chunk Creek, entering the river in the borough. This stream is not acid, the coal measures running out on the northern slope of Pisgah Mountain. In consequence the pollutions of the Lehigh River by coal mine drainage and refuse occurs on the water shed above the Mauch Chunk dam. Coal is not found and mined anywhere east of the river in sufficient quantities to be mentioned.

East Mauch Chunk borough was incorporated in the sixties. In one thousand eight hundred and seventy the population was fifteen hundred; in one thousand eight hundred and eighty, two thousand; in one thousand eight hundred and ninety, twenty-two hundred and seventy-two; in nineteen hundred, three thousand four hundred and fifty-eight; and at the present time it is estimated to be three thousand eight hundred. Owing to the precipitous topography of the site of Mauch Chunk borough, many of the business citizens of this place reside in East Mauch Chunk. The topographical advantages of the latter place account for its growth. Besides the employments afforded by coal mining and allied interests, there are two local manufactories, one a silk mill employing about two hundred hands, and a brewery.

While the corporate territory of East Mauch Chunk borough is quite extensive, the built up portion lies along and north of Ruddles Run, a stream rising in the Pocono Mountains, as does a second stream known as Robinson's Run which forms the northerly boundary of the borough and the built up part. These streams are each about two and a half miles long, drain wooded areas and descend in the neighborhood of seven hundred feet from the summits of the water shed to the river. Between them is a ridge gradually sloping to the river on which the dwellings of the borough are located. The silk mill and a few houses are located in the valley of Ruddles Run south of it. Surface drainage, therefore, is excellent. Ruddles Run is enclosed in a culvert covered over, about ten feet wide, and five or six feet high, from the silk mill, a distance of about a half mile to the canal into which it empties. The drainage from the silk mill and from the other buildings in the vicinity is discharged into the arched portion of the Run.

With hardly an exception the townspeople use the public water supply which comes from the upper water shed of Ruddles Run, in which there are springs, flowing artificial wells, an intake dam and two small storage reservoirs for the collection of surface waters. About two of the three square miles of water shed are reported to be owned by the Mauch Chunk Water Company.

About twenty people permanently reside on the drainage area. Besides, on the mountain there is a hotel known as "Pocono Cliff House." The petitioners represent that the efforts of the local authorities to provide preventive measures will not assure the town against an epidemic unless the State enforces regulations with respect to the disposal of sewage at the hotel and the four dwelling houses on the water shed. The hotel privy rests on the surface of the ground from which focal matter may be washed down the steep incline into the ravine at a point possibly one-half mile above the intake dam of the water works. Drainage from the barn also flows directly into the same ravine.

On Frank Eckart's property there is a surface privy located about fifty feet from a small ravine leading to the main stream and the intake dam, similarly constructed and drained and on George Linedecker's property adjoining, there is a barn twenty feet from the ravine and stream. No provision is made on this property for disposal of sewage. It is reported that all household wastes are thrown out on the ground on the edge of the ravine. On Fred Ketner's land there is a privy without a vault about one hundred feet from the stream which enters the upper reservoir. The kitchen slops are thrown on the ground near the house. The members of the family do laundry work and bathe at a spring on the north side of the reservoir near the house. A cake of soap, towels and some wearing apparel were seen at the spring on the day of the inspection by the Department's officer.

The drainage from George Meyer's is into the stream just above the intake dam. The drainage from a surface privy, barn and chicken yard is down a steep slope to the run.

The upper reservoir is less than a half a mile above the intake dam and the middle reservoir is immediately below the upper reservoir. The latter basin is formed by a masonry dam across the run, length about one hundred and forty feet, by means of which the water is backed up stream about two hundred feet. The greatest depth is about eight feet and the storage capacity in the neighborhood of eight hundred and fifty thousand gallons. Two eight inch blow-offs are provided for drainage purposes at the dam. A six inch gravity main extends from this reservoir down the valley to the town or the higher portion of it east of Sixth street. The middle reservoir is connected with this pipe also. It also is constructed by a cement dam, is provided with a ten inch blow-off, holds about two hundred and fifty thousand gallons and has a maximum depth of about eight feet.

The intake dam is an earth structure, except the spillway and a short distance either side of it where the construction is masonry. The water here at its deepest point is about ten feet deep and at the sides and upper end the water is shallow. The storage capacity of this basin is about five hundred and thirty-five thousand gallons. From it a six inch gravity main conveys water to the lower parts of East Mauch Chunk borough. By an arrangement of gates the borough can be entirely supplied from the two upper reservoirs, but the lower reservoir, owing to its elevation can only furnish the town within the low level district.

Evidence in abundance, consisting of quantities of leaves, dark green scum and other deposits, may be seen on inspection at the reservoirs at any time, and it is reported by local authorities that during the summer time when the flow of the stream is small and the consumption of water in the town large, the draft on the storage capacity is such, that the surface of the water in the reservoir is lowered six feet or more, and that at such times the accumulated vegetable matter on the shores of the basin is exposed to the air and sunlight and in consequence decomposes, creating offensive odors at the reservoirs and also imparting a disagreeable taste to the waters. The reservoirs should be thoroughly cleaned out.

Mauch Chunk is connected by a highway bridge spanning the river with East Mauch Chunk. The structure is at the foot of South street in the latter borough, which street extends back up the ridge at right angles to the river and is the southerly highway of the village. Centre Street parallels it and is next north, then comes North Street, Lehigh and Pine Streets. The latter is the most northerly street in the village, and is near the stream in the ravine which is tributary to Robinson's Run. At right angles to these east and west thoroughfares are the streets designated by numbers beginning with Front Street (along the banks of the river and on the bluff seventy five feet or so higher than the canal) and including Eleventh Street. The elevation at Eleventh Street is seven hundred and fifty. Front Street is about five hundred and forty. In Fifth Street from Centre southerly, there is a private combined sewer twenty inches in diameter which runs out onto the surface of the ground south of South Street in the vicinity of dwellings, at which point the sewage is discharged over the edge of a bluff into Ruddles Run ravine. This main sewer receives laterals east and west in Centre and South Streets and in Fern Alley between these streets. In all there are said to be sixty-five buildings connected with these private sewers. The original sewer was constructed by parties for purposes of surface and under soil drainage. Since then other property owners have been granted permission to connect by payment of an entrance fee to the original owners. At the point of discharge a nuisance is created which has been the subject of neighborhood complaints. House sewage, roof and cellar water and street drainage is taken into this system. Elsewhere in the borough surface drainage is provided for in street and alley gutters. It is reported that no regulation as to privy vaults and cesspools has been enforced in the town. Ordinary privies placed over dug vaults are the rule for the disposal of excrement, and in most of such cases kitchen waste and wash water is drained to the street gutter. Where there are bath tubs and water closets in the building, generally speaking, percolating cess-pools have been attempted. The number of these in the town is not known, but they are said to be quite numerous. Part of the town is located on soil of a clay formation, where cesspools fill up and overflow creating a menace to public health. It is to obviate this general unhealthy condition and to afford means for the abatement of the Fifth Street sewer outlet nuisance, that the public sewerage system is proposed.

The plans submitted for consideration comprise a system of sanitary sewers whose sizes range from eight to twelve inches in diameter, there being eighteen thousand feet of eight inch, seventeen hundred feet of ten inch, and three thousand feet of twelve inch proposed. The grades are naturally steep and hence will be self-cleansing. Ventilation is to be secured through ventilated manhole covers, which manholes are to be located at street intersections and at changes of grade, and further ventilation is effected through the main house drain which is to be untrapped and carried up above the roof of the building. Whatever flushing may be necessary is to be accomplished by hand at the manholes and is to be made apparent by inspection. Ordinary bell and spigot terra cotta pipe is to be used and the joints are to be made with American cement termed in the specifications "Rosendale."

In the sewer districts, which comprise practically all of the village, there is in the neighborhood of one thousand possible sewer connections. It is expected that possibly two hundred connections will be made with the sewer system during the first year.

The plan provides for the conveyance of the sewage by gravity to the valley of Robinson's Run in the northwest corner of the town just north of the junction of Front and Lehigh Streets where the disposal plant is to be located. That part of the borough in the valley of Ruddles Run is too low to be sewered by gravity into the proposed system. Here is a silk mill and a dozen houses or so. If the district grows in the future and sewers are provided there, the sewage must be pumped therefrom up into the high level sewers now proposed. As previously stated the mill and these buildings are now drained into Ruddles Run Culvert and the pollutions reach the canal.

It is proposed to treat the sewage in septic tanks and a sprinkling filter to be located south of Robinson's Run in the ravine at the foot of a bluff just north of Lehigh Street. On this bluff facing the street there are houses overlooking the street and the ravine. There is room in this ravine for additional filter and septic tank units. It appears to be the only available site for a sanitary plant in the town. It is within four hundred feet of dwellings so that careful maintenance is requisite to prevent a nuisance being created.

The plans show two uncovered septic tanks, each one hundred and ten feet long by twenty-five feet wide and eight feet deep, and one sprinkling filter, one hundred and five feet square and six feet deep. The works are designed to treat six hundred and twenty-five thousand gallons daily. For the treatment of the sewage for the next three or four years, but one tank will be provided and one-half the filtering area above mentioned. The operation of the plant is to be continuous.

The septic tanks are to be built of concrete, bottom and sides, and to be set side by side. The sewers are to terminate in an open gate chamber, eight feet square, provided with a by-pass to Robinson's Run. From this chamber the sewage is to pass either through an opening leading to an inlet chamber extending across the entire width but outside of the end of septic tank number one or through a similar opening into a similar chamber at tank number two. Through the end walls of each tank, three twelve inch pipes spaced equal distance will admit sewage from the inlet to the tanks. Thus by the opening or closing of the sluice valve at the receiving chamber sewage may be shut off from either one or both of the tanks. When both tanks are cut out the sewage would be by-passed to Robinson's Run.

Across the tanks three baffle boards suspended from the surface to mid depth are provided. One is about midway of the length of each tank, another about ten feet from the inlet end and the third about six feet from the outlet end. The effluent is to pass over a weir across the entire width of the outlet end of each tank into a collecting trough extending the entire width of the ends of both tanks from which an eight inch cast iron pipe will conduct sewage to the sprinkling filter. The elevation of the weir is four hundred and sixty-two. The bottom of the tank here is to be eight and five-tenths feet lower. The slope of the bottom of each tank is one foot in the total length of one hundred and ten feet towards the outlet. At the bottom a twelve inch drain pipe is provided in each tank, extending to Robinson's Run by means of which the deposits in the tank and the sewage, whenever drainage is required, is to be discharged into Robinson's Run. It is reported that these tanks are to be located on the slope so that their foundations will be partly in excavation and partly on an embankment.

About seventy-five feet from the septic tanks are to be located the sprinkling filters, a four-inch concrete base is provided to be about one hundred and twelve feet square and sloping six inches towards the outlet side where a concrete collecting gutter twelve inches deep, and twelve inches wide is provided to collect the effluent and deliver it to the river. No side walls are contemplated. On this platform, whose elevation is to be four hundred and fifty at the gutter, is to be placed six feet of crushed stone or slag or waste from cement mill, pieces to range in size from one to two inches in diameter. The slag is to rest on underdrains of paving brick or rough stones. No details of this important feature of the design have been submitted.

The sewage is to be delivered on to the filters by means of two four inch cast iron delivery pipes from which right angle, one and five-tenths cast iron branches are to lead on either side paralleling each other, thirteen feet apart, from which vertical pipes to be fitted with sprinkling nozzles, are to be attached, so that the surface of the sprinkling filter will have a nozzle at the corner of each thirteen foot square. By means of a valve either one of the four inch iron mains, and hence one-half of the total filtering area may be shut off.

The horizontal pipes will rest on the filtering material under but near the surface thereof.

Since the plant is to be continuous in operation and but a comparatively few connections with the sewer system are anticipated for the first year or so, and even if all of the buildings in the borough were connected, the entire flow of sewage daily should not be large, during periods of several hours, especially in the night time, an inconsiderable flow will occur through the plant. In consequence of this dribbling flow, the sewage instead of being sprayed over the surface of the filter beds would barely flow out of the vertical pipes and pass down the filtering material around the pipe. In cold weather this would promote the formation of ice pillars and seriously interfere with the operations of the plant.

It appears that the estimated cost of the disposal plant is about ten thousand dollars and for the sewer system twenty-four thousand dollars, which estimates are believed to be low. If as reported, the assessed valuation of the borough is three hundred and thirty thousand dollars and the present bonded indebtedness four thousand dollars, the limit of the municipal borrowing capacity is nineteen thousand dollars in round numbers. So the borough is not financially able to defray the cost of the sewerage system and the sewage disposal works, but the borough can raise sufficient funds with which to pay for the installation of a proper disposal plant. It is possible for the local authorities to assess the cost of the sewers on abutting properties, and if this were done the entire improvement could be built.

The site of the disposal works, being at the immediate edge of the village, demands that ample precaution should be taken to obviate a nuisance. The receiving chamber and the septic tanks should be covered over.

The by-passing of crude sewage or the drainage of sludge and liquids from the septic tanks into Robinson's Run or the river as now contemplated in the plans is objectionable, unnecessary, and should not be approved. The said by-pass is useless. There should be two septic tank compartments, one of which should always be in use, the choice resting with the management. Hence, by this arrangement, necessity for an overflow device is obviated. Further, from the standpoint of a nuisance, more objection could be raised to the sudden emptying of accumulated deposits from the septic tank into the river than to the continuous discharge of crude sewage from the sewer system.

The department is informed that the septic tanks can be located at a sufficiently high elevation to provide for gravity discharge of the tank effluent and the drainage thereof through a dosing tank to the sprinkling filters. Thus no liquids need be discharged into any water course before having passed through the sprinkling filters.

The sludge should be deposited on a drying area to be located on the further side of Robinson's Run, as far away from Lehigh Street as possible. Abundance of lime or other disinfectant should be used to prevent a nuisance. The cleaning out of tanks may not occur more often than every two or three years. Some tanks do not require cleaning more than once every five years, while others have to be cleaned out every few months. However, the necessity for the preparation of a suitable area upon which to deposit the sludge and to permit the liquid to drain away through porous material, and the drying of the solid matter, is great enough to demand that provision for it shall be incorporated in the design.

A dosing tank arranged to receive the effluents from the septic tanks and to automatically discharge when full, the volume upon the sprinkling filters is a prime requisite for the proposed plant.

It appears that one septic tank only should be needed for the present at East Mauch Chunk, but, this tank should be divided by a longitudinal reinforced concrete partition, extending the whole length of the tank and dividing it into two equal and separate compartments.

For a similar reason, one-half of the proposed filtering area only need be built at once; but as far as the construction goes, it should be in keeping with the best practice and adapted to future extensions. Complete details upon which the success of a filter plant depends should be worked out and submitted for approval. Undoubtedly, an eighth of an acre of well designed, constructed and operated sprinkling filters would successfully treat the sewage of the village during the first few years of the use of the new sewer system. To overcome difficulties of operation in coldest weather, the filters should be arranged to admit of their operation as contact beds, if desirable. This dictates that their should be concrete walls on the sides with valves at the outlet underdrains, admitting of closing or opening at will, and the underdrainage system should be so designed as to effect complete drainage of any retained dose in the filter in a short time.

The distributing pipes and nozzles should rest securely on foundations or piers provided for the purpose, and the pipe arrangement should be such that a small part of the filter surface can be put out of commission for repairs or cleaning without putting other portions of the filter out of commission.

It should be clearly understood that the bedding material will rapidly accumulate suspended matter and that this will first adhere to the stones, finally dry, crack, peel off and be washed downward to the underdrainage system. At irregular intervals the filter will thus free itself of large quantities of flocculent matter, provided ample facilities are afforded on the bottom of the filter in the underdrainage system for the passage away of this stuff. Therefore, a very important factor in the successful operation of a sprinkling filter, is the underdrainage system. Too much care cannot be bestowed on this feature of the design.

It is desirable that these suspended matters should be retained on the premises. They discolor an effluent and have the appearance of sewage. If discharged where now contemplated in the plans, at a point in the river about three hundred feet above the dam and the head of the canal, they would be liable during a part of the year to pass down with the flow in the canal and deposit somewhere there. This should be prevented. It does not appear why the borough should not provide the customary arrangement for the interception of these solids. A settling tank of about four hours retention is desirable and should be required.

Relative to the kind of bedding material to be used in the filters, great caution is demanded if slag is to be selected. Some kinds of slag will disintegrate. Broken stone will last and may prove the cheapest in the end. All fine material should be absolutely excluded. Upon the care in selecting the material and placing it will depend the capacity of the filter. A sample of filtering material should be submitted for approval before the beds are constructed.

In view of these and other considerations, the State Department of Health will send an officer to the hotel and four other properties on the water shed to obtain information against those committing nuisances there and take such steps as may be necessary to immediately bring about abatement of the same. And the Mauch Chunk Water Company will be requested to inspect the properties on the water shed once monthly and to submit a report thereof to the State Department of Health relative to any nuisance or menace existing thereon. And the said Water Company will also be requested to thoroughly clean out the reservoir and to remove all objectionable matter therefrom.

It has been unanimously agreed by the Governor, Attorney General and Commissioner of Health that the interests of the public health demand that the Commissioner of Health give approval and it is hereby and herein given to the proposed sewer plans and a permit granted for their construction, under the following conditions and stipulations:

First. That all storm and roof and ground water shall be excluded from the sewer system and that no existing sewers shall be connected or permitted to connect with the proposed sewer system, but the borough shall cause the sewage from all estates now sewered into the Fifth street drain or tributary drains to be discharged into the public sewer system.

Second. At the close of each season's work, the borough shall prepare a plan and profile of the sewers laid during the year and file the same, together with such other information relating thereto, as may be required, with the State Department of Health.

Third. That in order to exclude ground water from the sewer system, the joints of the sewer pipe shall be laid with Portland hydraulic cement mortar instead of Rosendale cement mortar. The lamp holes shall be plastered inside and outside with Portland cement mortar.

Fourth. In order that the sewers shall be properly laid, it is stipulated that they shall be constructed under the direction and supervision of competent and experienced engineers, skilled in this kind of work.

Fifth. The local authorities shall make or cause to be made, at least once monthly, an inspection of the sewer system, and if necessary the sewers shall be flushed. A record shall be kept on file in the borough of all inspections and a copy thereof shall be submitted to the State Department of Health whenever required.

Sixth. All house connections shall be recorded and laid under the supervision of a borough officer. Inattention to this matter may easily render the entire improvements a failure. The total length of house connections in the borough will equal if not exceed the total length of the sewers in the streets. The line from the sewer to the inside of the cellar wall should be straight in line and grade, if possible, and there should be a clean-out plug at the bend of the soil pipe in the cellar. The borough is advised to adopt a set of plumbing rules and regulations.

Seventh. The borough shall reconsider the sewage disposal plans and modify and amend them to conform to the general suggestions herein before offered and submit such plans to the Commissioner of Health for approval on or before the beginning of the construction of any part of the public sewerage system herein and otherwise approved. The construction of a sewage purification plant will be required by the State co-temporaneously with the construction of the sewer system, in order that the borough's sewage shall be purified and the effluent only, dicharged into any of the waters of the State.

Eighth. If the sewer system or any part thereof, becomes prejudicial to public health, in the opinion of the Commissioner, then such remedial measures shall be adopted by the borough, as the State Department of Health may approve or advise.

Ninth. No pathological material from any laboratory shall be permitted to dicharge into the sewer system. The proper authorities shall cause these wastes to be destroyed on the premises.

The borough is advised to enforce regulations with respect to cesspools, privies and waste water discharged, and to provide and use disinfectants to the end that sanitary conditions may be improved in the borough, pending the installation of the general sewerage system.

Harrisburg, Pa., July 24th, 1907.

COPY OF PERMIT ISSUED BY THE STATE COMMISSIONER OF HEALTH OF PENNSYLVANIA TO NEW JERSEY ZINC CO., PALMERTON, CARBON COUNTY.

This application was made by the New Jersey Zinc Company of Pennsylvania, Village of Palmerton, Lower Towamensing Township and is for approval of sewerage and sewage disposal plans.

It appears that the manufacturing plant of the New Jersey Zinc Company of Pennsylvania is located on the north bank of the Lehigh River, in Lower Towamensing Township, Carbon County, beginning at the Aquashicola Creek which comes down from the east, draining the north slope of the Kittatinny Ridge and emptying into the river just above Lehigh Gap. The property of said company extends up the valley of this creek and northward along the bank of the Lehigh River for a distance of one and a half miles in each direction. Fourteen hundred persons are employed at the works, and this number is likely to be increased in the future because the plant is being rapidly extended.

For the accommodation of its employees, the Company has laid out the village of Palmerton, which is located on the north bank of the Aquashicola Creek, erected many dwellings, established a water works system, sewerage and electric lights, and maintains an active interest in the administration of local matters for the health and well being of the citizens of the village. The present population is estimated to be in the neighborhood of eighteen hundred. The tract occupied by the shops and buildings at the works of the Company is distant about a mile from the village, and connecting the two is a railroad owned and operated by the Company. This tract is hemmed in between the river on the south and the mountains on the north distant about one thousand feet. At the foot of the slope extend the tracks of the Central Railroad of New Jersey, and following the river bank is the canal of the Lehigh Navigation Company. Between the two is the land upon which the buildings of the Zinc Company are located.

The raw products received at this plant are, the zinc ore from New Jersey, limestone and anthracite coal, besides a few minor chemicals. The finished products comprise white oxide of zinc, spelter's zinc, sulphuric acid, lithopone and spiegeleisen.

In the process of manufacture of white oxide of zinc, the ore is vaporized, and the vapor is then oxidized in its transit to the bag-houses, where facilities are afforded for the escapement of the gases and the collection of zinc in the form of oxide, in which form it is a dry powder resembling a very fine quality of flour. Thus it is shipped in barrels.

The furnaces are operated by forced draught, and the cooling of the fan shafts requires a considerable volume of water. This is discharged into the main storm water drain of the works at a temperature of about seventy degrees.

Some of the residium from the oxide furnaces contains iron in sufficient quantities to render it profitable for reclamation. This is accomplished in blast furnaces of which there are two, a third one being contemplated. These furnaces are of the ordinary type, water cooled. About one million gallons daily of water are used at each furnace, and from there it is discharged directly into the main storm drain of the plant, and thence into the Lehigh River.

The liquid waste from the process of sulphuric acid manufacture is discharged largely, if not wholly, upon the cinder bank in the vicinity of this part of the plant. Any of this liquid which does not soak away in the cinder bed would naturally find its way through an open ditch under the canal and eventually to the river. The river at this point contains mine drainage to a sufficient extent to render the water undesirable for general manufacturing purposes.

In the spelter process the zinc ore is roasted by heat produced by burning gases manufactured on the premises, resulting fumes from this roasting process being condensed and the result being a liquid zinc, which when cooled represents the marketable article called spelter. No liquid wastes, whatever, are produced. Various parts or mechanisms of the plant are water-jacketed and drainage therefrom goes to the main storm drain.

The steam engine plant is condensing and the drainage is also discharged into the main storm drain.

The company obtains its water supply from the Pohopoco Creek, entering the Lehigh River at Parryville, six miles above the plant. Water is brought down in a thirty inch gravity main terminating at the pump suctions at the engine house. Here there are installed six pumping engines, by means of which water is delivered to all parts of the plant and also to the water works system of Palmerton village. The total daily consumption for all purposes is about nine million gallons.

During the spring and summer of the year one thousand nine hundred and six, there was an outbreak of typhoid fever in Palmerton, attributable to the pollution of Pohopoco Creek. On application from the Company, the State Department made an inspection of the sources of pollution on the water-shed and ordered their abatement. Immediately upon the outbreak of the typhoid epidemic, totaling one hundred cases in six months, the Company drilled a well at its plant for the purpose of securing, if possible, a temporary supply of pure water for domestic uses in the village. The ground supply was furnished for the first time about the middle of August, since which time it has been the only source of supply to the village. The water, however, is extremely hard and very unsatisfactory on this account. The creek water, however, is in use at the works. There is an emergency intake from the river to the pumping station which is maintained for use in case of accident to the gravity supply main from the creek. The main leading from Parryville is laid in the bed or along the banks of the Lehigh River and at numerous places is necessarily exposed.

A vigilant patrol of the Pohopoco Creek watershed is maintained and the State is prompt in removing any nuisance or menace thereon reported. Owners of property have been required to go to considerable expense in providing proper water tight receptacles for sewage. The Zinc Company upholds the sanitary policy of the State with respect to the discharge of sewage into any body of water used for drinking purposes and since the Lehigh River is a source of supply to the public in Bethlehem, lower down stream, and since at present some of the sewage from the Zinc Company's works is discharged into the river, the said Company has been prompt to voluntarily propose to discontinue such discharge.

At the present time masonry privy vaults are in use at the company's plant, with two exceptions. There is a water closet at the general office and at the laboratry, and all sewage from these two buildings is discharged into a sewer which empties into the storm drain previously referred to. This drain, where is passes under the canal to the river, is reported to be thirty inches in diameter. It removes roof and storm water from the upper half of the plant. The water course above referred to serves a similar purpose for the lower half of the plant.

The petitioners represent that a system of sewers and sewage disposal works is necessary for the convenience of the workmen about the plant and for the protection of the general health of the community. The plans submitted contemplate the construction of a system of sanitary sewers into which is to be admitted sewage only, and for the erection of intermittent sand filters for the treatment of the sewage. At present the water-tight receptacles for sewage require cleaning out continually. The contents are removed in wagons to farm lands in the vicinity. The cleaning process is a nuisance both to the company and to the neighborhood at large.

The proposed system contemplates the erection of seventeen comfort stations, to be located at convenient places throughout the plant. The arrangement is of special design, adopted by the Company after experiments. Each station is to consist of a range closet for a seating capacity of from five to seven people, flushed by automatic tank discharging twenty-five gallons every half hour, more or less.

The sewers are to range in size from five to twelve inches in diameter laid on grades sufficient to maintain a cleansing velocity to be provided with manholes at changes in line and grade, of suitable construction to admit of inspection and proper maintenance, and to comprise all told a total length of eighty-six hundred feet.

The disposal plant is to consist of a dosing chamber and four sand filter beds. No attempt to store the sewage or to obtain the liquification of the solids is made. The intention of the design is to convey the sewage to the filter beds while it is in a fresh condition. The dosing tank is provided for the purpose of effecting economical and satisfactory distributions of the sewage over the surface of the beds. This tank is to be built of concrete bottom and sides, thirty-six feet long, eighteen feet wide and two and one-half feet in depth to the flow line. The sewage in passing into the tank is to enter through a screen chamber. It is to be operated by a siphon set to discharge when the tank fills to the depth of two and a half feet, giving a flush volume of thirteen thousand gallons, to which should be added about one thousand gallons in-flow during the period of discharge which is designed to be twenty minutes to one-half hour. The total daily output from the works is estimated at forty thousand gallons. The works are operated day and night so that the flow of sewage will be fairly uniform during the twenty-four hours of the day.

The filters are to be built of good sand, to be obtained by crushing sandstone rock quarried in the vicinity by the McFarland Sand Company, which is extensively engaged in this line of business. The filters are to be one hundred feet wide by two hundred feet long, divided on the surface into four compartments, each fifty feet wide by one hundred feet long. Excavations in the natural earth are to be made, four inch underdrains (laid in parallel lines twenty feet apart, connecting to a main drain extending longitudinally through the center of the four beds), are to be laid on the floor over which is to be placed four and a half feet of sand. The sewage from the dosing tank is to be delivered through a twelve inch pipe into a central gate chamber from which it may be diverted either into one or both of two secondary gate chambers, from which surface sluice boxes are to extend longitudinally across each filter, by means of which sewage is to be discharged in the surface of each compartment. The total area of the four beds is equivalent to one-half acre, and at the estimated output of sewage from the works will give a filtering area equivalent to eighty thousand gallons of sewage per acre daily. This rate has been demonstrated by experience to be a normal one, and with careful operation of the beds, should be capable of producing an effluent of high purity.

The effluent from the filter beds is to be discharged by means of a ten inch pipe into an effluent chamber having a division wall with four five inch flop valves, by means of which sewage or river water in high stages will be prevented from backflooding into the underdrainage system. This keeps a water seal on the underdrain and will keep animals out of the pipes. From this chamber a ten inch pipe is to conduct the effluent to a culvert which passes under the canal to the river. The filter beds are located along the canal near the said culvert. This location is near the down stream end of the tract upon which the Company's work are located. The surface of the filter beds is to be three hundred and ninety-two. The normal level of the river water is three hundred and eighty-two. The elevation of the water in the canal is three hundred and ninety-four. The mean high water in the river is about three hundred and eighty-six, which is to be the elevation of the ten-inch effluent pipe at the effluent chamber. In the year one thousand nine hundred and two, the Lehigh River reached the elevation of four hundred, so that practically the entire tract upon which the works are located was under water. A high water like this is reported to have occurred in the year one thousand eight hundred and sixty-two. So it appears that the filter beds will be in commission during the ordinary freshets except possibly for a short period of a few hours. In the event of an extraordinary flood stage the entire plant will be out of commission.

The proposed plans are well-conceived and designed according to the best practice in sanitary engineering. The law does not permit the Commissioner of Health to grant permission to a private corporation to discharge sewage into any of the waters of the State. Further, it is not necessary for such a corporation to make application to the State Department of Health for approval of plans for the treatment of sewage, but since the State has by law forced corporations like the New Jersey Zinc Company of Pennsylvania to go to large expenditure in preparing sewerage and sewage disposal works, and since a corporation seeking to comply with this law and making an expenditure of twenty-five thousand dollars, such as that contemplated in the present instance, may reasonably expect the co-operation and advice of the State Health Department, it has been determined to be good public policy for the Commissioner of Health to approve plans under certain conditions and stipulations:

In view of all the circumstances and in conformity with the policy of the State, it has been unanimously agreed by the Governor, Attorney General and Commissioner of Health, that the interests of the public health demand that approval be given and it is herein given to the proposed sewerage and sewage disposal plans and a permit is granted therefor under the following conditions and stipulations:

FIRST: That when the works shall have been completed, detailed plans of the filter beds and dosing tanks with their appliances and appurtenances shall be prepared and filed in the Department of Health.

SECOND: Relative to the operation of the disposal works, records shall be kept by the Zinc Company on such blank forms as shall be furnished by the State Department of Health.

THIRD: If at any time in the future it shall appear that the filters are becoming over-taxed or not properly performing their work, then the plant shall be enlarged and improved, or such remedial measures adopted as the said Zinc Company shall be made in writing, accompanied by plans and adequate information, and submitted to the Commissioner of Health for approval; and the Commissioner of Health may amend or approve said plans or measures and stipulate the conditions under which approval thereof is given.

Harrisburg, Pa., July 6th, 1907.

Disinfection of Sewage.

Disinfection of Sewage.

During the fall of 1906 arrangements were made by the Commission and the Hydrographic Branch of the United States Geological Survey jointly, to experiment in sewage disinfection. The Geological Survey was represented in this matter by Earle B. Phelps, Assistant Hydrographer. Arrangements were made with the authorities of the Town of Red Bank to carry on the experiments at the sewage disposal plant of that town. Some work was done during November and December, 1906, and some data secured as to results from the use of chlorine on the effluent from the Red Bank septic tank. The work was discontinued during the winter. In 1907, the Commission arranged to continue these experiments. Because of lack of funds, the United States Geological Survey was unable to participate in the work done during 1907. This work was carried on jointly by Professor Phelps and the Commission. The following report of this work was made to the Commission by Professor Phelps.

To the Honorable, The State Sewerage Commission of New Jersey:

Gentlemen.—I submit to you herewith the complete and final report upon the Red Bank experiments on the disinfection of sewage. This report will include in the order given—a description of the sewage disposal works at Red Bank; plan of the experimental work on disinifection; summary of the results obtained; general conclusions based upon these results and summary of other disinfection experiments; appendix, plans and tabulated statement of daily results and general averages.

I. THE SEWAGE DISPOSAL WORKS AT RED BANK.

Red Bank is a town situated upon the Navesink River in Monmouth County. It had a population in 1905, according to the New Jersey State census, of 6,263, which has probably increased to 6,500 or more at the present time. The sewerage system is on the separate plan with special drains to carry off the rain-water. On account of the sandy nature of the soil and poor construction of the sewers, there is, however, a considerable volume of storm water which finds its way into the sewers during a storm. The average dry weather flow of sewage is about 265,000 gallons per day.

Reference to the accompanying plan and sectional views, appendix A and B, will facilitate the description of the disposal works. On entering the works the sewage flow divides into two streams passing through two grit chambers, each 5x8 feet in plan and three feet deep to the flow line. The flow may be entirely diverted through either tank to allow the other to be cleaned out. From these chambers the sewage flows to the septic tank.

The septic tank is circular in plan, forty-three feet in diameter. Its normal depth to the flow line is 9.0 feet at the periphery and 5.0 feet at the center, the bottom being conical. Its capacity at that depth is about 82,000 gallons, or approximately an eight-hour dry weather flow. For the purpose of these experiments, however, it was necessary to raise the flow-line throughout the system by a foot, increasing the capacity of the tank to about 93,000 gallons. At the opposite side of the tank the septic sewage passes out through a submerged twelve-inch pipe which later divides into a *Y*. Each branch then turns downward to the bottom of one of the filters, thence horizontally to a point beneath the center and thence upward into the filter as shown in the sectional view.

The so called filters are two in number, each twelve feet in diameter. Tank A is nine feet deep to the flow line, with a capacity of seven thousand six hundred gallons, and tank B 8 feet 3 inches, with a capacity of seven thousand gallons. They were originally filled with stone and brick, over a false bottom, and were practically strainers for the removal of suspended matter. Each filter is provided with a twelve-inch overflow leading to a manhole outside the building. For the purpose of these experiments the filtering material was entirely removed from both tanks, one of the outlets was closed and a cross connection was put in to conduct the sewage from the top of one tank to the bottom of the second. By closing the inlet valve of the latter, the entire flow can be made to pass through the two tanks in series. Suitable baffles were provided as shown so that the entire capacity of the tanks could be utilized to the best advantage. As thus arranged each tank holds about three-quarters of an hour's flow of sewage so that the effect of the treatment can be observed at the end of three-quarters and of one and a half hours respectively.

In this report reference to tank A is to the first effluent, after three quarters of an hour treatment, and to tank B to the final effluent.

There are also provided suitable sludge pipes for the withdrawal of sludge from the septic tank and the two treatment tanks. These are indicated in the plan, A.

II. PLAN OF THE EXPERIMENTAL WORK ON DISINFECTION.

(1) *The Disinfecting Solution.* The disinfecting agent used in the present investigation was commercial chloride of lime or bleaching powder, whose active constituent is calcium hypochlorite. The reasons for the selection of this material will be more fully discussed in the general summary. The commercial product contains, in addition to calcium hypochlorite, a considerable amount of free lime and calcium carbonate. For the preparation of the solution of bleaching powder two hogsheads of about 240 gallons capacity each were provided. In one of these, which was elevated over the other, the requisite amount of bleaching powder was mixed with water and allowed to settle over night. The next morning the clear supernatant was drawn off into the second hogshead. The latter was directly connected with a constant level tank in which the solution was kept at constant level by an ordinary ball-cock. A glass ball and special fittings were necessary to prevent corrosion. This tank was directly connected by a flexible rubber connection, with the dosing tank, a box 6x6 inches in plan and 8 inches deep, provided with a 3-16 inch orifice in one side and suspended on the end of a six-foot lever arm. The other end of this arm was connected with a large float in the first tank (A). This tank was provided with a one foot weir at its outlet by which the water level was made to vary with the flow. An increase in this flow increased the elevation of sewage in the tank, raising the float and lowering the suspended box at the other end. Since the box is connected with the constant level box, the effect of this change is virtually to increase the head over the orifice. In this way the flow of the bleaching powder solution was automatically kept about proportional to the flow of sewage. The proportionality was not exact since the variation in flow with the head is not the same with a weir and an orifice but within the range of flows used it was quite satisfactory. By discharging from the tank through a sub-

merged pipe instead of a weir the proportionality between the two flows could be made perfect at all heads. The solution of bleaching powder then passed into the outlet pipe from the septic tank at a point indicated on the plan where it mixed with the main flow of sewage. The treated sewage then passed through the two disinfecting tanks and was finally discharged into the river.

The extraction of the hypochlorite was not complete in the one leaching given it. In the mills where large quantities are extracted, three successive lixiviations are allowed to complete the extraction. This process was not feasible here and the sludge remaining in the first hogshead was each day dumped into Tank A, where it settled to the bottom and was slowly leached out by the sewage. In this way all the available chlorine was utilized.

(2) *Analytical Methods.*

Throughout this work of 1907, the analytical methods used were as far as possible those of the Standard Methods Committee of the American Public Health Association. Bacteriological determinations were made of the total numbers of organisms growing on agar at 20 C. and of the numbers of the bacillus coli present in the septic sewage, and effluents of the two disinfection tanks. For the determination of the bacillus coli, advantage was taken of a new test proposed by Jackson, known as the bile broth test. The solution used for the test is sterilized ox bile to which 2 per cent. of lactose has been added. An elaborate study of this medium has led its author to the conclusion that the formation of 25 per cent. of gas in the tube is practically a positive test for B. coli. While the writer is not prepared to accept the test as a conclusive one, especially in sewage work, where it has not been so freely studied, he is convinced that the results obtained by this simple procedure are quite as satisfactory as the more elaborate methods, and probably indicate within 10 per cent. of the true figures. For this present work therefore the term B. coli means "an organism giving 25 per cent. or more of gas in Jackson's bile medium when incubated for two days at 37 C." The adoption of this simple method has made it possible to make a much larger number of determinations than could otherwise have been made.

It was considered essential also to have certain information about the chemical composition of the septic sewage under treatment and to make certain chemical tests of the effluent. For this purpose average samples of the sewage and of the final effluent have been collected daily and determinations of the oxygen consumed have been regularly made upon them. These determinations give us a comparative indication of the strength of the sewage as it fluctuates from day to day. In the final effluent determinations were also made of the dissolved oxygen and the effluent was tested for free chlorine. The septic sewage never contains any dissolved oxygen and under normal conditions this would be true of the effluent. The application of free chlorine to the sewage gives rise to chemical reactions whereby free oxygen is formed. This is used up in large measure in the oxidation of the organic matter but in the final effluent there was always found some free dissolved oxygen. The presence of this oxygen is of great value to the further self-purification of the sewage after reaching the river. Free chlorine was never found in the final effluent. Its presence would be highly injurious to fish life and disinfection work of this nature should always be so controlled that no excess of free chlorine escapes into the stream. In addition to these daily determinations, composite sterilized samples have been preserved and sent to Boston regularly where they have been submitted to a complete chemical analysis.

Regular chemical analyses of the bleaching powder used and daily analyses of the disinfectant solution have also been made.

Reference has been made to the weir at the outlet of tank A. A suitable gage was set up in that tank and the elevations of the sewage over the weir crest were recorded at intervals of two hours from 6 A. M. to 6 P. M. or more frequently when necessary. These readings were converted into gallons and from them the daily discharges of sewage have been calculated. The night flow has been approximately determined by calculations based upon two sets of hourly observations extending over twenty-four hours, and from the relation of these sets of data to the general averages of day flows.

When the weir gage was read, readings were also taken of a gage placed in the lower mixing hogshead, calibrated to read directly into gallons. By this means the hourly flows of disinfectant solution were known at all times and could be compared with the corresponding sewage flows.

III. SUMMARY OF RESULTS.

For convenience of discussion, this investigation may be divided into two major portions: preliminary studies made in the fall of 1906, and the final studies made in the summer of 1907.

During the preliminary work, amounts of chlorine varying from five to ten parts per million were employed, and the results were uniformly unsatisfactory from the standpoint of bacterial removal. The operation of the experiments was necessarily intermittent, and analyses were made only at infrequent intervals. Before arrangements could be completed for a more perfect operation of the plant, the experiments were interrupted by the advent of cold weather and were discontinued for the year.

As a result of these experiments, it was determined however that amounts of chlorine up to ten parts per million were insufficient for satisfactory disinfection, and that the operation of the experiments or all of the practical work must be continuous in order to insure satisfactory results.

In July, 1907, work was resumed and continued throughout the summer. During this time, Mr. F. E. Daniels was placed in charge of the investigation and remained on the ground continuously. A laboratory was fitted up in an adjoining carriage house, and all the necessary bacteriological and chemical work was done on the ground

All the complete data of the final study of 1907 have been brought together in the tables which accompany this report. For convenience of discussion the work has been divided into three periods, according to the amount of chlorine used. During the period, July 17-Aug. 16, there were used 100 pounds of bleaching powder per day; from Aug. 17 to Aug. 29, 50 pounds per day, and from Sept. 7 to Sept 26, 75 pounds per day.

To determine the actual rate of application of the chlorine it was necessary to know the amount of available chlorine in the bleaching powder and the daily flow of sewage. The former figure was determined by daily analyses of the bleaching powder solution, and by frequent analyses of the bleach itself. The flow was determined by weir readings during the day. To get an approximate idea of the night flow, two 24-hour series of hourly readings of the weir were made, one on Aug. 16 and one on Sept. 9. From the relation between the day and night flow on these dates and the general curve of daily flows a curve of night flows has been plotted which is probably approximately correct. These two curves of day and night flow are here given as a matter of record in Diagram III. The total flow per 24 hours, expressed in thousands of gallons, is given in column two of the tabulated results. In column three are given the daily amounts of chlorine used, based upon the analyses and expressed in Kilograms. Column four gives the actual rate of application of chlorine in parts per million.

One part per million means 8.3 pounds per million gallons of sewage. Then follow the detailed results of the chemical and bacteriological analyses, the daily temperatures at 9 A. M., and meteorological observations.

All observations made are here given. In general three bacterial analyses and two B. coli. determinations were made each day. Blank spaces indicate that for some unavoidable reason the determination was not made. In Table I two sets of bacterial analyses, July 24 and Aug. 7, are enclosed in parenthesis. These figures are so far from the others that it was thought unfair to include them in the average. They indicate some undetected condition, such as a stopping in the supply of chlorine for a short time, and are therefore excluded as abnormal.

In the following table, the average results and per cent. removals have been brought together for convenience of reference.

TABLE OF AVERAGE RESULTS ARRANGED BY PERIODS.

PERIOD.	Available chlorine. Parts per million.	Total Bacteria Per cubic centimeter.			B. Coli. Per cubic centimeter		
		Sewage.	A.	B.	Sewage.	A.	B.
July 17-Aug. 16...	11.5	1,059,000	580	314	51,020	16	9
Aug. 16-Aug. 29...	7.3	875,000	42,300	40,700	113,500	6,500	9,900
Sept. 7-Sept. 26...	12.1	735,300	5,900	3,360	411,780	182	184

PER CENT. REMOVED.

	Total. A.	Total. B.	B. Coli. A.	B. Coli. B.
July 17-Aug. 16...........................	99.95	99.97	99.97	99.98
Aug. 16-Aug. 29...........................	95.2	95.3	94.3	91.2
Sept. 7-Sept. 26...........................	99.2	99.43	99.95	99.95

During the period July 17 to Aug. 16, the amount of available chlorine used was at the rate of 11.5 parts per million. At the end of 45 minutes, 99.945 per cent. of the total bacteria and 99.969 per cent. of the B. coli present were killed. After one and a half hours these figues were increased to 99.970 and 99.982 respectively.

During the period Sept. 7 to Sept. 26, the application of chlorine was at the rate of 12.1 parts per million, the bacterial reductions were 99.20 and 99.43, and the B. coli reductions 99.95 and 99.95, after three-quarters and one and a half hours respectively.

During the period Aug. 17 to Aug. 29, with an average amount of chlorine of 7.3 parts per million, the corresponding reductions of total bacteria were 95.2 per cent. and 95.3 per cent and of B. coli 94.3 per cent. and 91.2 per cent.

Several interesting facts are here developed. It is evident that 7.3 parts of available chlorine is not enough for efficient disinfection. The results are themselves poor and frequently an increase in numbers occurred in Tank B. Fermentations were observed in both tanks during this period. The B. coli actually increased in tank B in the average results, as we know it often does increase in septic tanks.

During the September period although the actual amount of chlorine added was less than in the first period, July-August, yet the chlorine in parts per million was greater. This is due to the fact that the flow decreased steadily from the beginning of these experiments. This decreased flow probably means only a decreased ground-water flow so that we were treating in September a more concentrated sewage. This increased strength of sewage was compensated by increased efficiency in the septic tank due to a longer period of storage and does not appear in the oxygen consumed figures. The products of the septic tank action, however, have a strong tendency to remove the chlorine before it has acted upon the bacteria and that is doubtless what has occurred here. In confirmation of this view is that fact that the dissolved oxygen is the final effluent is 0.4 part less than it was during the entire period. This is the equivalent of 1.6 parts of chlorine and probably represents the increased chemical work which was done by the chlorine before it was able to act as a germicide. This observation is of great interest and illustrates the value of continuous experiments carried over a considerable period of time.

The average results of the last period are nearly as good as those of the first but considered individually they are more erratic and indicate that we are working near the danger line. This illustrates another point which may well be discussed here, the misuse of averages. Erratic results may average up as good as a smooth series. A few bad results are easily hidden among a number of good ones. Unfortunately the human system does not average things in this way. One batch of infected oysters for example, is not rendered less harmful because for the rest of the time the oysters were all right. In addition to a statement of averages we need a statement of the evenness of the results and of the number of times the average is exceeded. The following table gives these facts for the three series of results.

TABLE SHOWING THE RELATION OF INDIVIDUAL RESULTS TO THE AVERAGE FINAL EFFLUENT.

Results exceeding average by	Series July 17-Aug. 16. Average 314. No. of samples, 65.		Series Aug. 16-Aug. 29 Average 40,667. No. of samples, 29.	
	No. of results.	Per cent. of total	No. of results.	Per cent. of total
0— 50 per cent.	3	4.6	2	6.9
50—100 per cent.	2	3.1	1	3.5
100—500 per cent.	1	1.5	2	6.9
over 500 per cent.	3	4.6	2	6.9
Total	9	13.8	7	24.2

Results exceeding average by	Series Sept. 7—Sept. 26. Average 3,362. No. of samples, 47.	
	No. of results.	Per cent. of total.
0— 50 per cent.	3	6.4
50—100 per cent.	0	0.0
100—500 per cent.	2	4.3
over 500 per cent.	1	2.1
Total	6	12.8

It may be concluded from these results that twelve parts per million of available chlorine will in general produce a satisfactory result. In times of dry weather it will be necessary to increase this amount to fifteen parts. This matter will be more fully taken up in my general conclusions.

At the conclusion of these experiments, both tanks were emptied and measurements made of the accumulated sludge in their bottoms. In tank A, into which it will be remembered the extracted bleach sludge was deposited, there was found a layer some three feet deep of soft sludge. This sludge, on analysis, was found to contain 90 per cent. by weight of water and, of the remaining dry solids, only about 2 per cent. was organic matter.

In tank B, a very little accumulation of sludge was noted, not over six or eight inches, which, on analysis, was found to contain 95 per cent. of water, and whose solids were largely organic in nature. Figured into parts per million on the total volume of sewage passing through these tanks during the experiments, the removal of the organic matter by sedimentation in both tanks is found to be about two parts. Compared with the total amount of suspended matter in the sewage, this quantity seems to be quite negligible, and the conclusion is reached that sedimentation played an insignificant part in the bacterial purification noted. This result might readily have been foreseen, since the upward velocity of the flow through the tanks was too great to allow of any serious sedimentation taking place.

IV. GENERAL CONCLUSIONS.

The subject of sewage sterlization is by no means a new one, as early in 1875, a plant was installed at Brewsters, New York, for the electrolytic sterlization of crude sewage. This plant is said to be still in operation. The process used is known as Woolf's Electrozone process in which a solution of salt is electrolyzed and added to the sewage. Another installation of this process was made at Danbury, Connecticut, in 1896. The aim in this case was to do away with a serious physical nuisance in the stream below. As might be expected, no great improvement followed, and the plant was abandoned. The particular limitations of disinfection are here illustrated. It is not in any sense a substitute for purification. It will not prevent the pollution of a stream or lessen to any marked degree such a nuisance. Only when there is no question of a nuisance and there is an object in removing from the sewage all danger of bacterial contamination of a drinking water or shell fish area, does this treatment find an application. When both physical nuisance and bacterial pollution are feared, disinfection should follow some purification treatment.

In the writer's opinion, no purification, no matter how perfect, can be relied upon to remove all danger of infection and in no case should sewage effluents be discharged into waters which are used in their raw state for domestic purposes. Even chemical disinfection therefore is useful only in the protection of shellfish beds from sources of pollution, which otherwise may require little or no further treatment.

It may be used as an additional safeguard for the protection of drinking waters which are themselves filtered before use.

With this purpose in view, Rideal conducted some interesting experiments at Maidenhead, England, in 1897 and later at Guilford. In both these cases, electrolytic treatment was resorted to. The results obtained were satisfactory, but the cost of treatment made its general application prohibitive.

For some two years the writer has been conducting experiments at the Sanitary Research Laboratory of the Massachusetts Institute of Technology. It appeared that the process of disinfection was desirable and could be made feasible, given a sufficiently cheap disinfectant. A review of all the various agents which had been suggested indicated that only two were worth further study,—compounds of copper and compounds of chlorine.

A comparative study of these two classes of disinfectant showed quite conclusively that satisfactory disinfection could be produced by either, but that chlorine compounds had decidedly the greater cost-efficiency.

It was also learned that chlorine in the form of ordinary bleaching powder could be obtained at a much lower cost per unit of available chlorine than in any other form, and at less than one-half the cost of the "electrozone" or "oxychloride" chlorine used in England.

It was for this reason that chloride of lime was selected for further study in the present experiments. It is believed that these experiments are the most severe test to which the process of disinfection has ever been submitted. The test has been practically continuous for a period of about ten weeks,—fifteen million gallons of sewage having been treated. In general three samples were examined each week day. It has been demonstrated that with proper care the results are as reliable and constant as those from any other method of treatment. A method of applying the disinfectant has been devised which operates automatically and proportions the dose to the flow of sewage. The results indicate clearly just what can be accomplished with a septic sewage of the nature of that at Red Bank, New Jersey. In connection with other results obtained at Boston, these results are of particular value. It has been found, for example, that to disinfect a good trickling filter effluent requires about five parts per million of chlorine. Crude sewage, owing to its greater content of organic matter, has been found to require ten parts. Such a septic sewage as that at Red Bank requires from twelve to fifteen parts, although in organic matter it is lower than Boston sewage. The explanation of this is found in the character of septic sewage. Septic sewage contains, beside organic matter, a considerable amount of hydrogen sulphide and other oxidizable compounds. These require oxidization and use up a certain amount of chlorine before disinfection can become effective. It is apparent, therefore, that in the disinfection of unfiltered sewage, the septic tank adds considerable to the expense of treatment. On the other hand, efficient aeration of the septic sewage before treatment would do much to remove the harmful gaseous products and improve the results.

The cost of the treatment is the vital point. At the present market price of bleaching powder, chlorine will cost about three cents a pound. On this basis the application of fifteen parts of chlorine to one million parts of sewage will cost $3.75 per million gallons of sewage treated. The raw sewage of Red Bank could probably be treated for $2.50 per million gallons to obtain the same result. If a disinfected effluent is required in any case and the desirability of the septic tank is in question it will be seen that $1.25 per million gallons represents the extra cost of the septic treatment. Under existing conditions the results would seem to justify this additional cost. Under other conditions where there might be no question of a nuisance from floating and solid material, raw sewage might be treated with chlorine, while in the extreme case, when the greatest possible purification is called for, the disinfection may be applied after treatment in filters. The cost of disinfection in such a case will depend upon the quality of the effluent and will range from $1.50 for a low grade contact filter effluent to perhaps .50 or less for a sand filter effluent.

Accompanying this report, as an appendix, are the following tables and diagrams.

Diagram 1. Plan of Red Bank Works.

Diagram 2. Sectional view of same.

Diagram 3. Diagram of daily sewage flows, showing measured day flow and estimated night flow.

Table I. Tabulated results; July 17-Aug. 16.

Table II. Tabulated results; Aug. 17-Aug. 29.

Table III. Tabulated results; Sept. 7-Sept. 26.

Respectfully submitted,

EARLE B. PHELPS.

EAST RUTHERFORD.

At a meeting of the Commission held June 27, 1907, plans for a system of sewers for the Borough of East Rutherford were submitted to the Commision on behalf of the Borough by Colin R. Wise and Robert M. Watson, Engineers of the Borough, together with a certified copy of a resolution of the Borough Council requesting the approval of the plans by the Commission.

On motion of Mr. Fleming, the plans submitted by the Borough of East Rutherford, providing for a system of sewers to discharge into Berry's Creek, were approved, subject to such conditions of construction and operation as this Commission may from time to time require; provided that a sewage disposal plant shall be constructed for the purification of the sewage to be discharged from said system in accordance with plans which shall be first approved by the State Sewerage Commission before the said system shall be placed in operation.

A special election was held in the borough at which there was an almost unanimous vote in favor of the construction of the sewerage system approved by the Commission. Questions were raised as to the validity of the bonds to be issued as a result of this election, and the borough authorities decided to call another election to be held January 14, 1908, to pass on the question again.

ELIZABETH.

At a meeting of the Commission held September 12, 1907, the secretary was directed to notify the authorities of the City of Elizabeth to show cause at a meeting of the Commission to be held September 26, 1907, why the city should not be notified to cease polluting the Elizabeth River.

At a meeting of the Commission held September 26, 1907, in response to notice to show cause, William H. Luster, Jr., City Surveyor, appeared before the Commission, and submitted a printed copy of the report made by him to the City Council of Elizabeth, showing what action was necessary to remove the sewage from the Elizabeth River. He stated that the matter was being acted upon by the City of Elizabeth and that the necessary ordinances for the work were now pending in the City Council, and that he would submit plans and specifications of the work at an early date.

At a meeting of the Commission held October 3, 1907, the Chairman reported that Wiliam H. Luster, Jr., City Surveyor of Elizabeth, had requested that the Commission take no action in relation to the pollution of the Elizabeth River by the City of Elizabeth until the city authorities had had an opportunity to submit the plans which had been prepared for the disposal of the sewage of the City of Elizabeth now being discharged into the Elizabeth River.

At a meeting of the Commission held October 24, 1907, plans for a sewerage system to intercept the sewage of the City of Elizabeth now being discharged into the Elizabeth River and to discharge the same into the Arthur Kill at Bayway, were submitted to the Commission for approval by William H. Luster, Jr., City Surveyor, on behalf of the City of Elizabeth.

Part of the report made by William H. Luster, Jr., City Surveyor, on the disposal of the sewage of the City of Elizabeth, is printed herewith.

EXTRACTS FROM REPORT OF CITY ENGINEER W. H. LUSTER, JR., OF ELIZABETH.

April 2, 1906.

To the Honorable The City Council:

GENTLEMEN—In accordance with the resolution of the City Council, passed October 16, 1905, authorizing the City Surveyor to prepare plans and estimates for a comprehensive scheme for cleansing the Elizabeth river, I beg leave to submit the following report; together with the recommendations that in my opinion would best accomplish the desired end.

The report is divided into four general heads, viz., Rivers, Sewers, General Remarks and Cost.

RIVER.

The physical conditions existing to-day are the same as at the time Francis Collingswood, C. E., made his report to the City Council in 1896. The investigations as made by him relative thereto have been approved and accepted by me, after careful examination, and have been supplemented by many new observations and surveys made during the course of my investigation.

There can be no question in the mind of any thinking person, who has ever walked along the river from South street to Westfield avenue, but that some radical change should be made in its present condition. Sewage has made deposits along its sides and bed and has caused it not only to be an unsightly and forbidding spectacle to travelers over the bridges, but we have its odor whenever the weather is warm enough to cause fermentation of the deposited filth. With repeated rains this condition would not exist, but as we neither have control of the weather, nor have a large mechanical flush tank, we cannot depend on the flushing action of water to do our cleansing.

NEW JERSEY STATE SEWERAGE COMMISSION. TABLE I.

Disinfection Experiments, Red Bank, N. J.

Tabulated Daily Results for the period July 17—August 16, 1907.

Date	Flow Thous. Gals. per 24h.	Available Chlorine		Parts per Million			Total Bacteria per C.C.				B. Coli per C.C.			Temp. (F)		Remarks.
		lbs. per 24h.	Parts per Million	Oxygen Consumed Sewage	B	Dis. Ox. B	Time	Sewage	A	B	Sewage	A	B	Air.	Sew.	
July 17	283	11.3	10.8	—	—	—	5 P	1,750,000	1,500	1,750	1,000	10	10			
18	311	11.3	9.9	—	—	—	1 P	550,000	100	300	10,000	1	10	72°	59°	Showers P.M.
							5 P	500,000	250	500	10,000	1	0			
19	271	11.3	11.3	45	50	1.1	1 P	500,000	100	150	100,000	1	1	76°	54°	
							5 P	750,000	450	200	1,000	1	1			
20	314	8.5	7.6	72	55	2.1	10 A	860,000	350	100	100,000	10	1	76°	55°	Showers 12-1 P.M.
							5 P	700,000	150	200	100,000	1	1			
22	278	11.3	11.0	54	49	2.4	10 A	750,000	110	150	100,000	1	1	74°	56°	
							2 P	600,000	3,000	4,000	—	—	—			
							5 P	650,000	420	240	100,000	10	1			
23	267	6.4	6.5	65	61	2.4	10 A	720,000	90	110	100,000	1	1	78°	56°	
							1 P	900,000	8,000	1,000	—	—	—			
							5 P	1,000,000	70	70	100,000	10	100			
24	267	6.4	6.5	77	75	1.3	9 A	1,050,000	60	110	100,000	1	1	74°	55°	
							1 P	(500,000	60,000	30,000)	—	—	—			
							5 P	700,000	110	120	100,000	1	0			
25	265	12.8	13.0	61	59	1.2	9 A	510,000	200	210	100,000	1	0	76°	56°	
							1 P	500,000	200	180	—	—	—			
							5 P	570,000	320	150	100,000	10	—			
26	263	12.8	13.1	54	42	1.3	9 A	700,000	80	100	10,000	100	1	79°	58°	Storm 3 P.M
							1 P	360,000	50	150	—	—	—			
							5 P	500,000	190	140	10,000	10	10			
27	258	12.8	13.4	38	40	1.3	9 A	300,000	110	100	10,000	10	10	72°	56°	
							1 P	800,000	130	90	—	—	—			
							5 P	670,000	210	230	100,000	1	1			
29	277	9.6	9.4	52	51	1.6	9 A	760,000	120	60	100,000	1	0	66°	55°	Light Rains.
							1 P	920,000	80	50	—	—	—			

TABLE I—Continued.

							5P	750,000	180	130	100,000	1	1			
30	276	12.8	12.6	66	65	1.4	9A	9,250,000	6,400	100	10,000	1	1	76°	56°	
							1P	650,000	220	70	—	—	—			
							5P	9,500,000	170	80	100,000	10	10			
31	265	12.2	12.4	64	56	1.6	9A	950,000	90	40	100,000	10	1	72°	56°	
							1P	670,000	230	50	—	—	—			
							5P	570,000	140	70	10,000	1	1			
Aug 1	279	12.8	12.4	60	46	1.2	9A	550,000	110	—	10,000	10	1	74°	55°	
							1P	1,310,000	690	400	—	—	—			
							5P	1,000,000	260	210	10,000	100	10			
2	276	12.8	12.6	58	42	2.2	9A	1,080,000	180	60	10,000	100	10	76°	56°	
							1P	1,400,000	130	350	—	—	—			
							5P	740,000	110	130	10,000	1	10			
3	258	9.2	9.7	52	39	2.0	9A	910,000	90	80	10,000	10	1	72°	56°	Rain during night.
							1P	700,000	110	160	—	—	—			
							5P	850,000	330	100	10,000	10	10			
5	266	10.0	10.5	58	38	1.2	9A	900,000	170	80	10,000	10	1	70°	56°	
							1P	920,000	110	60	—	—	—			
							5P	1,000,000	810	150	—	1	—			
6	265	10.0	10.2	60	57	1.1	9A	650,000	80	70	—	—	—	72°	56°	
							1P	—	—	—	100,000	1	1			
							5P	740,000	210	210	10,000	1	10			
7	263	10.0	10.6	52	46	0.7	10A	—	—	—	10,000	1	1	76°	57°	
							1P	(580,000	150,000	150,000)	—	—	—			
							5P	740,000	180	150	10,000	1	1			
8	263	9.6	10.2	59	56	3.3	9A	—	—	—	100,000	10	1	77°	56°	
							1P	670,000	100	20	—	—	—			
							5P	—	300	270	—	—	—			
9	271	12.8	12.8	70	60	1.6	9A	—	—	—	100,000	0	1	74°	58°	Rain to 7 AM

TABLE I—Continued.

							1P	1,020,000	220	130	—	—	—			
							5P	920,000	—	230	100,000	10	1			
10	246	12.8	14.1	60	61	0.7	9A	—	—	—	10,000	0	0	76°	56°	
							1P	860,000	—	120	—	—	—			
							5P	1,080,000	—	130	100,000	100	1			
12	256	12.8	13.5	55	46	0.9	9A	760,000	—	—	10,000	10	0	74°	56°	
							1P	—	—	130	—	—	—			
							5P	700,000	—	140	100,000	10	10			
13	263	12.8	13.7	61	49	2.2	9A	—	—	—	10,000	0	0	76°	56°	Shower at noon
							1P	940,000	—	560	—	—	—			
							5P	730,000	—	370	100,000	10	10			
14	243	12.8	14.2	70	70	0.9	9A	—	—	—	100,000	—	1	66°	56°	
							1P	870,000	100	80	—	—	—			
							5P	600,000	6,000	4,500	100,000	100	100			
15	243	12.8	14.2	53	47	1.2	9A	500,000	120	80	100,000	100	100	68°	56°	
							1P	690,000	150	40	—	—	—			
							5P.	700,000	150	150	10,000	10	10			
16	238	12.8	14.5	41	44	1.9	9A	1,170,000	90	60	100,000	1	1	71°	56°	
							1P	550,000	90	60	—	—	—			
							5P	700,000	40	70	100,000	1	1			
AVE.	268	11·2	11·5	58	52	1·6		1,059,000	580	314	51,020	16	9	74°	56°	

Earle B. Phelps.

NEW JERSEY STATE SEWERAGE COMMISSION. TABLE II.

Disinfection Experiments, Red Bank, N. J.

Tabulated Daily Results for the Period August 17—August 29, 1907.

Date	Flow Thous. Gals. per 24 h.	Available Chlorine		Parts per Million			Total Bacteria per C.C.				B. Coli per C.C.			Temp (F)		Remarks.
				Oxygen Consumed		Dis. Ox.										
		Kg per 24 h.	Parts per Million	Sewage	B	B	Time	Sewage	A	B	Sewage	A	B	Air	Sew.	
Aug 17	237	6.4	7.2	61	43	0.4	9 A	1,020,000	790	80	100,000	10	1	74°	56°	
							1 P	650,000	430	1,100	–	–	–			
							5 P	790,000	15,000	15,000	10,000	100	100			
19	243	6.4	7.0	57	44	1.3	9 A	710,000	2,700	300,000	100,000	100	100	66°	56°	
							1 P	700,000	1,900	300	–	–	–			
							5 P	600,000	90,000	80,000	10,000	1,000	1,000			
20	234	6.4	7.3	58	51	0.3	9 A	750,000	6,000	–	100,000	1,000	700	75°	56°	
							1 P	710,000	350,000	300,000	–	–	–			
							5 P	550,000	160,000	150,000	100,000	1,000	1,000			
21	235	6.4	7.3	56	41	0.7	9 A	850,000	6,800	5,700	100,000	100	1,000	78°	57°	Rain 4:30 P.M.
							1 P	600,000	–	3,700	–	–	–			
							5 P	620,000	–	21,000	10,000	1,000	1,000			
22	235	6.4	7.3	70	42	0.8	9 A	1,620,000	–	22,000	100,000	100	10	66°	57°	
							1 P	580,000	–	10,000	–	–	–			
							5 P	680,000	31,000	20,000	100,000	1,000	1,000			
23	227	6.4	7.5	65	51	0.9	9 A	760,000	1,000	2,000	10,000	100	100	70°	56°	
							1 P	450,000	1,800	1,400	–	–	–			
							5 P	300,000	5,000	5,000	10,000	1,000	1,000			
24	233	6.4	7.3	40	45	1.4	9 A	380,000	2,200	400	100,000	1,000	100	70°	58°	Rain, Early A.M.
							1 P	1,360,000	200	1,500	–	–	–			

TABLE II—Continued.

							5P	350,000	1,200	5,700	100,000	1,000	1,000			
26	237	6.4	7.2	56	54	0.7	9A	430,000	300	400	1,000,000	100	100	66°	56°	
							1P	600,000	40,000	48,000	—	—	—			
							5P	6,000,000	150,000	11,000	100,000	100,000	1,000			
27	225	6.4	7.6	64	65	0.7	9A	820,000	400	150	10,000	10	10	67°	57°	
							1P	600,000	8,000	3,800	—	—	—			
							5P	550,000	45,000	42,000	100,000	1,000	1,000			
28	224	6.4	7.6	52	46	0.7	9A	760,000	90	100	10,000	1,000	100	68°	57°	
							1P	720,000	30,000	39,000	—	—	—			
							5P	750,000	150,000	90,000	100,000	10,000	10,000			
29	—	(0.4)	—													No Samples.
AVE.	233	6.4	7.3	58	48	0.8		875,333	42,277	40,667	113,500	6,531	9,862	70°	57°	

Earle B. Phelps

NEW JERSEY SEWERAGE COMMISSION. TABLE III.

Disinfection Experiments, Red Bank, N. J.

Tabulated Daily Results for the Period September 7—September 26, 1907.

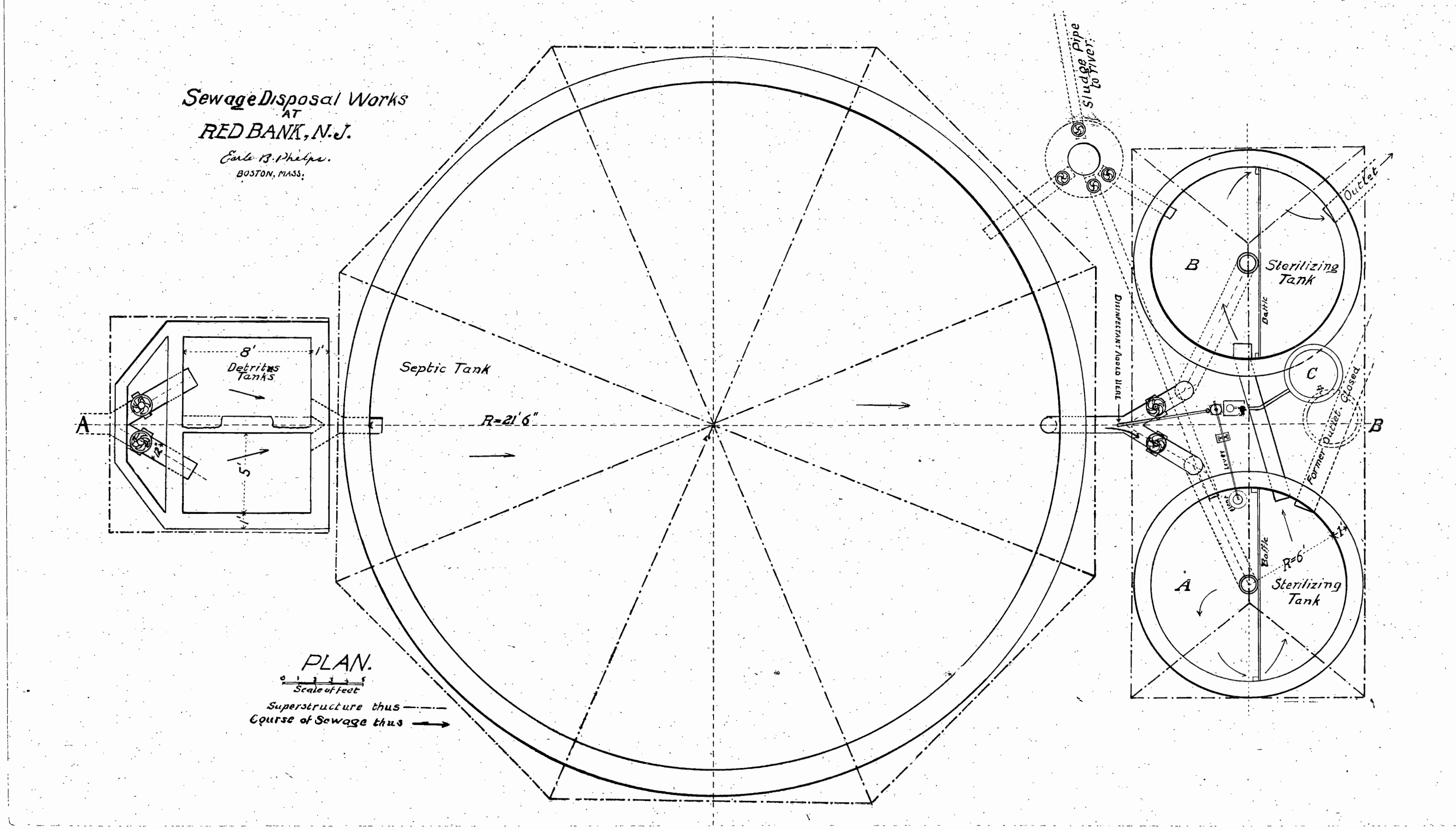
Date	Flow Thous. Gals. per 24 h.	Available Chlorine		Parts per Million: Oxygen Consumed		Parts per Million: Dis. Ox.	Total Bacteria per C.C.				B. Coli per C.C.			Temp (F)		Remarks.
		Kg per 24 h	Parts per Million	Sewage	B	B	Time	Sewage	A	B	Sewage	A	B	Air	Sew.	
Sep. 7	212	9.6	12.1	—	—	0.6	9 A	590 000	400	—	—	—	—	67°	57°	
							1 P	—	120	1,400	—	—	—			
							5 P	620 000	70	30	10,000	0	1,000			
9	221	9.6	11.6	—	—	0.9	9 A	500	3,000	1,670	100,000	—	—	68°	57°	
							1 P	980	5,500	330	—	—	—			
							5 P	310	450	200	10,000	100	10			
10	227	9.6	11.3	65	59	1.0	9 A	550	200	120	100,000	10	10	71°	57°	Shower at Noon
							1 P	560	590	400	—	—	—			
							5 P	590	460	—	1,000,000	100	100			
11	234	9.6	10.9	55	49	1.1	9 A	910	330	180	100,000	10	100	76°	58°	Rain 4 P.M.
							1 P	900	10,000	4,000	—	—	—			
							5 P	870	5,000	90	10,000	100	100			
12	216	9.6	11.9	53	44	0.6	9 A	800	150,000	120,000	100,000	100	100	64°	58°	
							1 P	680	—	—	—	—	—			
							5 P	1000	75,000	10,000	100,000	100	100			
13	211	9.6	12.1	57	45	0.7	9 A	850	80	60	1,000,000	100	1	65°	57°	
							1 P	860	155	90	—	—	—			
							5 P	1 050	500	480	100,000	100	100			
14	204	9.6	12.6	55	42	0.7	9 A	900	360	100	100,000	1,000	1	70°	57°	
							1 P	800	7,000	2,250	—	—	—			
							5 P	810	1,630	1,120	1,000,000	100	10			
16	215	9.6	12.0	55	43	0.6	9 A	1250	200	100	100,000	1,000	1,000	71°	57°	
							1 P	830	2,000	2,250	—	—	—			
							5 P	950	1,120	400	1,000,000	1,000	100			
17	210	12.8	16.3	65	53	0.6	9 A	900	1,360	200	1,000,000	100	—	74°	57°	
							1 P	500	200	240	—	—	—			

TABLE III—Continued.

							5 P	750	610	350	100,000	100	—			
18	228	9·6	11·3	63	47	0·8	9 A	1000	200	100	100,000	100	1	66°	57°	Rain, P.M.
							1 P	900	4,200	670	—	—	—			
							5 P	800	1,000	4,000	1,000,000	10	100			
19	208	9·6	12·3	55	47	3·7	9 A	510	120	90	1,000,000	—	—	61°	57°	
							1 P	740	190	180	—	—	—			
							5 P	590	790	410	1,000,000	10	100			
20	202	9·6	12·6	57	50	1·3	9 A	650	130	100	100,000	—	—	63°	57°	
							1 P	680	1,080	230	—	—	—			
							5 P	530	800	200	100,000	100	—			
21	205	12·8	16·2	49	44	2·6	9 A	530	100	200	—	—	—	72°	57°	
							1 P	720	270	510	—	—	—			
							5 P	1020	1,300	4,400	100,000	10	1,000			
23	245	9·6	10.5	48	44	1·2	9 A	550	100	150	1,000,000	100	1	64°	58°	Storm, Gate to tank B opened.
							1 P	620	250	140	—	—	—			
							5 P	—	—	—	—	—	—			
24	252	9·6	10.2	—	—	1·4	9 A	—	—	—	—	—	—	70°	58°	
							1 P	890	170	110	—	—	—			
							5 P	500	160	100	100,000	100	100			
25	245	9·6	10.5	65	56	1.9	9 A	1000	20	40	—	—	—	58°	58°	Rain, night before
							1 P	830	80	70	—	—	—			
							5 P	1000	150	80	1,000,000	100	10			
26	244	9·6	10.6	65	45	1.4	9 A	610	80	50	—	—	—	52°	57°	
							1 P	550	90	40	—	—	—			
							5 P	500	—	100	100,000	10	1			
Ave.	222	10.0	12.1	58	48	1.2		735,306	5909	3362	411,786	182	184	67°	57°	

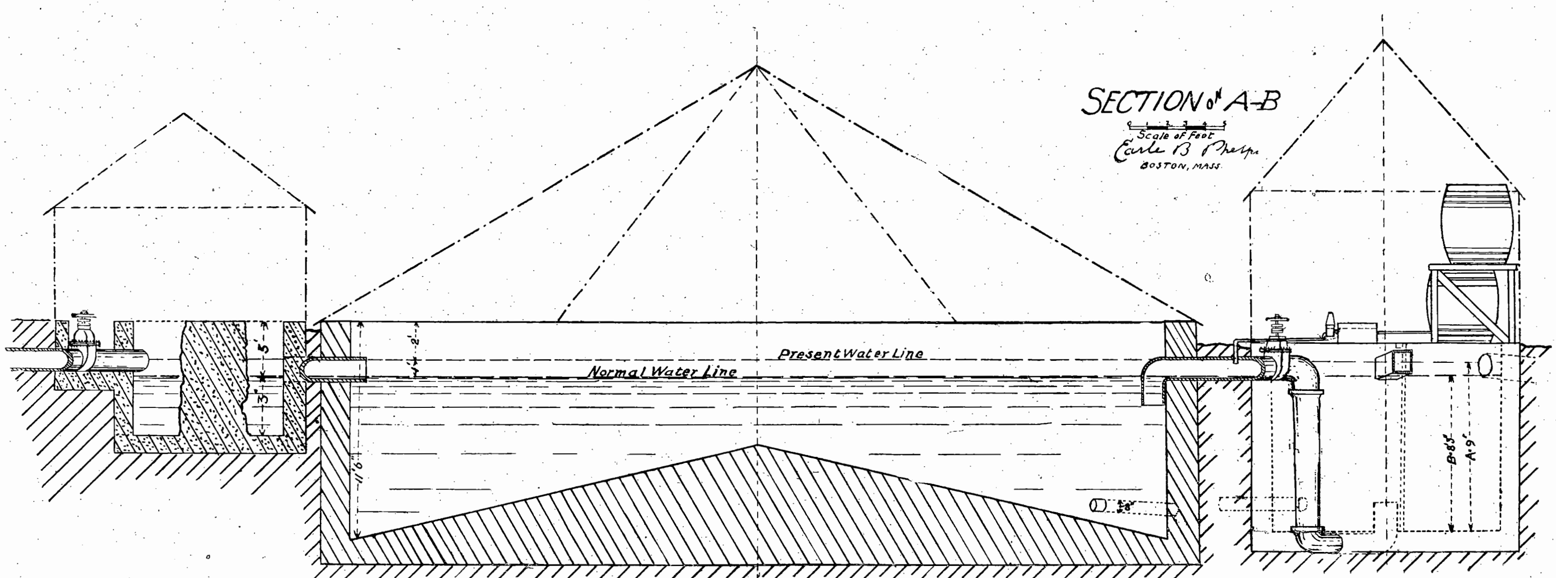
Earle B. Phelps.

DIAGRAM I.

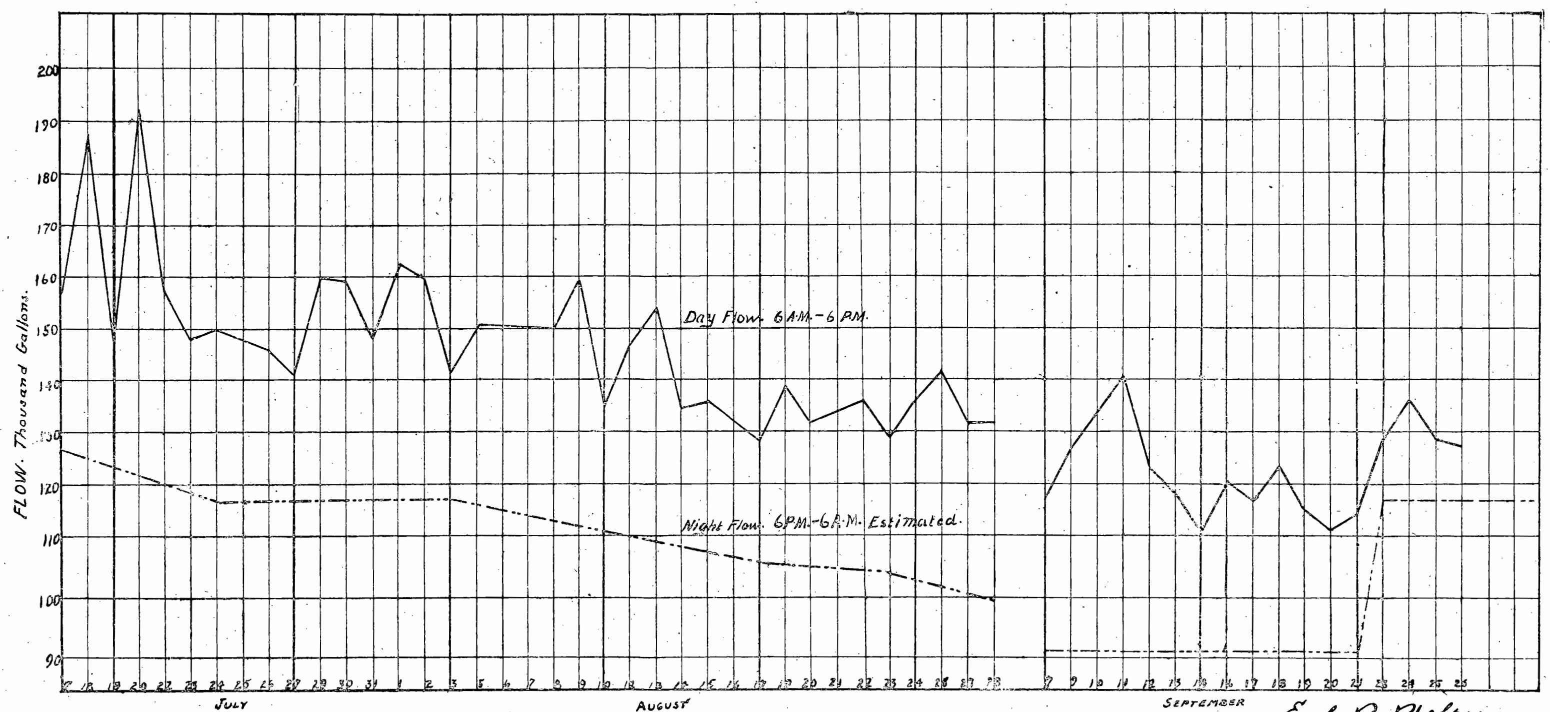


Sewage Disposal Works
AT
RED BANK, N.J.
Earle B. Phelps.
BOSTON, MASS.
Sludge Pipe to river.
Outlet
B
Sterilizing Tank
Baffle
Septic Tank
Detritus Tanks
8'
1'
5'
A
B
R=21' 6"
C
Former Outlet Closed
A
Sterilizing Tank
R=6'
PLAN.
Scale of feet
Superstructure thus
Course of Sewage thus

DIAGRAM II.


SECTION ON A-B
Scale of Feet
Earle B. Phelps
BOSTON, MASS.
Present Water Line
Normal Water Line
2'
5'
3'
11'6"
8"
B-8'5"
A-9'

NEW JERSEY STATE SEWERAGE COMMISSION. DIAGRAM III.
Disinfection Experiments, Red Bank, N. J.
Daily Flow of Sewage.



Earle B. Phelps
BOSTON, MASS.

Consequently some remedy must be applied which obviates the uncertainty of the flush by storms.

Unnecessary Deposits.—The sewers are not the only cause of the unsightly and unsanitary condition of the river, but adjoining owners are very largely to blame, as they utilize the river as a place for the disposal of refuse that the scavenger is not required to remove, and also some waste material that should be removed by him.

During the course of my investigation I had the various articles which were in the river noted and the following is a partial list: Two baby carriages, one mattress, about 400 feet of stove-pipe, innumerable tin cans and bottles, wire, and dead domestic animals.

This practice can not be too severely condemned, and if it is possible or legal, persons who wilfully cause such articles to be thrown in the river should be apprehended and heavily fined as a warning against a further continuance of this intolerable practice.

Retarding the Flow—These obstacles cause a retardation of the flow of water and consequently a larger deposit of the heavier parts of the sewage, while a swifter flow would carry the suspended solids further down the stream. In some localities the velocity of flow was only about six inches per second, and the greatest velocity about two feet per second at low water. Could the stream be regulated so as to give a two-foot velocity, some of the objectionable matter would be removed, but not enough to afford radical relief. This is due to two causes; insufficient water flowing in the river and the backing of the tide, which often reaches the West Grand street bridge. These obstacles which I have enumerated are two of the causes that depreciate the velocity of flow, and another cause can be found in the uneven bed, caused by boulders and sand deposits. The impediments to storm water flow will be taken up under the proper head.

Remedy.—The remedy for this foul condition is a serious problem, and requires radical measures and a large outlay of money to obtain the desired results. First and foremost, the sewage must be removed from the river along its entire course, except possibly some very small pipes which can cause no perceptible pollution; and second, all objectionable matter must be removed from the bed and sides of the stream to a safe distance; otherwise if another freshet should come, possibly most of it would again be carried back to the river. The bed of the river should be brought to a regular grade, though the latter, as a sanitary measure, is not absolutely necessary as long as the objectionable matter is removed, and no more placed therein, but while performing one operation it would add very little to the cost to properly grade it.

Dredging or cleaning the river without removing the sewers would be of no avail as a permanent remedy, and would mean a large expenditure of money for temporary relief; and to keep the river in fair condition it would be necessary to clean it year after year.

CAUSES OF FLOOD.

Rainfall.—The drainage area above the Prince street bridge is about twenty-one square miles or thirteen thousand four hundred and forty acres.

Taking the rainfall to be one and one-third inches per hour, the fall on that surface would amount to seventeen thousand, nine hundred and twenty cubic feet of water every second. This amount is not all delivered to the stream, but much of it is taken up by absorption and evaporation; the amount actually reaching the Prince street bridge at the highest level of flood has been calculated by an accepted formula for the run off of streams and is found to be three thousand, four hundred and five cubic feet per second. That amount in the present instance is, in my judgement, too small, as many localities in this drainage area allow of very little absorption. So for the purpose of calculation, that amount has been increased by ten per cent., making it three thousand, seven hundred and forty-five cubic feet per second during the highest stages of the freshet. Taking the Prince street bridge as a basis, as it has the greatest waterway of the highway bridges along the river, it is found that this bridge will just carry such an amount without actually flooding the streets, providing the bridges below did not back up the water.

All of the floods have occured after a prolonged period of rainfall of lesser violence than the one which caused the highest flood and the flood of October, 1903, was no exception to the rule. The record of rainfall being as follows: September 27, 0.56 inches, October 3, 0.46 inches, October 5, 0.04 inches, October 8, 2.65 inches, and October 9, 5.65 inches. The storms preceding October 9th thoroughly saturated the ground so that most of the precipitation of that day found its way to the river, the highest water appearing in the city about four and a half hours after the heaviest fall.

Clearing of Wooded Area.—If the section of country in this drainage area had not been denuded of trees the period of time between the shower and highest water would have been lengthened and the heighth to which the water would rise would have been consequently lowered. The denuding of any drainage area of its forests causes the water to reach the streams more rapidly and in greater volume; thus the streams are more heavily gorged at the present time than in years past. This latter statement is a fact not only in theory, but is an actual condition if we can believe the evidence acquired from our oldest residents.

Bridges.—The bridges along the river in every case act as dams and cause a rise in the river on the up-stream side of about one foot over the down-stream side. Any such indication is an infallible sign of congested waterway.

Contraction of Storage Capacity.—Filling in the low lands along the river has left much less ground for the water to spread upon, which otherwise would have a regulative effect on the flood. While this is not a very large quantity in the case of our river, it still has some influence.

Near Broad street, both east and west of the bridge, large tracts of land have been filled from building excavations and the stream contracted thereby, The P. R. R. freight yard is another locality where this condition prevails; also part of the river between Westfield avenue and Morris avenue.

REGULATING THE FLOOD.

A complete plan for regulating floods should contemplate straightening, widening and deepening the river from the sound to Bridge street, which would make it of more avail for commercial purposes, and at the same time relieve the flood. In some locations the present lines of the river would have to be abandoned and a new course made, while in other places widening only would be necessary.

These operations indicated under the head of Flood Situation would cause some relief from the stench arising from the sewage, as it would be kept in motion in the centre of the river, which would allow of no time for putrefaction, but between Bridge street and Broad street no relief would be noticed as this reach of the river seems to be the meeting place of the tidal flow and the flow from the drainage area above, making practically stagnant water on an incoming tide, which allows the suspended sewage to deposit. No detail plans were made for the purpose of straightening, widening and deepening the river, but enough surveys were made to give a general idea of the necessities of the situation.

BEAUTIFYING THE RIVER

A plan for beautifying the river above Broad street has been suggested, namely that of building a dam at South Broad street and making a pond above that point. This plan has a very serious defect. In order to make a presentable pond we would have to construct the dam at least five feet above the present high water, and in times of flood we would have a much worse situation than at present. There is such a small dry weather flow in the stream that we would have stagnant water during the summer months, which would soon become objectionable. There would be the cost of maintenance, which would be slight.

SEWERS.

The elimination of the sewage entering the river, is the only method by which the river can be made sanitary and sightly, and with this end in view I have studied many plans, some of which I rejected without noting in this report, others that are feasible are here noted.

Estimated Population.—In making calculations for these sewers I have estimated the population at a larger figure than will ever locate along the line of the area proposed to be drained, and have allowed fifty gallons of water per capita per day. The estimated population included in this area would be 134,700, and the water calculated to be carried by the sewer, 6,735,000 gallons per day, of which one-half would have to be taken care of in six hours.

I had the flow of the Mill lane sewer roughly gauged by floats and found that the present Monday flow was 253.2 cubic feet per minute. Leakage has also to be provided for, and what that quantity will be, depends largely on the manner in which the proposed sewers are constructed. The sizes given on the various maps and profiles are large enough to take care of the large estimated population, leakage and the first flush of storm water.

Gravity Sewer.—The first plan studied was the ideal economical one of gravity disposal to the sound. To this end I have had exact levels run from the invert of the Westfield avenue or Mill lane sewer to the water front at Elizabeth avenue and Spring street, and from there to the Elizabeth river via Third avenue. The grades for this sewer are very light and it would have to be cleaned very often to keep it free from sediment.

This system would afford only a partial elimination of the nuisance as the grades are such that the sewers in West Grand, West Jersey, Murray streets, Rahway and Washington avenues, South Broad, Niles and Summer streets would still have to enter the river, and the only sewage to be eliminated would be from the Westfield avenue, Broad, Bridge and Reid street districts so that only about one-half of the sewage would be disposed of at the sound front. Another sewer can be built on the south side of the river taking that sewage at an added expense.

Routes.—Four routes for the sewer were considered. 1st, through Union street to Rahway avenue, then through Rahway avenue and Elizabeth avenue to the sound; or through Union street to West Jersey, thence through Jersey street to Reid street, Reid street to Elizabeth avenue and thence to the sound via either Elizabeth avenue or Third avenue. Third avenue being route No. 2. The first route through Elizabeth avenue would cause such great disturbance in the present sewer system that the Jersey street route to Reid street is to be preferred as the cost of each is about the same.

The route down Third avenue is much cheaper, as the excavation is lighter. This route contemplates removal of the present sewer in that street. This removal would not be much of an added expense, as that sewer is to-day in very bad shape, and is the source of great trouble to our sewer department, as it constantly fills with sand which has to be removed at great cost to the city. My levels on this sewer show that the cause of the great amount of sediment arises from the fact that in one place it runs up hill instead of having a steady downward grade. While taking levels on this sewer we had to have about one foot of sand removed before we could reach the bottom to obtain the elevation. In my estimation it is only a short time before we will have to reconstruct this entire sewer.

In view of the contemplated elevation of the tracks of the Long Branch Railroad it seems advisable that if either of these sewers are built, that a larger section should be constructed from the outlet to that railroad crossing, to take care of any drainage that may become necessary on account of such change of grade.

Partial Gravity System.—I have also examined another gravity system which would benefit the portion of the river between South Broad street and Westfield avenue; that is by bringing the sewage of the Mill lane sewer to Bridge street and having it enter the river at that point. (This plan is shown as route 3). This would make an added nuisance at Bridge street, which would extend at least to Broad street. A better plan would be to carry the sewage of the Mill lane, Broad street and Bridge street sewers to South street. (This is shown as route No. 4). The water at South street is deeper and the tide somewhat stronger, so the sewage would not only be carried away more quickly, but would be much more diluted at low water. These are only partial systems and throw the nuisance from one locality to another. I have not considered either of them seriously.

A direct continuation of the main sewer down East Jersey street to the sound would be somewhat cheaper than the Elizabeth avenue route, but the outlet is in such an unfavorable place that a nuisance would be created at that point which would cause much unfavorable comment.

PUMPING SYSTEM.

The second plan studied was for some system of disposal by pumping, and the first plan examined under this head was the original "Collingswood Plan," and the only feature that I have changed is the elimination of the tide gates, which I do by tapping the main sewer at a point above the flood level by building laterals about one block long. This, in my estimation, would pay, as it would decrease the pumping account by keeping all the tide water out of the sewer. By the elimination of these gates a better flow is obtained for storm water, as any obstacle to flow at the outlet might cause backing up in the sewer, and cellars would probably be flooded, thus causing criticism on the design of such an important work as this.

MODIFIED COLLINGSWOOD PLAN.

The next plan is a modification of the preceding plan, and follows the "Collingswood Plan" as far as Bridge street, from thence it runs through Bridge street, Pearl street and Clarkson avenue to Summer street, where the pumping plant would be located, and then to the joint trunk sewer, as shown on the map. This route saves about 2,000 feet of sewer, and would save in the size of the sewer, were I not compelled to go so deep at the Bridge street river crossing. Another advantage is that we cross the river at practically the head of navigation, so that the sewer will not have to be placed as deep as at Summer street, thus saving considerable expense. This sewer is of such depth that another line can be built parallel to the south side of the river, tapping all the sewers that now enter the river on that side, and deliver the sewage to the main trunk at Pearl and Bridge streets. This would save the lateral lines crossing the river at Jersey, Murray, Rahway, avenue, and South Broad street. These lines have to cross the river below low water and under the present bridges. The cost of construction would be nearly as great as the south side lateral and not as efficient.

This plan of the main trunk and south side lateral has its imperfections as all other plans for adapting old systems to new must have. It will require tide gates or very long laterals at South and John streets, but as an offset against that, we take care of the South street sewage west of the river, and also of Norwood Terrace and Montgomery avenue, giving Pearl street sewer facilities which it does not now have. These last sewers being small, were not included in the original Collingswood Plan. Another feature is, that Clarkson avenue from Pearl street to Summer street, will have to be acquired for street and sewer purposes.

I have also examined the route following the "Collingswood Plan" to Broad street and Rahway avenue, and thence down South Broad street to Pearl street, down Pearl and then continuing on the Modified Plan. The cost of this would be about the same as the Modified Plan. If this route were followed, the Bridge street sewer would have to be carried under the river, and the difficult construction under the South Broad street bridge led me to eliminate that route from further consideration.

The Schon system of pumping has been suggested as one to investigate. In our case, where we can get one grade from head of sewer to the pumping plant without any excavation as would be prohibitive, I do not see the necessity of what I may call a subdivision of the pumping units.

We would still need a central pumping station, or compressor station, iron pipe to carry compressed air, and a number of the lifts at various places. The cost of equipment and maintenance would be more than the cost of extra digging, and probably more than the cost of the pumping plant.

If any such subdivision of the sewer is necessary, I would advise independent stations, operated by an automatically controlled electric motor, connected to centrifugal pumps. A large Schon lift might be used instead of pumps at the pumping station.

No plan for the purification of the river by the method of diverting the sewage would be complete unless the sewer sediment now lying on the banks and bed of the river were removed, and whether the river is graded or not, much of the filthy bottom must be taken out to prevent nuisance from ancient sources.

GENERAL REMARKS.

In view of the facts as stated in the foregoing report there does not seem to be any doubt as to which is the best system of sewerage to follow.

Any gravity system would have such small grades that there is great danger of sediment collecting, as the sewers are filled with water during every high tide. The cost of keeping such sewers clean would be a heavy annual expense, though not as much as the maintenance of a pumping plant. They also enter tidal water at points to which property owners might object, and which certainly will not give as good an outlet as the one at the foot of Bayway.

The intercepting sewers with pumping plant as contemplated by Mr. Collingswood and myself have much better grades, yet not as heavy as desirable, and in both cases the utmost care will be demanded in construction to obtain a smooth and perfect sewer in order to avoid any unnecessary friction. The sewage in the intercepting system, with pumping plant, is delivered to one of the best points of disposal that can be found in the vicinity of New York, the tides being such that it is carried directly to the center of the sound and no deposits are made along the banks.

Purification.—In view of the fact that our inland tidal waters are year by year becoming more polluted by sewage, it is my opinion that in a short time municipalities will be confronted with the problem of disposing of sewage in such a manner as to avoid the pollution that now exists, and will continually increase.

Shell fish are being killed, and the water is becoming so vile that all kinds of food fish that are caught in such polluted streams are rendered unfit for table use. Many experts on sewage purification give as their opinion that purification is not necessary when the sewage flows into tidal water and becomes diluted, unless the shell fish and other fishing industries are of such importance as to warrant the added expenditure. I do not claim that at the present or for some time to come that the sound will be in a bad sanitary condition, but eventually it will become unsightly and later unsanitary. Our shell fish industry is small, and is becoming smaller year by year. The catch of food fish has ceased to have value, caused by pollution of the water by sewage and factory waste.

New York City has recognized this condition and has had a bill prepared to present to the New York Legislature to have a commission appointed to investigate the reason why: First, the Hudson River is dirty? Second, Whose fault is it? Third, Can it be helped? Fourth, Why it can or cannot.

New York desires the cleanliness of its rivers the same as do citizens of Elizabeth its waterways, but the scope of the two problems are nearly as widely separated as daylight from dark, yet fundamentally they are the same, we both desire to be clean.

In the sewers along the Ocean Front the various municipalities have recognized the fact that outlets must be at a great distance from the shore or the floating matter will soon come back to the beach under wind and tidal action. In view of the knowledge of scientific principles acquired by modern research in the matter of scientific sewerage disposal, can the City of Elizabeth stand in the background and continue to pollute her tidal water? Or should we be one of those progressive municipalities to take advantage of the advance of sanitary science and apply to the disposal of our sewage such methods as have been proven to purify it, and put it back in our streams in such a condition of purity that it would not be objectionable either from a sanitary or aesthetic standpoint? We have near the Summer street bridge an ideal location for such disposal, and the land required can be purchased cheaper now than in the future. To install this system would cost much more than either the gravity or pumping system to the shore front. Either the Collingswood Plan or the Modified Plan is the first step towards this system of disposal. Beds for purification can be placed between Clarkson avenue and Brunswick avenue, on the sloping ground, so that if double purification were desired the contents of one bed would flow naturally to the one below, and from thence to the river in its purified state.

The intercepting sewer with a pumping plant somewhere in the vicinity of Summer street, with purification beds (the kind to be decided upon when necessary), stands first in my opinion as the ideal method of disposal. If we desire to be sanitary, let us be so entirely and not shift any of the burden from one locality to another. For the present the Disposal at Bayway will not be a nuisance, but as sewer after sewer is placed in the sound waters, the nuisance will come. By acquiring land for the purpose of purifying the sewage we take a step that in the future may be of inestimable benefit to the City of Elizabeth.

The cost of the purification plant would probably be $100,000 or over, exclusive of land.

We have seen our present system become a menace to health during the thirty years it has been in operation. In another thirty years with a more rapid advance than in the past why will not similar conditions be created in the larger stream? And when that time comes the Boards of Health, both State and Municipal, will demand a change and the same proposition we are now figuring on will have to be gone over again.

Some years ago a plan was formulated to drain the towns along the Passaic Valley in a manner very similar to the plan outlined in this report, but of course on a much larger scale. The sewage in this case was to be brought to the City of Newark by gravity and from there pumped across Newark Bay and the City of Bayonne to New York Bay. A commission was at once appointed by the New York State Legislature of 1903 to examine the plan and report on it. Their report was adverse, on the ground that it would pollute the waters of New York Bay to a greater extent than was deemed prudent. The estimated population draining into New York Bay and tributaries from Yonkers down, according to that report, is 4,550,000, and the estimated sewage from that district is 445,000,000 gallons per 24 hours. This report is accompanied by a map which shows all the sewer outlets and the shell fish beds which are liable to pollution, and also shows by chemical and bacteriological tests that the water of New York Bay is at present polluted and that shell fish show evidence of pollution.

The shad fisheries of the Hudson or North River are showing signs of deterioration, and while years ago the North River shad were held in the highest esteem, they are not now regarded with much favor, simply because of the pollution of the water. The wiping out of these two industries means a great financial loss.

The City of Paterson has within the past few months engaged an expert, Mr. Allan Hazen, to study a plan for purifying Paterson's sewage, which will make Paterson independent of the other municipalities along the Passaic river in their plan of drainage by intercepting sewers.

The Ontario Board of Health has just approved of plans for septic sewage disposal for use in Toronto, another large city that is now draining into one of our Great Lakes.

I quote these articles and reports to show that the tendencies of the time are towards purification before turning sewage into streams.

If we continue to discharge sewage into the rivers and bays tributary to New York Harbor we may expect in the course of twenty-five or thirty years to find that the shell fish industry has been vastly impaired, that the fisheries have been destroyed, that the bay will be unsightly and that the bathing beaches around New York will be rendered unfit for bathing purposes. In view of these facts do not let us throw our burden in our neighbors, but put ourselves in position to be able to purify our own sewage when the proper time arrives.

The second plan in point of excellence is the intercepting sewer with pumping plant near Summer street, with disposal through the sewer of the Joint Municipalities to the foot of Bayway, and the Modified Collingswood plan with the south side lateral is the most suitable.

This system disposes of sewage from a district as large as the Collingswood plan, takes all the south side drainage, saves in length—consequently in money, and lends itself to a method of purification at a later period.

The "Collingswood Plan" is excellent and is only slightly different from the Modified Plan, and its action and results would be the same, but the cost is slightly greater. It would disturb more paved streets, and have a greater distance to its outlet. The south side lateral can be connected to it at Bridge street.

The Gravity interceptor by great care in construction and almost constant supervision, will do the work for the limited area which I have before mentioned, and that in my opinion it is not sufficient to warrant tthe expenditure of money which would be required. In the near future a sewer will have to be built on the south side for the same purpose.

This south side can be built at present and taken to the Summer street sewer, where the volume of water in the river would make it of very small nuisance. It will be a very easy matter to construct it to this point, and it can be included in a gravity system with the sewer on the north side.

Should the city desire to spend money to entirely reconstruct the whole sewer system of the city, I do not doubt that one could be built that would need no pumping plant, but the expense would be so enormous that I have not made figures on any such plan.

A dam placed at Broad street and allowed to fill between tides, would be a partial solution of the problem; the unsightly river bottom would be covered nearly all the time but with water that in the summer would be about one-third sewage, which would be very unsightly, but which would probably be the means of killing the smell which now arises from the foul bed. It would be stagnant water during the time of filling, which would allow the heavier particles of sewage to settle. The flush when emptying the river above the dam would not be sufficient to dislodge the heavy solids, so at the end of the flush we would still have an unsightly stream, and while full the appearance, instead of being clear, would have that milky, greasy appearance so noticeable around the sewer openings.

I cannot close without saying that the efficiency of our present sewer system could be much improved by a larger appropriation.

Simply because a sewer is underground and out of sight leads one to forget there is such a structure, until stoppage or breakage occurs. The amount of money invested in sewers in this city is too large to jeopardize by an appropriation for cleaning and maintenance of only $4,000 per annum. Regular inspections are necessary so that small imperfections may be cured before they develop into larger evils.

COST OF VARIOUS PLANS.

GRAVITY SYSTEM TO FOOT OF ELIZABETH AVENUE.

Removing small obstacles and grading river	$12,000 00
Gravity sewer to foot of Elizabeth Avenue	133,840 06
	$145,840 00

THIRD AVENUE TO RIVER.

Removing small obstables and grading river	$12,000 00
Gravity sewer to foot of Third avenue	109,125 80
	$121,125 80
Same sewer carried through Butler street to Elizabeth avenue	11,224 00
	$132,349 80

PUMPING SYSTEM.

COLLINGSWOOD PLAN.

Removing small obstacles and grading river	$12,000 00
Sewer, including pumping plant, to Summer street	115,767 42
	$127,767 42
From Summer street to Joint trunk sewer	21,877 01
	$149,644 43
Cost of land for street openings	

MODIFIED COLLINGSWOOD PLAN.

Removing small obstacles and grading river	$12,000 00
Sewer, including pumping plant, to Summer street	95,043 37
Sewer South side	11,486 20
	$118,529 57
From Summer street to Joint Trunk Sewer	21,877 01
	$140,406 58
Cost of land for street openings	

GRAVITY SYSTEM.

Removing small obstacles and grading river	$12,000 00
Gravity system to Bridge street	29,900 00
South side system to Bridge street	11,486 20
	$53,386 20

GRAVITY SYSTEM TO SOUTH STREET

Removing small obstacles and grading river	$12,000 00
Sewer	41,400 00
South side sewer to Bridge street	11,486 20
From Bridge street to Summer street	21,993 95
	$86,880 15

The annual cost for maintaining the pumping plant is estimated to be $6,000.00.

An advance in the cost of material and labor may raise the prices in the future. I have calculated everything on the basis of prices of about February 1, 1906, and am confident that my figures are not much different from what contractors would make, though as a protection to themselves against possible loss, they may add a greater percentage than I have allowed. In the absence of borings, the rock excavation is simply an assumption, based on my observations of street openings in and around the locality of these proposed sewers, and the amount I used in my calculation may be increased largely.

Respectfully submitted,

W. H. LUSTER, JR.,

City Surveyor.

FORT LEE.

At a meeting of the Commission held July 18, 1907, plans for a combined sewerage system for the Borough of Fort Lee, to discharge into the Hudson River, were submitted to the Commission by C. H. Eckerson, Borough Engineer, and Alexander Potter, Consulting Engineer, who appeared before the Commission and explained the plans.

At the same meeting, Messrs. Capstick, Herbert and Jacobson were appointed a committee for the purpose of visiting the Borough of Fort Lee and inspecting the nature of the ground and the proposed place of discharge of the sewage of that borough.

At a meeting of the Commission held July 25, 1907, Commissioner Capstick reported that the committee had visited the Borough of Fort Lee on July 24, 1907, and would report its conclusion to the Commission at a later meeting.

At a meeting of the Commission held August 15, 1907, this committee reported that it had inspected the proposed place of discharge of the sewerage system of the Borough of Fort Lee and the line of the proposed sewers; that it recommended that the plans submitted on behalf of the Borough be disapproved, and that the Commission suggest to the proper authorities that plans be prepared for a separate system of sewers for that borough, providing for the future installation of a purification plant for the treatment of the sewage.

At the same meeting, the secretary was directed to return the plans submitted on behalf of the Borough of Fort Lee, providing for a combined system of sewers, with direct discharge into the Hudson River, without the approval of the Commission, and to suggest that plans be prepared by the borough providing for separate systems of sewers for house drainage and storm water, and that provision be made for the future installation of a purification plant for the treatment of the sewage.

At a meeting of the Commission held September 5, 1907, plans for a system of separate sewers for the Borough of Fort Lee, to discharge into the Hudson River, with provision for future purification, were submitted to the Commission by Charles H. Eckerson, Borough Engineer. At the same meeting, the plans submitted on behalf of the Borough of Fort Lee, providing for a sewerage system for house drainage only, to discharge into the Hudson River, with provision for the future installation of a sewage purification plant, were approved, subject to such conditions of construction, operation and purification as this Commission might from time to time require.

At a meeting of the Commission held October 24, 1907, William M. Seufert, Borough Counsel of Fort Lee, consulted with the Commission in relation to granting permission for the temporary discharge of roof and cellar drainage into the system of sewers for the Borough of Fort Lee, plans for which had been approved by the Commission.

At a meeting of the Commission held October 31, 1907, a communication was received from William M. Seufert, requesting on behalf of the Mayor and Council of the Borough of Fort Lee that permission be granted for the connection of roof and cellar drainage with the proposed sewerage system of that borough, the plans of which had been approved by the Commission, with the provision that such drainage would be discontinued when required by the Commission.

At the same meeting, the following resolution was adopted:

"*Resolved,* That the State Sewerage Commission grants the request made on behalf of the Mayor and Council of the Borough of Fort Lee for permission to discharge roof and cellar drainage into the proposed sanitary sewers of that borough, the plans of which had been approved by this Commission on September 6, 1907; provided that such connections shall be discontinued when required by this Commission."

Gas Wastes.

Gas Wastes.

At a meeting of the Commission held August 8, 1907, Messrs. Jacobson and Herbert were appointed a committee to investigate the pollution of streams caused by factory wastes. Owing to questions arising in the work of the Commission concerning pollution caused by the wastes produced in the manufacture of gas, it was determined to make a special study of this subject, especially as there was little available data in relation to it. The engineering firm of Hazen & Whipple were consulted in relation to this matter, and the following report on the subject was prepared by George C. Whipple, C. E.:

New York, N. Y., Dec. 21, 1907.

To the Honorable the State Sewerage Commission of New Jersey:

Gentlemen—In accordance with your request I have prepared a brief report on the problem of the disposal of the waste products from gas works, and the same is herewith respectfully presented. On account of the short time allowed for the preparation of this report it has not been feasible to discuss any of the particular gas works problems in the State of New Jersey, but it is believed that it will not be found difficult to apply the general principles set forth to any particular case.

The problem of gas works wastes is an important one, and one which has never yet received adequate consideration. The scientific knowledge of the subject is quite limited. The expenditure of a comparatively small amount of money for a more complete investigation would yield important results. When one considers the amount of money that might be saved by recovering the waste products and the damage that is done by allowing these wastes to flow into streams there is reason to believe that some properly directed experimental researches would be valuable alike to gas manufacturers, to riparian owners, and hence to the State.

Notwithstanding that the scientific knowledge on the subject is limited, it has been practically demonstrated that the methods of treating gas works wastes in order to prevent the objectionable effects of pollution, are fairly simple and effective.

Yours respectfully,

GEORGE C. WHIPPLE.

THE DISPOSAL OF GAS WORKS WASTES.

The manufacture of illuminating gas is an industry in which there are certain inherent nuisances. Gas is made essentially from coal or oil and the process consists of breaking up the complicated hydrocarbons and forming others, collecting for distribution the gases which have heating and illuminating properties, utilizing various by-products, and wasting whatever it is not profitable or convenient to recover. Some of the products which result from the distillation of the coal and from the splitting up of the gas oil are intensely disagreeable on account of their odor, and the atmosphere in and around a gas works is notoriously unpleasant. Among the waste products some are liquid, or semi-liquid, and have to be discharged somewhere, and if the works are located near a body of water they are likely to be dicharged into it. This method of disposal may be a proper one if the body of water is large enough and if there are no riparian owners to be inconvenienced, but the disposal of such waste liquors into streams often results in serious nuisances and these have been the cause of complaint in many a New Jersey town. It is for this reason that it has been deemed worth while to set forth in a brief way the principal factors involved in this phase of the subject of stream pollution and to point out what can be done to ameliorate the conditions attendant upon the disposal of the liquid wastes from the manufacture of illuminating gas. The logical order of taking up this question will be to consider first the nature of the process of gas manufacture, and then the amount and character of the resulting wastes, the nature of the nuisances to which they give rise, and methods of treating the wastes so as to avoid these nuisances.

THE MANUFACTURE OF GAS.

There are two kinds of gas used in Ney Jersey for illuminating purposes, coal gas and water gas, these names being taken from their process of manufacture. Coal gas has been used for a century; houses were lighted in London in 1792, and streets were lighted with gas in 1812. Water gas has been in common use only about twenty years, but during that time it has very largely superseded the manufacture of coal gas. At first its use met with great opposition on the ground of danger to health. It contains a much higher percentage of carbonic oxide (CO) than coal gas. This is poisonous, and as water gas has less odor than coal gas its escape into a room is less likely to be detected and more serious consequences are likely to result than with coal gas. But water gas can be made cheaper than coal gas and its candle power can be made higher; so that after legislation permitted the use of water gas its manufacture steadily increased, until to-day the process is much more largely used than the old method of coal distillation. It is said that three-quarters of the gas now used in American cities is water gas, coal gas being used chiefly in older and smaller works, or used to mix with water gas in the larger plants. As the waste products are different for the two methods, it will be necessary to consider them separately.

Coal Gas.

Coal gas is derived from the destructive distillation of bituminous coal. Years of practice have improved the processes and cheapened the cost of production, but the essential features of manufacture have always been the heating of the coal in closed retorts and the subsequent cooling and purification of the evolved gases. The latter involves the removal of such impurities as tar, ammonia, carbon dioxide, hydrogen sulphide, carbon bisulphide, etc. The most desirable coal for this use is one which is rather low in sulphur and which cakes to a good coke. In this country the Pennsylvania gas coals fill these qualifications well, yielding a large amount of gas of good quality. The cannel coals of Great Britain, which are non-coking also yield a large amount of gas of very high illuminating power.

Distillation.

For the distillation of the coal fire-clay retorts are used, which are long and approximately semi-circular in cross-section. They hold 200 or 300 pounds of coal each and have a length of 8 or 10 feet, a width of 18 inches and a height of 15 inches. They are generally arranged eight or ten in a furnace, the whole constituting a *"bench,"* which is heated from beneath by means of a coke fire or by a generator gas to a temperature of 1,000° to 1,200° C. Too high temperatures have to be guarded against as they increase the yield of non-illuminants and tar, decompose some of the heavy hydrocarbons with deposition of carbon which chokes up the apparatus and causes loss of heat, and increase the yield of benzene, napthalene and compounds which may cause clogging in the service pipes and burners. The retorts are charged either by hand or mechanically and require from 4 to 6 hours' heating to expel the volatile substances. Among these volatile substances will be found the hydrocarbons desired in the gas itself, tar, a very complex organic product, water, ammonia, carbon dioxide, carbon monoxide, hydrogen sulphide, and carbon bisulphide.

Hydraulic Main.

The vapors from each retort are collected in a 6-inch standpipe, which conveys them to a long iron box half filled with tar and liquor, which forms a seal over the end of the pipe. This box is known as the "hydraulic main," and extends over the entire "stack" or series of "benches." It serves to collect the products of a great many retorts into one conveyor, cools and consequently liquefies some of the more easily condensable substances, and by acting as a water-seal prevents any gas from rushing back through the "standpipe" when the charge is withdrawn from the retort. The greater part of the tar is condensed in this "main" and the salts of ammonia are also removed as the gas bubbles through the liquor.

Condensers.

Leaving the hydraulic main the gases pass to the condensers, a series of iron pipes arranged either horizontally or vertically and presenting enough surface to the air to allow of the cooling of the gas to the temperature of the atmosphere. These pipes are connected at the top, and at the bottom open into an iron box partially filled with ammoniacal liquor from the "hydraulic main." The box is divided into sections by means of plates dipping below the liquid in such a way that the gas is forced to traverse each pipe. During this course more tar, water, vapor, etc., are condensed and drain into the box below, from which they flow to the tar well. Here the tar and liquor separate by virtue of their different specific gravities; or they may be previously separated and stored in individual cisterns. There are several varieties of condensers in use, some of which employ water for cooling, but in the latter the temperature is not allowed to go below that of the atmosphere because of the condensation and loss of some of the illuminants.

Exhauster.

In order to draw the gas quickly from the retorts, thereby preventing any accumulation of pressure and consequent decomposition of the gas, an exhauster is used, which serves this purpose, and forces the gas on through the washing apparatus. It is placed immediately after the condensers. Several forms are in common use.

Tar Extractor.

From the exhauster the gas is forced into a tar extractor, one form of which contains numerous iron plates with small perforations in a short tower, through which the gas passes and by which the tar is removed mechanically.

With the tar removed and the temperature reduced to that of the atmosphere the removal of those impurities which cannot be condensed has to be considered. These consist of ammonia, carbon dioxide, carbon bisulphide and hydrogen sulphide.

Scrubbers and Washers.

The ammonia must first be removed and this is accomplished by means of scrubbers and washers, some carbon dioxide and hydrogen sulphide being removed at the same time. The tower scrubber used in older plants consisted of a cast-iron tower built up in segments, and having gratings upon which rested coke, boards, pebbles or other coarse material. The gas passed up the tower and came in contact with thin layers of ammoniacal liquor from the "hydraulic main" or condensers. A second tower fed with fresh water was also used to remove the last traces of ammonia. Modern practice, especially in this country, is making use of the "scrubber-washer machine," which is a tank partially filled with liquor and having a revolving central shaft, to which are attached thin wooden or metal discs, bolted together with narrow openings between them. The box is divided into narrow chambers so that the gas must enter at the centre and find its way out to the circumference of the grids by means of these openings. As these grids are constantly revolving and dipping into the liquor at the bottom the gas is brought into contact with fresh solution. Liquor from the hydraulic main and from the condensers may be used for this purpose until more highly concentrated. Two or more washers are generally used in series, the last one, through which the gas passes, containing clean water.

Purifier.

Washed free from all but traces of ammonia the gas passes to the purifiers, which are shallow iron boxes with false bottoms. It enters at the bottom and leaves by a pipe opening at the top. The object of the purifiers is to remove more particularly the sulphur compounds, sulphuretted hydrogen (H_2S) and carbon bisulphide (CS_2) and generally the carbonic acid (CO_2). Lime was the oldest material used for this purpose, but because of its bulk and foul odor after use, it was found difficult to dispose of. Consequently hydrated ferric oxide in the form of a bog iron ore, or precipitated oxide, has come into use along with the lime. This removes the hydrogen sulphide (H_2S) according to the following reactions:

$$Fe_2O_3.H_2O+3H_2S=Fe_2S_3+4H_2O$$
$$Fe_2O_3.H_2O+3H_2S=2FeS+S+4H_2O$$

When the oxide becomes inactive it can be "revivified" by spreading out in the open air where the sulphides are oxidized with considerable evolution of heat in the following manner:

$$2FeS+3O=Fe_2O_3+2S$$
$$Fe_2S_3+3O=Fe_2O_3+3S$$

The oxide can thus be used a number of times, or until the sulphur content approaches 55 per cent when it is sold to sulphuric acid manufacturers or otherwise disposed of. From the reactions given above it can be seen that carbon dioxide and carbon bisulphide are not removed by iron oxide alone. Slaked lime will remove these impurities after the following reactions:

(1) $Ca(OH)_2+CO_2=CaCO_3+H_2O$
(2) $Ca(OH)_2+2H_2S=Ca(SH)_2+2H_2O$
(3) $Ca(OH)_2+H_2S=CaS+2H_2O$
(4) $CaS+CS_2=CaCS_3$

Carbon dioxide, however, decomposes the sulphur compounds of calcium thus:

$$CaS+CO_2+H_2O=CaCO_3+H_2S$$
$$CaCS_3+CO_2+H_2O=CaCO_3+CS_2+H_2S$$

Consequently there must be sufficient lime to care for the CS_2 and H_2S which is released and carried along. One method of arranging the purifiers to do this is to have them connected in three or four couples, the first removing CO_2 by means of slaked lime, the second removing H_2S by means of iron oxide, the third removing CS_2 by means of Ca $(SH)_2$ (calcium sulphydrate) prepared according to reaction (2), and the fourth caring for any traces of H_2S by means of slaked lime.

Any cyanogen compounds not removed by the gas liquors are taken out in the purifiers as sulphocyanogen or ferrocyangen.

Constituents.

Upon leaving the purifiers the gas contains only traces of impurities such as have been removed. The quantities of these which may be present are often regulated by law.

The principal constituents are hydrogen, methane, carbon monoxide, nitrogen, and many other hydrocarbons. The following may be taken as a typical analysis:

Hydrogen	49.0 per cent.
Methane, (marsh gas)	34.5 per cent.
Carbon monoxide	7.2 per cent.
Illuminants	5.0 per cent.
Nitrogen	3.2 per cent.
Carbonic acid gas	1.1 per cent.
	100.0 per cent.
Candle power	17.5 per cent.

Measurement.

The purification being completed the gas is measured in the station meters. This provides a means of watching the production and detecting any defects in the management of the retorts. One ton of good gas coal will yield approximately 10,000 cubic feet of 16 candle-power gas.

Storage.

For storage large iron tanks are provided, which hold from a few hundred thousand to several million cubic feet of gas. They are telescopic in their action and can be regulated to furnish the pressure desired for delivering to the service pipes. They have a water seal at the bottom.

Water Gas.

The production of this gas on a large scale is the accomplishment of rather recent years, although its manufacture has been known since early in the last century. Primarily it is a mixture of nearly equal parts of hydrogen and carbon monoxide with small amounts of carbon dioxide and nitrogen; but as supplied for illuminating purposes it contains various gaseous hydrocarbons necessary to give it illuminating power. These hydrocarbons also serve to impart an odor to the gas, making its detection possible in case of leakage. Pure water gas has very little odor, and is exceedingly poisonous owing to the high percentage of carbon monoxide. For this reason there was a great deal of prejudice against it when first used for domestic purposes. Below is given a typical volumetric analysis of a sample of purified water gas which has been enriched with petroleum products:

Hydrogen	31.4
Carbon monoxide	28.0
Methane	20.2
Heavy hydrocarbons	12.6

Nitrogen	3.2
Carbon dioxide	3.0
Hydrocarbon vapors	1.2
Oxygen	.4
	100.0
Candle power	25.0

Manufacture.

Water gas is made by passing steam over heated coke or anthracite coal, when the following reactions take place:

$$C+2H_2O=CO_2+2H_2$$
$$C+CO_2=2CO$$

The expenditure of 60 pounds of carbon in this way gives about 1,000 cubic feet of gas, or about 34,000 cubic feet per ton of coal. From 4 to 5 gallons of oil are used for every 1,000 cubic feet to give the desired luminosity, between 5 and 6 candle power being obtained from each gallon of oil used. This step is known as "carburetting" and three classes of oils are employed for the purpose, crude petroleum, naptha and gas oil. The latter is most often used in New Jersey. It is a refuse oil which contains those constituents of petroleum which cannot be utilized for any other purpose. It embraces a large number of distillates from the petroleum which comes over at a temperature between that of the light illuminating varieties and the heavy lubricating oils. Its specific gravity runs from 1.25 to 1.3. "Texas Oil" is a kind of gas oil commonly used in New Jersey.

Methods of Manufacture.

There are two general methods in practice for the manufacture of water gas for illuminating purposes. (1) The Lowe process and (2) the Williamson process. In the former the carburetted gas is prepared in one operation, in the latter the gas from the generators is first stored in a holder and afterward run into the carburettor and superheater for enrichment.

Description of Generators.

In both these processes about the same form of generator is used. It consists of a circular steel sheet, the height of which approximates one and one-half times its diameter, and lined with fire-brick. It has grate bars at the bottom with doors for the removal of ashes, and at the top doors for charging with fuel. This is done on the second floor of the building where the coal is stored. There is also connections for the escape of gas and for the proper supply of steam and air. The fuel is fired and blown by an air blast until incandescent, the product of combustion, known as producer gas, being carried by a pipe from the top of the generator.

Description of Lowe Process.

The Lowe apparatus is the form most generally employed in water gas manufacture, and produces the carburetted gas in one operation. The hot generator gases are conducted to the top of a circular chamber, lined with fire brick, and containing a "checker-work" of the same material. This is known as the "carburettor." Meeting a blast of air at this point the producer gas is carried downward and partially burned, raising the temperature of the checkerwork. Passing on the gases enter at the bottom of the "superheater" another chamber containing checkerwork. A second air-blast here completes the combustion and the waste gases escape through a hood to the open air. When the checkerwork of the carburetor and superheater have reached a very bright red heat the air blasts are cut off, and steam at a very high temperature enters either at the bottom or top of the coal. Some plants are so arranged that the steam passes in alternate blows from top to bottom and from bottom to top of the fuel bed. Coming in contact with the white hot fuel the steam is decomposed with the formation of carbon monoxide and hydrogen, according to the reactions already given. These gases pass to the carburettor into which is being introduced by means of a pipe at the top the oil used for enrichment. The high temperature of the brick checkerwork decomposes, or "cracks," the oil into various illuminating gases, which mix with the water gas from the generators and pass to the superheater, where they are "fixed" as non-condensable compounds. Upon leaving the superheater the gases pass through a "seal-pot" containing water. This water seal prevents a back rush of gas into the generators and also serves to condense a large portion of the tarry matters present in the hot gases. Before entering the purifying apparatus the gas is passed into a relief holder or gas storage tank.

Renewal of Temperature.

When the temperature of the generator has fallen below that at which decomposition takes place the steam is cut off and the air blasts again turned on until the fuel reaches a temperature around 1100 degrees C., and the carburettor and superheater are likewise hot enough to perform their function. Eight minutes is an average length of time for running the air blast, and six minutes for the steam.

Modified Lowe Apparatus.

A very modern type or modification of the Lowe apparatus consists of a single shell in which are the generator and above it the carburetor and superheater arranged side by side. The arrangement economizes in both space and heat.

Williamson Process.

In this method of preparing water gas the product from the generator is stored in a holder after which a measured quantity is introduced into the carburettor, which is a closed iron box with a steam jacket and coils for maintaining the desired temperature. The oil is allowed to flow over inclined iron plates, the exact amount necessary being allowed to enter. The mixed oil and water gas passes into the superheater, which is heated from without. It is a fire clay retort and is kept at a white heat at which temperature the hydrocarbons are broken down and "fixed" as non-condensable gases. The enriched gas is then passed to the purifying apparatus.

Purification.

The impurities found in water gas do not require for their removal the treatment necessary in the case of coal gas, as they are less numerous and occur in smaller amounts. The condensation of tar in the seal pots has already been mentioned. Further quantities of this substance are taken out by the condensers, and in fact separated from the gas continually during purification. No ammonia is produced. Carbon dioxide is not ordinarily removed, but may be by use of lime. Hydrogen sulphide is absorbed by layers of iron oxide just as in the case of coal gas. This substance is produced from the sulphur in the coal and sometimes from that in the oil. Before passing the gas from the condensers to the iron oxide purifiers, a shaving scrubber is sometimes interposed. This is a tank containing several shelves over which are spread layers of wood shavings. Its action is mechanical and affords opportunity for the condensation of tarry substances, thus preventing the early clogging of the iron oxide.

Storage.

The purified gas is stored in large telescopic holders built of steel and arranged so as to allow of pressure regulation. Before entering the service mains the large delivery main sometimes passes through a reservoir of cool water which reduces the temperature of the gas and consequently lessens the amount of condensation products in the service pipes.

NATURE AND AMOUNT OF WASTE PRODUCTS

The waste products from the manufacture of gas consist of solids, semi-liquids, liquids and gases, but of these only the liquids and semi-liquids are important from the standpoint of water pollution. The others will, therefore, be considered only incidentally. Although referred to as waste products these are not to be considered as without value. Some of the products are of great value, and in fact, may be of even greater worth than that of the gas itself.

Solid Wastes.

The principal solid waste is coke. Good gas coals yield from 60 to 70 per cent. of coke. It is utilized as fuel for heating the retorts, or is sold for domestic use.

Among the solid wastes must also be reckoned the spent lime in the form of carbonate or sulphide of calcium, provided that lime has been used, and the iron oxide which has been converted into FeS and Fe_2S_3 and subsequently oxidized in part to ferric oxide and sulphur. The spent lime can be reburnt to caustic lime and used again, after slaking, for the absorption of CO_2 and CS_2. It is sometimes disposed of by dumping, but this is objectionable as it is liable to create a nuisance on account of the odor. The iron oxide of water gas plants has little or no practical value and is easily disposed of by dumping in some out of the way place. In coal gas plants, however, where the amount of sulphur after repeated revivification sometimes reaches 50 per cent. or more, this material can be sold to sulphuric acid manufacturers. Ammonium salts and tarry matters, however, interfere somewhat with this purpose if they are present in appreciable quantities.

Semi-liquid Wastes.

The semi-liquid waste is tar,—a word used to cover a thick viscous black liquid very complex in composition, and also very variable. In coal gas plants the tar amounts to about 120 or 130 pounds per ton of coal (i. e. 10 or 11 gallons), or to about 6 or 6.5 tons of tar per million cubic feet of gas. In water gas plants the tar amounts to about half as much, or,—say 500 gallons or 3 tons per million cubic feet of gas.

The composition of coal gas tar varies with the temperature of distillation. At a temperature around 800 degrees F. the tar produced is thinner and lighter than water, but around 1700 degrees F. it becomes thick and contains little paraffine and olefiant hydrocarbons. Ordinarily it contains pitch, creosote, anthracene oil and a large number of complex substances. It is said that from it upwards of 600 different useful products are obtained,—coloring matters, antiseptics, solvents, varnishes, timber preservatives, lubricants, fuels and pitch.

Tar from water gas plants has much less value as a source of these various "coal tar products" and is easily burned as fuel under the boilers, or perchance wasted.

Liquid Wastes

The most important liquid waste in the coal gas process is the ammoniacal liquor obtained from the hydraulic main, and the condensers and scrubbers after the tarry matters have been separated by sedimentation. This ammoniacal liquor is of much value. Gas coals contain from 1 per cent. to 2 per cent. of nitrogen, and of this it is possible to recover 12 to 15 per cent. as ammonia. In the liquor it is present partly as free ammonia and partly as carbonate, sulphide, chloride, sulphate, thiosulphate, etc. The liquor as ordinarily stored has a "10 ounce strength," which means that one gallon of liquor will yield ammonia enough to neutralize 10 ounces of sulphuric acid. Such a liquor yields about 2.17 per cent. by weight. As to the amount of this ammoniacal liquor, it is said that one ton of good gas coal will yield about 20 gallons of liquor of 10 ounce strength.

The ammonia in the liquor can be neutralized directly with sulphuric acid, but this gives a salt contaminated with tar. A modern method of recovering ammonia is by the use of a Feldmann machine. In this machine the liquor is led through a series of small pipes in an economizer which is heated by the hot H_2S and CO_2 gases given off in the absorption apparatus. The hot liquor enters the top of a tower where, as it runs over a series of trays, it meets with steam, which drives out the free ammonia and other gases. These are led into a vessel containing sulphuric acid and the ammonia is retained, while the H_2S and CO_2 are passed on, being warmed by the heat of the reaction. The liquor flowing into the bottom of the tower contains the fixed salts of ammonia. Here it is mixed with milk of lime which sets free the ammonia. The treated liquor passing into a small tower or still, meets another steam jet which drives out this ammonia released from the fixed salts, and carried it into the first tower and so on with the other gases. The waste liquors escape from the bottom of the second tower and are allowed to flow to the sewer. The lime sludge in the first tower is also drawn off at regular intervals. The foul gases are sometimes burned in an atmosphere containing a large amount of SO_2, where the following reaction occurs. $2H_2S+SO_2=2H_2O+3S$. The product of the absorption vessel is crude ammonium sulphide in crystals if a strong acid is used, or a solution of this salt if a dilute acid is used. The crystalline product will usually contain tarry impurities as the liquor has not been allowed to clarify itself by settling. Much of the ammonia produced in this way is used in connection with the refrigerating industry.

In small works the ammonia is usually not recovered at the gas works but the ammoniacal liquor is sold to manufacturing chemists. Often, however, in very small isolated plants, the liquor is wasted.

In water gas plants the liquid wasted consists chiefly of water containing oily and tarry matters, together with various hydrocarbons and other complex compounds resulting from the "cracking of the gas oil," and the heating of the anthracite coal. In these plants practically no effort is made to recover any valuable constituents other than the tar which is used for fuel. The most important substances are the oils and complex substances resulting from the breaking up of the oils. Some of these are quite offensive and they constitute an important element in the problem of the disposal of wastes from the gas industry.

The gaseous wastes need not be considered in this place. They pass away in solution in the waste water or in the gas and are, to a great extent, removed by the scrubbers and purifiers as already mentioned.

Volume of Wastes.

There are very few reliable data obtainable for the total amount of waste liquor from gas works. In Lowell, Mass., it was estimated that it amounted to 12,000 gallons per million cubic feet of gas. In Paterson, N. J., where water gas is made, it amounted to about 16,000 gallons per million cubic feet of gas. In some works the waste liquors are considerably in excess of this, but in carefully managed works it is said that the volume sometimes falls as low as 2,000 gallons per million cubic feet of gas. This, however, occurs only in places where the waste water is partially purified and where some of it is used over and over.

Source of Liquid Wastes.

Looking at the wastes from another standpoint they may be classified according to their source as follows:

1. Waste liquors discharged from drains with or without partial purification.

   a. Gas liquor, or ammoniacal liquor.
   b. Liquor from seal pots.
   c. Overflow from tar tanks, etc.
   d. Condenser water.

2. Leaks, or drips from tar tanks, scrubbers and condensers, receiving tanks, purifiers, relief holders, oil barrels, oil tanks, pipes, etc., which may

seep into the ground or flow out upon the floors of the building or on the surface of the ground.

3. Surface washings at times of rain, including leaching of spent lime or old oxide.

Few, if any, gas works waste their gas liquor or the seal pot liquor without some attempt to recover the tar or other constituents of value,—hence the first two items on the list may be practically ignored, so far as the question of water pollution is concerned. The recovery of the tar is usually made by simply allowing the liquor to flow through settling tanks or "tar separators" so as to obtain a better sedimentation, and sometimes heated with steam so as to obtain a better separation of the tarry matters. In the best managed plants where water gas is made the overflow liquor from these settling tanks is pumped back into the seal pots to restore loss by evaporation, so that the actual waste of liquid is very small. More often, however, the overflow is wasted. Sometimes it is allowed to flow into a cess-pool, or hole in the ground, and, after that has filled up, into a second hole, but it is more common to allow it to flow into some stream or whatever body of water happens to be near at hand. In some instances such overflow liquors are allowed to flow into the public sewers, but this is an objectionable practice and in many places there are laws forbidding it.

The various leaks referred to are partly avoidable, but some of them are drips which cannot be easily done away with. In many cases, however, the disposal of these drips is not given proper care. If the leaks occur in structures above the ground the material can be collected and properly disposed of. Often, however, important leaks occur in tanks sunk in the ground.

In former days it was a common custom to put all these tar tanks, settling tanks, etc., in the ground and to build them of wood. In time these became leaky and the contents would ooze out. Similarly metal tanks would rust out and leak, and brick tanks would become more or less permeable. The present tendency is towards the use of better tanks, in order to avoid losses of valuable substances and in order to prevent pollution. The wastes from water gas plants are more troublesome in this respect than the waste from the coal gas plants. The "relief holder" and gas holders have a water seal at the bottom and their lower compartment ought of course to be watertight. Often the flow of the tanks is built of concrete or brick and there is danger of leakage from such holders, as their area is considerable.

In all gas works the grounds are likely to be covered in places with matter of an oily character, resulting from various drips, leaks from barrels, washings from floors, etc. After a rain these run off in part and in part sink into the ground. Too little care is given to general cleanliness. In some places the yards are paved or covered with concrete, but in most places, particularly in the small works, the yards consist of the natural soil. Little attention is given to the disposal of roof water, other than to let it flow over the ground.

EFFECT OF POLLUTION FROM GAS WASTES.

The most troublesome substances among the waste products from a gas works are the oily and tarry matters, and whether derived from the regular overflow wastes, from the drips from the various processes, or from the washing of the yard, they are essentially the same in character. The wastes from water gas plants are well represented in character by the liquid taken from the water seals.

Through the courtesy of Mr. E. C. Uhlig, chemist of the Brooklyn Union Gas Company, I was able to make some studies of some of the wastes from the Citizens' Works at various stages of the recovery process.

A sample of the liquid from one of the seal pots gave the following analysis:

	Parts per Million.
Total solids	3,832
Loss on ignition (hydrocarbons, chiefly)	3,408
Fixed solids	424
Oily matter, soluble in ether	1,960
Free ammonia (direct nesslerization)	352
Solids in suspension	1,572*
Solids in solution	2,260
Specific gravity	1.005

*This figure is probably too low as not all the suspended matter filtered out well on the filter paper.

This liquid had a strong tarry odor, a yellowish-brown color, and was very turbid. It contained a large amount of suspended matter of a tarry nature as the analysis shows.

A sample of the overflow from the tar separator was also collected, as it was being pumped back to the seal pots. This also had a tarry odor, but was less turbid and contained less tar and oil. It gave the following analysis:

	Parts per Million.
Total solids	2,606
Loss on ignition	2,318
Fixed solids	288
Oily matter soluble in ether	800
Free ammonia	328
Solids in suspension	2,362
Solids in solution	244

In this sample the suspended matter filtered out much more easily than in the preceding one.

The effect of gas waste pollution is shown in various ways according to circumstances. These may be enumerated as follows:

1. Pollution of surface water.
2. Pollution of ground water.
3. Clogging of sewers and effect on odors in sewers.
4. Clogging of filter beds and effect on sewage purification.

Pollution of Surface Water.

The discharge of gas wastes into surface waters, including small streams, rivers and lakes, is usually attended with various objectionable effects, among which may be mentioned disagreeable odors, the appearances of an oily scum or sleek upon the surface of the water, the fouling of the bottom through deposits of tar, the destruction of fish and other forms of animal life, the destruction of vegetable life along the shores and at the bottom. These are matters which effect the value of the natural resources of the streams; they tend to cause a depreciation in the value of property along the shores; they interfere with the use of the water for drinking purposes, for making ice, and for various industries. They do not, however, to any very material extent, affect the sanitary quality of the water.

Odor.

The odor of the gas oil used for carburetting water-gas is very disagreeable and very penetrating. The odor persists even after the oil has been greatly diluted with water. A series of experiments recently made have shown that most people can detect its presence when diluted one to 5,000,000, although, on the other hand, other observers failed to detect it when diluted only one to one hundred thousand.

The odor of the liquor from the seal pots is also very penetrating, but is not quite as offensive in character as that of the gas oil itself. The recognizable dilution of seal pot liquor varies, of course, with the amount of waste oils which is contained in it. A sample collected from one of the Brooklyn gas works, and which may be taken as fairly representative of seal pot liquor, had an odor which could be recognized when diluted one to 20,000. In other works, if one gallon of seal pot liquor were mixed with 20,000 gallons of water, the gassy odor could still be observed by most individuals. The overflow liquid from the settling basin is, of course, less offensive, but even this has an odor which can be detected after being diluted 5,000 times. These figures for dilution cannot be applied generally to all gas works, but they serve to give an idea of the extremely persistent quality of the odor in the waste products from the manufacture of illuminating gas.

That dilutions very much less than these figures are obtained in actual practice may be illustrated by the Passaic River at Paterson, N. J. It has been estimated that the amount of waste liquid passing from the settling basins of the Paterson gas works into the river is from 30,000 to 40,000 gallons per day. The minimum flow of the Passaic River at that point may be taken as something over 100 million gallons per day. This would be equivalent to a dilution of only about one in 2,500 or 3,000, which is less than the dilution limiting the odor. It is a well known fact that the river below the gas works has a strong gassy odor which persists for many miles down stream.

Temperature has an important influence on the odor of diluted gas waste. In warm weather such odors are very much more pronounced than in cold weather.

The odor produced by gas works, when not sufficiently strong to compel their recognition as such, are often mistaken for odors due to sewage pollution. Very often the waste of gas works and the sewage of a city enter the same stream, and in such cases the odor of the gas is liable to be stronger than that from the sewage, and to be mistaken for it. The presence of gas wastes may, however, increase the odor of the sewage by forming a film upon the surface of the water which prevents needed aeration. In some cases, as in the Cuyahoga River in Cleveland and in the Chicago River in the days before the drainage canal was constructed, this condition was so much exaggerated that the streams were practically septic tanks. Here the wastes acted in two ways,—the tarry matter falling to the bottom carried with it the sewage sludge, where it decomposed, while the lighter oils formed a film upon the surface which excluded the oxygen of the air and thus produced an objectionable anaerobic condition.

In the Passaic River below the city of Paterson, and above the Dundee dam, the water of the river has a noticeable odor of gas tar at all the points below the gas works. At most times this odor is stronger than that due to the sewage pollution and the wastes from the silk mills, and it has been estimated that the tarry odor produces about two-thirds of the total nuisance due to the odor coming from the river. When the wind blows across the stream the tarry odor is noticeable for a considerable distance from the shore. The gas wastes also account for about 80 per cent. of the oily sleek in the water of the Passaic River in Dundee Lake.

On January 19 and 20, 1906, hourly samples were collected from the Passaic River above the city of Paterson, at the 19th Street bridge just below the city, and at the Dundee Dam a few miles down stream. Of the samples collected above the city, not one had any odor suggestive of gas works, but at the 19th Street bridge the tarry odor due to the gas wastes was noticeable at all times, varying in intensity from a very slight odor to one which was very decided. At the Dundee Dam the odor was somewhat less marked, but was never absent. Another series of samples was collected at the same places on February 17-19, 1906, this series including Sunday. Similar results were obtained, but the tarry odors below the city were considerably less marked than they were during the preceding set of observations which were made on week days. On January 19, a series of samples was collected through the city of Paterson at various points in the Passaic River. No tarry odors were observed above the gas works, but below them they were very distinct.

In the East River in the vicinity of 42nd Street, New York, there are extensive gas works, from which large volumes of waste are being constantly discharged at the docks. These wastes spread out over the surface of the water so that some of the ferry boats are compelled to pass through considerable areas of oily sleek, much to the inconvenience of the passengers. Areas of this oily sleek can be seen far up and down the river. The tarry matters accumulate on the piles, and form black unsightly coatings which at low tide are not without odor. These various effects of the oil wastes in the river are attributed by many to the discharge of the sewage.

Oily Scum or Sleek.

It is a well known fact that when oil is dropped upon water it will spread out over large areas as a thin film. A single drop of gas oil let fall upon water in a water-pail will completely cover the surface with an iridescent film. Two drops of oil put into a pail full of water and vigorously stirred will show an iridescent film upon the surface after standing for a short time. This will give some idea of the large area that may be affected by the discharge of a comparatively small amount of gas wastes.

Sediment.

The waste products contain more or less tarry matter in suspension. Thus, in the sample of the overflow from the tar separator, the solids in suspension formed the bulk of the total solids in the liquid. This tarry matter tends to settle, and, as a result of this, streams in which gas wastes are discharged become covered at the bottom with black tenacious deposits. Tar also spreads out on the rocks and twigs along the shore, on the piles of wharves, the bottoms of boats, and elsewhere. These deposits are very unsightly and when uncovered they emit a strong odor.

Effect of Gas Wastes on Fishes.

It is a well known fact that in streams which are polluted with gas wastes the fish gradually disappear, and unquestionably these wastes are very deleterious to fish life. Mr. M. C. Marsh of the U. S. Bureau of Fisheries at one time carried on some investigations to determine the effect of gas wastes on fish of various kinds. The following is a quotation from his report:

"WASTES FROM THE WATER GAS PROCESS."

"Filter effluent.—A cloudy grayish liquid with a moderate odor of gas; specific gravity 1.00 at 24 degrees C. This is the effluent from filter beds which remove the tarry oils at the plant of the Washington Gas Light Company.

"Undiluted and unaerated, it was fatal to bass within 6 minutes. Unaerated, 1 in 10 killed bass in 22 hours, 1 in 20 killed perch in 68 hours, 1 in 30 failed to kill perch during 32 days, and in 1 in 50 a perch spawned after 24 days and died the next day. Control perch usually died after spawning.

"Tar from wells.—This sample consisted of two parts, a floating black tarry liquor and a grayish watery liquid beneath.

"The lighter liquid, which floats diluted 1 in 1,000, unaerated, killed a perch in a few minutes, and 1 in 100,000 caused evident distress within 9 hours, but did not kill until the fifth day.

"The heavier grayish liquid, diluted to 1 in 40, unaerated, was fatal to perch within a few hours, while 1 in 80 failed to kill during 34 days and 1 in 100 had no effect during a trial of 21 days.

"Tarry liquor.—A black, tarry, strongly aromatic liquor, lighter than water; specific gravity 0.95 at 21 degrees C. It has the highest toxicity of all the wastes of whatever nature with which experiments were made. It does not visibly mix with water, but spreads out in a film on the surface. The dilutions were made by volume, as in other cases, through evidently only a small portion of the liquor attains solution in the water.

"Eight solutions stronger than 1 in 100,000 were first tried, but all were fatal in a few minutes or hours. Unaerated, 20 liters of 1 in 100,000 killed perch in 102 to 117 hours; 1 in 200,000 in 100 to 115 hours; 1 in 300,000, in 52 to 67 hours, and 1 in 400,000 killed a perch in 12 days, but failed to kill bass during 41 days. A solution of 1 in 500,000 was made up by weighing off 40 milligrams of the liquor in a watch glass and placing it with the glass in 20 litres of water. Two perch lived in this for 24 days, when one spawned and both died the next day. The weather had become warm and the temperature of the dilution reached 19 degrees C. A dilution of 1 in 500,000 may be considered practically harmless to perch and bass.

"Aeration reduced markedly the poisonous effect. Aerated, 1 in 60,000 killed one perch in 24 hours, another after 3 days; 1 in 80,000 failed to kill during 11 days, and 1 in 100,000 during 9 days.

"The sealing of the water from contact with the air, by means of the surface film, may possibly contribute slightly to the harmful effects in the higher dilutions not artificially aerated. That the substance is tremendously poisonous, however, is evident from the fact that even dilutions as weak as 1 in 40,000 kill in a very few hours, long before the exhaustion of oxygen could play a part. Moreover, the symptoms at death are manifestly not those of suffocation. Nearly all the fishes dying from gas wastes in the higher dilutions display characteristic movements. There is a rapid nervous fluttering of the fins, particularly the pectorals, with rapid respiration, and the body may assume the perpendicular. They sometimes appear to be dying for days before they finally succumb."

"WASTES FROM THE COAL GAS PROCESS."

"Tar from wells.—This is ordinary coal tar, a thick black liquid with the typical odor. When dropped into water, the main portion of the drop sinks, while a lesser part separates and spreads gradually into a surface film.

"The dilutions were not made volumetrically. The amount desired was weighed in drops on a strip of bristol board and then smeared in a thin layer and the strip placed in the measured quantity of water, which was stirred thoroughly. Only unaerated dilutions were used. One of 1 to 4,000 (5 grams of tar in 20 liters of water) was fatal to perch within less than 19 hours, 1 to 66,666 was fatal to both bass and perch in 4 days, and 1 to 200,000 failed to kill perch during a trial of 34 days.

"Ammoniacal liquor (a).—A nearly clear pink liquid of marked ammoniacal odor, specific gravity 1.029 at 14 degrees C.

"Unaerated, 1 in 100 killed perch in 5 minutes; 1 in 1,000 in 40 minutes; 1 in 2,000, in less than 18 hours, and 1 in 3,000 failed to kill during 24 days.

"Effluent from ammonia sludge bed (b).—A clear watery liquid with no very marked odor, specific gravity about 1.00 at 12 degrees C.

"Undiluted and unaerated, the effluent killed bass in 18 minutes. Unaerated, 1 in 10 killed perch in 20 hours, and 1 in 100 was not fatal during 34 days."

"WASTES FROM BOTH WATER AND COAL GAS PROCESSES."

"Lime from 'purifiers.'—This is a coarse gray powder consisting originally of quicklime and having a strong odor of illuminating gas. The gas is passed through large tanks of the substance in order to remove carbon dioxide.

"Five grams in 10 liters of unaerated tap water caused distress to perch in a few hours and was fatal in less than 21 hours; 1 gram in 10 liters, unaerated, killed a bass within about 69 hours; 1 gram in 20 liters, unaerated, failed to kill bass during 41 days.

"Calcium oxide alone is fatal to trout fry at about 18 parts per million.

"Iron oxide from 'purifiers,'—Iron rust is used to purify the gas of sulphur compounds. Iron fillings and small pieces are mixed with wet wood shavings or thin chips and allowed to rust. The material is held in large purifiers, through which the unrefined gas is passed. The sample received for the test was of a dark-brown color, with a strong odor of gas.

"Twenty grams in 10 liters of water, unaerated, killed a perch in less than 20 hours; 5 grams in 10 liters killed a perch in 29 hours; 4 grams in 20 liters was fatal to perch in 56 hours, and 2 grams in 20 liters failed to kill during 9 days.

(a) From the Clapp Ammonia Company, Washington, D. C. It comes originally from the ammonia well of the gas manufacturing company.

(b) From works of the Clapp Ammonia Company, which recovers ammonia from the waste products of the coal process of gas manufacture.

Effects on Bacterial Life.

Some of the waste products from gas works are disinfectants, and this is particularly the case in coal gas plants. Samples of water into which gas-tar has been poured have been found by analyses made several days later to contain almost no bacteria. The oily wastes, however, have little or no disinfecting power. In attempting to show by laboratory experiments what were the effects of the oily wastes from the water seal of a large gas works, varying proportions of the mixed oil and water from the seal pots were added to water known to be rich in bacteria, and the somewhat surprising fact was learned that the seal pot liquor had practically no powers of disinfection, indeed, the liquor itself, which had been standing in the laboratory for several days, contained upwards of two million bacteria per cubic centimeter.

The disinfecting powers of gas works wastes have often been set forth by the gas companies as an argument why they should be permitted to discharge their wastes into streams. This argument does not appear to be sound, especially in the case of water gas plants, as experiments show that the principal portion of the discharged wastes have little or no efficiency in this direction. A practical example of this is the Passaic River at Paterson. The data obtained during a recent study of the situation there show no evidences of any practical disinfecting action on the water below the gas works by the waste products discharged therefrom.

Effect on Oxygen.

The oily and tarry wastes from gas works influence the oxygen contents of the waters into which they are discharged first by forming a film upon the surface of the water and thus preventing the absorption of oxygen from the air; and, second, by themselves using up the oxygen dissolved in the water. By way of illustration the following experiments may be cited.

About two gallons of tap water were boiled until nearly free of oxygen cooled in an atmosphere of carbonic acid, siphoned into a glass jar and covered with a layer of gas oil to a depth of about one-sixth inch. After standing at a temperature of about 68° F. portions were withdrawn and tested for oxygen. In this experiment the depth of water varied from 8 inches at the beginning to 5 inches at the end. A second experiment was made in a similar way except that the thickness of the oil at the top was about one-fiftieth inch. A third experiment was made using a layer of oil one-tenth inch thick and having the water contained in a shallow tray where it was only about 2 inches deep at the beginning of the experiment. The following figures show the quantities of oxygen found in the water after different intervals of time.

	Oxygen in Parts per Million.			Oxygen in Per cent. of Saturation.		
Time of exposure.	Experiment No. 1. Depth of water 8″. Thickness of oil 1-6″.	Experiment No. 2. Depth of water 8″. Thickness of oil 1-50″.	Experiment No. 3. Depth of water 2″. Thickness of oil 1-10″.	Experiment No. 1. Depth of water 8″. Thickness of oil 1-6″.	Experiment No. 2. Depth of water 8″. Thickness of oil 1-50″.	Experiment No. 3. Depth of water 2″. Thickness of oil 1-10″.
0	.28	.78	1.20	3	8	13
1 hour	.29	...	....	3	..	..
3 hours	....	.86	1.40	..	9	16
4 hours	.29	....	....	3	..	..
1 day	.90	.98	3.30	10	11	38
2 days	1.30	.98	5.80	15	11	62
3 days	....	....	8.10	..	..	85
4 days	1.60	1.70	....	16	20	..
5 days	....	2.10	....	..	24	..

These results show that there is a very slow passage of the oxygen through the oil into the water. Naturally it was more rapid in the pan, where the area exposed was greatest. In a large body of water of considerable depth the oily layer would quite effectually exclude the oxygen of the atmosphere.

Gas-oil standing over water tends to absorb some of the oxygen of the water and to produce such conditions that oxygen is lost by being used up by the decomposition of any organic matter that may be in the water. The amount of oxygen taken up by the lighter oils that make up the wastes is much less however than that taken up by the tarry matters that settle to the bottom. This is shown by the following figures.

Into a jar of fully aerated tap water was poured some of the oily wastes. They naturally rose to the surface and formed a film. Into a second jar was poured some of the gas tar from the tar separator of a water gas plant. This sank to the bottom and there was no surface scum. Both jars were allowed to stand and at intervals portions were withdrawn for analysis. The following were the results.

	Oxygen in Parts per Million.		Oxygen in Per cent. of Saturation.	
Time of exposure.	Oil Experiment.	Tar Experiment.	Oil Experiment.	Tar Experiment.
0	...	10.0	..	100
15 hours	...	7.4	..	82
1 day	8.4	6.6	99	74
2 days	8.2	....	93	..
3 days	8.2	6.4	93	73

It is thus seen that gas works wastes tend not only to prevent the admission of oxygen from the air into the waters into which they are dicharged, but to rob the water of the oxygen originally present.

This is a matter of considerable importance where gas works and sewage are discharged into the same stream. The gas wastes by using up the oxygen originally present and preventing the addition of more, interfere with the natural purification of the sewage, and tend to promote anaerobic conditions, with accompanying offensive odors, thus making the pollution due to sewage much more offensive than it would be without the gas wastes.

Compensating Advantages.

While the sum total of the effects of gas waste pollution is highly objectionable, there are one or two mitigating features. Where gas is turned into streams in large quantities there are no offensive slimy growths of algae to be found along the shore and where the amount of oil is enough to form a film upon the surface, the opportunities for the development of mosquitoes are lessened. There might therefore be some beneficial results from this influence of the gas wastes, but the cases where they would be of practical moment are probably very rare.

Pollution of Ground Water.

The pollution of ground water in the vicinity of gas works seems to have become a more important matter since the water gas process superseded the coal gas process. The wastes from the coal gas process contain rather more tarry matter which would settle out in the tar separators and settling tanks, while wastes from the water gas process contain larger amounts of oil of such a character that it will flow through the ground with the water or above it.

A number of instances are on record where wells in the vicinity of gas works have been contaminated with oily and tarry matters, but just how these wastes have found their way through the ground to the wells has not always been clear, and whether the troubles have been due to leaks from various containers, or to improper disposal of the final effluent has not always been determined.

There are usually a number of possible opportunities for the waste products to get into the ground. For example, the relief holders which usually have a concrete or brick bottom, may leak and allow the oily matters to leach into the ground; the settling tanks may leak; the drips from the purifiers may not be properly taken care of; oily and tarry substances and various waste products may be improperly left around the yard so that the rain can leach through them and carry them into the ground.

Comparatively little is known about the flow of these mixtures of oil and tar and water through the ground. Reasoning by analogy, however, it is fair to suppose that most of the suspended matter, including most of the tar, would be filtered out and left in the interstices between the soil grains in the immediate vicinity of their source, but that the lighter oily matters might flow with the water or form a layer at the bottom of the water table.

Some interesting studies by Isaiah Bowman relating to this topic were published in Water Supply and Irrigation Paper No. 113 of the U. S. Geological Survey. These studies were made at Marion, Ind., where there are numerous oil wells. In the vicinity of these wells the ground water becomes considerably polluted with salt water and oil. It is said that in the ground a differentiation of the oil well wastes takes place, the oil remaining undiffused and comparatively near the surface, while the salt water sinks down and diffuses through the ground.

Effect of Wastes on Odors in Sewers.

The discharge of gas works wastes into sewers is objectionable for a number of reasons. In the first place the tarry matters tend to settle out upon the sides of the pipes and in time this causes an appreciable amount of clogging. More important, perhaps, is the effect of the hydrocarbon wastes on the odors carried by the sewer air. The mixture of these wastes with the decomposing organic matter of the sewage tends to break up some of the hydrocarbons, and to form very offensive gaseous compounds, especially when the amount of sulphur in the wastes is large, while the tarry matters tend to rob the sewage of any oxygen that it may have. In some places there has been a great deal of trouble from this gas, notably in Lowell, Mass., where the discharge of wastes from the gas works and the leakage of polluted ground water into the sewers caused a great deal of trouble. These nuisances and the methods adopted to get rid of them were fully described by Mr. Arthur T. Safford in a paper published in the Journal of the Association of Engineering Societies, September 1907, entitled "Wastes from the Lowell Gas Light Company's Yards."

Unpurified gas wastes should unquestionably be kept out of the sewers altogether, and in some places there are strict rules to this effect. Inflammable gases in sewers are always dangerous. In London there have been numerous accidents, and some fatal accidents, due to the blowing up of manhole covers by the explosion in the sewers of gases derived from the discharge of gasoline wastes from automobile garages, and, as a consequence, the discharge of such wastes into the sewers of London is prohibited.

Effect on Sewage Purification.

Another objection to allowing gas works wastes to be discharged into the sewers is the effect which they may have on the subsequent purification of the sewage. If the amount of waste was small this effect would probably be little noticed, but there have been cases in England and elsewhere where the proportion of such wastes has been so large that the bacterial conditions in septic tanks and contact beds were seriously interferred with and this caused a deterioration in the efficiency of the plant. Thus far in New Jersey this problem has not required attention, so far as the writer is aware, but that in some cases it is a matter of importance cannot be questioned.

METHODS OF TREATMENT.

The first requisite in avoiding trouble from gas works pollution is to prevent leakage from the various structures. All tanks should be rendered water-tight; the use of wooden tanks sunk into the ground for collection of tarry matters should be done away with. If brick or concrete tanks are used the work should be thoroughly done, and the walls made thick enough to prevent leakage. Whenever possible, tanks placed above the ground should be used, as then any leakage can be detected and corrected. Particular attention should be given to the foundations of the large relief holders, for, because of their large size, cracks in the concrete are more likely to occur. Care should be taken also that all pipes and drains are tight.

The next requisite is that the drips from the various tanks should be properly collected and removed. Preferably they should be carried to some central point so that their purification can be carried on together. These drips may be carried in pipes or even in channels above the ground. The latter is objectionable, however, as heavy rainfalls are likely to cause the channels to overflow, and thus carry pollution into the soil, while there is more or less odor from them.

The yards of the gas works should preferably be paved, and rain leaders and drains should be used to carry away the roof water. In many of the best works the yards are entirely covered with brick or concrete. This is true also of the floors of the buildings.

Purification of Waste Liquors.

The extent to which the waste liquors need to be purified must depend upon the local conditions at each place. Under some exceptional conditions a partial improvement in the liquid wastes is all that is required, but in most cases the purification ought to be most thorough.

The first step in the purification of the wastes is naturally that brought about by the separation of the tar and other suspended matter in the settling tanks. These settling tanks are now quite generally found in gas works, for the reason that the products saved have a money value. The tanks are usually operated from the point of view of saving valuable substances rather than with any intention of securing a satisfactory effluent. It has been found that generally a settling capacity equal to 3 or 4 hours flow is sufficient to remove the bulk of the tarry matters from the waste liquors, although often the tanks are much smaller in size than this. It has been found that the use of vertical baffles by which the liquid is made to flow through a tank, first downwards and then upwards, around them is very desirable and it has been found also that it pays, in large plants at least, to heat these settling tanks with exhaust steam in order to facilitate the separation of the tar. But even in the best conducted water gas works, with adequate tankage it is not common to-day to find that more than two-thirds or three-quarters of the suspended matter is removed from the seal pot liquids and it is very rare indeed that the effluents from these settling tanks can be considered satisfactory enough to allow them to be discharged into water courses without some further form of treatment. In the case of the coal gas plants a somewhat better efficiency is obtained, as the tar settles out more readily. It is said that in the later modifications of the water gas process the tar settles out better than in the machines of older design.

Mr. H. W. Clark, chemist of the Massachusetts State Board of Health, and others, have found that the effluents from the separating tanks can be very materially improved in quality by further sedimentation, preceded by the application of lime. In Lowell, Mass., and elsewhere excellent results have been obtained by using this method and in some cases the effluent has been deemed good enough to be allowed to flow into the city sewers. It is said that the amount of lime required is ordinarily about 3 pounds per 1,000 gallons of liquid, but the amount will vary, of course, in different plants according to the nature and the volume of the wastes and the efficiency of the first separating tanks. A few simple experiments, however, would be sufficient to determine the economical amount to be used. The lime may be applied in the form of lime-water, or as milk-of-lime. The use of lime serves to give an effluent which is quite clear, although it still has more or less odor and color. It is far less objectionable, however, than the untreated liquor from the tar separator and can be discharged into streams in moderate volumes without causing a nuisance.

The size of the settling tanks required must depend somewhat upon circumstances, but in most cases it need not be more than sufficient to hold three hours' flow of the liquid. If the liquid wastes from a water gas plant be taken as 12,000 gallons per million cubic feet of gas, then in a gas works where this amount of gas is made daily the settling tanks should have a capacity of 1,500 cubic feet, or say, a tank 5 feet deep, 10 feet wide and 30 feet long. Such a settling tank should be preferably made with two compartments so that one could be used while the other was being cleaned.

The efficiency of these tanks may be increased by providing at the lower end a small compartment filled with coke, through which the liquid is obliged to pass in an upward direction before leaving the tank. This straining will serve to collect the suspended matter which has not settled out in the tanks, and will result in making the effluent much clearer. As the suspended matter is largely of a tarry nature the coke when clogged can be dried and burned under the boilers.

A still greater degree of purification can be effected by passing the effluent from the settling tank through a filter of coarse sand or coke breeze. It has been found that a rate of filtration of one to two million gallons per acre daily will suffice, which is equivalent to a rate of flow of about 25 to 50 gallons per square foot per day. For a plant manufacturing one million cubic feet of gas daily, there would be required, therefore, an area of 250 to 500 square feet. Such a filter should have a depth of about three feet and be constructed substantially along the lines of a water works filter, with tight bottom and side walls and suitable underdrains. Sand will give fully as good results as coke, but the latter has the advantage that when clogged it may be removed and burned, while the wastes from the former have to be gotten rid of in some other way. Thus far, such methods of treatment as these have not been put into practice to any extent. There is no reason to believe that they would not be entirely successful, while their operation in the case of large plants, at least, would be comparatively inexpensive. In all probability, the material saved and the relief from complaints and damage suits that would result would practically pay for the cost of the process.

THE PROBLEM IN NEW JERSEY.

The data regarding the extent of the trouble caused by gas waste pollution in the State of New Jersey are not at hand. In some places, however, the problem is very serious, and suits for damage caused thereby have not been infrequent. As the cities grow and the population increases, the use of gas will increase likewise, so that as time goes on the effects of pollution upon the water resources of the State may be greater and greater, and there will be a corresponding depreciation in the value of these water resources unless steps are taken to prevent such pollution.

There are in the State to-day upwards of fifty gas works, in fact almost every city in the State of any considerable size is furnished with illuminating gas. Data are not at hand to show just where these works are located, or the extent of the damage which is being done by each one. Just because a plant is small, however, is not a guarantee that no nuisance will result from it; for, as has been stated above, many of the products are allowed to go to waste in small plants which in large works are carefully saved and utilized. The problem is one which needs serious consideration and it seems likely that an inspection of the various works of the State, and a tabulation of the data thus secured, would be most valuable in the formulation of proper restrictions governing the discharge of waste liquors into the water courses of the State. Such a collection of data could not be obtained in time to be included in this report.

CONCLUSIONS.

1. The wastes from gas manufacturing establishments may pollute both surface waters and ground waters.

2. In surface waters the effects of gas waste pollution is to produce objectionable odors, which are often mistaken for odors due to sewage, to

produce unsightly oily sleeks upon the water, to foul the bottom and shores with tarry deposits, to kill fish and injure plant life along the shores, to interfere with the processes of natural purification of polluted streams and make more objectionable the nuisances due to sewage pollution.

3. The waste liquors can be so treated as to prevent these nuisances almost completely, and the valuable products saved would go a long way towards paying for the expense of purification.

4. A satisfactory method of treatment consists of passing the waste liquors through well baffled and heated settling tanks, treating this effluent with lime-water (or milk-of-lime), and subjecting it to a second sedimentation and filtration through coke or sand. The most economical design for such purification devices would probably have to be worked out for each particular case along the general lines indicated.

GLOUCESTER.

At a meeting of the Commission held December 17, 1906, the secretary was directed to obtain a report on the use of water from Newton Creek for drinking purposes by the City of Gloucester.

At a meeting of the Commission held January 21, 1907, the secretary reported that he had received a report on the use of water from Newton Creek for drinking purposes by the City of Gloucester, from G. E. Hill, C. E., and that information in relation to the water supply of Gloucester had been requested by William J. Thompson, a member of the City Council of Gloucester.

The secretary was directed to furnish to William J. Thompson a copy of the report of the pollution of the water supply of Gloucester, made by G. E. Hill, and to call the attention of Mr. Thompson to the danger of disease being caused by the use of the water from Newton Creek, and to state that, while the Commission had taken such action as lay in its power to protect the waters of the creek, these waters were not even a reasonably safe source of water supply, and that the Commission considered that it was an error of judgment on the part of the City of Gloucester to continue to use water from this source.

The report made by Mr. Hill is as follows:

January 4, 1907.

To the Honorable the State Sewerage Commission of New Jersey:

Gentlemen—On January 2nd, in accordance with your request, I visited Gloucester and investigated the source of its water supply and the conditions under which this supply is obtained and sent to the City mains. In connection with this report, I submit a sketch-map showing the location of Gloucester and its surroundings. It lies at the junction of the Delaware River and Newton Creek, and south of the latter. The population is about 8000, but the recorded pumpage (uncorrected) averages about 2,500,000 gallons a day, sometimes running as high as 3,000,000. Somewhere there is great waste.

The pumping station, indicated on the plan, is situated on the bank of the South Branch of Newton Creek, a little less than one mile from its junction with the North Branch and Main Branch, and about one mile and three quarters from the Delaware River, on the course of the stream. Water is drawn from the creek through a 20-inch intake, protected by a bulkhead and screen. Fifteen driven wells are also connected with the pumps, but these "have never supplied half of the consumption." On the day of inspection, all water was being drawn from the creek.

The water is first pumped to the filters, four wooden tanks filled with sand ("Pittsburgh filters") with mechanical devices for washing and stirring the sand. Alum is used as a coagulant, normally 180 pounds in twenty-four hours. No alum was going into the water on the day of inspection. From the filters the water drains to a large circular basin lined with concrete, and from this it is pumped to the delivery system. The filters are washed twice a day as a rule; sometimes the creek water is so dirty that they have to be washed four times a day. The pumps are run regardless of tide, and water from the upper branches of Newton Creek, and from the Delaware as well, undoubtedly reaches the intake on the flood.

The sources of possible contamination are many. Woodlynne pours the untreated sewage of three hundred and fifty people into the North Branch; the effluent from the Collingswood disposal plant goes into the Main Branch; and some drainage goes directly into the South Branch from Oaklyn and Audubon. Gloucester herself discharges into the Creek at the Boulevard, about half a mile below the intake, the flow of an oval trunk sewer 16x22, 3,800 feet long and draining about twenty per cent. of the city's area, though not a thickly settled section. Six other sewers discharge the rest of Gloucester's sewage into the Delaware River just below the mouth of Newton Creek, and Camden pours in all its wastes just above.

The authorities realize the danger of the situation, and they are striving to improve conditions. Eight new wells have been driven and connected, and it is hoped that these, in conjunction with the old wells, will furnish an abundant supply and permit the permanent closing of the Creek intake.

Respectfully submitted,

G. EVERETT HILL.

HIGHLANDS.

At a meeting of the Commission held August 15, 1907, Commissioners Herbert and Jacobson reported that they had inspected the disposal of sewage in the Borough of Highlands and found that sewers principally owned by private parties in that borough were discharging sewage into the Shrewsbury River, and causing injury to inhabitants of this State in their health, comfort and property, and recommending that the authorities of the Borough of Highlands be notified to show cause why they should not be notified to cease polluting the Shrewsbury River. The committee also recommended that an inspection be made at Higlands for individual sources of pollution.

At the same meeting, the secretary was directed to notify the authorities of the Borough of Highlands to show cause at a meeting of the Commission to be held August 29, 1907, why they should not be notified to cease polluting the waters of the Shrewsbury River.

The secretary was also directed to have an inspection made for individual sources of pollution at Highlands.

At a meeting of the Commission held August 29, 1907, in response to this notice, H. A. Brown, Mayor of the Borough of Highlands, appeared before the Commission and stated that the borough owned no sewers, but that a number of private sewers in the borough did pollute the waters of the Shrewsbury River, and that these should be removed; that the borough had not yet taken up the question of providing sewers, but that he expected it would do so in the near future, it not being able to do so at the present time on account of the expense of obtaining a water supply, and that the borough authorities would be glad to co-operate with the Commission in preserving the river from pollution.

The inspection made at the Borough of Highlands is included in the report of inspection of the Shrewsbury River made as part of this report.

INSIDE THOROFARE.

At a meeting of the Commission held October 15, 1906, notice was given to the Consumers Gas and Fuel Company to cease polluting the waters of Inside Thorofare with waste tar and oil prior to the first day of December, 1906.

The Commission met at Atlantic City December 1, 1906, and inspected the Inside Thorofare and found that the Company was still polluting it with waste tar and oil.

At a meeting of the Commission held December 3, 1906, the secretary was directed to request the Attorney General to take such legal steps as might be necessary to secure an injunction against the Company restraining it from discharging waste tar and oil into Inside Thorofare.

At a meeting of the Commission held March 25, 1907, a communication was received from the Attorney General stating that the Chancellor had granted a rule to show cause why an injunction should not issue against the Consumers Gas and Fuel Company. This order was continued by consent, with a restraining order.

At a meeting of the Commission held April 8, 1907, a complaint was received from L. S. Eldridge of Atlantic City that the Company was still discharging waste tar and oil into the Thorofare, notwithstanding the restraining order of the Court of Chancery. The secretary was directed to investigate the complaint and to request the Attorney General on behalf of the Commission to take such action in the matter as might be proper to secure the enforcement of the order of the Court of Chancery.

At a meeting of the Commission held May 16, 1907, the secretary reported that he had visited Atlantic City on May 11, 1907, in company with Mr. Theodore Backes of the Attorney General's office, and had inspected the plant of the Consumers Gas and Fuel Company; that he found that the pollution of Inside Thorofare by waste tar and oil from that plant had been stopped, excepting in so far as some of the tar which had soaked into the ground was being washed into the stream; that he was informed by Mr. Backes that a permanent injunction had been granted against the Company, and that contempt proceedings had been brought against the President of the Company for a violation of the injunction in pursance of the request of the Commission; that unless the Commission requested further action, the contempt proceedings would be discontinued and in case of further violation of the injunction, proper action would then be taken.

At a meeting of the Commission held June 27, 1907, Commissioner Herbert reported that he had inspected the plant of the Consumers Gas and Fuel Company and found that there was escaping from the plant into the Thorofare a small amount of oil, but that he did not consider it sufficient to recommend any action in regard to the matter by the Commission.

At a meeting of the Commission held August 1, 1907, a complaint was received from L. S. Eldridge that the Company was again discharging tar and oil wastes into the Thorofare. The secretary was directed to investigate the complaint, and if such pollution were found, to request the Attorney General to take proper legal steps to punish the Company or its officers for contempt of the Court of Chancery.

At a meeting of the Commission held August 29, 1907, the secretary reported that on August 16, 1907, he had inspected the plant of the Consumers Gas and Fuel Company and found that a new separating apparatus had been installed and that practically clear water was being discharged therefrom on the ground in the yard of the gas plant, from which it ran into a small ditch and thence by pipe in Georgia avenue into the meadow near Inside Thorofare; that the ground was so saturated with waste tar and oil that before the water had flowed across the yard of the gas plant it had collected a large amount of tar and oil which was discharged into Inside Thorofare; that the pollution of Inside Thorofare was sufficient in quantity to cause considerable nuisance which could be obviated by piping the water direct to the river.

The secretary was directed to communicate with the Consumers Gas and Fuel Company, informing it that the Commission did not see any difference between discharging the waste tar and oil directly into the Thorofare and the present system whereby the waste tar and oil were first discharged in the ground and then washed into the Thorofare; that the Commission desired that the matter be corrected at once, or it would be compelled to again apply to the Court of Chancery for assistance in the matter, and that the Commission suggested that the best plan of action would be the complete elimination of all tar and oil from the waste water and the piping of the water to the Thorofare in such a manner that no contamination would be washed from the saturated ground.

At a meeting of the Commission held November 14, 1907, in reply to inquiry, a communication was received from L. S. Eldridge stating that he had not noticed any tar being discharged from the plant of the Consumers Gas & Fuel Company for some time, but that a small amount of oil escaped which did not seem to be very objectionable.

A report was also received from the company stating that it had been selling the tar wastes recovered at its plant at $1.50 per barrel, and that all of the tar not sold was used for fuel at the plant; that the company had worked out the plan of preserving the tar carefully so as not to allow the least quantity to escape; that in addition to the pump used to circulate the surface water through the cooling apparatus, a second pump had been installed for the same purpose with satisfactory results; and that the company was pleased to report that it had received considerable pecuniary returns from the sale of its tar wastes, so that the price of gas in the holder had been lessened.

JERSEY CITY.

At a meeting of the Commission held July 11, 1907, plans of a sewer constructed in Manhattan avenue, Jersey City, without the approval of the Commission, were filed with the Commission by C. A. Van Keuren, Chief Engineer of Jersey City.

LAKEHURST.

At a meeting of the Commission held July 18, 1907, R. H. Warren, of the Lakehurst Sewer Company, consulted with the Commission in relation to changing the site of the sewage disposal plant of that company. He stated that plans for a new site had been approved by the Commission at the request of the company, but that it had been impossible to make an agreement with the owners of the property; that a new site was under consideration, and that the company was planning to dispose of the septic effluent by broad irrigation.

At a meeting of the Commission held October 3, 1907, plans for the reconstruction of the septic tank and the construction of new filter beds for the disposal of the sewage of the Lakehurst Sewer Company at Lakehurst, were submitted to the Commission on behalf of the company by R. W. Smith, C. E.

At the same meeting, the plans submitted by the Lakehurst Sewer Company, providing for the reconstruction of its septic tank and the construction of two new filter beds, were approved by the Commission, subject to such conditions of construction, operation and purification as this Commission may from time to time require.

LAKEWOOD.

At a meeting of the Commission held April 8, 1907, a communication was received calling attention to the pollution of the Metedeconk River by the Lakewood Water, Light and Power Company.

The secretary was directed to notify the Lakewood Water, Light and Power Company to show cause at a meeting of the Commission to be held April 22, 1907, why it should not be notified to cease polluting the Metedeconk River.

At a meeting of the Commission held April 22, 1907, a further communication was received in relation to the pollution of the Metedeconk River.

The secretary reported that notice had been given to the Lakewood Water, Light and Power Company to show cause at this meeting why the company should not be notified to cease polluting the river, and that no reply had been received and that no appearance was made by the company or in its behalf.

Harry E. Newman of Lakewood appeared before the Commission on behalf of the Lakewood Board of Trade, for the purpose of learning what action was being taken by the Commission in relation to the pollution of the Metedeconk River at Lakewood.

At the same meeting, the following resolution was adopted:

"Whereas, The State Sewerage Commission has found that the waters of the Metedeconk River are being polluted to the injury of inhabitants of this State in their health, comfort and property: therefore be it

Resolved, That under the authority conferred upon it by section 5 of chapter 72 of the laws of 1900, the State Sewerage Commission hereby notifies the Lakewood Water, Light and Power Company that prior to the first day of December, nineteen hundred and seven, it must cease to pollute the waters of the Metedeconk River, and make such disposition of its sewage and other polluting matter as shall be approved by this Commission."

The secretary was directed to have a notice in writing in accordance with the foregoing resolution served.

At a meeting of the Commission held April 29, 1907, a communication was received from Carroll P. Bassett, Treasurer of the Lakewood Water, Light and Power Company, stating that he regretted that matters of importance had prevented his attending the last meeting of the Commission in response to the notice to the company to show cause why it should not be notified to cease polluting the Metedeconk River.

At the same meeting, a communication was received from Harry E. Newman, of Lakewood, stating that the Lakewood Board of Trade was preparing a map of the locality of the proposed sewage disposal plant of the Lakewood Water, Light and Power Company, and desired to present the map for the consideration of the Commission before any plans for such a disposal plant were approved.

At a meeting of the Commission held May 6, 1907, Charles E. Snyder, of Lakewood, representing the Lakewood Board of Trade, consulted with the Commission in relation to the location of the proposed sewage disposal plant, and requested that the Board of Trade be given a hearing before any plans for such a plant be approved by the Commission.

At a meeting of the Commission held May 16, 1907, Carroll P. Bassett, Treasurer of the Lakewood Water, Light and Power Company, consulted with the Commission in relation to the plans for the disposal of the sewage of Lakewood, and stated that the company had purchased a twelve-acre tract on the Metedeconk River at the foot of Clover Street, for the location of a disposal plant, because the elevation and the character of the soil were almost ideal and because of its proximity to the gas works; that there was local opposition to the construction of the plant and because of this opposition the company had not proceeded with the construction of the plant; that the population of Lakewood was from twenty-five hundred in summer to eight or ten thousand in winter; that the soil of the location selected was suitable for the purification of the quantity of sewage which would be received; that a permanent plan had not been adopted by the company and that it would modify its ideas to meet the views of the Commission.

At the same meeting, the Commission decided to meet at Lakewood on May 23, 1907, for the purpose of holding a public hearing in relation to the disposal of the sewage of Lakewood, and the secretary was directed to notify the interested parties.

The Commission met at Lakewood on May 23, 1907, and inspected the proposed site of the sewage disposal plant at Lakewood in company with Carroll P. Bassett, Treasurer of the Lakewood Water, Light and Power Company, Charles E. Snyder and J. J. Cowan, of the Lakewood Board of Trade, and George G. Smith and Samuel S. Taylor, of Lakewood.

The Commission also inspected the plant of the Lakewood Gas Company and the place of discharge of its waste tar and oil into the Metedeconk River.

The Commission also held a public hearing in relation to the proposed sewage disposal plant at Lakewood. There were present: Messrs. C. P. Bassett, Charles E. Snyder, W. G. Schauffler, M. D., S. G. Wallace, M. D., E. P. Harris, M. D., T. J. Buchanan, J. B. Thomas, A. P. Conkling, J. J. Cowan, H. T. Hegeman and G. C. Brown.

Mr. Bassett explained the plans of the Lakewood Water, Light and Power Company, showing diagrams of the property owned by the company. He stated that the company had purchased a twelve acre tract lying on both sides of the Metedeconk River near Clover Avenue, and had also secured an option of a strip of woodland between the twelve acre tract and the nearest houses; that the company had straightened the bed of the river and had started to level up the land along the old bed of the stream with gravel taken from the southerly side of the tract; that the gravel and sand on the property were sufficient to grade it all to the proper level for intermittent filtration beds, and that it was of an almost ideal character for such use; that it was proposed to divide the property into beds, each one hundred feet square, and to discharge the sewage intermittently on these beds after such treatment as might be best for the purpose of removing the solids; that the company was prepared to use either a septic tank or such other device as might be recommended by the Commission for that purpose.

Mr. Snyder stated that he knew of no objection to the construction of septic tanks and filtration beds, but that on behalf of citizens living in the neighborhood and of the Board of Trade of Lakewood he desired to make objection to the proposed location of the plant because of its proximity to residences and the built up section of Lakewood, and although the plans might be good theoretically, the works would be dependent on the amount of care given them and that there was a possibility of danger of nuisance and the probable reduction of the value of adjoining property, due to sentimental objections; that Lakewood was essentially a resort town, there being no manufactories or other businesses located there, and that it was the desire of its citizens that nothing should be done which would impair its reputation; that any carelessness in running the plant would result in injury to the town, whereas, if the plant were located far enough away, no injury would result.

Mr. Cowan stated that Lakewood was a health resort and that its main attraction was the fine air, and that anything which might cause an odor would be a nuisance and destroy one of the chief assets of the town; that Ocean avenue, which was the second street from the proposed location of the disposal plant, was the main thoroughfare and many people passed in the neighborhood, and that if any nuisance were caused at the place proposed, it would tend to injure the reputation of Lakewood; that a quarter of a mile away was located a school which might be affected by any nuisance created at the proposed location of the plant; that there had been serious illness in Lakewood and some deaths, and it was said that this was in part due to the sewage.

Dr. Schauffler stated that Mr. Cowan must be misinformed; that he was familiar with statistics in Lakewood: that it was an unusually healthy place and that there was no sickness from typhoid at Lakewood and no deaths from illness which could have been caused by sewage disposal; that he had been misinformed as to the character of the disposal plant which it was proposed to be built, and that he desired to withdraw his name from the petitions opposing the same.

Mr. Conkling stated that he owned property in the neighborhood of the proposed disposal plant and expected its value to depreciate if the plant were permitted to be constructed at that place; that he bought his property twelve years ago, and that the property in that neighborhood was restricted; that he was a member of a committee of a taxpayers' association which had been formed to object to the location of the plant.

Mr. Thomas stated that there was five hundred thousand dollars worth of property within the area between the proposed disposal plant and the railroad station at Lakewood, and that he would expect all of this property to depreciate ten per cent in value if the disposal plant were located at the place proposed.

Mr. Brown stated that in his judgment the value of the property in that section of Lakewood near the proposed plant would depreciate if the plant were constructed at the proposed site, and that he objected to the same because he desired to care for the interests of his home.

Petitions objecting to the proposed location of the sewage disposal plant at Lakewood on the ground that it would be a nuisance and a menace to health, and would affect the value of property there were submitted to the Commission and filed.

The Chairman explained the nature of the proposed disposal plant of the Lakewood Water, Light and Power Company, and stated that in the judgment of the Commission no nuisance would be created by the construction of such a plant; that the result of the construction of such a plant would be to improve the reputation of Lakewood, rather than injuring it, because it provided a more sanitary method of the disposal of the sewage than that now in use, and that the construction of such a plant would be no menace to health, but rather a protection, and that it would not affect the value of the adjoining property after it had been erected and it was out that no nuisance would be created.

Mr. Bassett also stated that if it were desired by the people in Lakewood, the company had no objection to constructing the plant on the south side of the Metedeconk River, a little further away from the residences in Lakewood, provided it could secure the property.

At a meeting of the Commission held June 20, 1907, the following resolution was unanimously adopted:

"Whereas, The State Sewerage Commission has found that the waters of the Metedeconk River are being polluted to the injury of inhabitants of this State in their health, comfort and property; therefore be it

Resolved, That pursuant to chapter 72 of the laws of 1900, and the supplements and amendments thereto, the State Sewerage Commission hereby gives notice that prior to the first day of July, nineteen hundred and seven, the Lakewood Gas Company must cease to pollute the waters of the Metedeconk River, and make such disposition of its sewage and other polluting matter as shall be approved by this Commission."

On motion, the secretary was directed to have a notice in writing served in accordance with the foregoing resolution.

At a meeting of the Commission held July 25, 1907, a communication was received from Joseph Mayer, Superintendent of the Lakewood Gas Company, stating that that company had no connection with the Metedeconk River during the past few months.

At a meeting of the Commission held October 24, 1907, a communication was received from C. P. Bassett, Treasurer of the Lakewood Water, Light and Power Company, stating that that company had secured ground for sewerage disposal plant, and that an engineer had been engaged to design septic tanks and filter beds, plans for which would be submitted to the Commission for approval as soon as they had been prepared.

LINEN THREAD COMPANY.

At a meeting of the Commission held March 25, 1907, plans for the disposal of sewage from a manufacturing plant were submitted to the Commission by the Linen Thread Company of Paterson. The secretary was directed to acknowledge the receipt of the plans and to request further information in relation to the location of the plant and the water into which the effluent was to be discharged, and the nature of the sewage to be treated.

At a meeting of the Commission held April 8, 1907, a communication was received from the Linen Thread Company stating that the plant for the disposal of the sewage from its manufacturing plant, plans of which had been submitted to the Commission by it, was located on the Passaic River just north of the City of Newark, and that the plant was designed for the treatment of sewage only.

The secretary was directed to return to the Linen Thread Company the plans submitted by it for the disposal of sewage from a factory near the Passaic river just north of the City of Newark, the effluent to discharge into the Passaic River, for the reason that the plant was located within the boundaries of the Passaic Valley Sewerage District.

At a meeting of the Commission held April 22, 1907, a communication was received from the Company, expressings its appreciation of the suggestions made to it by the Commission in relation to the disposal of sewage, and stating that it would take the matter up with the Passaic Valley Sewerage Commission.

LOCH ARBOUR.

At a meeting of the Commission held October 10, 1907, plans for the construction of a septic tank for the purification of the sewage from the sewerage system of the East Jersey Coast Water Company at Loch Arbour, were submitted to the Commission by G. E. Hill, C. E., on behalf of that company.

On motion of Dr. Jacobson, the plans submitted by the East Jersey Coast Water Company, providing for the purification of the sewage from its sewerage system at Loch Arbour by the construction of a septic tank, were approved, subject to such conditions of construction, operation, and purification as this Commission may from time to time require.

The following letter of application for approval submitted to the Commission includes a description of the tank to be constructed by the East Jersey Coast Water Company for the purification of its sewage:

"October 10th, 1907.

To the Honorable State Sewerage Commission of New Jersey, Jersey City, N. J.

GENTLEMEN—At the request of the East Jersey Coast Water Company, by whom I have been engaged as consulting engineer, I beg to submit for your approval plan of a septic tank which the Company proposes to install for the clarification of the sewage of Loch Arbour before its discharge into the Ocean.

At present the main sewer ends in a small circular storage tank located on the beach near the Government Life Saving Station. The outlet from this tank is protected by a tidal-gate which shuts out sea-water while the tide is high. As the tide falls, the sewage escapes through an iron outlet which discharges 516 feet from shore.

The main sewer lies at such a low elevation (1.59 above low tide) that the construction of the new tank will be somewhat difficult. To secure the best results it has been decided to build the tank above ground on a heavy timber shoe, sinking this after completion by water-jet and sand-pump. For this reason the tank has been made cylindrical in form.

The inside diameter of the tank is 16 feet, and its working depth—below the normal flow line of the sewer—is seven feet. Its capacity is 10,500 gallons, which equals the average flow of eight hours.

The tank is divided into two unequal portions by a weir-wall 11 feet from the inlet pipe and 5 feet from the outlet pipe. Between this weir-wall and the outlet an apron wall is built, as shown on the plan, to prevent the escape of scum. A baffle plate opposite and one foot away from the inlet sewer checks the velocity of the incoming sewage and distributes the flow laterally. The storage tank now in use will receive the flow from this septic tank. Its capacity, however, is sufficient for the storage below the sewer of only a little over three hours normal flow. The water line in the septic tank will therefore rise and fall with a maximum variation of about two and one-half feet. The apron wall is built unusually high so that no scum can pass over it even at times of exceptional flood tide.

The entire structure is to be roofed with steel and concrete. A manhole provides access for inspection or cleaning.

The existing iron outlet will be used for the discharge of the clarified effluent.

Asking your favorable consideration, I am

Very respectfully yours,

(Signed) G. EVERETT HILL."

MADISON.

At a meeting of the Commission held April 29, 1907, George W. Fuller, engineer of the Sewerage Commission of the Borough of Madison, consulted with the Commission in relation to the plans which had been prepared for a sewerage system and a sewage disposal plant for the borough.

At a meeting of the Commission held May 16, 1907, Commissioner Capstick reported that he had been requested to confer with the Madison Sewerage Commission on May 17, 1907, in relation to the plans prepared for the disposal of sewage at Madison.

At a meeting of the Commission held May 23, 1907, Commissioner Capstick reported that he had visited the Borough of Madison at the request of the Madison Sewerage Commission on May 17, 1907, and consulted with Messrs. J. P. Albright, C. A. Anderson, J. N. Van der Water, Samuel Brant, George W. Downs, C. E. Cook and C. A. Rathbun, members of the Borough Board of Health and Sewerage Commission; that the object of the meeting was to arrange a final report to the Mayor and Council of the Borough of Madison in relation to the proposed disposal plant for the borough, and that he had been requested to attend the meeting in order to give information in regard to attitude of the Commission in reference to the future management of the plants located in the State, and also in relation to the plans prepared by Hering and Fuller of the sewerage system and disposal plant.

At the same meeting, plans and specifications for a sewerage system and disposal plant for the borough of Madison were submitted to the Commission by Hering and Fuller, engineers, together with a certified copy of a resolution adopted by the Mayor and Council of the Borough of Madison applying to the Commission for its approval of the plans.

At the same meeting, the plans submitted to the Commission on behalf of the Borough of Madison, providing for a sewerage system and a sewage disposal plant consisting of septic tanks, contact filters and sand filters, the effluent to discharge into Spring Garden Brook, were approved, subject to such conditions of construction, operation and purification as this Commission may from time to time require.

At a meeting of the Commission held October 3, 1907, Commissioner Capstick reported that he had received a request from James H. McGraw of the Madison Sewerage Commission that the members of the State Sewerage Commission should attend a public meeting to be held on October 7, 1907, at Madison, for the discussion of plans for a sewerage system for that borough.

It was decided that the members of the Commission attend the public hearing to be held at Madison on October 7, 1907.

At a meeting of the Commission held October 10, 1907, the Chairman reported that in company with Commissioner Capstick, he had attended the public hearing at Madison on October 7, 1907, for the purpose of considering the proposed sewerage system for that borough, and that he and Commissioner Capstick had recommended the adoption of the plans prepared by the Borough Sewerage Commission.

At a meeting of the Commission held November 21, 1907, a communication was received from James H. McGraw, Chairman of the Madison Sewerage Commission, stating that an election had been held at Madison on the question of sewerage on October 14, 1907, resulting in a majority of 180 in favor of sewerage according to the plans approved by the Commission; that in accordance with the Borough Act, another election had been called for December 2, 1907, on the question of issuing bonds. The proposed bond issue is $125,000. It is probable that this election will also be decided in favor of the sewerage proposition.

The following report was prepared by Hering & Fuller, engineers, in relation to the sewerage of Madison:

March 18, 1907.

Mr. James H. Mc Graw, Chairman Sewerage Commission, Madison, New Jersey:

DEAR SIR—In accordance with your request of February 26, we beg to hand you herewith plans and specifications for a sewerage system and sewage disposal works for the Borough of Madison.

The plans, containing 13 sheets, show the size of sewers on all of the improved and accepted streets of the Borough, and which streets approximate 25 miles in length. They also show profiles of the street surface based on surveys as they now exist and of all sewer lines both for present and future requirements; together with all necessary appurtenances. The sewage disposal works are shown in detail complete for the contractors to bid upon after the necessary action is taken by the Borough authorities and by the State Sewerage Commission.

The plans are accompanied by complete specifications, form of contract, notice to bidders, etc., for placing under contract the work now required.

With this letter of transmittal is embodied a brief report setting forth the needs, extent, nature and accomplishments of the works under consideration.

As it has been decided by the Mayor and the Council that it would be prohibitively expensive for the Borough to dispose of its sewage into the trunk sewer extending from Summit to tide water at Arthur Kill, we shall not discuss that feature, but confine the report to the main subjects, namely, the sewerage system and sewage disposal works.

SEWERAGE SYSTEM

1. *Area in Sewerage Districts.* Within the present Borough limits Madison has an area of about 2,035 acres. This area contains 4 natural watersheds or sewerage districts, the approximate areas of which are as follows:

a. Main district	1,500 acres.
b. North Street district	275 "
c. Loantaka Way "	35 "
d. Shunpike Road "	225 "

The main district extends from the summit in the vicinity of High Street to the northern Borough limits, excepting the North Street District bounded by Morris Place, Ridgedale Avenue, etc. The sewage from the Main District will flow by gravity to a suitable site for the disposal works. The other three districts are named from the street on which is located the pumping station to lift the sewage into the area of the Main District. The last two districts are on the southern slope beyond the summit near High Street and do not need to be sewered at present. There is a short stretch of low ground on Rosedale Avenue through which, when the area is built up, the sewage can pass in an inverted siphon. By obtaining authority from Floram Park the houses on this small low tract could be drained directly by gravity to the sand filter portion of the disposal works, so that a pumping station is not needed here. The small volume of sewage from the few houses which may be built upon this portion of Rosedale Avenue will not overload the sand filters. The area from which the sewage is planned to flow through an inverted siphon to the outfall sewer on or near Rosedale Avenue, lies east of Greenwood Avenue and beyond the ridge near Fairview Avenue. It is assumed that at a later date when this area requires sewers, the Floram Park authorities will permit a sewer to be built across the eastern half of Rosedale Avenue, so as to permit the sewage from the area to reach the disposal works by gravity. If this permission is not obtained it will be necessary, instead of building an inverted siphon on Rosedale Avenue, to put in a pumping station and pump the sewage to a point on Rosedale Avenue about 500 feet north of Main Street.

2. *Needs of Sewerage.* There is but little to say as to the needs of a sewerage system for a community which has been provided with a public water supply for over 15 years. It goes without saying that a sewerage system for the removal of the liquid waters of the household will be a material improvement over the existing sanitary arrangements. This is shown by general experience elsewhere and it is more than ordinarily true in the case of Madison, which derives its public water supply from wells in the low lands at the foot of the hillside upon which there resides a large portion of the present population of the Borough and upon which hillside falls a portion of the rainfall that maintains the public water supply. It is unnecessary for us to enter into details as to the unsanitary condition of Spring Garden Brook, especially in warm weather, as that subject has been fully covered by the reports of the Borough Board of Health.

3. *Separate System.* A system of "separate sewers" has been designed, that is, the sewers will remove only household wastes and are not intended to remove roof water or street water. Storm drains have received no considerations in this project.

4. *Size of Sewers.* The sewers are 8 inches in diameter over most of the area except on Main Street. No street sewers smaller than this size will be used. Ten-inch lines are required on Greenwood Avenue, Prospect Street, North Street, Madison Avenue, Kings Road, etc., as shown on Sheet No. 1 of the drawings. On Main Street the pipes increase in size as they approach Rosedale Avenue. The pipe coming from the west will be 15 inches in diameter and from the east 12 inches. Including the 18-inch outfall sewer, which will convey the sewage from the low point on Main Street near Rosedale Avenue to the disposal works, the length of each size of sewer which it is proposed now to build is substantially as follows:

8-inch	48,480	feet.
10 "	4,100	"
12 "	1,400	"
15 "	2,175	"
18 "	3,600	"
	59,755	feet.

5. *Extent and Location of Sewers.* On Sheet No. 1 of the drawings there are shown, in full lines, those streets on which it is now proposed to build sewers. The sewers have an aggregate length of about 11.32 miles and are of the sizes shown in the above table. The sewers for the remaining streets, which are sparsely built upon, are shown in broken lines. They amount to about 14 miles. The specifications are drawn so that the Borough has the

right to take from or add to the amount of construction work to the extent of 20 per cent. of the total aggregate price bid on the 11.32 miles of sewers and the disposal works. This will readily enable the Borough to build sewers in the streets where they are now r ded and at the same time keep within the necessary limits of expenditur

6. *Depths.* Inspection of the profiles on Sheets Nos. 2 to 7, inclusive, will show that the sewers in most cases are to be built at a depth of 7 to 9 feet. Special care has been taken to provide for laundries and closets in the cellars of properties situated a considerable distance from the street. This affects the required depth of the street sewers because it is necessary to have a slope of about one-quarter inch per foot for the pipe leading from the house to the street sewer.

7. *Slopes.* The slopes of the sewers, as may be noted on the profile sheets, are ample to give a self-cleansing velocity when running half full. The upper end of all sewer lines, when the flow of sewage is quite small, will be kept clean by automatic flush tanks.

8. *Alignment.* The sewers in all cases are shown to be built in a straight line from manhole to manhole to facilitate inspection and cleaning. The manholes are placed at intervals of about 300 to 400 feet.

9. *Construction.* The specifications have been prepared so as to make it imperative for the contractor to build these works in a first-class manner in every respect. The pipe joints will have gaskets of jute and be filled with rich cement mortar in such a manner as to secure practically water-tight work. Rigid tests, before acceptance and final payment, are required in order to demonstrate that there are no substantial openings or cracks in the pipe joints through which ground water may enter the sewers, or through which sewage may flow out. The streets are required to be resurfaced promptly and put in as good condition as found. The contractor is required to replace all defective work and maintain the entire works free from structural defects for a period of one year after completion and acceptance.

10. *House Connections.* Provisions are made for a "Y" branch in the street sewers opposite each occupied or unoccupied property and a 5-inch branch will be built from the sewer to the curb line. The estimates provide for about 2,000 such connections on the 11.32 miles of sewers now to be built, but the number, under the terms of the contract and specifications, can be increased or decreased as you see fit.

11. *Ventilation.* It is highly important to ventilate thoroughly a system of sewers. The depth of flow in the sewers varies materially at different hours of the day. If the sewers are not ventilated the air above the flowing liquid would contract and expand with the changing flow line, with the likelihood of unsealing the traps of the house plumbing. Ventilation in these sewers will be thoroughly provided for by means of perforated manhole covers and through the house connections leading to the soil pipe at each building. This will secure a constant flow of fresh air through the sewers and dilute thoroughly with fresh air the small amount of gases coming from the sewage. There will also be automatic flush tanks of a capacity of about 250 gallons provided at the head of each sewer line with which to keep the sewers clean by flushing them with water about once a day to dislodge particles of sus-

pended matter which may have become deposited on the sides of the sewers. Flushing of the larger pipes, which will run at only a small fraction of their capacity during the first few years, can be effected by putting in temporary stop planks in the manholes, thus backing up the sewage until sufficient head is obtained to produce a velocity to remove deposits.

12. *Capacity.* These works, so far as it is now proposed to build them, will be of sufficient capacity to serve the borough for many years to come. The outfall sewer has a capacity of about 2,300,000 gallons per 24 hours when running full. With reasonable allowance for ground water seeping into the sewers through hair cracks in the joints and for rate of water consumption during hours of maximum use, this should provide for a population of about 12,000 people.

13. *Extensions.* As additional streets become occupied the 11.32 miles of sewers can be readily increased in later years as required, to cover the full 25.3 miles of streets as shown on Sheet No. 1 of the drawings. The main sewers and outfall sewer are to be built at the beginning of sufficient size, so that none of them will need duplication until the population connected with the sewers exceeds 12,000 people.

14. *Maintenance.* After the sewers are put in service it will be necessary to have careful and reliable attendants inspect them at frequent intervals to see that the flush tanks discharge in a proper manner, and empty from the dust pans the street dirt which will enter the manhole covers through the perforations. It is also urgent that there should be competent inspectors to see that adequate and proper plumbing laws established by the borough are carried out in every household.

SEWAGE DISPOSAL WORKS.

15. *Location* The topography of the land in the borough and general neighborhood is such that there is one location which stands out conspicuously as the most suitable and best adapted site on which to build the disposal works recommended in this report and detailed in the plans and specifications accompanying it. That location is in the Valley of Spring Garden Brook at such a point below the water works property that there will be no possibility of the effluent from the disposal works contaminating the public water supply. Such a location is found on the lands owned by the William Tooth Estate and situated about five-eighths of a mile north of Main Street and one-eighth of a mile east of Rosedale Avenue. This location is sufficiently isolated so that the disposal works will not be objectionable either as to the view or as to odors. The highly purified effluent will discharge into Spring Garden Brook at a point where the ordinary water level in the brook is 8 feet lower than it is at the corner of the water works property, and 17 feet lower than at Main Street. As this effluent cannot run up-hill it can be stated without any qualifications whatever that there is absolutely no ground for apprehension that the effluent will in any way affect the quality of the public water supply. As to the outfall sewer, or the pipe through which the sewage will flow from the lowest point on the streets now to be sewered, in the Main District, namely, Main Street near Rosedale Avenue, we have shown it on the

plans as an 18-inch line of vitrified pipe surrounded with concrete where it passes through low wet ground. The plans show it to be constructed on a private right-of-way a few feet east of Rosedale Avenue, the center of which for some distance is the boundary line between Floram Park and the Borough of Madison. If this pipe were built in the center of the street or on the upper side of the street (belonging to the Borough of Madison) it would be necessary to secure the consent of the Floram Park authorities to cross their half of the street at a point opposite the disposal works. By building the outfall pipe on private rights-of-way it will not be necessary to consult the Floram Park authorities in the matter, as we understand the Borough Laws of New Jersey. Those people on Rosedale Avenue who live in Madison could, presumably as individuals, secure permission from the Floram Park authorities to build their house connections across the half of the avenue belonging to Floram Park and thus enter the outfall sewer leading to the disposal works. If this were not the case it would be perfectly feasible to build an 8-inch line of sewer along Rosedale Avenue on the half of the street owned by Madison and thus lead the sewage to a point near Main Street where it could enter the Main outfall sewer. You called our attention to the question of building this outfall sewer of cast iron pipe, perhaps laid above ground on concrete piers, in order that there might be an additional safeguard in preventing any leakage from the sewers entering the ground water and reaching the wells of the public water supply. This would cost about $5,000 more than a tile line reinforced with concrete rings at the joints. In our opinion it is not necessary from a sanitary standpoint. Should it be the wish of your Commission or of the Council to put in a cast iron force main as a further safeguard for sentimental reasons it would, of course, be a simple matter to change the plans and specifications to carry out your instructions. In discussing the site for the disposal works, a number of locations have been considered, namely, in the lower portion of the valley of Spring Garden Brook quite near the Passaic River; in the valley east of Spring Garden Brook and in which low ground the wells of the public water supply of Chatham are located; and also the low lands to the south of Madison in the vicinity of what is spoken of as the "Great Swamp." To enable the disposal plant of the borough to operate properly during times of high water it will be necessary to pump the sewage to either of the first two of the three sites mentioned above. Obviously it would have to be pumped to the Great Swamp. It also would be necessary to secure the consent of the Floram Park authorities to locate in their territory near the Passaic River, and of the Chatham Township authorities to locate either in the neighborhood of the Chatham Water Works or near the Great Swamp lying south of Madison. The reason of this is that the Borough Laws require that before a sewer of one community crosses the highway of another community, the consent of the latter must first be formally obtained. We shall leave to you the question of informing the Council as to the probabilities of being able to secure such consent in order to make possible any one of these sites. We dismiss them from consideration on the ground that they offer no greater or better sanitary advantages than the fully satisfactory site first described in this paragraph and that they would be needlessly expensive for the borough both as regards first cost and additional cost for pumping. These additional costs above that for the site recommended may be briefly summed up for the three sites approximately as follows:

	Near Passaic River.	Near Chatham Water Works.	Near Great Swamp.
Additional investment for construction work	$24,000	$14,000	$21,000
Operating expenses, chiefly for pumping, capitalized at 5 per cent	40,000	37,000	80,000
Total additional cost	$64,000	$51,000	$101,000

The above costs are on the basis of pumping 400,000 gallons of sewage daily, equivalent to a population of about 4,000 actually connected with the sewers. As the population increased the cost would increase both for equipment and maintenance.

16. *Kind of Works.* The proposed sewage disposal works as detailed on the drawings will consist of:

(a) Covered septic tanks.
(b) Primary and secondary contact beds filled from below.
(c) Settling basins.
(d) Sand filters.

These works are the most efficient and suitable which can be applied to local conditions.

17. *Other Methods Considered.* An intermittent sand filter plant, such as used so generally in New England, is not applicable owing to the absence of suitably located tracts of porous sandy soil. Sprinkling filters, in which the sewage in the form of a spray is thrown over beds of broken stone and which are coming rapidly into use in this country and abroad, are not applicable at Madison owing to inability to deliver the sewage to such filters without pumping. Contact filters, as recommended, can be used without pumping.

18. *Septic Tanks and Contact Filters* These structures, built of concrete, are in accordance with successful practice in several dozen plants in this country and scores of plants in Europe. Covered septic tanks of a capacity of about 150,000 gallons will be arranged in two compartments and well baffled. The sewage enters these tanks after passing through two sets of screens. As it flows through the tanks about two-thirds of the suspended matters in it become deposited. The partially clarified sewage by means of automatic controlling apparatus then successively passes through the primary and secondary contact filters. These contact filters cover a total area of two-thirds of an acre and are filled with broken stone 4 feet in depth. They differ from any others used in this country in that they are provided with a false bottom to guard against clogging, and the septic tank effluent will be applied to them from below to within about 6 inches below the top of the broken stone. These contact filters are recommended after careful scientific investigations of their merits both in this country and abroad and also after personal

examination of their behavior in practice in England and Germany. Compared with contact filters filled from the top they have the advantages of less frequent clogging and also of being able to prevent the sewage from being exposed to view until it has passed beyond the odor-producing stage. After passing through these filters the sewage will not putrefy upon standing. This degree of purification suffices at a great many plants. Under local conditions, however, this non-putrescible but somewhat turbid effluent is subjected to additional purification, in a manner resembling water purification practice.

19. *Settling Basins and Sand Filters.* The effluent of the secondary contact filters passes through a small settling basin holding about 50,000 gallons and in which a large portion of the remaining solid particles are deposited. The effluent from the settling basin then passes through a sand filter one-half acre in area and thence to Spring Garden Brook. The size and arrangement of each individual portion of the plant may be seen from the drawings.

20. *Degree of Purification.* The final sand filter effluent will be clear and bright in appearance and will easily meet what is ordinarily spoken of as "99 per cent. of purification." Practically, this means that there will be a removal ranging from about 97 to 99.5 per cent. of the bacteria and other objectionable constituents of the original sewage. A higher purification than this is never attempted in practice to our knowledge; indeed it is seldom equalled.

21. *Appurtenances.* On the drawings are shown roadways, walkways around the works, a building over the screen chamber, in which is located a laboratory and tool room, all necessary pipes, drains, manholes, etc.

22. *Odor.* There will be no objectionable odors resulting from the operation of these works in the hands of an intelligent caretaker. Indeed the sewage is not exposed to view until it has passed beyond the odor-producing stage on its way to the high degree of purification stated above.

23. *By-passes.* The automatic devices will consist of a set of carefully arranged siphons for controlling the flow of the sewage through these works. They and all other portions of the works are arranged so that there will be no by-pass or "back door" through which the sewage in an unpurified state can reach Spring Garden Brook. All of the sewage must be purified.

24. *Sludge.* The solid matters accumulating in the septic tank from the sewage which will contain practically no street wash, will be liquified to a large extent by bacterial decomposition. Under similar conditions septic tanks in a number of places in this country have served several years without cleaning. When the residual sludge is then removed it has been reduced to an enert, inodorous humus mass which can be applied to land without any trouble from odors, or it can be disposed of in other ways. Several times each year the sludge accumulating in the settling basins and coming from the effluent of the contact filters will require removal. This sludge in non-putrescible and inodorous, resembling top soil in a field. The septic tanks and settling basin will drain to a manhole as shown on the drawings and in which will be placed a pump connected with a portable motor for pumping the sludge to a suitable point of disposal. None will enter Spring Garden Brook.

25. *Maintenance.* There are no complicated devices or structures needing expert attention in these disposal works as designed. Like every sewage dis-

posal plant, its operation should be placed in the hands of an intelligent and faithful caretaker. We do not mean a skilled engineer, but a man who could be secured for $100 per month. The laboratory building is provided and it is expected that the caretaker will daily make a number of simple, practical tests to show the borough and State authorities that the plant is uniformly doing the work expected of it. In fact, in order to overcome the criticism of neglect in the management of disposal works, which is frequently heard in this country, we consider it highly desirable to increase the analytical supervision of the works. For Madison this would presumably mean two regular attendants, one of whom would be an analyst and the other a laborer to do outside work. In addition to the one or two regular attendants extra labor will be required from time to time to remove sludge from the septic tanks and settling basin and to care for the grounds. The regular force can care for the sand filters. The contact filters will not need cleaning oftener than once in five years. As the material is somewhat coarser than that generally used in such filters, and as there will be no surface clogging, it is expected that this period between cleanings will be substantially greater than that above stated. When the contact filters become clogged, it will be necessary to take out all of the material, clean it with water and replace it at a total cost of about $2,600, according to experience elsewhere. The annual cost of maintenance would range from $1,500 to $2,000, depending upon the amount of analytical supervision, but exclusive of the cost of cleaning of the contact filters. Including this periodical cleaning the average annual cost will range from about $2,000 to $2,500.

26. *Capacity.* These works have an average capacity of 400,000 gallons daily. For short intervals they can treat much more than this. The average water consumption in Madison is now 200,000 gallons daily, but this figure is largely increased during very dry weather and during wet weather there is more or less leakage into the sewers as already stated. For the first year or two it would be possible to get along with works somewhat smaller than those shown on the drawings, but the saving in interest would not equal the increased cost of extending such works a little later. These works will serve a population of fully 4,000 people actually connected with the sewers.

27. *Extensions.* These disposal works are designed so that additional units can be readily added as required in order to treat the increased flow of sewage coming from extensions to the sewer system.

PUMPING STATION

On North Street a pumping station will be required at the location shown on Sheet No. 1 of the drawings. It will consist of a small receiving chamber into which the sewage of this drainage district will flow by gravity. Thence the sewage will be pumped to the main district, through a cast iron force main extending to Ridgedale Avenue, by three small centrifugal pumps connected to motors, to be operated by electricity furnished by the borough plant. The pumping devices will be automatic in operation, a set of floats in the receiving chamber stopping and starting the motors as required. The details are shown on Sheet No. 13 of the drawings. Operating expenses will be but little, as the electric current will mean only a small increase in coal consumption at the present borough plant, and the only labor normally required will be for an attendant on other portions of the work to visit this little station twice daily to oil the bearings and remove the solid matters retained by the screens.

COST OF SEWERAGE AND SEWAGE DISPOSAL WORKS.

At present prices for labor and materials the cost of these works as shown in detail in the "Notice to Bidders," is liberally estimated, without any allowance for the cost of land for the disposal works or private rights-of-way for sewers, as follows:

11.32 miles of sewers, including outfall sewer to disposal works and all appurtenances, as specified	$65,600
Disposal works, complete	29,500
North Street Pumping Station with cast iron force main, complete.	5,200
	$100,300
Add for supervision and contingencies, 15 per cent	15,000
	$115,300

We recommend that application be made to the Council for the authorization of a system of sewers and sewage disposal works in accordance with the plans herewith submitted at a total cost not exceeding $125,000.

It is proper to add that it is quite rare for communities to pay by bond issue for the entire cost of sewerage and sewage disposal works. Sewage disposal works, pumping stations and outfall sewers are usually paid for in this way. The remainder, or what is frequently spoken of as "the collecting system," is usually paid for to a large extent by assessments on abutting property owners. The application of the assessment method varies widely in different places, depending on local laws and customs.

A fair custom in our opinion is to have abutting property owners pay the average cost of a 5-inch sewer from the street sewer to the curb line and also the average cost of the minimum size street sewer which in this case is 8 inches in diameter. If this procedure were adopted in Madison it would mean that about $45,000, or roughly one-third of the work to be done would not require a bond issue, but could be paid for temporarily by certificates of indebtedness. These certificates could be retired by assessing the abutting property owners the cost of their connection from the center of the street to the curb line and also about 45 cents per foot front to cover the cost of the 8-inch street sewer.

Very truly yours,

HERING & FULLER,
Engineers.

MANASQUAN AND SHARK RIVERS AND MINOR STREAMS IN EASTERN MONMOUTH COUNTY.

At a meeting of the Commission held August 15, 1907, the secretary was directed to have an inspection made of sources of pollution of the Manasquan and Shark Rivers.

At a meeting of the Commission held August 29, 1907, Commissioner Herbert reported that he had inspected the sewerage system of the Borough of Manasquan on August 27, 1907, and found that the septic tank was in good condition; that no odor was noticeable from it and that there were no signs of pollution on the beach; that Mayor Wilmer E. Hoskins and W. K. Potter, C. E., of Manasquan, and W. Pierce, bathing master at Brielle Beach, together with several other individuals complained of the pollution of the Manasquan River and its branches by the discharge of crude sewage into them, principally from the State Camp at Sea Girt, as well as from several minor sources, including a private school, several hotels, boarding houses and private residences; that on August 28, 1907, he inspected the State Camp at Sea Girt and found that all of the sewage from the camp grounds was discharged through sewers directly into a tidal branch of the Manasquan River, from which crabs were at that time being caught, and that he was informed that oysters and clams were taken from the same branch of the river and shipped to market; that he recommended that at an early date action be taken in relation to the pollution of the Manasquan River.

The secretary was directed to have the streams discharging into the Atlantic Ocean in Monmouth County inspected.

At a meeting of the Commission held September 12, 1907, a report of this inspection was received by this Commission, and the secretary was directed to notify all the parties reported to be polluting these streams to show cause at a meeting of the Commission to be held October 3, 1907, why they should not be notified to cease polluting the same. Notices were sent to twenty-seven parties reported to be polluting the Manasquan River, eleven parties reported to be polluting the Shark River, and five parties reported to be polluting Deal Lake.

In response to these notices, communications were received from twenty-four parties, and L. J. Potter, C. A. Sofield, Charles Hopper and Daniel Gerloch appeared before the Commission at its meeting held October 3, 1907.

L. J. Potter stated that he had an overflow from the cesspool running into the river and that he was ready to remove it when other sources of pollution were removea.

C. A. Sofield stated that he had no sewer discharging into the Manasquan River.

Charles Hopper stated that he had an overflow pipe from a cesspool discharging into the river, but that he did not know how to purify the effluent from the cesspool without endangering his water supply, and that he would be glad to prevent pollution if it were possible.

Daniel Gerloch stated that he conducted a large private school on the Manasquan River, and had a double cesspool, the effluent from which ran into the river; that he would be glad to take any proper steps to purify the effluent from this cesspool, and asked that he be advised in relation to the matter.

The secretary was directed to employ an engineer to report on the provision of purification for the sewage from the properties of D. Gerloch and L. J. Potter.

G. E. Hill, C. E., was employed for this purpose, and his reports are as follows:

October 31st, 1907.

To the Honorable the State Sewerage Commission of New Jersey:

GENTLEMEN—In obedience to your commands, I visited Brielle and examnied the property of the Gerloch School. I beg to submit the following report.

About twenty-five people (staff, pupils and servants) contribute to the flow of sewage. The average daily consumption of water is said to be 3,000 gallons. Engine drip and radiator wastes go into the sewer. The lowest plumbing fixtures in the building are in the basement, and the drain which receives the wastes from these lies about two feet below the surface of the ground and about four feet above high tide. (These elevations are estimated and approximate only. No levels were taken.)

All sewage discharges into one drain, which leads to a cesspool, 25 feet from highwater mark on the bank of the Glimmerglass, a tidal estuary of the Manasquan River. This cesspool is rectangular, fifteen feet long, six feet wide and eight feet deep, lined with 8-inch brick walls, and covered with flagging, save where removable wooden strips are inserted in lieu of manhole covers. From the cesspool a wooden box-drain overflow leads to an outlet on the mud flat just below highwater mark. Through the mud, the trickling stream of sewage has cut a tiny tortuous channel, and this is slimed with grease and coated with sewage fungus. A considerable area of bottom beyond and below the outlet shows plainly the evidences of pollution by sewage.

The land owned by the school, and lying between it and the water, is barely half an acre. Frontage on the stream is but thirty feet wide. The soil is fairly porous.

Satisfactory purification of the sewage can be secured without serious expenditure. The old cesspool should be abandoned, cleaned out and filled with fresh earth. A septic tank should be built, and the effluent from this delivered intermittently, by a shallow-siphon flushtank, alternately to two sand beds located on the water front. To facilitate the care of these beds and minimize the amount of scraping, the sewage delivered to each bed should pass first through a small screening apron filled with coal, coke or screened cinders, which will withhold the greater part of the greasy and gelatinous particles escaping from the septic tank. The screening material can be renewed from time to time (a wheelbarrow load or two for each apron will be sufficient) and the clogged material burned under the boilers.

An alternate, and possibly desirable, method of disposing of the septic tank effluent would be by application, on the ridge-and-furrow system, to the vegetable garden. I am not sure that this can be reached by gravity; but, as the school owns and operates its own power plant, as the volume of sewage is small and as the lift necessary to reach the garden would not exceed one or two feet, the net expense of pumping would be negligible. The provision of a small low-level filter-bed, fed by an overflow pipe, would preclude trouble, should the pumps break down, or the engineer be inattentive.

Respectfully submitted,

G. EVERETT HILL.

October 31st, 1907.

To the Honorable the State Sewerage Commission of New Jersey:

GENTLEMEN—I beg to submit the following report, ordered by you, concerning the disposal of sewage from the residence of Mr. L. J. Potter, at Brielle, N. J.

The house lies on the bank of the Manasquan River, separated from the water by a lawn of about forty feet depth, a street, and a narrow strip of land beyond the street. The family is small and the volume of sewage will probably never exceed five hundred gallons a day. Bath and water closet wastes flow into a cemented cesspool behind the house,—a hundred feet or more from the river, and the overflow from this passes into a leaching cesspool close beside the first. The tight cesspool is cleaned out yearly. Kitchen-sink wastes and the discharge from the laundry tubs enter the river through a graver danger, however, in the discharge of laundry-wastes; for the introduction of pathogenic organisms is possible.

Although considerable organic matter may enter the river from the kitchen-sink, it will consist of uneaten particles of food thrown away before infection with typhoid bacilli or other specific disease germs is probable. There is small drain-pipe, but no other fixtures are connected with this drain. The house stands well above high tide and there are no plumbing fixtures below the first floor level. In winter the house is closed.

There are land enough and fall enough between the house and the river to put in a system of subsurface irrigation tile, and the introduction of such a system would be wise. I do not, however, consider it imperative. The leaching cesspool passes water freely, and the ground around it has a chance, while the house is closed, to recuperate from its summer saturation. I believe that all requirements will be met, at least for a time, if the kitchen and laundry wastes be turned into the cesspool and the outlet to the river be closed.

Respectfully submitted,

G. EVERETT HILL.

At a meeting of the Commission held September 26, 1907, the secretary was directed to request the Quarter Master General of the Militia of the State of New Jersey to meet with the Commission at its meeting to be held October 10, 1907, for the purpose of considering the disposal of sewage at the State Camp at Sea Girt.

At a meeting of the Commission held November 14, 1907, the secretary was directed to communicate with the Quartermaster General of the Militia of the State of New Jersey, calling his attention to the previous communication of the Commission in relation to the sewage at Sea Girt which had remained unanswered, and again requesting him to meet the Commission for a conference in relation to this matter.

At a meeting of the Commission held November 21, 1907, a communication was received from Quartermaster General C. E. Murray, in relation to the disposal of sewage at the State Camp at Sea Girt, stating that by mistake the previous communication of the Commission had remained unanswered, and suggesting that the Commission have an inspection made of the camp and furnish his office with advice in relation to the proper disposal of the sewage from the camp grounds.

The secretary was directed to employ an engineer to report to the Commission as to the proper disposal of sewage at the State Camp at Sea Girt.

The inspection made of Monmouth County streams included Takanassee Lake, Deal Lake, Sunset Lake, Wesley Lake, Duck Pond, Shark River, Lake Como, Spring Lake, Wreck Pond and the Manasquan River. In most of these inspections, no pollution was found.

The individual cases referred to above are included in a list of individual cases of pollution in the appendix to this report.

MEDFORD.

At a meeting of the Commission held May 16, 1907, a communication was received from L. L. Sharp, M. D., a member of the Board of Health of the Township of Medford, complaining of a nuisance caused by the improper disposal of sewage at Medford.

The secretary was directed to notify Dr. L. L. Sharp that the Commission would have an inspection made of the nuisance complained of at Medford.

At a meeting of the Commission held June 20, 1907, a further communication from Dr. Sharp in relation to the complaint of nuisance at Medford was received.

Mr. Herbert was appointed a committee of one to investigate the complaint made by Dr. Sharp of the nuisance caused by the improper disposal of sewage at Medford.

At a meeting of the Commission held June 27, 1907, Commissioner Herbert reported that he had visited Medford and met Dr. Sharp and other members of the local Board of Health on June 24, 1907, and had made an inspection of Medford; that the complaint was that the sewage from a hotel in Medford ran into the street gutters; that the inspection showed that the sewage ran into an abandoned well, and when necessary, it was pumped out and allowed to run over the surface of the ground, where it formed pools, and was either dried by evaporation or washed into a branch of Rancocas Creek, two thousand feet away, in time of rain; that pollution was extremely remote, and that in his opinion it was a case for the local Board of Health and not for the Commission, and that he had so advised the Board of Health; that he had inspected Haynes Creek at Medford, and found that a private sewer about fourteen hundred feet in length, of 6-inch pipe, and having twenty-three house connections, had been constructed on Bank Street in Medford, discharging into Haynes Creek, about three years ago, without the approval of the Commission; that as originally constructed, two circular tanks had been placed at the outlet, one seven and one-half feet in diameter and six and one-half feet in depth, from which a pipe led to the second, fourteen feet in diameter and six feet in depth; that the connecting pipe had become clogged and was not being used; and that the sewage passed through the first tank only; that in this tank there was a fair septic action, but that the effluent was dark and offensive; that it was discharged through a small creek in the adjoining meadow for a distance of about three hundred feet, where it reached

Haynes Creek at a point about four and one-half miles above the intake of the Lumberton Water Company; that he also found four privies belonging to houses owned by the Star Glass Company situated on Mill Street; that these privies were directly on the bank of a small spring run about two hundred feet in length, which drained directly into Haynes Creek; that it was proposed to install a sewerage system at Medford, and that the preliminary steps were now being taken toward that end; that he recommended that the Commission take action in relation to the pollution caused by the parties using the sewer at Medford, and also in relation to the Star Glass Company.

This report was received and filed, and the secretary was directed to notify the Star Glass Company and the parties using the sewer in Bank Street in Medford to show cause at a meeting of the Commission to be held July 11, 1907, why they should not be notified to cease polluting Haynes Creek.

At a meeting of the Commission held July 11, 1907, communications from the Star Glass Company, S. D. Haines, Martha J. Hewitt and Edward B. Reeve, Cashier of the Burlington National Bank, in relation to the pollution of Haynes Creek at Medford, were received.

At the same meeting, W. B. Cooper of Medford, appeared before the Commission and stated that he represented all the parties to whom notice had been sent by the Commission to show cause why they should not be notified to cease polluting Haynes Creek except the Star Glass Company; that all of the other parties were connected with one sewer which had been constructed about two years before in ignorance of the law requiring the approval of the Commission; that there were connected with the sewer twenty sinks, ten closets and seven bath tubs; that it was provided with a double cesspool, from which there was no direct connection with the creek, and that the effluent from the second cesspool soaked away through the ground and caused no nuisance; that owing to an overflow, one of the parties in the neighborhood had broken the tank open some time before in order to allow the sewer to discharge more rapidly, and that since then the sewage flowed over the ground into the creek, causing pollution as stated by Commissioner Herbert in his report of inspection, but that since the date of inspection the tanks had been repaired and cleaned and are now in proper shape and cause no nuisance. He requested that no action be taken in the matter until such time as a proper sewerage system should be provided at Medford.

At the same meeting, the following resolution was adopted:

"*Whereas,* The State Sewerage Commission has found that the waters of Haynes Creek are being polluted to the injury of inhabitants of this State in their health, comfort and property; therefore, be it

"*Resolved,* That in pursuance of chapter 72 of the laws of 1900, and the supplements and amendments thereto, the State Sewerage Commission hereby gives notice to the Star Glass Company that it must cease to pollute the waters of Haynes Creek before the fifteenth day of August, 1907, and make such disposition of its sewage or other pollution matter as shall be approved by this Commission."

The secretary was directed to have a notice in writing served in accordance with the foregoing resolution.

At a meeting of the Commission held July 25, 1907, a communication was received from Dr. Sharp, inquiring whether the Commission would object to the additional use of the sewer in Bank Street by six or seven more houses, provided that the tanks into which the sewage was discharged were enlarged if it became necessary.

The secretary was directed to reply that the Commission would not object to the additional connections to the sewer in Bank Street, provided that proper precautions be taken to prevent any pollution of Haynes Creek.

MERCHANTVILLE.

At a meeting of the Commission held April 30, 1906, the Commission approved of plans submitted by the Borough of Merchantville providing for a sewerage system and purification plant located in the Township of Pensauken, on Cedar Run.

At a meeting of the Commission held June 10, 1907, a communication was received from Herbert A. Drake, as attorney for various citizens and property owners in the Township of Pensauken, together with a petition from these parties requesting the Commission to order a change in the location of the proposed sewage disposal plant of the Borough of Merchantville.

The Commission decided to hold a public meeting at Merchantville on June 13, 1907, for the purpose of hearing objections to the plans which had been approved by the Commission, and to inspect the proposed site of the Merchantville disposal plant. The secretary was directed to give notice of this meeting to all interested parties.

The Commission met at Merchantville June 13, 1907, and held a hearing at the Borough Hall in relation to the proposed sewage disposal plant of that borough. There appeared before the Commission William Longstreth Mayor; A. W. MacCullum, W. D. Wickel, H. E. Bodine and William P. Phelps, Members of Council, W. P. Stewart Clerk; William Early, Solicitor, and G. E. Hill, Engineer, of the Borough of Merchantville, and Herbert A. Drake, G. Genge Browning, Henry B. Hanford, Jonathan Cox, Atley Bingham and Edward Pettigree. The chairman annouced that the meeting was held for the purpose of considering a petition submitted by Herbert A. Drake as solicitor for a number of citizens and property owners, requesting the Commission to require a change in the site of the proposed sewage disposal plant for the Borough of Merchantville, plans of which had been approved by the Commission.

Mr. Drake stated that on behalf of the owners of the property on which the disposal plant was to be located and of adjoining property and on behalf of citizens residing in the neighborhood, he desired to make objection to the proposed location of the Merchantville sewage disposal plant on property in the Township of Pensauken; that the plant should be located in the Borough of Merchantville; that the sewage system would be of no use to people residing in the neighborhood in which it was desired to locate the plant; that the site was chosen and the proceedings taken to have the plans approved without notifying the parties now objecting; that proceedings had been taken to condemn the property and that these proceedings had been certioraried and the case was now being considered by the Supreme Court; that an injunction against the borough had been applied for to restrain it from proceeding with the construction of the plant, and that the injunction had been refused; that objection was also made on the ground that Cherry Run, into which it was proposed to discharge the effluent, was a private stream and was sometimes used for drinking water supply, and that adjacent owners were entitled to have it kept pure; that it was not a tidal stream, and that the location of the proposed plant at that site would reduce the value of property in the neighborhood. He suggested the location of the plant at various points in the Borough of Merchantville.

G. E. Hill, Engineer for the Borough of Merchantville, explained the plans which had been prepared for the borough sewerage system and disposal plant, and stated that the site chosen was almost an ideal site for a disposal plant; that it could be reached by gravity with sufficient fall to allow of the operation of the disposal plant by gravity; that his surveys showed that the sites suggested by Mr. Drake in the Borough of Merchantville were not practicable without expensive pumping, and that no other outlet could be used by the borough on account of the grades without expensive cuts through hills. He stated further that the sewage would be treated by a septic tank, contact filters and sand filters, and that the effluent would be purified to such an extent that there would be no danger of any nuisance; that the nearest houses were a considerable distance away; that the plant would be located in a hollow with a small hill between it and the road on which the houses fronted; that there was a sufficient flow of water in Cherry Run to dilute and carry away the effluent from the disposal plant, and that the site chosen was the only one which could be used without prohibitive expense; that the grade of the main outlet of the sewerage system and of the disposal plant was such that all of the houses in the neighborhood of the disposal plant could make use of it, and that a large part of the Township of Pensauken could easily be provided for by the sewerage system of Merchantville according to the plans approved by the Commission, and that negotiations had been entered into and that the borough had agreed to provide sewerage facilities for as much of the township as desired it at about the same rates to be paid by the properties in Merchantville.

Mr. Early stated that he had made inquiries as to the use of Cherry Run for drinking purposes and learned that it was only so used when the wells in the neighborhood ran dry, and that this had only happened twice in thirty-five years; that the stream ran through a swamp which made it difficult to approach the stream and that no practical use was made of it.

The Commission then inspected the proposed site of the sewage disposal plant of the Borough of Merchantville and the neighborhood of the site. At the same meeting, the following resolution was adopted:

"*Resolved,* That the State Sewerage Commission hereby denies the petition of certain property owners and residents in the Township of Pensauken requesting the Commission to order a change in the site of the proposed sewage disposal plant of the Borough of Merchantville."

METROPOLITAN SEWERAGE COMMISSION.

During 1906, the Metropolitan Sewerage Commission was appointed by the Mayor of the City of New York for the purpose of investigating means for the protection of the waters of New York Bay and vicinity against pollution. This Commission met with the State Sewerage Commission on October 5, 1906, for the purpose of outlining a plan of joint action for the two commissions. Committees were appointed by each commission for the purpose of conferring in relation to this work.

At a meeting of the Commission held March 11, 1907, the committee of the State Sewerage Commission reported that it had consulted with the committee of the Metropolitan Sewerage Commission on February 28, 1907; that it had been requested to go on record as to the extent that this Commission would co-operate with the New York Commission in reference to the objects for which the latter was created, and that it had decided not to give a definite answer to this question until it had reported to this Commission; that the committee of the Metropolitan Sewerage Commission had stated that it was the intention of that committee to frustrate any attempt on the part of the State of New Jersey or of any municipality of that State to empty sewage into New York Bay, and that it possibly would oppose other claims of rights in New York Bay made on behalf of the State of New Jersey; and it further stated that the Metropolitan Sewerage Commission would probably have one hundred thousand dollars to expend in its investigations. The secretary was directed to notify the Metropolitan Sewerage Commission that the Commission was prepared to co-operate with it in its work.

At a meeting of the Commission held May 6, 1907, a communication was received from A. J. Provost, Jr., secretary of the Metropolitan Sewerage Commission, expressing the pleasure of the Metropolitan Sewerage Commission at learning that the State Sewerage Commission was prepared to co-operate with it, and suggesting that a joint meeting of the committees of the two commissions appointed to confer be held.

The secretary was directed to acknowledge the receipt of this communication and to arrange for a time of such a meeting to be held.

At a meeting of the Commission held May, 16, 1907, a further communication was received from A. J. Provost, Jr., in relation to the joint conference.

No further action was taken in relation to this matter and the Commission is informed that the Metropolitan Sewerage Commission has discontinued its work.

MONMOUTH COUNTY SEASIDE RESORTS.

At a meeting of the Commission held June 27, 1907, Commissioners Herbert and Jacobson were appointed a committee to inspect the disposal of sewage at the seaside resorts in Monmouth County.

At a meeting of the Commission held July 11, 1907, this committee reported that it had inspected a number of seaside resorts in Monmouth County, and would make a report of its work at a subsequent meeting.

At a meeting of the Commission held July 18, 1907, Commissioner Herbert reported that the committee appointed to inspect the seaside resorts in Monmouth County had examined all of the sewerage systems along the shore in Monmouth County, and that a request had been received by the committee that a representative of the Commission attend a meeting of the Borough Council of Spring Lake on Monday evening July 22, 1907, for the purpose of consultation in relation to sewerage purification.

Commissioner Herbert was appointed a committee of one to consult with the authorities of the Borough of Spring Lake in relation to its sewage.

At the same meeting a communication was received from James J. Phelan, President of the Allenhurst Association, of Allenhurst, inquiring as to the power of the Commission to stop the pollution of the bathing beaches in Monmouth County by sewage, and stating that the Allenhurst Association desired to take action to assist the Commission in stopping this pollution.

The secretary was directed to reply, informing the Allenhurst Association that the Commission was inspecting the sewerage systems of the seaside resorts in Monmouth County, and thanking it for its desire to assist the Commission in the matter.

At a meeting of the Commission held July 25, 1907, Commissioner Herbert reported that he had consulted with the Mayor and Council of the Borough of Spring Lake, at a meeting of the Council held on July 22, 1907, in relation to the proper disposal of the sewage of the borough.

At the same meeting, the committee appointed to inspect the disposal of sewage at the seaside resorts in Monmouth County, reported that the sewerage systems at Deal, Allenhurst, Loch Arbour, Asbury Park, Ocean Grove, Bradley Beach, Avon, Belmar and Spring Lake were polluting the Atlantic Ocean and the bathing beaches, and recommended that the authorities of these municipalities should be given a hearing at an early date as to why they should not be notified to cease polluting the Atlantic Ocean.

At the same meeting, the Commission decided to meet at Asbury Park on August 1, 1907, and the secretary was directed to notify the authorities of the City of Asbury Park, the Boroughs of Spring Lake, Belmar, Avon, Bradley Beach and Allenhurst, the Ocean Grove Association and the East Jersey Coast Water Company to show cause at a meeting of the Commission to be held at Asbury Park on August 1, 1907, why they should not be notified to cease polluting the Atlantic Ocean, and to make such disposition of their sewage and other polluting matter as shall be approved by this Commission.

The Commission met at Asbury Park on August 1, 1907. There appeared before the Commission in response to notices to show cause why they should not be notified to cease polluting the Atlantic Ocean: Reverend A. A. Ballard, D. D., Vice President of the Ocean Grove Association, and J. H. Alday, its sanitary officer; Charles A. Atkins, Mayor, Councilmen C. S. Swain, and T. J. Winckler, and John L. Coffin, Superintendent of Sewers of the City of Asbury Park; William Hogencamp, Mayor of the Borough of Deal; J. M. Ralston, Mayor, and A. M. Hyatt, Councilman of the Borough of Allenhurst; and A. H. Kneen, General Superintendent, and C. A. Buck, Assistant Superintendent of the East Jersey Coast Water Company.

The Chairman stated that the notices had been issued and the meeting called for the purpose of a consultation between the State Sewerage Commission and the municipalities and parties interested in relation to the protection of the bathing beaches and shore front properties from injury by pollution of the Atlantic Ocean by sewage from the seaside resorts in Monmouth County; that under the amendment of the law in relation to the State Sewerage Commission, enacted during the present year, the Commission had jurisdiction to prevent such pollution; that an inspection made by a committee of the Commission showed that sewage pollution existed along the whole seashore of Monmouth County, and that the Commission desired to obtain the co-operation of the parties interested in removing this nuisance and to consult with them in relation to the length of time which would be needed to carry out the provisions of any order which the Commission might make in the matter.

Reverend A. A. Ballard, D. D., stated that he was the Vice-President of the Ocean Grove Association; that he did not think that the sewage of Ocean Grove was causing any pollution; that the sewage passed through a screening chamber where the coarser solids were screened out, and was then discharged at a depth of thirty-seven feet in the ocean twelve hundred feet from shore; that there was trouble along the beach from refuse which was emptied from scows at sea by the City of New York, and which floated in-shore; that T. J. Preston, of South Orange, had supervised the construction and operation of the sewer outlet, and that it was believed by the Association to be in good shape, and that there could be no cause for complaint; and that the Association would be glad to receive any advice for the purpose of improving the conditions which the Commission could give it.

John L. Coffin stated that he was the superintendent of Water and Sewers of the City of Asbury Park; that up to three years ago the city had two sewer outlets in the ocean, one four hundred feet from shore and the other two hundred feet; that this was found to be inefficient, and that in 1904 the city tried to remedy the conditions; that it employed F. Herbert Snow, C. E., who prepared plans for an eighteen-inch intercepting sewer to take the sewage to one outlet, and for a pumping plant, septic tank and outlet sewer running twelve hundred and twenty feet from shore; that the work was started in June 1905, and the interceptor and outlet were built; that there was opposition to the septic tank, as it had to be located two feet above tide, and needed to be protected from the tide, and because it would require a pumping plant to be constructed, which would be a nuisance on the beach, and that there were objections because of possible odors arising from the tank or pumping plant; that since the construction of the new outlet, constant inspection failed to show any sewage coming back; and that the Cameron Septic Tank Company demanded a royalty on the tank if it were constructed.

Mayor William Hogencamp, of the Borough of Deal, stated that the only trouble at Deal was caused by floating refuse from New York City, and that there were no complaints made of pollution by the sewage from Deal; that there were only 150 houses in Deal, the sewage from which was discharged from one outlet.

Mayor J. M. Ralston, of the Borough of Allenhurst, stated that Allenhurst pleaded guilty to polluting the ocean; that its beach was polluted; that it wanted something done and done quickly; that it was ready and had been for several years to do whatever the Commission desired, but that it had waited for similar action on the part of the other municipalities, as most of the pollution on its beach came from Asbury Park and Ocean Grove; that the borough desired to join with the East Jersey Coast Water Company in disposing of its sewage, because it only owned one-half of the street in which the outlet main was laid, and by joining with that company, it could secure the use of the entire width of the street for the construction of the septic tank.

C. A. Buck, Assistant Superintendent of the East Jersey Coast Water Company, stated that there were only 36 connections with the sewerage system of that company at Loch Arbour; that the sewage ran through a vault on the beach, in which was placed a screen to prevent the solid matter from being discharged; that the system was frequently flushed, and that the outlet pipe ran 500 feet from shore.

A communication was received from G. E. Hill, C. E., stating that he had been engaged by the East Jersey Coast Water Company, to represent its interests at the hearing in relation to the pollution of the Atlantic Ocean, but that he was unable to be present, and that the company would gladly listen to any recommendations that the Commission made.

The Chairman stated that the Commission was considering the advisability of notifying all of the municipalities along the Monmouth county shore to cease polluting the ocean prior to May 1, 1908, and asked whether that would be sufficient time for proper action by the municipalities represented. All of the parties present agreed that the pollution could be remedied by that time.

On motion of Mr. Herbert, the following resolution was unanimously adopted:

"*Whereas,* The State Sewerage Commission has found that the waters of the Atlantic Ocean are being polluted to the injury of inhabitants of this State in their health, comfort and property; therefore, be it

"*Resolved,* That in pursuance of Chapter 72 of the Laws of 1900, and the supplements and amendments thereto, the State Sewerage Commission hereby gives notice to the Ocean Grove Association, the City of Asbury Park, the Borough of Bradley Beach, the Borough of Belmar, the Borough of Spring Lake, the Borough of Deal, the Borough of Allenhurst, the Borough of Avon, and the East Jersey Coast Water Company, that prior to the first day of May, nineteen hundred and eight, they must cease to pollute the waters of the Atlantic Ocean, and make such disposition of their sewage or other polluting matter as shall be approved by this Commission."

The secretary was directed to have notices in writing served in accordance with the foregoing resolution.

At a meeting of the Commission held August 8, 1907, a communication was received from James J. Phelan, stating that the Allenhurst Association would be pleased to have an inspection made of the Beach at Allenhurst; that at times it was not fit to bathe there, especially since the sewage of Asbury Park had been discharged at one outlet, much of the sewage from which polluted the Allenhurst Beach.

The secretary was directed to reply, informing the Allenhurst Association of the action taken by the Commission in relation to the seaside resorts in Monmouth County.

At a meeting of the Commission held August 15, 1907, the committee appointed to inspect the disposal of sewage at the seaside resorts in Monmouth County reported that on August 10, 1907, it had inspected the sewerage system of the Long Branch Sewer Company, which delivered the sewage to a central point at which the sewage passed through coarse screens, and that from there a single outlet main discharged the crude sewage into the Atlantic Ocean. The Committee recommended that the Long Branch Sewer Company be notified to show cause why it should not be notified to cease polluting the Atlantic Ocean.

The secretary was directed to notify the Long Branch Sewer Company to show cause at a meeting of the Commission to be held August 29, 1907, why it should not be notified to cease polluting the Atlantic Ocean.

At a meeting of the Commission held August 29, 1907, a communication was received from W. A. Stevens, attorney for the Long Branch Sewer Company, acknowledging the receipt of the notice to the company, and requesting that on account of the absence of Mr. J. W. Slocum, the President of the Long Branch Sewer Company, the hearing be adjourned until the week beginning September 9, 1907.

The secretary was directed to notify the Long Branch Sewer Company that the hearing would be adjourned until the meeting of the Commission to be held September 12, 1907.

At a meeting of the Commission held September 12, 1907, John W. Slocum, president, and W. R. Warwick, superintendent of the Long Branch Sewer Company, appeared before the Commission in relation to the pollution of the Atlantic Ocean and the bathing beach.

Mr. Slocum stated that he was not familiar with what could be done by the company to purify its sewage, and that he would like to be advised by the Commission as to what could be done in the matter.

The secretary was directed to employ an engineer to examine the sewerage system of the Long Branch Sewer Company, and to report to the Commission what could be done by that company to prevent the pollution of the Atlantic Ocean.

At a meeting of the Commission held August 15, 1907, communications were received from Charles A. Atkins, Mayor, and John L. Coffin, Superintendent of the Department of Water and Sewers of the City of Asbury Park, in reply to a request for information as to the new sewers being constructed in Asbury Park, stating that plans for the new sewers would be submitted to the Commission.

At a meeting of the Commission held August 29, 1907, plans for separate sewers for the northerly part of Asbury Park and for a duplicate of the outlet main of the sewerage system of Asbury Park, to discharge into the Atlantic Ocean, twelve hundred feet from low water mark, were submitted to the Commission for its approval by John L. Coffin, Superintendent of Sewers of Asbury Park, on behalf of that city.

The secretary was directed to notify John L. Coffin to submit a further plan showing the location of the proposed new outlet main, and also to file a formal request for the approval of the plans submitted on behalf of the City of Asbury Park.

At a meeting of the Commission held September 5, 1907, an application for the approval of the plans submitted on behalf of the City of Asbury Park, providing for the construction of about ten miles of sewers in the recently annexed district of Asbury Park, the enlargement of the Lake avenue sewer, and the installation of a supplementary outlet pipe to discharge into the Atlantic Ocean twelve hundred feet from low water mark, together with a supplementary plan showing the proposed new outlet into the Atlantic Ocean, was received from John L. Coffin on behalf of the City of Asbury Park.

At the same meeting, these plans were approved by the Commission, subject to such conditions of construction, operation and purification as the Commission may from time to time require, and the secretary was directed to notify the authorities of the City of Asbury Park of the approval of the plans submitted on behalf of that city, and to inform them that the approval was made subject to the notice recently given to the City of Asbury Park to cease polluting the Atlantic Ocean prior to May 1, 1908.

At a meeting of the Commission held October 10, 1907, plans for the construction of a septic tank for the purification of the sewage from the sewerage system of the East Jersey Coast Water Company at Loch Arbour were submitted to the Commission by G. E. Hill, C. E., on behalf of that company.

At the same meeting these plans were approved, subject to such conditions of construction, operation and purification as this Commission may from time to time require.

At a meeting of the Commission held August 29, 1907, Commissioner Herbert reported that he had investigated the condition of the sewers in the Borough of Belmar on August 29, 1907, and found that the sewer in Fifth Avenue had become clogged and that it was broken at about low water mark and that the tide covered the break with sand, which backed the sewage up until there was sufficient pressure to blow off the sand and the sewage, which had become putrid in the meanwhile, would then be discharged on the shore, causing a nuisance to bathers and other persons in the vicinity.

The secretary was directed to communicate with the authorities of the Borough of Belmar, suggesting that action be taken to repair the break in the sewer laid in Fifth avenue.

At a meeting of the Commission held October 10, 1907, a communication was received from Carl Lentz, of Newark, stating that the authorities of the Borough of Belmar contemplated the construction of a new sewer outlet into the ocean at the foot of Third avenue in that borough, which was objected to by the citizens and tax payers in that section of the borough; that the present outlet at Fifth avenue, if repaired, would furnish the required sewerage accommodation, and requesting that the Commission take action to prevent the construction of a new outlet.

The secretary was directed to communicate with the authorities of the Borough of Belmar, suggesting that the sewer laid in Fifth avenue, Belmar, be repaired, as was heretofore recommended by the

Commission, and calling their attention to the law requiring the approval of all plans in cases where notices have been served by the Commission to cease polluting.

The secretary was also directed to acknowledge the receipt of the communication from Carl Lentz, and to furnish him with a copy of the communication sent to the authorities of the Borough of Belmar.

Plans for a septic tank for the disposal of the sewage of the Borough of Allenhurst were in course of preparation at the close of the fiscal year.

MORRISTOWN.

At a meeting of the Commission held February 11, 1907, plans for a system of sewers and for a sewage disposal plant consisting of a septic tank, primary contact filters and secondary sand filters, the effluent to discharge into the Whippany River, for the Town of Morristown, were submitted to the Commission by Williams, Proctor and Potts, engineers, together with an application for the approval of the plans from the Morristown Sewerage Commission.

At a meeting of the Commission held February 18, 1907, Clyde Potts, of the firm of Williams, Proctor and Potts, consulted with the Commission in relation to the plans for a system of sewers and disposal plant for the Town of Morristown.

The secretary was directed to notify Williams, Proctor and Potts that the plans submitted by them for a system of sewers and sewage disposal plant for the Town of Morristown were such plans as would be approved by the Commission when proper application for their approval should be made.

At a meeting of the Commission held April 1, 1907, a communication was received from Nathaniel C. Toms, Town Clerk of Morristown, stating that he had been directed by the Mayor and Board of Aldermen of the Town of Morristown to make application to the Commission for its approval of the plans for a sewerage system and sewage disposal plant for that town, previously submitted to the Commission by Williams, Proctor and Potts on behalf of the Morristown Sewerage Commission, at a meeting of the Commission held February 11, 1907, with the alteration that the lower end of the main trunk sewer be increased from twenty to twenty-four inches in diameter.

At the same meeting, the plans submitted on behalf of the Town of Morristown, providing for a sewerage system and sewage disposal plant consisting of a septic tank, contact beds and sand filters, the effluent to discharge into the Whippany River, were approved, subject to such conditions of construction, operation and purification as this Commission may from time to time require.

At a meeting of the Commission held June 20, 1907, Commissioner Capstick reported that he had been consulted by representatives of the Town of Morristown in relation to objections made by citizens and property owners to the proposed location of the Morristown sewage disposal plant.

At a meeting of the Commission held June 27, 1907, a petition from citizens and property owners in the Town of Morristown and the Townships of Morris and Hanover, requesting the Commission to rescind its approval of the plans for the location of the proposed sewage disposal plant for the Town of Morristown, was submitted by G. G. Frelinghuysen and C. Franklin Wilson.

At the same meeting, the Commission decided to meet at Morristown, Monday, July 8, 1907, for the purpose of holding a public hearing on the petition submitted by citizens and property owners to the Commission to rescind its approval of the location of the sewage disposal plant for the Town of Morristown, and for the purpose of inspecting the proposed site of the plant.

The secretary was directed to notify the interested parties and to request them to be present or represented at that meeting, and to suggest that no action be taken in relation to the contract for the disposal plant until the petition presented to the Commission had been disposed of by it.

The Commission met at Morristown July 8, 1907, and inspected the site selected for the proposed sewage disposal plant for Morristown, and also an alternative site about a mile further down the valley of the Whippany River.

The Commission also held a public hearing on the objections made by George G. Frelinghuysen and others to the proposed site of the sewage disposal plant at Morristown.

There appeared before the Commission George G. Frelinghuysen, Henry C. Pitney, Frederick V. Pitney, John O. H. Pitney, Grinnell Willis, Alexander C. Humphreys, Dr. Stephen Pierson, Charles S. Scribner, T. W. Brown, B. O. Chisholm, F. S. Smith, Frank Muir, John D. Canfield, Dr. S. C. Haven, Francis E. Woodruff, Isaac D. Lyon and other citizens and property owners objecting to the proposed site of the disposal plant, and J. B. Vreeland and C. F. Wilson, attorneys for the objecting parties, Willard W. Cutler, Emil Hertzig and E. S. Burke, members of the Board of Sewerage of Morristown, E. K. Mills, attorney of the Town of Morristown, Oliver K. Day, alderman, and Williams, Proctor and Potts, engineers, on behalf of the town of Morristown, and the Morristown Board of Sewerage.

C. F. Wilson, attorney for those objecting to the proposed site, stated that there were a number of citizens of Morristown and that vicinity present whom he desired to present to the Commission in order that they may state their views in relation to the matter.

George G. Frelinghuysen stated that he and other citizens and property owners in the vicinity of the proposed sewage disposal plant made objection to the proposed site because it was near residential property and because a better site could be chosen; that the objections had been made as promptly as they could be after it was learned what site was chosen for the disposal plant; that he and others had attempted to negotiate with the Board of Sewerage in order to secure the location of the plant at an alternative site on the Hill Farm further down the Whippany River, which was further away from the main road and from the residential property located near the site chosen, but that the Board had declined the offers made by him and others to exchange the Hill Farm for the property selected, although a right of way over the present property was offered and a site containing one hundred and sixty acres offered in exchange for one containing but nine acres.

Frederick V. Pitney stated that he had been employed as engineer by George G. Frelinghuysen, B. O. Chisholm and others to examine into the matter of the disposal of the sewage at Morristown, and had made a report which was read by him and filed with the Commission. In the report, he recommended the selection of the Hill Farm as the site for disposal in preference to the property chosen by the Board of Sewerage.

George G. Frelinghuysen read a letter from Rudolph Hering, C. E., stating that in his opinion a sewage disposal plant properly conducted at the site proposed would not be a nuisance, but that there would be sentimental objections to it, and that from information submitted to him it seemed that the Hill Farm would be a good location and that such a plant as had been designed for the other location could be constructed on the Hill Farm.

Henry C. Pitney stated that he had favored a sewerage system for twenty-five years and had tried to get one installed twenty years ago and at that time had employed an engineer and examined property for the purpose of selecting a place for a sewage disposal plant, and had selected a plot called the McEwan Tract near the Hill Farm, but that the matter was dropped for lack of interest and support; that he thought the Hill Farm was a better location for the plant because it was further from population than any other place reached by gravity; that in his opinion a sewerage plant should be as far away from population as possible; that the people of Morristown wanted the plant located at Hill Farm, and that it would be a mistake to locate the plant where it was proposed by the Board of Sewerage, as it would injure the Morristown school and other property; that there would be objections anywhere to the location of a disposal plant, and that it should be located where it would do the least injury; that sentiment could injure the value of property, and that he considered the laying of an iron pipe for the outlet sewer to be an unnecessary expense.

Grinnell Willis stated that he voted for the sewers but that the people of Morristown did not want to injure others, but wanted to place the plant where it would be the least offense, and that he thought such a location would be the Hill Farm.

Alexander C. Humphreys stated that he desired that the plans be reconsidered; that his estimates differed from those of the engineers, and that he questioned the reliability of the data of the engineers employed by the Board of Sewerage; that he had purchased 168 acres of land near Morristown, and expected to reside there for the rest of his life; that in his opinion the site chosen was unquestionably a mistake; that for a small saving, or no saving at all, a great injury would be done; and that in his judgment, there was no warrant for the use of iron pipe for the outlet sewer.

Dr. Stephen Pierson stated that he was a citizen of Morristown; that any sewerage plant located anywhere would be a nuisance to some extent, but thought that Morristown was willing to compensate for any damage done, and that the plant should be placed where it would do the least damage to property and population.

John Claflin stated that he was not personally affected by the location of the sewage disposal plant, but that he thought it would be a very great mistake to locate it so near to population as was proposed and on such a small piece of land and so near the Morristown school.

Richard W. McEwan, of Whippany, stated that he was a manufacturer of paper boards at Whippany; that the factory turned out one hundred tons each day; that the discharge of sewage into the river would do serious damage to his plant, which used river water in manufacturing; that the plans prepared for the proposed disposal plant provided for a by-pass to run crude sewage into the river in case the plant did not work; that he thought the Hill Farm would be a better location for the plant because there was more property and better provision could be made in caring for the sewage in case of an accident to the plant than could be made at the site chosen, because there was no additional ground between the plant and the river; that he requested that the change be made so that the works would not threaten his factory; that he had requested the Board of Sewerage to select some isolated place where there would be no damage caused, but that he had received no reply to his request; that the Town of Morristown had no permission from the Township of Hanover to use either location, they being both in that township, and that he did not think such permission would be given.

Willard W. Cutler, counsel for the Board of Sewerage of Morristown, stated that in his opinion the Board of Sewerage could not exceed the appropriation provided for at the election in favor of the sewerage proposition, and that the designs must be carried out substantially as submitted at the election; that the proposition for exchanging the properties made to the Board was that they should take an option to pay fifteen thousand dollars and turn over the property they had bought for sixty-eight hundred dollars, a net loss to the town of seventy-two hundred dollars; in addition to this, they would have to buy a right of way for some seven or eight thousand feet; that sand was not available; that the Hill Farm was less secluded and more open to objection than the site chosen; and that there had already been fifteen or twenty objections filed with the Board against the location of the plant on the Hill Farm.

E. K. Mills, attorney for the Town of Morristown, stated that the objections to the use of iron pipe and the proposition to save money by the use of other kinds of pipe should not be considered, because the town had already made a contract for the laying of iron pipe; that he believed an exchange of properties would cost the town seventy-five hundred dollars, besides the additional expense for a right of way, that his only interest in the matter was to keep the town from getting into trouble in making contracts.

F. C. Wilson stated that the offer made to the Board of Sewerage was to exchange the two tracts and that the Hill Farm would not cost the town anything more than the present site; that it was also agreed that the town should have a right of way over the present tract, and use the sand located on it if desired.

Clyde Potts stated that there were many of the statements and objections made by the opponents to the present site which could be controverted; that the cast iron to be used was not extra heavy as had been stated, but of the standard size.

The Chairman of the Commission stated that the Commission found no fault with the plans, the only objection being now considered was to the proposed location of the plant; that the Commission would approve of the change in location if it were requested to do so by the Board of Sewerage, but that he thought the plant would not be found to be a nuisance in either place, but that it was advisable for the Board of Sewerage and the opponents of the present site to come to an agreement if possible.

At a meeting of the Commission held July 18, 1907, the Chairman reported that he had held a consultation with the representatives of the Board of Sewerage of Morristown and the parties objecting to the proposed site of the Morristown sewage disposal plant, and that the parties in interest were trying to make an arrangement which would be satisfactory to both in relation to the location of the plant.

The report of the Board of Sewerage and part of the report prepared by Williams, Proctor & Potts, engineers, on the sewerage system of Morristown, are submitted herewith:

REPORT OF BOARD OF SEWERAGE.

To the Honorable the Mayor and Board of Aldermen of the Town of Morristown:

Gentlemen—The Board of Sewerage of the Town of Morristown, appointed by His Honor, Abram Q. Garretson, Judge of the Circuit Court of the County of Morris, under and by virtue of an act of the Legislature of the State of New Jersey, entitled "An Act to authorize incorporated towns to construct, operate and maintain a system of sewers, or a system of sewers and drains, and to provide for the payment of the costs of the construction, operation and maintenance thereof," approved April Third, One Thousand Nine Hundred and Two and Amendments thereto, hereby reports under the hand of its Chairman and Secretary its determination.

The members of the Board, having duly qualified according to law, met on the 13th day of April, 1906, and organized by the election of Rear Admiral Philip H. Cooper, as Chairman, and Eugene S. Burke as Secretary. Williard W. Cutler, Esquire, was appointed Counsel to the Board.

Morristown has reached a point in its growth where sewerage facilities are absolutely necessary to its general health and prosperity. There are to-day cesspools under buildings in Morristown which have to be pumped out from the cellar through the building to a vehicle in the street.

Furthermore, the streams flowing through the town are daily polluted by private drains and overflows from cesspools; the engineers estimate that more than a thousand people are so polluting these streams, so that when they are at a low stage, especially in the summer time, the raw sewage thus turned into them cannot be assimilated by dilution and an intolerable nuisance results therefrom.

The town is fully warranted in making the necessary expenditures, for aside from the necessity of considering the health of the people it is an indisputable fact that the introduction of a system of sewerage will very greatly enhance the value of real estate in the town and add to its prosperity. This matter being of so much importance to the community it is to be hoped that every taxpayer will carefully consider this and the Engineer's report.

After its organization the Board set out to determine the system of sewers most advantageous and for the best interests of the town.

Finding the maps, plans, estimates and data at its disposal entirely inadequate, the Board, after extensive inquiry respecting the different sanitary engineers who had been under favorable consideration, voted unanimously to employ Messrs. Williams, Proctor & Potts, of New York, to prepare and submit a report for the comprehensive sewering of the town, with a recommendation as to the best method of disposal. The Board of Sewerage, in submitting a report of its work feels that the exhaustive and excellent report of these engineers, herewith submitted, makes it unnecessary to state more than a few facts relating to the subject under consideration, which do not properly belong in the Engineers' report, but which may serve as an introduction to the same.

While the necessary surveys and plans were being prepared by these Engineers, the Board inquired into various methods for the disposal of sewage, considering first a connection with the Joint Outlet Sewer at Summit.

The Joint Outlet Sewer, completed in July, 1903, was built by eleven (11) separate municipalities in Essex and Union Counties, and runs from Summit to the Arthur Kill, a distance of twenty-three (23) miles. It was intended in the construction of this sewer to provide sufficient capacity for Madison, Morristown and Morris Plains (State Hospital), the extra capacity being taken by Summit with the idea of selling it to these municipalities when ready to connect with the sewer. Summit, however, is now unwilling to sell enough space for both Madison and Morristown, and, as the State Hospital has recently renovated its disposal system and will not entertain any proposition for connection with the Joint Outlet Sewer, the entire expense of connecting with the sewer would have to be borne by Morristown alone, if it should now adopt that system.

To connect with the Joint Outlet Sewer at Summit, Morristown would have to construct about fifty thousand (50,000) feet of open cut sewer, and either thirteen thousand (13,000) feet of tunnel under Hobart Hill, or establish a pumping station at this point to pump the sewage over the hill. There are so many objections to the establishment and maintenance of the pumping station that the Board could not consider it except as a last resort. The tunnel is feasible, but, owing to the uncertain character of the soil no engineer will guarantee an estimate without borings, which would cost a much greater sum than the Board has at its disposal.

From estimates submitted by competent engineers the Board believes the cost to Morristown of connecting with the trunk sewer would be at least Four Hundred and Sixty-three Thousand, Two Hundred and Fifty Dollars ($463,250.00). To this, of course must be added the estimated cost of sewering the town Two Hundred and Fifty-one Thousand, Five Hundred and Forty-five Dollars and Seventy Cents ($251,545.70), making a total of Seven Hundred and Fourteen Thousand, Seven Hundred and Ninety-five Dollars and Seventy Cents ($714,795.70) as the cost of this plan for collecting and disposing of sewage.

While Summit might be willing to share in the expense of building the tunnel the amount so contributed would not exceed the price that town would demand for the space in the Joint Outlet Sewer required by Morristown—one million (1,000,000) gallons a day which the Board estimates at One Hundred Thousand Dollars ($100,000). The Board has been unable to secure a definite proposition from Summit as to the price to be charged for this space, but bases its estimate of One Hundred Thousand ($100,000) on the amount recently demanded of Madison by Summit.

In addition to the large estimated cost of this plan for disposing of the sewage there is another serious objection to it. It is not a permanent plan, nor is it a final disposal. The Board believes that the time will come, and probably within the next ten (10) years, when not only the Federal authorities but the people living in the municipalities bordering on the New York Harbor line will demand that the sewage from the Joint Outlet Sewer be purified before it is turned into the Arthur Kill. To comply with such a demand it will be necessary to construct a joint disposal plant and it is estimated that it would cost Morristown nearly as much for its share of such a joint plant as to build a local plant at the present time.

In view of the very large and uncertain investment it would be necessary for the town to make, and because it believes a perfectly satisfactory system of disposal can be installed through a local plant at a much smaller cost; the Board cannot recommend a connection with the Joint Outlet Sewer.

Since the report of the last Sewerage Commission, in July, 1903, extensive and valuable experience has been gained throughout the country by sanitary engineers, until now the solution of the problem of local sewage disposal, with effective purification is fully and satisfactorily determined and Morristown is in a position to reap the benefit of the most modern and approved methods in the construction of a system of sewerage. Members of the Board have made personal investigation, jointly and individually, of local systems for the disposal of sewage in use in towns in the States of New York, New Jersey and Massachusetts, and they have conferred with the authorities of municipalities in which such systems have been in use, and the Board is satisfied that a local disposal system of sedimentation tanks, contact beds and intermittent sand filtration will take care of the sewage of Morristown and produce a high and uniform degree of purification.

Only domestic sewage, which lends itself to treatment much more readily than sewage containing large amounts of factory and chemical wastes, is encountered at Morristown, and hence the problem is comparatively simple. As a result of very extensive experiments in Massachusetts we know that crude domestic sewage can be finally disposed of in this way and that the putrescible matter in it is destroyed, so that the effluent is not poisonous to fish and is incapable of putrefaction, thus satisfying the requirements of the State Sewerage Commission in cases where the effluent must be discharged into streams forming part of a watershed used to supply other municipalities with drinking water.

In considering the best form of disposal plant the Board investigated carefully the disposal of sewage by chemical precipitation. This method of disposing of domestic sewage has been extensively used in England and has proved most unsatisfactory. It is very expensive and only prepares sewage for purification, a work economically and effectively done by the sedimentation tank.

Chemical precipitation might be used economically where many large manufacturing establishments contribute chemical and other refractory waste matters which are injurious to the bacterial life of filters. In such a case it would be economical to separate them in a special sewer and make them innocuous by chemical precipitation.

This is the situation at Worcester, Massachusetts, where a part of the sewage is so treated. It is not only unnecessary in Morristown, where we have only to deal with domestic sewage, but impracticable.

All the engineers consulted by the Board agree that the low point for the collection of the sewage from within the entire area of the Town is on Ridgedale Avenue, about one hundred (100) feet southerly from the bridge across the Whippany River. From this point it is easy to drain all of the Town lying east of the South Street and Madison Avenue and north of Court Street. The territory of the Town however, is divided by a ridge following generally the line of South Street, so that the sewage from the portion of Morristown lying west of this ridge must be either separately treated or brought into the system lying to the east by pumping or by a special intercepting sewer in the form of a tunnel through the ridge. The Board believes separate treatment to be impracticable and is advised that the tunnel would need to be constructed under air pressure and at great expense, but that the installation of the ejector type of pumps would be much less expensive and preferable under existing conditions. These ejector pumps are placed in chambers built in the streets so that no real estate or private right of way is required. They are operated by electricity and are nearly automatic. They are not expensive and can be easily and economically maintained. From the low point above mentioned it is practicable to drain the sewage by gravity to a point on the Whippany River where a disposal plant may be built for the purification of the sewage before its discharge in the River. The local disposal works recommended are designed to care for a maximum population of fifteen thousand, (15,000) but it is also so designed that it may from time to time be enlarged to care for such larger population without interference with the general arrangement.

The Board has visited different areas suggested for the location of the disposal plant and is unanimous in the choice of the site recommended in the Engineer's report, which is sufficiently large to take care of the increase in population. Within a few feet of this site sand of the best quality—an essential in the construction of the plant—is found in large quantities.

The Board desires to express its entire satisfaction with the work done by Messrs. Williams, Proctor and Potts, and its confidence in the plan recommended by them, and now determines that:

(1) The system of sewers most advantageous and for the best interests of the incorporated Town of Morristown, is a disposal system with sedimentation tanks, contact beds and intermitted sand filtration. The sewage to be carried by gravity (and ejector pumps where necessary) to a point on Ridgedale Avenue in the Town about one hundred feet southerly from the bridge over the Whippany River.

(2) Such system shall extend throughout the whole Town, the sewers to be vitrified tile with water tight joints of different sizes according to the location, varying from eight (8) inches to twenty (20) inches, with manholes, flushing tanks and necessary appliances, and located substantially as shown on a map filed herewith and made a part hereof.

(3) The sewage to be carried from the aforementioned point on Ridgedale Avenue in a general southerly direction to the old dam, thence crossing the Whippany River and extending in a general northeasterly direction and as nearly as practical parrallel with the Whippany River, through a twenty (20) inch cast iron pipe connecting sewer, to disposal works to be located near the road dividing the Township of Morris from the Township of Hanover and near the old burnt mill, said disposal works to be constructed without the limits of the Town of Morristown and in either the Township of Morris or in the Township of Hanover as shall be considered most desirable as the work progresses.

(4) The manner of disposing of the sewage will be briefly as follows: After the sewage is delivered at the disposal works it will pass through successive stages of treatment, consisting of sedimentation tanks with sludge bed, and contact beds, and the fluid finally, after passing by gravity through sand filters and thus purified, will be conveyed by a vitrified tile pipe to and discharge into the Whippany River.

The total estimated cost of the construction of the system of sewers, disposal works and connecting sewer, as above determined and as is more specifically set forth in the report of the Engineer (and designated thereon as C prime) hereto annexed and made a part of this report is:

Sewer complete in the town	$174,440 95
Disposal works	99,100 00
Automatic pumps for western half	10,100 00

Real estate, right of way, legal and miscellaneous expenses......	67,000 00
Engineering superintendence	18,437 25
	$369,087.20

Respectfully submitted,

P. H. COOPER,
Chairman.

Attest:
Eugene S. Burke,
Secretary.
Morristown, N. J., February 23rd, 1907."

EXTRACTS FROM REPORT OF THE ENGINEERS.

December 31st, 1906.

GENTLEMEN—In pursuance of an agreement entered into with your Honorable Body, dated August 10th, 1906, we submit herewith out report for the comprehensive sewering of the Town of Morristown, New Jersey, with a proper method of disposal.

SEWAGE FLOW PER CAPITA.

In designing the sewers and sewage disposal works for Morristown, the information first essential is, of course, the probable amount of sewage for which to provide. Morristown has no public sewers whose flow we can measure, therefore, the nearest approximation to the proper amount can be had only through the per capita consumption of water as furnished by the proprietors of the Morris Aqueduct, which is 40 gallons per person per day. Assuming the population of Morristown to be cared for in the proposed sewers to be 15,000 persons, would give a sewage flow of 600,000 gallons. Experience shows that when a system of sewers is constructed in a town, people use more water than formerly. For the purpose of our estimate, we have assumed that the per capita consumption of water at Morristown will increase from 40 gallons to 60 gallons per person per day. This gives us a probable sewage flow of 900,000 gallons.

LEAKAGE OR INFILTRATION.

No matter what care is taken in the construction of sewers, there is always more or less infiltration of ground water, depending on the character of the soil, the height, etc. This is usually approximated at 10 per cent. of the whole flow, or, in the case of Morristown, 90,000 gallons per day.

FUTURE POPULATION.

It is hardly probable that many more people will live within the Town limits of Morristown, certainly no considerable percentage of the present population. As a rule, the available building sites within the Town limits are occupied. While Morristown covers approximately 3 square miles, much of this is occupied by large estates, some of them occupying several acres, and it is hardly possible that these will be divided, at least, in this generation. We have, therefore, designed the sewers to care for a maximum population of 15,000, and have designed a sewage plant to treat a corresponding amount of sewage.

ELASTIC DESIGN.

The plant is designed to be elastic so that it may be added to without any hindrance to the general arrangements. It is proposed to build 4 sections of the sedimentation tanks at the present time, and any one of these may be thrown out of commission at the option of the operator, or, if desired, the entire sewage can be run through 1 unit and 3 thrown out of commission. The same arrangement is made for each remaining process in the method of disposal.

EJECTORS.

In draining the remainder of the Town, the plan recommended is by installing a pumping station or ejector chamber at Green and James Street and one on Wetmore Avenue to pump all the sewage over the ridge to a manhole at James and South Streets, and to a flush tank at Maple Avenue and DeHart Street respectfully. The sewage so pumped amounts to approximately 120,000 gallons per day. Other small ejectors could be built when needed, one being at the point where South Street crosses the Town line. These ejectors, which it is proposed to operate by electricity will be automatic, the electrical device being set in operation and stopped by means of a float in the ejector chamber which rises and falls with the sewage.

SEWER GRADES.

In laying out the sewers we have adopted for the minimum grades the following.

8 inch	.5
10 "	.35
12 "	.26
15 "	.16
18 "	.11
20 "	.09
24 "	.085

These grades will give a minimum velocity of 2 to 3 feet per second in the pipes, which experience has shown to be a self-cleansing velocity. The trunk sewers are about the only pipes that are affected by these minimum grades, the greater percentage of the laterals being laid on steeper grades to conform to the shape of the ground. Most of the sewers are laid at a minimum depth of 9 feet, in some cases more, as the depth of cellars were noted at the time of making the surveys and in nearly all cases it is attempted to lay the sewers at a sufficient depth to drain cellars.

FLUSHING.

Automatic flush tanks can be placed at the dead ends of laterals, laid on a less grade than 1 per cent. In every case where the dead ends are laid on grades exceeding 1 per cent., flushing manholes are sufficient. This type of a flushing manhole allows inspection of the dead ends and also flushing at periodic intervals. In flushing, the man hole is filled with water, the end of the pipe having been previously covered by a flap. Upon the removal of the flap, the contents of the manhole are allowed to rush through the sewer. This method of flushing gives a flush wave the full bore of the sewer, and its effects may be traced a thousand feet down the sewer.

PERIODIC VS. AUTOMATIC FLUSHING.

The question of flushing is one that is by no means solved, the evidence for and against being about evenly divided between periodic flushing of this kind and automatic flushing. Indeed, there are advocates of the idea of no flushing at all. Mr. F. S. Odell, of Portchester, N. Y., in an exhaustive article in the Transactions of the American Society of Civil Engineers in 1893, describes the sanitary sewers of Portchester in which periodic flushing only is used. His experience indicate that automatic flushing is a double waste of money, there being the first cost of the flush tanks and the cost of the enormous amount of water used by them annually.

COMPARATIVE COST OF PERIODIC VS. AUTOMATIC FLUSHING.

In Morristown there are approximately 126 dead ends which would require 126 flush tanks at a cost of $50.00 each more than flushing manholes. This item of first cost would amount to $6,300.00. The tanks would consume daily 33,900 gallons of water, which equals 13,797,000 gallons per year, which at 15 cents per thousand gallons, amounts to $2,069.75 per year for water alone. The interest on the first cost at 5 per cent. would amount to $315.50 per year, making a total annual cost of $2,384.75 as the charge against automatic flushing. On the other hand, with periodic flushing, it would require, as experience has shown in 6 towns in New England, flushing 4 times a year, which, for the 126 flush tanks, would require perhaps, 157,000 gallons, which, in so far as cost or value is concerned, is insignificant, but it would require the services of one attendant for at least 22 days during the year. This with the water, at most would amount to scarcely more than $100.00 per year, and as before shown, is offset by a charge of $2,384.76 for automatic flushing. In view of this, and also the lack of conclusive data by the advocates of automatic flushing, we recommend periodic flushing for Morristown. Periodic flushing is very effective when properly done, for it is begun at the flush tanks lying at the higher elevations, and from these tanks the sewers are flushed downward to the lower elevations, and any refuse lying in the upper reaches or the sewers is thus completely washed out. In using automatic flush tanks on a system where the sewage is treated in a disposal plant as at Morristown, the fact must not be lost sight of that capacity must be provided in the disposal plant for 37,800 gallons of water contributed by flush tanks. While this is an inconsiderable amount, it represents, however, a proper charge against automatic flush tanks.

INVERTED SIPHONS.

In four cases we have designed inverted siphons to carry the sewage across creeks and waterways. These are in accord with the best practice in sewer design, and make it possible to carry the trunk sewers under creeks. They are located on Atno, Ridgedale and Abbett avenues and Water and Centre Streets.

SIZE OF SEWERS.

The minimum size of sewers is taken at 8 inch, which is in conformance with the best practice. Some Engineers, notably the English Engineers, recommend 9 inch as the smallest allowable. While a less size than 8 inch might be large enough to carry the quantity it would receive, the danger of stoppage is very much greater. All sewers are designed to flow half full.

CHARACTER OF MORRISTOWN SEWAGE.

The sewage of Morristown is composed of practically domestic sewage only. Sewage of this quality lends itself to treatment much more readily than a sewage containing large amounts of factory or creamery wastes. We anticipate no difficulty in the treatment of Morristown sewage by any method of treatment now accepted as good practice among Engineers. Many of the complications that arise in the treatment of sewage in other localities are due to large amounts of dye, creamery, packing house or other industrial wastes. These add not only large quantites of solid matter to the sewage, but are generally supposed to contain chemicals and other ingredients detrimental to bacterial action in the process of treatment. For Ravenna, Ohio, where a plant of about the same size as that proposed at Morristown is now in course of construction, we recommended a method of disposal consisting of sedimentation or septic tanks followed by intermittent sand filters. The sewage contains about 27 per cent. of the factory wastes of which nearly 23 per cent. were wastes from a dye house containing large quantities of chemicals, including sulphuric and other acids. This dye house contributed 225,000 gallons of sewage per day. Our recommendations for intermittent and filtration following sedimentation, were accepted and approved by the Ohio State Board of Health as one of the best known for treatment of sewage of this character.

At Morristown, as before stated, we have only domestic sewage to treat, and the problem is comparatively simple.

WHIPPANY RIVER.

The Whippany River into which the effluent must discharge, regardless of the method of local disposal, drains into the Passaic River above Little Falls, consequently, the effluent of a disposal plant should be purified "to the highest practical degree," and should also be of as uniform a quality as possible. Inasmuch as the waters of the Whippany River are used for drinking purposes at a point lower down by other municipalities, Morristown would not be justified in turning an effluent into these waters that is not uniformly purified to a high degree. Beyond a question, at least 1,000 persons in Morristown now turn their raw sewage into the Whippany River; at a low stage of the river this cannot be assimilated by dilution, which is visibly apparent. A disposal plant in our judgement will materially improve the present quality of the water of the Whippany River. There is an old theory that running water will purify itself. Morristown can get no consolation from this, because the State Sewerage Commission has a dictum that "no river in New Jersey is long enough to purify itself."

ATTITUDE OF THE STATE SEWERAGE COMMISSION.

Morristown has no moral right to discharge crude sewage or any improper effluent from a sewage disposal plant into the Whippany River. Neither has it a legal right to do so and should such an attempt be made, the municipalities effected have recourse to order the cessation. Again the attitude of the State Sewerage Commission is such that only a plant giving the highest practicable degree of purification will meet with their approval. In our designs and recommendations we have attempted to secure proper disposal at as low a cost as possible, and have endeavored to carry out the teachings and high ideals which should govern a sanitarian in the design of works which so affect the health, happiness and lives of a population. We trust and believe that the Sewerage Commission and the Mayor and Board of Aldermen of Morristown will adopt our recommendation, together with such means as to conserve the health of the people of Morristown, as well as other municipalities effected.

EJECTORS.

In disposing of the sewage from the western slope by pumping, we have considered the ejector type of pump, as this is nearly automatic and is equally applicable whether the Town builds a pumping station on Ridgedale Avenue to pump the sewage to a disposal plant, or whether the sewage is ultimately disposed of by gravity. In case the pumping station is not built, the ejectors can be operated by electricity from the local lighting company. Should the pumping station be built, a dynamo can be installed which will generate electricity to operate the ejectors and at the same time generate electricity to light the pumping station and grounds.

OPERATION OF EJECTORS.

These ejectors are placed in chambers built in the streets and in operation they act as follows: As the sewage enters the ejector chamber, it is stored up until such a pre-determined quantity has collected to set the ejector in operation, when, by a type of air pump, the sewage in the chamber is elevated to any chosen point through a cast iron pipe. Ejectors of this type are used extensively for this purpose, in fact, nearly all the big buildings in New York were sewage drains to a point below tide, the sewage is discharged in this manner. The sewage of the World's Fair at Chicago, which was collected below lake level, was discharged in this manner.

ADVANTAGE OF EJECTORS.

One great advantage of the ejectors over the tunnel and which does not appear in our estimate, is that the ejector system does not require a foot of ground or private right of way. These estimates, as all estimates in this report, are exclusive of real estate and right of way.

COSTS.

We estimate the cost of three such ejectors, one located at Mt. Kemble Avenue near the Hospital, one on Green Street at the corner of James and one on South Street at the Town Line, as follows

FIRST COST—ESTIMATE OF SEWERING BY EJECTORS.

3 Ejectors, Dynamos, Machinery complete	$3,300 00
5,300 feet 6 inch Discharge Pipe	5,300 00
3 Ejector Chambers	1,500 00
	$10,100 00

Wiring is not included as it is presumed that the Town has franchise rights in existing conduits or pole lines. In case the electricity is bought from the local company, they will furnish their own delivery.

OPERATION—MAINTENANCE.

NOTE—The lesser permanence of some classes of work requires a greater per cent. for sinking fund charges.

Interest and Sinking Fund on $10,100 at 5 per cent	$505 00
Operation and Electricity	438 00
Cost of Maintenance	$943 00
Per Capita Cost	0.063

REMARKS.

This method of caring for the sewage possesses the advantage before noted in that the ejectors can be located so as to care for the sewage of the entire district. No private lands need be acquired, a feature which does not appear in the above discussion as the estimates given, as before stated, are exclusive of real estate. The ejector system will shorten the time of execution of the contract materially, as the ejectors can be built more quickly than the tunnel.

The ejectors are as nearly automatic as it is possible to make them, and further than occasional inspection will need little attendance. In case of accident or breakdown, no damage is liable to occur as the ejector chambers are provided with an overflow, also an alarm to indicate to the attendant at his office that attention is needed.

EJECTORS ARE MOVABLE.

The ejector at Green and James Streets is located at this point temporarily. When necessity requires, it can be located at the bridge on James Street below Foote's Pond. In this location it will collect the sewage from any houses that may be built on James Street below Green Street.

DISPOSAL BY GRAVITY.

To drain the sewage by gravity to a point on the Whippany River where a disposal plant may be built.

Surveys were made to locate a suitable site for such disposal works, and two pieces of ground about 4,000 to 5,000 feet down the river from the Ridgedale Avenue bridge were chosen. They are situated near the road leading to Monroe where it crosses the river. These sites are about 1,000 or 1,500 feet easterly from the sand pits on the Erie Railroad, where an admirable quality of sand can be obtained. These sites could be reached by about 4,000 feet of 20 inch pipe (most of which would be cast iron) laid along the old mill race. This outfall pipe would discharge into the disposal works at about an elevation of 280.8 and the outfall from the disposal works could discharge at an elevation of 267, giving a gross working head through the plant of 13.8 feet. This would, of necessity, limit the type of disposal works to intermittent sand filtration preceded by sedimentation tanks, and possibly, contact beds. For intermittent filtration and sedimentation tanks, fully six acres of sand filters would be required, allowing for an application of 150,000 gallons per acre (approximately 5½ inches) per day. To build six acres of filters on the site chosen would require considerable cleaning and grading and the lower side of the beds protected by a rubble wall along the river, approximately 1,000 lineal feet.

The cost of disposal without pumping is as follows:

ESTIMATE OF DISPOSAL WITHOUT RESORTING TO PUMPING.

4,000 feet 20 inch pipe at $5.00	$20,000 00
6 Acres Filters, including grading and grubbing	48,000 00
Sedimentation Tanks, Buildings and Machinery	9,000 00
Sludge Bed, Piping etc	8,000 00
1,000 feet Rubble Wall	5,000 00
Cost of Disposal Works	$90,000 00
Maintenance estimated at approximately	2,000 00
Interest Charges and Sinking Fund at 5 per cent	4,500 00
Annual Cost	$6,500 00
Annual Per Capita Cost	0.433

These figures are all based on cost of construction exclusive of real estate. It would, of course, be necessary to secure rights along the mill race, or buy the property outright, and also to secure about ten acres or more of ground for the disposal works.

PRELIMINARY TREATMENT.

Any system of disposal for Morristown designed to give the "highest practicable degree of purity" must be some method of sand filtration. The design might contemplate the discharge of raw sewage on to either natural or artificial sand beds. According to different ideas of different engineers, the raw sewage might have a preliminary treatment with septic or sedimentation tanks; trickling or primary filters; contact beds; double contact beds, aeration —forced or natural. One of these, or a combination of them, might precede filtration. One of these, or a combination of them, might, and experience shows they do, give a non-putrescible effluent. None, however, in the light of present American practice, give the highest degree of purification practicable. A preliminary treatment by one or more of the above mentioned methods will serve, however, to reduce the solids in the sewage and otherwise better adapt it to sand filtration, thereby reducing the size of the sand filters and prolonging their useful life. It is a mistake, at least in view of present day knowledge, to believe that sewage can be treated successfully without a solid residue in some form. There are certain chemical compounds, staple perhaps, if the plant is giving satisfaction, which must appear in a solid form, and these must be cared for. Mr. R. W. Pratt states that at Mansfield, Ohio,, the amount of sludge removed from the septic tanks after four years' operation was 0.8 cubic yards for each million of gallons of sewage treated. At this place they have contact beds which are undoubtedly becoming clogged. If to the information above given, Mr. Pratt had added the approximate amount of sludge retained by these beds, the data would be somewhat comparable to what might be expected at Morristown. It must be borne in mind that any device preceding sand filtration will prolong the life of the filters and reduce their size, but it must also be remembered that any relief afforded the sand beds does not relieve the disposal plant. The work of the filters in removing the solids is transferred to the preliminary devices.

PROPER MAINTENANCE.

The addition of preliminary devices tends to complicate the plant and more skilled attendants are required in its operation. For a plant the size of the one proposed for Morristown, a complicated plant is hardly justified. Any disposal plant requires proper maintenance. By proper maintenance is meant that one man should be in attendance at the works and be responsible for its operation. He should have such assistance from time to time as the needs of the work demand.

CONTACT BEDS USED.

While we have only a gross working head of 13.8 feet through this plant, we have considered giving the sewage preliminary treatment in septic or sedimentation tanks and contact beds. A profile through the plant shows the following elevations:

Inlet to Sedimental Tank..............	280.3	feet.
Surface of Contact Beds...............	280.4	"
Outlet Contact Beds....................	272.5	"
Surface of Sand Filters................	272.3	"
Outlet of Sand Filters..................	267.8	"
Surface of Sludge Bed..................	269.7	"
Outlet of Sludge Bed....................	265.2	"
River Surface Normal....................	263.0	"
Bridge across River (floor)...........	268.9	"

For purpose of a better understanding, the bridge across the Whippany River has an elevation of 268.9 feet, which means that the bottoms of the filters are scarcely a foot below the floor of the bridge, and the bottom of the sludge bed is 3½ feet below this floor. With an arrangement of this kind, water would enter the underdrains of the filters only when the river was so high as to be but one foot below the floor of the bridge. To enter the sludge bed, it would need to rise to within 3½ feet of the bridge, which it would probably do. To overcome this objection, sludge from the septic tank would need to be drawn off in times of drouth when the stage of the river is low. It is not certain by any means that water in the underdrains of the sludge bed would be detrimental to the plant to the extent of impairing its efficiency. It certainly would not be objectionable to the physical working of the plant. Again, the sludge bed is to be used for sludge removal at comparatively rare intervals, and to be used for an additional filter at the option of the attendant. We would say that to endanger the plant as designed, the water in the river would need to rise to a point within a foot of the bridge floor. Our estimate covers the expense of building a rubble masonry wall along the river to protect the plant. We have estimated contact beds six feet deep to receive sewage at the rate of about one million gallons per acre per day. With this preliminary treatment, we believe the sand filters can operate successfully at 660,000 gallons per acre per day, reducing their size to one and one-half acres.

COST WITH CONTACT BEDS.

Estimate of intermittent filtration preceded by sedimentation tanks and contact beds.

Sedimentation tank and machinery	$10,500 00
Contact beds and building	49,000 00
Piping, valves and manholes	2,100 00
Sand filters	9,000 00
Sludge bed and piping	3,500 00
4,000 feet rubble masonry wall	5,000 00
4,000 feet 20-inch C. I. pipe	20,000 00
Cost of disposal by using contact beds	$99,100 00
Interest and sinking fund at 5 per cent	4,955 00
Maintenance estimated	2,000 00
Annual cost of operation	$6,955 00
Annual per capita cost	.464

REMARKS.

The addition of contact beds possesses, we believe, one great advantage over intermittent filtration and sedimentation just previously estimated. The advantage is, we think, a more uniform effluent will be secured. The disposal plant will occupy less space. The treatment will, however, be more intense and require cleaning and washing in a period of from five to ten years, depending on the characteristics of the sewage and the works. This removal, washing and replacing costs from thirty to fifty cents per yard, assuming forty cents, and the life of the beds as ten years would give us the annual cost of washing the contact material at eighty dollars per bed. We have designed five contact beds of which one will always stand idle. We believe this arrangement will materially prolong the life of the beds. Again, it will give the advantage of the material, while idle, being exposed to the effects of the air, giving the voids complete aeration. Further, with the beds standing idle for a long term, the attendant can wash the contact material without conflicting with his routine duties.

FINAL LOCATION OF BEDS.

We wish it understood that while the locations chosen are believed to be the best, they need not be final. After the real estate is purchased and bids called for, we will stake out the final locations on the ground so that it may be viewed by prospective bidders.

A site for such disposal has been selected on or just outside the town limits and about 1,000 feet easterly from Ridgedale avenue. This site will give any desired fall through the disposal works, necessitating, of course, the elevating of the sewage to the works from the point of primary collection by pumping.

The various stages in the process of purification are as follows:

The sewage passes through—

(1) the sedimentation tank from which it passes to
(2) sprinkling filters, and from this to
(3) a settling tank, and finally through
(4) sand filters.

The four steps embraced in this process are, in the light of present engineering knowledge of the subject of sewage disposal, supposed to give the highest practicable degree of purification attainable. After considerable experimentation, such a scheme was recommended for Columbus, Ohio, and also later recommended for Baltimore, Md. By this process we substitute the sprinkling filters, settling tank and sand filters for the intermittent sand filters outlined in paragraph (c) Second Study. These filters require six acres. Owing to the preliminary treatment and the consequent removal of much suspended matter, we could run the sand filters at a higher rate than 150,000 gallons per acre per day. We have estimated 650,000 gallons per acre per day, which would require approximately one and one-half acres; the settling tank would need to be a 150,000 gallon tank, uncovered, and the sprinkling filters give good results at the rate of 2,000,000 gallons per acre per day, which would call for one-half acre of sprinkling filters.

COSTS.

Basing our estimate on these figures this method of disposal, exclusive of real estate, amounts to the following:

ESTIMATED COST OF DISPOSAL PLANT.

Sedimentation tank, buildings and machinery	$9,000 00
Settling tank, one-half acre	18,000 00
Sprinkling filters	30,000 00
Sand filters, 1½ acres at $5,000	7,500 00
	$64,500 00

ESTIMATED COST OF PUMPING.

Pumps, engines, dynamos and machinery	$10,000 00
Addition for pump use	2,000 00
Pump well	1,200 00
Chimney	1,100 00
Receiving basin	800 00
	$15,100 00
Total cost of disposal by pumping	$79,600 00

OPERATION.

$79,600.00 at 5 per cent	$3,980 00
Maintenance	3,000 00
Annual cost of disposal	$6,980 00
Less electricity furnished ejectors	300 00
Net annual cost of disposal	$6,680 00
Annual cost per capita	0.445

RECOMMENDATIONS.

In view of the points brought out in the preceding report, and review of our surveys, investigations and studies, we recommend:

I. That the sewage from the westerly portion of the town be pumped over the ridge to the main system by ejectors.

II. That those portions of the sewers indicated in the detail estimate be built at a later date than the first system.

III. Disposal by gravity to sedimentation tanks, contact beds and sand filters, as a proper method to give a high degree of purification.

IV. Disposal pumping to disposal works, as a proper alternate plan for disposal should the cost of securing property rights be disproportionately great, and

V. Proper and efficient care of the disposal works when built.

COST OF RECOMMENDED PLAN.

The cost of the recommended plan for the collection and disposal of the sewage of Morristown is $246,213.10. To this must be added the expenses of the bond issue, procuring of rights of way, real estate for the disposal works, legal and miscellaneous expenses and the cost of engineering superintendence.

In closing, we wish to compliment the members of the Sewerage Commission for the deep interest they have shown in the subject of sewerage and the insight displayed in the intricate subject of sewage disposal. We also wish to extend our thanks to the members of your Honorable Body for the courtesies shown us

Respectfully submitted,

WILLIAMS, PROCTOR & POTTS, Inc.

Clyde Potts, Vice-President.

NEWBOLD.

At a meeting of the Commission held May 16, 1907, a communication was received from H. W. Pettit of Woodbury, requesting permission to construct a sewer to drain two houses at Newbold, to discharge into Big Timber Creek, without purification.

The secretary was directed to suggest to H. W. Pettit that he submit a plant showing the location of the proposed sewer, and inform him that if the sewer was to discharge near the mouth of Big Timber Creek, the Commission would probably approve of an application for the approval of such a plan, subject to the requirement that the sewage must be purified in case it is found to create a nuisance.

At a meeting of the Commission held June 10, 1907, plans for a sewer to drain two houses on Third avenue, Newbold, to discharge into Big Timber Creek without purification, were submitted to the Commission by H. W. Pettit.

At the same meeting, these plans were approved, subject to such conditions of construction, operation and purification as this Commission may from time to time require, and with the further condition that when, in the judgment of the Commission, it becomes necessary to purify the sewage in order to prevent a nuisance in Big Timber Creek or the Delaware River, such purification of the sewage to be discharged must be provided as shall then be approved by the Commission.

NORTH BERGEN.

At a meeting of the Commission held December 17, 1907, plans for a sewerage system for part of the Township of North Bergen, consisting of ninety-seven acres on the west slope of the Bergen Hill, providing for the discharge of sewage into Pen Horn Creek by means of an open ditch across the meadows to begin two hundred feet west of the Susquehanna Railroad tracks, were submitted to the Commission by J. Emil Walscheid, attorney of the Township.

At the same meeting, these plans were approved by the Commission subject to the provision that if, at any time in the judgment of the Commission, it became necessary, for the prevention of pollution of Pen Horn Creek or the Hackensack River, to require purification of the sewage, that such a purification plant as shall then be approved by the Commission shall be installed by the Township of North Bergen.

At a meeting of the Commission held January 14, 1907, a communication was received from Charles C. Black, Attorney for the Borough of Secaucus, requesting a hearing for that borough in relation to the proposed sewer for part of the Township of North Bergen, to discharge into Pen Horn Creek. The secretary was directed to notify the authorities of the Borough of Secaucus and of the Township of North Bergen that the Commission would hear any matters in relation to the proposed sewer for part of the Township of North Bergen which they might desire to present, at a meeting of the Commission to be held January 21, 1907.

At a meeting of the Commission held January 21, 1907, Charles C. Black, Attorney for the Borough of Secaucus, William Hagen, Mayor of the borough, George Lausecker and Jacob Schmidt, Councilman, and August Becker, former Councilman, of the Borough, and Abel I. Smith appeared before the Commission for the purpose of objecting to the proposed discharge of sewage from part of North Bergen into Pen Horn Creek.

A communication was also received from J. Emil Walscheid, Attorney of the Township of North Bergen, stating that it was impossible for him to be present, and requesting a further hearing in relation to the proposed sewer for North Bergen.

Mr. Charles C. Black stated that the borough had applied for the hearing and was officially represented by those present for the purpose of objecting to the further pollution of Pen Horn Creek; that the borough authorities desired the Commission to investigate the question, and any assistance within their power would be given to the Commission; that they requested that the approval of the plans for the North Bergen sewer be reconsidered and that such requirements be made as would prevent a nuisance at or near the borough.

Abel I. Smith stated that he owned property in Secaucus; that the borough was practically an island, surrounded by the Hackensack River and two tidal creeks: Cromakill and Pen Horn; that the flow of Pen Horn Creek had been practically stopped by the construction of the Erie Railroad bridge and that repeated efforts to have the railroad company remedy this state of affairs had not been successful; that under special laws sewers had been constructed draining parts of Jersey City and West Hoboken into Pen Horn Creek above the railroad bridge, causing a great nuisance at present; that to prevent this sewage from backing up Pen Horn Creek, a dam had been constructed just above the outlet of the sewer; that the sewer proposed by North Bergen would discharge above this dam in a place where there was little if any flow of the creek and where a new nuisance would be created; that in his opinion the discharge of sewage into the meadow section should not be permitted because it would be carried into the swamps and held there by the obstructions to the flow of the creek, and that he suggested the propriety of constructing a sewer to accommodate all of the sewage now being discharged into the creek or which was proposed to be discharged therein and discharge it in the Hackensack River where there was ample flow of water to take care of it.

Mr. Hagen stated that the officials of Secaucus were strongly opposed to any further sewage nuisance; that there were houses within a few hundred feet of the place where it was proposed to discharge the sewage from North Bergen; that there were already many objections to the nuisance caused by the present discharge of sewage into Pen Horn Creek.

At the same meeting, Messrs. Capstick, Herbert and Jacobson were appointed a committee for the purpose of investigating the objections to the proposed discharge of sewage into Pen Horn Creek, and the secretary was directed to notify the authorities of the Township of North Bergen not to proceed with the construction of the proposed sewer to discharge into Pen Horn Creek, until the Commission had concluded its investigation of the objections of the borough of Secaucus.

At a meeting of the Commission held January 28, 1907, Robert Gaw, Township Engineer of North Bergen, consulted with the Commission in relation to the proposed sewer for part of North Bergen to discharge into Pen Horn Creek.

At a meeting of the Commission held March 25, 1907, Messrs. Capstick and Herbert reported that as a committee to investigate the objections of the Borough of Secaucus against the proposed sewer for part of the Township of North Bergen to discharge into Pen Horn Creek, they had visited the Borough of Secaucus and examined the ground in question on March 21, 1907, and had consulted with William Hagen, Mayor, John Passel, Borough Assessor, and Messrs. Henry Harms, George Lausecker, George Engelbrecht, Jacob Schmidt, Andrew Brenner and Sebastian Meisch, members of Council of the Borough of Secaucus, and Robert Gaw, Township Engineer, and Frederick Steinkopf, member of the Township Committee, of North Bergen; that they found that the flow of Pen Horn Creek was obstructed under the tracks of the Lackawanna Railroad by a number of piles, and that it was obstructed under the tracks of the Erie Railroad by a number of piles and a tidal gate; that at a point just north of the outlet of the joint sewer from West Hoboken and Jersey City, a dam had been constructed with a tidal gate, which blocked the flow of the creek at that point; that the proposed place of discharge of the North Bergen sewer is about two hundred feet north of the Paterson Plank Road, which is north of this dam; that there were a number of minor sources of pollution from fat rendering establishments along the shore of the creek, and that the creek is grossly polluted by the flow of sewage from the joint sewer of Jersey City and West Hoboken; that in the opinion of the committee, the best remedy for the pollution of the creek would be the construction of a trunk sewer by the Township of North Bergen, the Town of West Hoboken and the City of Jersey City to carry all of the sewage from the section of Bergen Hill drained into the Pen Horn Creek to a point in the Hackensack River near the mouth of Pen Horn Creek; that the committee recommended that the approval of the plans submitted by the Township of North Bergen for a sewer to discharge into Pen Horn Creek be rescinded and that the plans be disapproved; that the committee further recommended that the authorities of the City of Jersey City, the Town of West Hoboken and the Township of North Bergen and the Borough of Secaucus be invited to consult with the Commission in relation to the provision of sewerage facilities for the Township of North Bergen and the prevention of pollution of Pen Horn Creek.

At the same meeting, the following resolution was unanimously adopted:

"Whereas, The State Sewerage Commission, at a meeting held December 17, 1906, approved of plans submitted by the Township of North Bergen, providing for the discharge of sewage from part of that Township into Pen Horn Creek; and

Wheras, The State Sewerage Commission has found that the waters of Pen Horn Creek are now being polluted to the injury of inhabitants of this State in their health, comfort and property, and that the addition of any further pollution would increase the injury: therefore be it

Resolved, That the action of the Commission in approving of said plans submitted by the Township of North Bergen be rescinded and that the said plans be returned to the authorities of the Township of North Bergen without the approval of this Commission."

At a meeting of the Commission held November 21, 1907, a communication was received from J. E. Walscheid, Township Attorney, reporting that North Bergen had given up the project of installing a sewerage system, as had been proposed by it, to discharge into Pen Horn Creek.

NORTH PLAINFIELD.

At a meeting of the Commission held March 11, 1907, copies of the reports made by Hering & Fuller, engineers, and by the Sewerage Commission of the Borough of North Plainfield to the Mayor and Council of the Borough, were received by the Commission from William J. Buttfield, Secretary of the Sewerage Commission of the Borough.

At a meeting of the Commission held June 10, 1907, a copy of a resolution objecting to the proposed location of the disposal plant in the Borough of North Plainfield on the ground that it would be a nuisance to inhabitants of the Borough of Dunellen, was received from the Board of Health of the Borough of Dunellen.

At a meeting of the Commission held August 29, 1907, a copy of a further report made by the Sewerage Commission of the Borough of North Plainfield to the Mayor and Council of that Borough, was received from William J. Buttfield.

These reports in part are submitted herewith:

February 15, 1907.

W. J. Buttfield, Esq., Sec'y. Sewerage Commission, North Plainfield, N. J.:

Dear Sir—In accordance with your request that we make an investigation and recommendation as to a system of sewerage and sewage disposal works for the Borough of North Plainfield, we beg to record our findings as follows:

1. The Borough at present has a population of about 6,000 and occupies a district of about 452 acres in which there are approximately 16 miles of built-up streets.

2. There is no adequate brook or river available for disposing of the sewage by dilution and it will be necessary to purify the sewage. For this reason the household wastes should be removed in separate sewers from those for storm water. This report does not consider storm sewers or drains, but is confined to the so-called "sanitary sewers."

3. It is feasible to dispose of the sewage upon several different areas hereinafter described and to deliver to them practically all of the sewage from the present population by gravity. This requires an outfall sewer, 24 inches in diameter, with its bottom or invert at elevation 72 at the corner of West End and Rockview Avenues. This elevation is 7 feet below the surface of the ground.

4. The total area which will probably be built up in the future within the Borough limits lying east of West End Avenue, is about 900 acres. Of this total about 452 acres are tributary to the 16 miles of sewers which are now required; about 106 acres lying between Green Brook Road, Rockview Avenue and Rose Street and West End Avenue, are so low, that they will probably never be built upon away from the boundary streets mentioned;

and 89 acres are suitable for building purposes, but are located too low for the sewage to flow by gravity to the outfall sewer above mentioned. West of West End Avenue the area above Green Brook Road can be sewered by gravity, but the area below this road will require sewage to be pumped. The low lying area requiring pumpage is shown on the sewerage plan attached hereto.

5. When the low lying areas, both East and West of West End Avenue, are built up, it will be perfectly feasible to convey the sewage therefrom to a small receiving well or basin. Thence the sewage could be lifted into the outfall sewer by centrifugal pumps operated by electricity. Such automatic pumping devices are now in successful operation in various places and there is no question about their reliability and economy. They need no regular attention as a series of floats in the receiving well will start and stop the motors operating the pumps. Thus the amount of pumpage is made automatically proportional to the sewerage actually entering the receiving basin. The bearings, of course, need oiling from time to time, but otherwise no attention is required except that incidental to keeping the motors in good working condition. The cost of such a small pumping station, even if it should be required at the outset which is not the case, will be decidedly less than a design involving the pumping of the entire volume of sewage.

6. With an outfall sewer at elevation 72. 0 at West End and Rockview Avenues, it is feasible to give a gravity service for practically every house in the present built-up portion of the Borough. The slopes for the sewers would provide self-cleansing velocities with the aid of flush tanks at the head of the lines. The depth of the sewers below the street surfaces would give an adequate opportunity for house connections to be made thereto. With a few exceptions at and near the corner of Green Brook Road and Grove Street, the sewers would be 6.5 feet or more below the present street surface. At the point mentioned, personal examination shows that existing houses could without difficulty drain to the sewers.

7. It is prudent in building the outfall sewer to make it of 24-inch pipe which, with a slope of one foot in 1,200, would have a carrying capacity when running full of about 5,000,000 gallons per 24 hours. Taking into acount a reasonable amount of ground water leakage and the probable rate of sewage flow at hours of maximum water consumption, we estimate that this ought to serve an ultimate population of at least 16,500 people. To do this would mean, of course, that the 16 miles of collecting sewers which are required at the outset would have to be materially extended. The capacity of the sewers which will be first built will be adequate for the full population stated and will not later require any duplicate pipes.

8. Over an area of about 100 acres there is much ground water to be expected. It will be highly advantageous to prevent the leakage of such ground water into the sewers and we have made every reasonable effort to guard against the same. As a result of this ground water we have increased the estimates about $15,000, partly on account of the pumping of the water from the trenches, partly on account of putting in cast iron pipes in places as a substitute for vitrified pipes and partly for concrete rings to secure greater tightness at the joints of vitrified pipe.

9. As to house connections we have provided "Y" branches on the Main Street sewers every 25 feet on an average, that is, 50 feet on each side of the street. We have provided 1,200 house connections from the street sewer to the curb line to take care of the existing properties. The remaining "Y" branches are to be capped at the main sewer, but these house connections are to be built later as required. We have included the cost of these "Y" branches and all present house connections to the curb line as a part of the collecting system. It is preferable to build these house connections at the same time as the street sewers, so that the streets will not have to be dug up on more than one occasion and can thus remain in good condition following the completion of the main sewers themselves. The cost of these house connections from the street sewer to the curb line is sometimes paid out of the general appropriations and sometimes assessed upon the abutting properties according to local policy or custom.

10. Regardless of the method of sewage disposal or the location of such works, the outfall sewer will in any event continue along West End Avenue to Green Brook Road thence to Clinton Avenue. The extent of the system of collecting sewers in the Borough to the point last mentioned is indicated by the following approximate summary:

Cast iron pipe, 6-inch, 2.80 miles; 8-inch vitrified pipe, 8.90 miles; 10-inch vitrified pipe, 1 mile; 12-inch vitrified pipe, 0.56 mile; 15-inch vitrified pipe, 1.10 mile; 18-inch vitrified pipe, 0.35 mile, and 24-inch vitrified pipe, 1.60 miles; 2,700 "Y" branches on above pipe; 73 flush tanks; 147 manholes, and 1,200 house connections from street sewer to curb line. In addition there would be resurfacing of streets, concrete for water-tightness, etc.

11. The cost of building about 16 miles of collecting sewers as shown on the accompanying plant with all appurtenances, including flush tanks, manholes, "Y" branches, house connections and resurfacing of the streets, is estimated at about $165,000, as shown in Table A below. For the sake of securing better protection against leakage of ground water, we have included items of over $15,000. This estimate covers all the required works east of Clinton Avenue. The item of 15 per cent. is in accordance with our regular practice to cover preparation of plans, specifications, supervision of construction and various incidental expenses, some of which are of an administrative nature and some of which pertain to minor elements of construction too small to be listed separately.

TABLE A.

Cost of sewers east of West End Avenue	$120,230 00
House connections, 1,200	9,700 00
Outfall, West End Avenue to Clinton Avenue	13,600 00
	$143,530 00
Add 15 per cent. for contingencies and supervision	21,530 00
	$165,060 00

12. In regard to the cost of operating a system of collecting sewers east of Clinton Avenue, the principal item of cost is that of fixed charges. We

have assumed for present purposes that the Borough ought to be able to borrow money on a 40-year bond at 4½ per cent. interest per annum. If we are in error regarding this assumption you can, of course, readily correct it. We have also included a sinking fund of 1.183 per cent. which would retire the bonds at the end of forty years with the annual contributions to the sinking fund compounded at 3½ per cent. interest per annum.

TABLE B.

Annual Maintenance and Operating Expenses of Collecting Sewers.

Interest 4½ per cent. on $165,000	$7,012 50
Sinking fund, 1.183 per cent. invested at 3½ per cent. to retire bonds in 40 years	1,952 00
Sewer attendant at $60 per month	720 00
Extra labor and supplies as required, including water for flushing	700 00
	$10,384 50

13. The annual charges above noted can properly be reduced by assessing a part of the cost of constructing the street sewers and all of the cost of house connections against abutting property owners. An assessment up to $1.00 per running foot of sewer (50 cents for owners on each side of the street) is frequently the custom. This arrangement would reduce the bond issue in the neighborhood of $75,000.

14. In regard to sewage disposal there are no suitable areas of sufficiently porous sand to dispose of the sewage of the Borough by intermittent filtration.

15. There are several sites below Rock Avenue for purification works of artificial construction to which the sewage can flow by gravity, as we have informed you. The details need not be repeated here.

16. We have considered two styles of sewage purification works, each of which involves septic tanks as a preliminary treatment. In the one case the sewage, after partial clarification in the septic tanks, would be passed through contact beds in a manner quite similar to the treatment at the Plainfield City Sewage Works. The other is by the method of sprinkling filters, whereby the clarified sewage would be applied to beds about six feet in thickness of stone or other firm material practically as large as the fist. The sewage would be applied from sprinkler jets in the form of spray. One advantage is that they can operate at rates three to four times as great as contact filters. The other advantage is that they are self-cleansing and can be operated for 10 or 15 years or longer without cleaning, whereas contact filters require cleaning from top to bottom every four or five years. The coarse particles detached from the material of sprinkling filters require the effluent to be clarified in small settling basins before discharging into the small adjoining brook.

17. The cost of building a sprinkling filter plant similar to that now under construction at Columbus, Ohio, Reading, Pa., Washington, Pa.,

and similar to that recommended at Baltimore, Md., including engineering, contingencies and reasonable allowances for land and rights of way. This plant would include a covered concrete septic tank holding about 400,000 gallons, and a sprinkling filter, 0.4 of an acre in area, arranged in three units with complete appurtenances, including a small shallow settling basin holding a flow of about 60,000 gallons. This plant would readily take care of the sewage of a population of from 8,000 to 10,000 people, according to practical experiences elsewhere.

18. The cost of operating this sprinkling filter plant we estimate at $1,500 per annum, which sum is substantially independent of the number of house connections made with the sewers up to the limit of total population above stated. This sum includes adequate provision for taking care of the sludge and an annual contribution to a fund which, at the end of ten years, would be sufficient to pay for the cost of cleaning the filtering material. Adding $1,500 to the interest and sinking fund charges for an investment of $71,000, there is obtained $5,358 as the annual cost of sewage purification, including delivery of the sewage to the works from Clinton Avenue.

19. Such a sprinkling filter system would produce a well clarified effluent which will not putrify upon standing at summer temperatures. The degree of purification would approximate or slightly exceed that of the present works of the City of Plainfield. With fairly intelligent management no odors would be noticeable one-fourth of a mile distant. The filter would be arranged so that it could be temporarily operated as a contact filter if deep snow, prolonged zero weather or other conditions interferred with the discharge of the sewage as a spray.

20. If contact filters were adopted at this site, instead of sprinkling filters, we estimate that it would increase the investment for the outfall sewer and purification works from $71,000 to $94,000, and the annual operating expenses from $1,500 to $2,700. Including capital charges on the basis above described, the total annual cost would be increased from $5,358 to $7,809. Contact filters require several feet less head for their operation than sprinkling filters, but this advantage can hardly be availed of under local topographical conditions.

21. At your request we have considered the practicability of delivering the Borough sewage to the City of Plainfield's sewage works where, for a period of ten years, the City has made a proposition to treat the sewage for $25 per million gallons. We have assumed for purposes of comparison that 300 house connections will be made annually, thus requiring four years to connect the 1,200 properties which we estimate are now within the Borough limits. We have further estimates, based largely upon data obtained from the City of Plainfield, that from each connection there would be a sewage flow of about 400 gallons daily. To this is added an estimated average ground water leakage of 100,000 gallons daily, which figure would, of course, fluctuate materially depending upon rainfall, etc. It would cost, including engineering rights of way, etc., about $9,000 to build two cast iron pipes or siphons from Clinton Avenue to the City plant, so that under a head of about five feet the Borough sewage would flow by gravity to the

present city plant. Adding the capital charges upon the $9,000 siphons to the charges of the City for purification ($25 per million gallons), the figures for each of the first four years' operation of the plant may be estimated as follows:

First year	$2,480
Second year	3,589
Third year	4,689
Fourth year	5,789

22. Comparing the annual costs above stated with the $5,358 for a Borough plant, it is seen that the City proposition would be economical for three years, during which the present houses in the Borough are being connected with the sewers. There would be a saving of about $4,500, or 50 per cent. of the cost of the siphons leading to the City plant. After three years the advantage lies with a Borough plant. During the fourth year the annual saving with a Borough plant is estimated at about $400. In ten years it is estimated at about $1,000, on the basis that after four years there would be added twenty-five new connections annually, and that each connection averages 400 gallons of sewage daily, exclusive of ground water. If the City proposition were availed of for only ten years then the $9,000 investment for siphons would be of but little or no use at the termination of that period. We estimate then that the Borough would be fully $15,000 better off if it built its own plant. This figure allows no consideration for services which the Borough plant might render to Dunellen.

CONCLUSION.

The Borough requires a system of separate sewers to the extent of about sixteen miles to sewer the present built-up area.

These sewers should discharge by gravity to purification works. In later years most of the additional sewers will also discharge by gravity into the outfall sewer now required. Some of the area later to be built up, however, will require the sewage to be pumped into this outfall sewer.

From an engineering standpoint it is better and cheaper for the Borough to build its own purification works rather than accept the proposition of the City of Plainfield.

For reasons of policy and quite aside from engineering conditions, it may be considered preferable to accept the proposition of the City, even at an ultimate financial loss as above indicated.

If the Borough builds its own purification works it will require a total investment of $240,000, including cost of building house connections for existing properties. The total annual expense, including interest, sinking fund charges and operating costs, will approximate $16,000. This annual outlay for the Borough can be reduced by the fixed charges on sewer assessments, say up to about $75,000.

If the Borough should decide to accept the proposition of the City of Plainfield to purify the sewage, then an investment of $175,000 would be required. For a ten-year period the total annual expense would range from about $13,000 to $17,000, and average about $16,000. This sum can be reduced just as indicated in the above paragraph by reducing the bond issue through payments on the assessment basis.

At first glance the two propositions appear about equal, but it is to be pointed out that with the City proposition at the end of ten years on investment of $9,000 might become practically valueless, whereas with its own plant it would have economical means of purifying its sewage at an isolated location for many years to come and would have its plant partially paid for through sinking fund charges.

Very truly yours,

(Sgd.) HERING & FULLER,
Consulting Engineers.

March 1, 1907.

The Honorable Mayor and Council of the Borough of North Plainfield:

GENTLEMEN—Under the authority delegated to this Commission by the Committee of Fifty, and confirmed by resolution passed by the Council August 20th, 1906, we submit the result of our investigations to date, as follows:

It is superfluous for us to enlarge upon the work of this Commission, and we will briefly state the conclusions reached and recommendations as to same.

The prime requisite to a successful determination of the problem before us was the employment of a disinterested and unbiased engineer of unquestionable ability to advise a feasible system most efficient and economical under existent circumstances. With this in view, and after careful inquiry, we secured the services of Messrs. Hering & Fuller, and are confident that in so doing we have served the best interests of the Borough.

Upon personal interview with the State Sewerage Commission we were convinced that no new municipal sewerage system would be permitted to empty into any of the streams or rivers of this State, unless the effluent was first purified, and that the same degree of purification would be required whether the effluent was discharged into a large river or one of our smaller streams. The trend of public opinion is strongly in favor of compelling the disuse of the rivers or even tide-waters for disposal of crude sewage. It is evident, therefore, that a tide-water trunk line would be a useless additional expense, unless such was built jointly with the aid of other thickly populated municipalities. This course is not open to North Plainfield.

Negotiations were entered into with the City of Plainfield for the joint use of their disposal works, and we received a prompt and business like proposition, which in effect offers to contract for the disposal of the Borough's sewage for a term of ten years at the rate of $25.00 per million gallons.

From an economic standpoint, there are certain factors in connection with the installation of sewers at the present time less favorable than in previous years, viz.: The ruling high cost of material and labor, together with the extreme rates for money.

The figures given seem large, but it must be borne in mind that the plan advised covers practically the entire Borough, and in capacity of collecting sewers, provides amply for posterity, thus accomplishing as an immediate and permanent improvement that which in most suburban towns is installed section by section over a large term of years. There are decided objections to so extending the time of making this improvement, as far as our Borough is concerned. The main expense is that for a 24-inch outfall sewer from the center of the Borough, and this charge must be incurred irrespective of the area connected. The cost of lateral sewers will be largely offset by direct assessment against property benefited, and on the other hand there would doubtless be much dissatisfaction if any particular section was discriminated against.

While wishing to adhere strictly to that which is germane to the scope of our work, we cannot ignore the fact that many will wish to know what, if any, change will be made in the system proposed if "Consolidation" was consummated in the near future. We are advised that to reach the City's present works no plan other than that now presented would be practicable. If, on the other hand, it is found more economical to establish our own disposal plant, it might reasonably be argued that the same saving would be obtained under "Consolidation." We cannot, therefore, recommend that the present merger agitation be considered a factor which might of itself call for the postponement of action in this sewer question.

In the installment of any system we cannot too strongly urge the necessity of safeguarding the Borough's interests by ensuring that no contract shall be entered into, or payment made, or employment given, except upon the closest scrutiny by all charged with the responsibility of carrying out this work.

After carefully considering the whole subject, notwithstanding the present high cost involved, the Commission concludes that the sanitary needs of the Borough, the safeguarding of the health of our community, and the economic advantages to Borough residents and owners of property, render necessary the installation of an adequate and thoroughly modern system of sewage, and is strongly in favor of immediately undertaking the improvement, believing that the cost will be largely offset by the more rapid growth and consequent enhanced values.

Believing that the Mayor and Council of the Borough will agree with the Commission in its opinion, we have the honor to recommend as follows:

That the Borough Council authorize this Commission, in conjunction with the Mayor, subject to the necessary formal approval of the Council, and subject to the consent of the property owners and legal voters:

To negotiate with the City of Plainfield for the disposal of the Borough sewage on terms and conditions that will best conserve the Borough's interest;

Or to take the necessary steps to provide an independent disposal plant, and to negotiate terms and conditions for its joint use with the Borough of Dunellen, should it be so disposed;

To obtain from the property owners their necessary written consent;

To re-engage the services of Messrs. Hering & Fuller, engineers;

To prepare a contract for the construction of a sewerage system, to be submitted and approved by the Mayor and Council of the Borough;

And to suggest and arrange a method of financing any accepted plan.

Respectfully submitted,

C. W. McCUTCHEN,
EDWIN S. HOOLEY,
CHARLES L. NICHOLS,
J. H. COOLEY,
W. J. BUTTFIELD.

July 24th, 1907.

Hon. Mayor and Council of the Borough of North Plainfield:

GENTLEMEN—Since our report under date of March 1st, last, this Commission has continued its work along the lines therein suggested and is now prepared to submit its conclusions and recommendations.

In addition to legislative amendments needed as pointed out in our previous report, it was found that there were other defects in the laws governing the subject now under review and at our request the attorneys for the City and Borough Councils prepared and obtained the necessary legislative enactments, authorizing the City and the Borough to mutually contract for the disposal of the Borough's sewage by the City, and also authorizing the issuance of longer term bonds against the improvement contemplated, as well as a minimum sinking fund of one per cent. to retire such bonds at their maturity.

As before indicated, the comparative financial advantage between the installation by the Borough of its own plant as compared with a contract for disposal of the Borough's sewage by the City, is inconsiderable and further negotiations with the City have resulted in a tentative proposition, which, in respect of the life of the contemplated agreement, is more favorable to the Borough and overcomes what otherwise would prove an unsurmountable obstacle to such a contract.

To obviate possible litigation it was deemed advisable to secure the consent of the North Plainfield Township Committee to the location of purification works within the limits of said township, should it be deemed advisable for the Borough to install its own disposal plant.

With this in view, an option was secured upon a suitable site, fairly remote from any built-up section. Application was thereupon made to the Township Committee for its consent, in return for which this Commission suggested that the Borough might agree to dispose of the Township sewage free of charge for a term of years. No favorable response to this application has been received. Furthermore, the Borough of Dunellen—whose co-operation was expected—has entered a protest against any disposal works at the location selected.

While the figures of Messrs. Hering & Fuller indicate a saving of about $6,000 during the first ten years in favor of a Borough disposal plant, we would point out that a large proportion of this saving is obtained by figuring the amount annually set aside for sinking fund, against cost (about

$30,000) of the Borough's own disposal works, as representing a permanent investment; whereas, it seems to us this should be written off to depreciation. We are of the opinion that the most up-to-date system of sewage purification will in the course of ten or fifteen years become obsolete or at least uneconomical when compared with more improved methods which science and ingenuity will doubtless evolve. Furthermore, we are inclined to believe that house connections with the collecting sewers will not be made as rapidly as planned, and for this reason the average daily sewage flow for the first ten years and consequent payment to the City will be less than that indicated in Hering & Fuller's report. The present time is not opportune for economical construction nor for sale of bonds on a favorable basis, and therefore we favor the Borough saving the extra amount —of about $65,000—which would be involved by building its own purification plant and outfall sewer thereto, pending the time when a final solution of this problem can be made in conjunction with the City and possibly other municipalities.

In view of the foregoing, this Commission is in favor of a contract with the City of Plainfield upon the following terms and conditions: The City and Borough to enter into a contract providing for the disposal of the Borough sewage by the City at a rate for the next ten years of $25 per one million gallons. At the expiration of said ten years and at the end of each ten years thereafter contract shall be renewed upon terms and conditions to be fixed by appointing a joint Commission, composed of one representative from the City and one from the Borough, these two to select a third, or should they be unable to agree, the selection of a third Commissioner shall be made by the court usually charged with similar appointments. Should at any time the City deem it necessary or advisable to remove its disposal plant to a more remote situation, then the City and Borough shall jointly construct an outfall sewer and disposal works, the cost and maintenance of which shall be borne by the two municipalities pro rata, according to the valuation of their respective ratables, in lieu of said rate of $25 per million gallons, or other terms agreed upon for use of the City's present disposal works.

We advise that collecting and outfall sewers to the City's works be installed in accordance with Messrs. Hering & Fuller's general specifications and plans previously submitted by us and that Messrs. Hering & Fuller be retained to prepare detailed specifications and to oversee the work until its completion; and that real estate in the Borough shall be assessed for cost of all house connections from sewers to curb line and for 60 cents per running foot of collecting sewer, i. e., 30 cents per foot frontage on each side of all streets sewered. To otherwise provide for the cost of the improvements we advise the issuance and sale of Borough Sewer Bonds bearing interest at the rate, if possible, of 4¼ per cent. per annum to be retired at maturity by creation of a sinking fund at the rate of say 1.183 per cent. per annum. After deducting the assessments just mentioned the cost to the Borough of installing, collecting and outfall sewers, including siphons to City's works, is estimated at $124,000; and for the first ten years the average annual expense for maintenance, payments to the City, interest and sinking fund is estimated at $13,500.00. This annual charge is predicated upon the ability of the Borough to sell its 40-year bonds on a basis of 4¼ per cent.

We therefore recommend:

(a) That a formal contract between the City and the Borough for disposal of the Borough's sewage be drawn up and submitted to the Borough Council for approval; that the same be endorsed by the City Council and finally sanctioned by the Borough's property owners and voters as required by law.

(b) That Messrs. Hering & Fuller should prepare detailed specifications and plans and form of contract for the work.

(c) That proper steps be taken to insure a favorable sale of the Borough's bonds sufficient to cover the proposed improvement.

(d) That a special committee be appointed to supervise all work connected with the installation of the sewers, including that of securing the necessary consent of property owners—preparation of agreements with the City and contractors—securing rigid inspection of all work, and that of obtaining the best terms for the necessary issue of Borough Sewer Bonds.

Respectfully submitted,

C. W. McCUTCHEN,
EDWIN S. HOOLEY,
CHARLES L. NICHOLS,
J. H. COOLEY,
W. J. BUTTFIELD.

OAKLYN.

At a meeting of the Commission held December 31, 1906, a communication was received from Richard T. Collings, president of the Bettlewood Land Company, in reply to a communication from the Commission, stating that that company had constructed sewers for a few houses at Oaklyn, and requesting that the location be inspected and the company be advised as to what action on its part would be required by the Commission in respect to sewering its land in the Borough of Oaklyn.

At the same meeting, Commissioners Jacobson and Herbert were appointed a committee to inspect the sewerage system of the Bettlewood Land Company at Oaklyn.

At a meeting of the Commission held January 7, 1907, the committee reported that it had consulted with the representatives of the Bettlewood Land Company in relation to the sewerage of its property in the Borough of Oaklyn, and that it had been assured by them that the company would soon submit plans providing for the purification of the sewage either by connecting the sewer with the sewerage system of the Collingswood Sewerage Company, or by the construction of independent works, including sand filtration beds.

PEN HORN CREEK.

At a meeting of the Commission held April 1, 1907, a complaint of pollution of Pen Horn Creek by sewage from Jersey City and West Hoboken was received from F. D. Boulanger, Clerk of the Borough of Secaucus, on behalf of that borough.

At the same meeting, the secretary was directed to notify the authorities of the City of Jersey City and West Hoboken to show cause at a meeting of the Commission to be held April 15, 1907, why they should not be notified to cease polluting Pen Horn Creek, and to inform the authorities of the Borough of Secaucus that a hearing on the complaint would be held April 15, 1907, at which time the Commission would be pleased to have the borough of Secaucus represented.

At the same meeting, the secretary was directed to notify the authorities of the Township of North Bergen to consult with the Commission in relation to the provision of sewerage facilities for that section of the township on the west slope of Bergen Hill, at a meeting of the Commission to be held April 15, 1907.

At a meeting of the Commission held April 15, 1907, Frederick K. Hopkins, Town Attorney of West Hoboken, appeared before the Commission and requested further time on behalf of the Town of West Hoboken in which to examine into the facts concerning the pollution of Pen Horn Creek.

William Hagen, Mayor of the Borough of Secaucus, appeared before the Commission and stated that the borough had made complaint against the pollution of Pen Creek and desired to have the nuisance stopped.

The further consideration of the pollution of Pen Horn Creek was postponed until April 29, 1907, and the secretary was directed to notify the authorities of Jersey City of the postponement.

At a meeting of the Commission held April 22, 1907, a communication was received from C. A. Van Keuren, Chief Engineer of Jersey City, stating that he was prevented from attending the hearing of the Commission held April 15, 1907, in relation to the pollution of Pen Horn Creek, but that he would be present at the further hearing to be held April 29, 1907.

At a meeting of the Commission held April 29, 1907, C. A. Van Keuren, Chief Engineer of Jersey City, and Frederick K. Hopkins, Attorney of the Town of West Hoboken, appeared before the Commission in relation to the complaint of pollution of Pen Horn Creek.

Mr. C. A. Van Keuren stated that a joint outlet sewer draining part of the City of Jersey City and part of the Town of West Hoboken, had been constructed jointly by the two municipalities and was discharging into Pen Horn Creek, causing some pollution; that there was a question whether the pollution was sufficient to warrant the expense of changing the proposed outlet; that he did not consider the pollution serious or that there was any present necessity of changing the method of disposal, but that he believed that if a change were required, it would be necessary to carry the sewage to the Hackensack River, and that he did not think that this could be done in less than one year.

Mr. F. K. Hopkins stated that the joint sewer discharging into Pen Horn Creek was built about 1892, and that he had examined the sewer and found not over four inches of sewage in a four foot main and that he did not believe there was sufficient sewage flowing in the creek to cause a nuisance; that the flow of sewage was seriously interfered with by piling and a tide gate under the tracks of the Erie Railroad and by piling under the tracks of the Lackawanna Railroad; that this blocking of the stream prevented the sewage from running out as it naturally would, thereby causing the nuisance complained of; that there was considerable pollution of Pen Horn Creek by parties along the creek in the Borough of Secaucus, and that he considered that no complaint should come from Secaucus while this nuisance continued.

At the same meeting, the following resolution was adopted:

"Whereas, the State Sewerage Commission has found that the waters of Pen Horn Creek are being polluted to the injury of inhabitants of this State in their health, comfort and property; therefore be it

Resolved, That under the authority conferred upon it by section 5 of chapter 72 of the laws of 1900, the State Sewerage Commission gives notice to the City of Jersey City and the Town of West Hoboken that, prior to the first day of May, 1908, they must cease to pollute the water of Pen Horn Creek, and make such disposition of their sewage or other polluting matter as shall be approved by this Commission."

The secretary was directed to have notices in writing served in accordance with the foregoing resolution.

PERTH AMBOY.

At a meeting of the Commission held March 25, 1907, a communication was received from Charles C. Hommann, City Attorney of Perth Amboy, inclosing a plan of a sewer in Sheridan Street in the City of Perth Amboy, to discharge into the Raritan River.

The secretary was directed to suggest to Mr. Hommann that he attend a meeting of the Commission in order to explain the plan, and also that a copy of the specifications be submitted to the Commission.

At a meeting of the Commission held April 22, 1907, Charles C. Hommann, Attorney of the City of Perth Amboy, consulted with the Commission in relation to the plan submitted on behalf of the City of Perth Amboy, providing for a sewer to discharge directly into the Raritan River at the foot of Sheridan street.

At the same meeting, Commissioners Capstick, Jacobson and Herbert were appointed a committee to inspect the proposed place of discharge of the sewer to be constructed in Sheridan street, Perth Amboy, and also to inspect the present outlet of a sewer discharging into the Raritan river at the foot of Second street, Perth Amboy.

At a meeting of the Commission held April 29, 1907, this committee reported that it had visited the City of Perth Amboy on April 25, 1907, and in company with the Mayor, Members of Council, City Attorney and City Engineer of Perth Amboy, had examined the sewer in Second street and the proposed site of sewer in Sheridan street; that the area to be drained by the proposed sewer was sparsely populated, but that rapid growth in population was anticipated; that in some of the streets where pavements are being laid some portions of the sewer had already been constructed, the built portion extending for several blocks and being about eighteen inches in diameter; that the main outlet of the sewer was to be in the Raritan River, more than a mile from the mouth of the river and at the site of the county bridge at Sheridan street; that the point at which the sewer would end was about one hundred feet from low water mark on the shore and about midway between the shore and the edge of the channel; that at this point soundings showed about three feet of water at low tide and a river bed of soft mud; that the outlet sewer was to be seven feet in diameter, and designed to care for surface water and domestic sewage; that piles for the approaches to the county bridge and for a pier are in the immediate neighborhood, and that numerous fishing boats were observed in the vicinity; that the present outlet of the sewer in Second street was about four feet in diameter, and extended into the river to a point where the depth is similar to that at the proposed outlet of the Sheridan street sewer; that the sewer is about four feet in diameter, and at the time of inspection (two o'clock) during dry weather, the flow of sewage in the sewer was not over one inch in depth; that the neighborhood of the outlet was noticeably fouled by the sewage; that the City of Perth Amboy had not complied with the requirements of the Commission in regard to the outlet of the Second street sewer; that it also inspected two small combined sewers discharging at the two streets next east of Second street; that both of these sewers emptied at the end of piers above high water marked and caused an offensive nuisance owing to the presence of a considerable amount of sludge; that it considered that the outlet of any sewer at Sheridan street should be carried to the edge of the channel of the river in order that it be submerged to a depth sufficient to prevent a nuisance, and that owing to the possibility of the City of Perth Amboy being required to purify its sewage, it would not be justified in expending any considerable sum of money for combined sewers, and that should purification be required at the present time there are ample facilities for the location of a purification plant in the neighborhood of Sheridan street; that it recommended that the plans submitted by the City of Perth Amboy providing for a sewer in Sheridan street be disapproved; that the authorities of the City of Perth Amboy be advised that it may be necessary to purify the sewage of the city in the near future, and that the suggestion be made to them that plans be prepared for separate sewers in the district which was to have been drained by the proposed Sheridan Street sewer, and that these plans should provide for the treatment of the sewage by a septic tank and trickling filters, or other efficient method of purification.

This report was received and the recommendations therein contained adopted, and the secretary was directed to return to the authorities of the City of Perth Amboy the plans submitted on behalf of that city, providing for a sewer to discharge at the foot of Sheridan street into the Raritan River, without the approval of the Commission, and to advise the authorities of that city that it may be necessary to purify the sewage of that city in the near future, and to suggest that plans be prepared for separate sewers in the district which was to have been drained by the proposed Sheridan Street sewer, and that these plans should provide for the treatment of the sewage by a septic tank and trickling filters or other efficient method of purification, and to notify the authorities of the City of Perth Amboy that unless the requirements of the Commission in regard to the ouelet of the sewer discharging into the Raritan River at the foot of Second street be complied with within thirty days, the Commission would request the Attorney General to apply to the Court of Chancery for an injunction restraining the City of Perth Amboy from discharging sewage from the said sewer.

At a meeting of the Commission held May 6, 1907, Charles C. Hommann, City Attorney of Perth Amboy, consulted with the Commission in relation to the proposed sewer in Sheridan street, Perth Amboy. At the same meeting, the secretary was directed to employ an engineer for the purpose of advising the Commission in relation to a proper plan of sewerage for the City of Perth Amboy.

George W. Fuller, C. E., of New York, was engaged for this work.

At a meeting of the Commission held June 10, 1907, a report on the sewerage system of Perth Amboy and the proposed sewer in Sheridan street, Perth Amboy, was received from George W. Fuller, C. E., which report is given in full herewith. The secretary was directed to send a copy of this report to the authorities of the City of Perth Amboy, and to notify them that the Commission could see no reason for changing its position in relation to the sewerage of Perth Amboy as indicated by its disapproval of the plans submitted for a sewer in Sheridan street in the City of Perth Amboy:

June 1, 1907.

To the Honorable, the State Sewerage Commission of New Jersey, 1 Montgomery Street, Jersey City, New Jersey:

GENTLEMEN—In response to your request I beg to hand you a report on the general question of sewerage and sewage disposal at Perth Amboy, N. J., and with particular reference to the feasibility of the Sheridan Street sewer project.

PROBLEM STATED.

The City of Perth Amboy is located at the mouth of the Raritan River and has a population of about 26,000, which forms essentially a manufacturing community. The average daily water consumption is about 145 gallons per capita. The sewerage system now built (some 14 miles) is entirely on the combined plan and there are some fifteen outlets through which the sewage is discharged in an untreated state into the Arthur Kill and the Raritan River.

Up to the present time, so far as I have been able to learn, there have been no complaints of nuisances occasioned by this method of disposal except in two cases. These are the Lewis street sewer, which now empties into the Arthur Kill at a point even with the bulkhead line, and the Second street sewer, which empties at a point about 200 feet from the shore line at high water. At low water the bed of the river is exposed for some distance beyond the end of the sewer.

The city authorities have been instructed by you to improve conditions here, and I am informed that the matter will be attended to as soon as money is available for the purpose, which is expected to be the case very shortly.

The Sheridan Street combined sewer project entails the construction of a seven-foot sewer and street laterals to drain an area of approximately 200 acres, as shown on the plans on file in the office of the City Surveyor of Perth Amboy, Mr. Forrest L. Smith. The district lies within the general limits of Hall Avenue, Cornell, Stockton, Bertrand, Market, Herbert, Convery and Carsons Streets and the Raritan River. The construction of this combined sewer has already been put under contract and the Market Street branch, from Grand Street to Sheridan Street, consisting of some 150 feet of 12-inch pipe drain and 600 feet of 2-ft.x3-ft. brick sewer has already been constructed.

The whole project has been disapproved by your Commission and construction work which was commenced in anticipation of approval of the plans has ceased.

On May 23rd Mr. G. A. Johnson, Principal Assistant Engineer, visited Perth Amboy and went over the ground in considerable detail with Mr. Forrest L. Smith, City Surveyor. Smith has furnished me with many maps and statistics, all of which have been of assistance in preparing this report.

SHERIDAN STREET SEWER PROJECT.

Starting from the Raritan River outfall at the foot of Sheridan Street and 100 feet from shore the proposed main sewer, called by some the "trunk sewer," extends east and northeast to Market Street. No laterals are designed to enter the sewer below Market Street. At Market Street the main line swings to the west and extends up Grace Street to Smith Street; east on Smith Street to Goodwin Street, up which it extends to New Brunswick Avenue; thence northward on New Brunswick Avenue to Groom Street, up Groom Street to Grace Street, where it branches in both directions at right angles to Groom Street. The main sewer is, roughly, 6,750 feet in total length and ranges in diameter from seven feet to three feet six inches. There are, roughly, 2,000 feet of seven-foot sewer, 600 feet of six-foot two inch, 350 feet of five-foot eight inch, 1,800 feet of five-foot four inch, 900 feet of four-foot eight inch and 1,100 feet of three-foot six inch. It is proposed to connect with this sewer, roughly, 17,800 feet of street laterals, ranging in diameter from twelve inches to twenty-four inches. The total area drained amounts to about 200 acres, and the population resident in this district is in the neighborhood of 2,000.

FEASIBILITY OF THE SHERIDAN STREET PROJECT.

It is certain that a storm water sewer is needed in this district and as designed the proposed sewer appears to me to amply cover the requirements in this connection.

The objection to this sewer is that it is proposed to use it as a collector of sewage as well as of storm water, but as I understand it, the project meets with the approval of the property owners along the water front near the point of discharge.

There are sound reasons why the use of this sewer as a collector of rain water combined with sewage are not well advised, as will be explained later. In granting your approval of this project I recommend that the city authorities be advised to terminate the trunk line at the Market Street culvert discharging into the creek at this point, thereby saving the cost of about 1,800 feet of brick sewer amounting to some $20,000, to build a separate system of sanitary sewers, as required, for this area, laying them in the same trench with the storm sewer where feasible, and to extend this sanitary sewer across the low land to the river.

Upon reaching the shore of the Raritan River, or vicinity, the contents of the main sanitary sewer of this district should be disposed of in a manner to prevent any nuisance. This can now be done either by purification works or by discharging into fairly deep tide water either in the Raritan River or in Arthur Kill (Raritan Bay).

Some day purification works will no doubt be required and this is a sufficient reason for insisting upon separate sanitary sewers for this district.

If tide water disposal for this district is now sanctioned it should be for only a limited period and the Commission should reserve the right to review the question at any time and render a decision in accordance with the local sanitary conditions, the sanitary laws then in effect and the state of the art of sewage disposal as then practised in this general vicinity.

The main point now to determine is whether sewage purification works for this Sheridan Street district should be insisted upon at the outset, or at a later date, in accordance with the facts and conditions existing in the future as outlined in the last paragraph.

As I understand the sanitary and statutory situation, I advise the issuing of a permit to dispose of the sewage in deep tide water subject to the reservations above stated. The reasons for this position are as follows:

1. Deep tide water disposal will eliminate nuisance as to sight and smell.

2. Sanitary conditions of the tide water are scarcely involved, as the sewage from a population of some 2,000 persons can hardly affect, in a measurable degree, the general quality of the water in lower New York Bay or the shellfish therein.

3. Although this area is tributary to the Raritan River, its location at the very mouth of that stream entitles it to consideration as a tide water district rather than one tributary to an inland stream. By means of an intercepting sewer it would not be difficult to deliver all the sewage from this district to a point where it would enter Arthur Kill or Raritan Bay.

4. While I strongly believe that some communities on tide water are so located, especially with reference to large shellfish industries, that purification is necessary as soon as practicable, I am equally certain that the only equitable and satisfactory manner of bringing about the result required is to proceed in such a manner that no one community will be asked to practice a more advanced state of the art of sewage disposal than is required of the general district where the community is situated.

5. Throughout the civilized world tide water disposal of sewage is practiced with few exceptions. In general the results are satisfactory, although much improvement can be effected in many places without going to the expense of purification works. These improvements within the same district can logically come only in a gradual and fairly uniform manner.

GENERAL SEWERAGE PROBLEM AT PERTH AMBOY.

Outside of the Sheridan Street district the requirements of the general problem of sewerage at Perth Amboy may be summed up as follows:

1. All extensions to the sewerage system should be on the separate plan, that is, sewage to be kept in separate pipes from the storm water.

2. The four-foot sewer at the foot of Second Street should be promptly extended into the river some 500 feet or so in order that the discharge will be well below low water.

3. As fast as feasible all sewer outlets in the city should be extended to the outer end of the piers. The Lewis Street sewer now needs attention.

The above program should give satisfactory results for some time to come, and until a definite program can be laid down as to the ultimate method of sewage disposal.

It is perfectly practicable to collect in an intercepting sewer all of the sewage of the City of Perth Amboy at a single point and then to pump it to a site where it could be purified by septic tanks and either sprinkling filters or contact filters.

The cost of such treatment, however, would be much more than that of collecting the sewage at one or more points and discharging it into deep tide water after freeing it of suspended matter by means of a fine wire cloth strainer or by subsidence in tanks. Such deep water disposal of the sewage of Perth Amboy would not result in any nuisance, according to present evidence, if we ignore the question of shellfish pollution.

Clarified sewage might also be thoroughly disinfected at a cost less than that of pumping and purifying the sewage by what is now considered to be standard practice.

I do not consider that at present it is wise to decide finally upon such problems of final disposal as that at Perth Amboy. The delay in the appearance of the final report of the Royal Commission in Sewage Disposal in Great Britain, appointed in May, 1898, is strong evidence as to the uncertain features of such questions as obtain at Perth Amboy according to data now available.

SUMMARY AND CONCLUSION.

To recapitulate, my recommendations and views upon the Sheridan Street sewer project are as follows:

1. No sanitary wastes should be permitted to enter the Sheridan Street projected sewer which should be reserved for storm water removal.

2. The storm sewer should terminate at the Market Street bridge and discharge into the creek at that point.

3. A separate system of sewers should be laid to receive only sewage.

4. The new sanitary main sewer should be extended to fairly deep tide water, such permit to be subject to further action by the Commission, in order to have this district keep well abreast of advances in sewage disposal as practiced by other communities in this general district.

Very truly yours,
G. W. FULLER.

At a meeting of the Commission held September 20, 1907, the secretary was directed to request information from the authorities of the City of Perth Amboy in relation to the new sewer proposed to be constructed by that city.

At a meeting of the Commission held October 3, 1907, a communication was received from Charles C. Hommann stating that plans were being prepared for a sewerage system for the westerly portion of the City of Perth Amboy, in accordance with the recommendations of the Commission.

PHILLIPSBURG.

At a meeting of the Commission held October 8, 1906, the Commission notified the Town of Phillipsburg to cease polluting the waters of the Delaware River prior to the first day of October, 1907.

At a meeting of the Commission held October 3, 1907, the secretary was directed to ascertain whether the Town of Phillipsburg had complied with the notice to cease polluting the Delaware River prior to October 1, 1907, and in case it had not, to request the Attorney General to bring proper legal proceedings to enforce the notice.

At a meeting of the Commission held October 24, 1907, it was reported to the Commission that no action had been taken by the Town of Phillipsburg in relation to the notice to cease polluting the Delaware River.

At a meeting of the Commission held October 3, 1907, the secretary was directed to employ an engineer for the purpose of reporting to the Commission as to the proper disposal of the sewage of Phillipsburg. George W. Fuller, C. E., was employed for this purpose. His report is as follows:

November 25, 1907.

Boyd MacLean, Sec'y., State Sewerage Commission, Jersey City, N. J.:

DEAR SIR—Pursuant to the request of the Commission I beg to report the results of my findings upon the main features of providing a sewage disposal works for the town of Phillipsburg, N. J.

This town is located on the east bank of the Delaware River opposite the town of Easton, Pa., where the Lehigh River enters the Delaware. There are about 2,000 acres within the present town limits. A population of about 14,000 people is located partly upon a narrow river plain, not much higher in places than extreme high water in the river, and partly upon much higher ground lying back of this river plain. Much of the population is located upon a precipitous hillside, the top of which is 100 to 200 feet or more above the river level. In places the bluffs are very precipitous; in fact, almost vertical. Adjoining land outside the town is for the most part on this high level, as the bluffs approach the river a short distance above the northern town limits, and on the south there is practically no low land. The topography of the hill section is broken up by several ravines and railroad cuts.

A sewerage system on the combined plan was designed for Phillipsburg in 1888 by Mr. C. P. Bassett. This system has not been built in its entirety and, in fact, a number of departures from the original plan have been made in the sewers now built. At present there are about seven miles of sewers, receiving storm water, industrial wastes and domestic sewage.

There are now only about 425 connections with the sewerage system and for the most part these are confined to the higher class of dwellings and particularly to business houses. The proportion of industrial wastes reaching the sewers as compared with domestic sewage is very high.

The existing sewers have been built, I am informed, from the general funds of the town without any assessment having been levied against abutting property owners. A fee of $25 is charged to all who made a connection with the sewers. These financial conditions and the existence of porous soil over a considerable area of the built-up portion of the town explains in a large measure the absence of an up-to-date and efficient sewerage system.

The town records, as furnished by Mr. R. P. Howell, Town Engineer, show the following list of sewer outfalls:

1. A 7′ 0″-combined sewer discharging into the Delaware River opposite the plant of the Andover Iron Company.

2. A 3′x4′-combined sewer discharging into the Delaware River near Union Square and about 100 feet below the Delaware bridge.

3. A 3′ 0″x4′ 6″-storm water sewer discharging into the Delaware River near the foot of Third street.

4. A 16″-combined sewer discharging into the Delaware near the foot of Second street.

5. A 4′-storm water sewer discharging into the Morris Canal near the

upper end of the railroad incline. This sewer carries besides storm water the wastes of the Pintsch and Easton Gas and Electric Company's plants.

6. An 18"-storm water sewer discharging into the Morris Canal near the foot of McKeon street.

7. Two small private sewers, 8-inch and 14-inch in diameter, discharging into the Delaware River from the Penna. and C. R. R. of N. J. stations and shops, respectively, near Union square and the foot of Hanover street.

The total flow of sewage into the Delaware River during dry weather was found in September, 1906, to be in the neighborhood of 800,000 gallons daily, about 600,000 gallons of which enter the river at the main outfall near the Andover Iron Works. Local authorities claim that not more than ten per cent. of this volume is domestic sewage. This would make the daily sewage flow from each sewer connection less than 200 gallons. Exactly what this quantity is cannot be told from available data, but it is safe to say that from business houses the amount of sewage is frequently much less in proportion to the population than it is from dwellings. Records of water consumption, from the privately owned water works plants, were not found to be available.

Without doubt the great majority of the dry weather flow of existing sewers comes from industrial establishments, of which the principal one is the Standard Silk Company. This establishment employs from 1,500 to 2,000 hands and is said to have paid the town a certain sum of money for the privilege of discharging all of its waste liquids into the public sewer. Other large industrial establishments are those of the Ingersol-Rand Drill Co., Warren Foundry & Machinery Co., Tippet & Wood Boiler Works, American Horseshoe Works, and the shops of the Central Railroad of New Jersey. The Baker Chemical Works discharge some chemical products directly into the river and the Pintsch Gas and the Easton Gas and Electric Lighting companies drain into the Morris Canal through a small sewer.

The sanitary wastes of all the industrial establishments should be connected with sanitary sewers, and this is true of the spent dyes and portions of the wash water from the silk mills. The wastes from the gas works should be treated on their own property in a suitable manner and not allowed to enter either the sewers, the canal or the river. Some wastes from chemical works come in the same class as gas wastes.

A careful study of the remaining waste water from industrial establishments would doubtless result in permitting the discharge of a considerable portion of it into the storm sewers rather than into the sanitary sewers. This certainly could be arranged in a satisfactory manner if care were taken to keep grease and oil excluded. Even in the case of the silk mills I believe that a substantial reduction could be made in the volume of liquid which should be received into the sanitary sewers. In this way the cost of new sewers and of the disposal works could be kept to a lower figure than otherwise would be the case.

In accordance with the policy decided upon in conjunction with the

State Health Department of Pennsylvania whereby all sewage is to be eliminated as soon as practicable from the Delaware River above the City of Philadelphia, you gave notice to the town of Phillipsburg in October, 1906, to cease the pollution of the Delaware within a certain period. Practically nothing has been done by the town in taking steps to that end. There are several reasons for this apparently, one of which is the difficulty and expense of rearranging their sewerage system and pumping the sewage to a point where a suitable disposal site may be found.

Mr. Geo. A. Johnson, Principal Assistant Engineer, and I have each looked over the ground with a view to selecting the most suitable site for the disposal works and to formulating a general procedure by which the sewage in the most economical manner can be delivered to a suitable site. The problem is not so simple that it can be satisfactorily solved in precise terms from the meager data now available, but we have examined into conditions on the ground sufficiently to outline the most practical procedure for carrying out your instructions to the town.

I will first outline the results of our inquiry as to disposal sites, and then the means for getting the sewage to such site at least cost, as well as outlining what seems most feasible as to the method of disposal. The cost can be entered into only in a comparative way from the experience of other communities in dealing with works of similar magnitude.

At the outset it is to be stated that all future sewers should be built upon the separate system. Some of the existing sewers may be converted into storm sewers and others retained for sewage alone. The entire question of sewage collection within the town, and also of storm water drains, needs thorough overhauling, practically involving complete new designs.

There are three sites which have received attention for the location of the sewage disposal works; namely, the river plain near the northern town limits; a site adjoining the Morris Canal and north of the Alpha Road near the southern limits of the town; and finally low lands across the Delaware River in the State of Pennsylvania at a site opposite the southern portion of the town.

The site in Pennsylvania is the one to which the greatest portion of the sewage of the town could be delivered by gravity. The cost of crossing the river with cast iron siphons would be less than that of pumping. We have not looked into this matter in detail, as I am unable, from present information, to say whether it will be feasible or not to secure suitable legislation to make this suggestion practicable. It is a proposition which should be looked into as to its legal significance, and if it is feasible, I advise that its engineering and economical merits be investigated.

For present purposes I have assumed that suitable authorization from Pennsylvania could not be obtained readily, and have looked for sewage disposal sites on the eastern bank of the Delaware in the localities mentioned. The northern site, which comprises the river plain above the Canister Mfg. Co., is composed in places of porous gravel and sand, evidently glacial drift deposit. This strip of sandy gravel is ordinarily not more than 100 to 200 feet wide until a point is reached in the neighborhood of the wells and pumping station of the Phillipsburg Water Works. If the influence of sewage applied to this coarse material above the Phillipsburg Water Works were disregarded, it would seem to be the most feasible procedure to apply this sewage after some sedimentation to this coarse material. There are several disadvantages to this however, in that there is not a sufficient area of such material adequately removed from the water works and neighboring dwellings; and the areas adjoining this gravel deposit contain such fine sand mixed with loam that it does not seem feasible in my opinion to use intermitten filtration in this locality. Another objection is that the intake of the Easton Water Works is located near the southern limits of this territory which already is surrounded with quite a number of houses but a short distance away.

Taking everything into consideration, it is my judgment that a more suitable location is to be found east of the Morris Canal and north of the Alpha Road. Here it is possible to secure an adequate field for disposal works which would be a quarter of a mile or so removed from built-up streets and where it is entirely feasible to build disposal works in a satisfactory manner.

It is not possible, in my opinion, to find any practicable site in the State of New Jersey for Phillipsburg to dispose of its sewage by intermitten filtration through natural deposits of sand or gravel. Such deposits are to be found along the river plain, but they have already been built upon so that there remains practically nothing except the ravines with their impervious material.

This southern site is a suitable one and in the absence of evidence to justify a study of the site in Pennsylvania I advise that details be prepared for delivering the sewage to this field at an elevation of approximately 65 city datum, or say about 30-35 feet above ground level near Union square.

It is entirely feasible to collect the sewage from nearly half of the present population residing on land at a higher elevation than that mentioned for the flow line at the disposal works. Including trade wastes, more than half of the present sewage can apparently be delivered to the disposal works at this site by gravity. To do this detailed studies should be prepared for a gravity interceptor, which with a few short siphons would intercept most of the sewage on the hillside and hill tops above Washington street, the D., L. & W. R. R. and along Warren street to Center street. In the latter locality a receiving basin should be built at the head of a cast iron pipe line which would serve as a siphon through which the sewage would flow from the receiving basin to the disposal works. This siphon of cast iron pipe would extend down Center street and South Main street, and thence to the disposal works. It would have a length of some 7,000 feet and should be of a size sufficient only for the requirements of the first few years of service, say 12 inches in diameter, and then later as the volume of the sewage flow increases a duplicate line should be built. The receiving basin would provide facilities for storing the sewage so as to equalize the flow at different hours during the day and particularly to allow the sewage to accumulate when the siphon is first put in use so that a scouring velocity each day would be insured to remove deposits.

Below the level of the gravity interceptor there is fully one-half the population now resident on land too low to permit a gravity flow to the disposal works. This sewage should be collected by a system of sewers leading to a series of small electric pumping stations which could be automatically operated with the use of floats to throw in and out of service electric motors for driving centrifugal pumps. This is the cheapest and most practical way of lifting sewage from the low district to the gravity interceptor. It is in successful use at various places, the largest of which that we recollect is Saratoga, N. Y. This method requires no regular attendant, but simply an occasional visit of someone to oil the bearings and see that the floats and screens are operating satisfactorily.

From existing data it is difficult to outline the area which would be tributary to each of these electric pumping stations. This difficulty results partly from the absence of sufficient street grades at controlling points and partly to data required to make the most advantageous use of existing sewers. The results of our inspection indicate that one pumping station should be located a short distance north of Union square, a second one at the foot of Center street, and probably a third on Stockton street in the vicinity of Sitgreaves street where it would take the sewer from an intermediate level between the gravity district above outlined, and the two low level districts. The first station named above would deliver to the third station. The pumping lifts of these three stations would range from about 35 to 45 feet. The last two mentioned stations would deliver through cast iron force mains to the gravity interceptor.

At each of these pumping stations there would be built a receiving well to store extreme high flows of sewage, and in which would be located three centrifugal pumps operated by motors. These pumps take their suction at different levels and would have automatic starting and stopping devices connected with floats set to operate at different levels in the well, so that the amount of pumping capacity would be thus adjusted to the volume of sewage to be pumped.

The volume of sewage which would reach these stations at the present time probably would not exceed 200,000 gallons daily. With more houses connected with the sewers these figures would be materially increased. We have assumed 600,000 gallons as the ultimate flow of sewage from the low districts.

As to trade wastes, those coming from the large silk works and forming the greater proportion of flow now entering the sewers are fortunately located above the gravity interceptor and will not require pumping. There is no indication of much ground water leakage coming into the sewers.

Assuming that the pumps and motors will have an efficiency of 50 per cent., there would be required to pump a total of 200,000 gallons daily from these three stations, an average amount of electric current of about 90 kilowatt hours. For 600,000 gallons this figure becomes about 220 k.w. hours. Electric current costing 2.3 cents per k.w. hour will amount per day to about $2.07 and $5.06 for these two figures, respectively. One man per shift should be able to take care of the pumping stations and the receiving basin at the head of the siphon.

The cost of building the three pumping stations, force mains and mechanical appliances complete, together with the receiving basin and siphon for the gravity interceptor may be roughly estimated as in the vicinity of $30,000. This is exclusive of land. The gravity interceptor could be arranged to serve as a sewer, so it adds no extra cost to disposal appurtenances.

As to the style of purification works most suitable for local conditions, I advise the adoption of covered septic tanks, holding about 12 hours' flow, and of double contact beds filled from below. The contact beds I should make five feet in depth with an area sufficient to provide one acre of filtering surface for 500,000 gallons of sewage daily. I should make the secondary bed of somewhat finer material than frequently is the case, and pass the effluent from the secondary contact filters through covered settling basins, holding about four hours' average flow. With this arrangement the sewage would not be exposed to view at all, and after passing through these works it would enter a small brook flowing alongside Morris Canal, in a non-odorous condition, substantially freed from its suspended matter, and with a bacterial removal of approximately 90 per cent., provided the plant was well managed. Under existing conditions it is my judgment that such a plant would prove satisfactory in purifying the local sewage, and should it be necessary to secure a higher degree of bacterial purification before this effluent enters the Delaware River, from which I understand no public water supply is drawn for a distance of 40 miles below Phillipsburg, it would be entirely practicable to treat it with some form of sterilization.

Such purification plant would be similar in many respects to the one now in operation at Plainfield, N. J., except that the contact beds filled from below would be deeper, and that the effluent from these filters would be settled in order to bring about a deposition of suspended matters. The action of the septic tank in effecting a removal of about two-thirds of the suspended matter and of the contact filters in still further clarifying the sewage, after causing the organic matter to be oxidized through bacterial agencies, is too well known to you for me to detail the processes here.

Such a plant for the present needs of Phillipsburg I estimate would cost, exclusive of land, about $70,000, for a capacity of 800,000 gallons daily and about $100,000 for a capacity of 1,200,000 gallons daily. The size of the first installation will depend upon the policy of the town as to compelling householders to connect with the sewers.

In purchasing land, a sufficient area should be provided to allow the deposits of inert, inodorous sludge from the septic tanks and settling basins to be disposed of from time to time by applying to lower portions of the land. If desired these deposits may be plowed into the land. With fairly intelligent management such a plant would not produce any nuisance in the immediate neighborhood, having all of its structures arranged so that the sewage would not be exposed to view. It would cost to operate this plant properly about $2,000 per year, exclusive of fixed charges on the investment and independent of the cost of cleaning the broken stone filtering material at intervals of say once in five or six years.

SUMMARY.

From preliminary studies of the Phillipsburg problem my conclusions and recommendations as to the best procedure for the town to adopt in order to eliminate pollution from the Delaware River are as follows:

1. Consider the local practicability of disposing of the sewage on the river plain in Pennsylvania across the Delaware River from the lower portion of the town. If this is feasible, have the engineering data prepared to develop this project along the most effective and economical lines. If this is not practicable, then have surveys and plans made for disposing of the sewage upon the southern site above mentioned, in accordance with the general procedure above described.

2. Design the system of sewers yet to be built, and to such an extent as necessary rearrange existing sewers, so as to get as large a portion as possible of the sewage to the disposal works by gravity.

3. Build all new sanitary sewers on the separate system, bearing in mind that of the existing sewers some may to advantage be kept as sanitary sewers and others can be better devoted to use for storm water only.

4. As to trade wastes, careful study should be made to permit the town authorities to make decisions at every plant as to what wastes must go into the sanitary sewers and which wastes are of a nature that they may properly go through the storm sewers directly to the river. As stated above waste liquors from gas works should not be allowed to reach either the sewers, canal or river. Chemical products capable of injuring the sewers should also be disposed of at the point of origin.

5. The disposal of sewage at the southern site makes it imperative for economical reasons that a most careful study should be made to reduce the amount of pumpage to the minimum. The method of procedure to give the best results is above indicated, but full details cannot be worked out in the absence of a considerable amount of engineering data not yet available.

6. Topographic conditions at Phillipsburg, and the distribution and occupation of its population, are such that more data than usual, in proportion to the population of the town, are required in order to allow this community to carry out your recommendations in the most practical and economical manner. It would take a good sized engineering corps several months to design all the details of the required new works, preparatory to the town authorities arranging the financial side of the question.

Very truly yours,

GEORGE W. FULLER.

PLAINFIELD.

At a meeting of the Commission held February 21, 1907, a complaint of pollution of Green Brook by the effluent from the sewage disposal plant of Plainfield, and a protest against the proposed enlargement of that plant to accommodate the sewage of North Plainfield, was received from F. H. Herkstroter, Secretary of the Green Brook Improvement Association. Commissioner Herbert was appointed a committee of one to investigate the complaint of pollution of Green Brook.

At a meeting of the Commission held March 11, 1907, Commissioner Herbert reported that he had examined the sewage disposal plant of the City of Plainfield, and had found it to be in good condition; that he took a sample of the effluent and found it to be well purified; that he saw no sign of nuisance except at the sludge bed where a fresh discharge of sludge caused considerable smell, and that as yet he had been unable to confer with the parties making the complaint.

At a meeting of the Commission held March 18, 1907, Commissioner Herbert reported that he had consulted with F. H. Herkstroter in relation to the complaint of pollution of Green Brook, and that Mr. Herkstroter had stated that the brook was polluted and offensive; that the pollution was carried into the meadows in times of flood, and that he believed the pollution came from Plainfield, and that he considered it necessary that the brook be inspected after the high water had subsided.

At a meeting of the Commission held May 16, 1907, Commissioner Herbert reported that he had inspected the sewage disposal plant of Plainfield on May 15, 1907, and had found that sewage was leaking probably from the septic tank into the underdrains of one of the abandoned sand beds.

The secretary was directed to notify the authorities of the City of Plainfield that it had been reported to the Commission that sewage was leaking from its sewage disposal plant through an abandoned underdrain into Green Brook, and to request that immediate steps be taken to prevent such leakage.

At a meeting of the Commission held May 23, 1907, a communication was received from A. J. Gavett, Street Commissioner of the City of Plainfield, stating that the communication from the Commission in relation to leakage in an underdrain of the sewage disposal plant of Plainfield had been received, and that steps had been immediately taken to stop the leak and that it had been entirely stopped.

POINT PLEASANT BEACH.

At a meeting of the Commission held August 8, 1907, a communication was received from Abraham Lower, Clerk of the Borough of Point Pleasant Beach, stating that the Council of that Borough desired to consult with the Commission in relation to a proposed sewerage system for the borough.

Commissioner Herbert was appointed a committee for the purpose of consulting with the Council of the Borough of Point Pleasant Beach.

At a meeting of the Commission held August 20, 1907, Commissioner Herbert reported that he had visited Point Pleasant Beach on August 19, 1907, and consulted with Mayor Dampman in relation to the installation of a sewerage system and the purification which would be required by the Commission in case a sewerage system should be installed, informing him that for the present a septic tank with an outlet pipe carried not less than five hundred feet from shore would be necessary if the sewage were discharged into the ocean, and that in case it was discharged into the Manasquan River, a greater degree of purification would be required.

Under date of November 13, 1907, Abraham Lower, Borough Clerk, reported to the Commission that a petition had been prepared and signed in due form requesting the borough council to call an election on the question of having sewers, and that engineers were working on the question of the disposal of the sewage, and that further action was delayed until a report was received from the engineers.

PRINCETON.

At a meeting of the Commission held October 8, 1906, the secretary was directed to suggest to the authorities of the Borough of Princeton that steps be taken by them to improve the condition of the sewage disposal fields of that borough.

At a meeting of the Commission held February 11, 1907, plans for the disposal of the sewerage of part of the Borough of Princeton, providing for the construction of a septic tank at the north disposal field of that borough, were submitted to the Commission by William A. McKenzie, C. E., on behalf of the Borough Council.

At a meeting of the Commission held February 25, 1907, the secretary was directed to return the plans submitted on behalf of the

Borough of Princeton, providing for a septic tank at the northwest disposal field of that borough, with the recommendations that the plans be changed so as to provide for sand filtration of the effluent from the septic tank, and for the subdivision of the septic tank in such a manner that a section of it may be used in case the flow of sewage should be insufficient to warrant the use of the entire tank.

At a meeting of the Commission held October 10, 1907, a communication was received from William A. McKenzie, C. E., stating that work had been done on the northwest disposal field in accordance with the suggestions of the Commission, and also stating that plans of the work would be submitted to the Commission as soon as possible.

At a meeting of the Commission held October 24, 1907, plans of sand filter beds constructed at the northwest disposal field of the Borough of Princeton, were submitted to the Commission by William A. McKenzie, C. E.

The secretary was directed to request that plans of the septic tank at the northwest disposal filed at Princeton be also submitted to the Commission.

RAHWAY.

At a meeting of the Commission held September 26, 1907, the Secretary was directed to notify the authorities of the City of Rahway to show cause at a meeting of the Commission to be held Thursday, October 10, 1907, why they should not be notified to cease polluting the Rahway River.

At a meeting of the Commission held October 10, 1907, in response to this notice, Francis V. Dobbins, City Attorney, appeared before the Commission and stated that there was no question that the Rahway River was polluted by sewage, but that the city was not in a position to expend the money necessary to install a purification plant, because of its indebtedness and the impossibility of increasing its tax rate; and that in case action were taken by the Commission in regard to the pollution of the Rahway River, he requested that as long a time as possible be given the City of Rahway in which to make any changes that might be required.

On motion of Mr. Herbert, the following resolution was adopted:

"Whereas, The State Sewerage Commission has found that the waters of the Rahway River are being polluted to the injury of inhabitants of this State in their health, comfort and property; therefore, be it

Resolved, That under the provisions of Chapter 72 of the Laws of 1900, and the supplements and amendments thereto, the State Sewerage Commission hereby gives notice to the City of Rahway that it must cease to pollute the waters of the Rahway River prior to November 1, 1911, and make such disposition of its sewage or other polluting matter as shall be approved by the State Sewerage Commission."

On motion, the Secretary was directed to have a notice in writing in accordance with the foregoing resolution served on the authorities of the City of Rahway.

RAHWAY RIVER.

At a meeting of the Commission held November 26, 1907, a communication was received from A. C. Benedict, inspector of the Board of Health of the Village of South Orange, complaining of the pollution of the east branch of the Rahway River by the City of Orange.

The Secretary was directed to reply that the Commission had notified the City of Orange to cease polluting the Rahway River, but was unable to enforce its notice because of the limitation in its powers made by the laws in relation to the Passaic Valley Sewerage District.

This matter was called to the attention of the Legislature in the last annual report of the Commission, and a new statute was enacted extending the jurisdiction of the Commission so as to permit it to take cognizance of cases in the Passaic Valley Sewerage District pollution of streams other than the Passaic River.

At a meeting of the Commission held July 11, 1907, the Commission directed the Secretary to have made a sanitary inspection of the Rahway River. This inspection was made with the special view of protection of the water supply of the City of Rahway.

At a meeting of the Commission held July 18, 1907, a complaint of pollution of the Rahway River by acids discharged from a factory at Springfield was received by the Commission.

The Secretary was directed to have this complaint investigated in connection with the inspection of the Rahway River, ordered by the Commission. The inspection showed that the pollution complained of, if there were any at all, was not sufficient to warrant action by the Commission.

At a meeting of the Commission held August 15, 1907, a report of inspection of the Rahway River was submitted to the Commission.

The Secretary was directed to notify all the parties reported to be polluting the Rahway River to show cause at a meeting of the Commission to be held September 5, 1907, why they should not be notified to cease polluting the river.

Reports of thirty-five cases were submitted to the Commission, of which twenty-three cases of private parties and the City of Orange were deemed worthy of action by the Commission, and notices were sent to these parties of a hearing to be held by the Commission on September 5, 1907. At that meeting of the Commission, in response to these notices, there appeared before the Commission, Frederick T. Crane, City Engineer of Orange; T. E. Chace, President of the Petrifoid Company; Ernest Meyer, Proprietor of the Kenilworth Glove Leather Company; Richard Kernan, Alfonse Lapis, Peter Albanese and Mrs. N. Nardiello.

Communications in reply to notices were received from twelve other parties.

On behalf of the City of Orange, City Engineer Frederick T. Crane stated that the storm drain constructed by the City of Orange had formerly been connected with overflows from the sewage system of the City of Orange, so that when any blocking occurred in the sewage system, the sewage would overflow into the storm drain and be discharged into the Rahway River; that the City had taken steps to remedy this by disconnecting the sewers from the storm drain; that the city had also inspected all of the properties along the creek running into the storm drain constructed by the city, and had found that they were all connected with the city sewers except in one instance where the connection had been made by mistake with the storm drain and that in this case the storm drain connection had been removed, and the sewage was now being discharged into the city sewers; that he did not know to what extent sewage or factory wastes were being discharged into the storm drain, but thought that the Board of Health of the City of Orange could remedy any such defect by taking action in the individual cases.

T. E. Chace stated that the company of which he was president discharged into the Rahway River only the water which had been used for washing acid-soaked cotton from its mill at Springfield; that all of the acid possible was recovered, and what remained in the water was neutralized with soda.

Ernest Meyer stated that all wastes from his property at Kenilworth were discharged on the ground and that they soaked away through the ground, and that care was used to prevent anything escaping into the river.

Richard Kernan stated that he was a part owner of property in South Orange complained of; that he thought that he could arrange within a short time to prevent any pollution reaching the river from the property.

Alfonse Lapis stated that he owned property in West Orange from which pollution was reported to be reaching the river; that after his attention had been called to the matter by the inspector, he had taken action to prevent the pollution reaching the river.

Peter Albanese stated that he was not responsible for pollution reported by the Inspector as being discharged into the river from property occupied by him at Springfield.

Mrs. N. Nardiello stated that she owned property in West Orange from which pollution was reported to be reaching the river; that she would take precautions to prevent any pollution of the river as far as possible; that she had requested that a sewer be laid in the street on which her property fronted, but that she had been unable to procure a sewer.

Communications from the Trimble Hat Company, the Pike Adding Machine Company, E. V. Connet & Company, and F. Berg & Company, owning manufactories in the City of Orange, stating that they were permitting no wastes to escape into the storm drain of the City of Orange, were received and filed.

At the same meeting of the Commission, the following resolution was adopted:

"Whereas, The State Sewerage Commission has found that the waters of the Rahway River are being polluted to the injury of inhabitants of this State in their health, comfort, and property; therefore, be it

Resolved, That pursuant to Chapter 72 of the Laws of 1900, and the supplements and amendments thereto, the State Sewerage Commission hereby notifies Peter Albanese, C. and J. Witcopp, Richard Kernan, T. Giowano, Mrs. M. Compione, the City of Orange, F. Berg and Company, E. V. Connet and Company, Trimble Hat Company, the No Name Hat Company, Guisseppe Ubertino and Mrs. Lamb, to cease polluting the waters of the Rahway River prior to November 1, 1907, and make such disposition of their sewage and other polluting matter as shall be approved by this Commission."

The Secretary was directed to have notices in writing served in accordance with the foregoing resolution.

At a meeting of the Commission held September 26, 1907, the Secretary was directed to notify the City of Rahway to show cause why it should not be notified to cease polluting the Rahway River.

A hearing was held at a subsequent meeting, and notice was given the City of Rahway to cease polluting the river, which action is reported herewith under the heading "Rahway."

A list of the reports of inspections made by the Commission during the fiscal year ending October 31, 1907, is printed as an appendix to this report. This list includes the cases in the Rahway River.

RARITAN RIVER.

At a meeting of the Commission held February 25, 1907, a complaint of pollution of the Raritan River was received from F. R. Williamson of Flemington. The Secretary was directed to have an inspection made of the Raritan River.

At a meeting of the Commission held April 8, 1907, reports of sources of pollution of the south branch of the Raritan River were received, and the Secretary was directed to notify all parties reported to be polluting the south branch of the Raritan River to show cause at a meeting of the Commission to be held April 29, 1907, why they should not be notified to cease polluting the Raritan River.

Notices were sent to ninety-one parties.

At a meeting of the Commission held April 29, 1907, in response to these notices, there appeared before the Commission Shafer & Conkling, Attorneys for Willswood Farms Dairy Company; James D. Manning, Attorney for Mark Fleming; Mark Fleming, J. R. Dilts, M. K. Thorp, for H. Quell; P. F. Swearer, W. Atkinson, for C. H. Cook; S. Nielenburg; H. E. Deats, for himself and William Burgess; Hiram Deats, Jr., George H. Lodge, Attorney for Edward Able, E. E. Thompson, C. Thompson, Edward Humphrey, Mrs. William Richards and William E. Emery; Dr. Edgar Allen and William Holges.

Mr. Cook Conklin, on behalf of the Willswood Farms Dairy Company, stated that this company owned a creamery which was constructed in a sanitary manner and was frequently washed, and that the bottles and cans were washed; that the washing was done with boiling water in order to kill all the germs; that he did not believe that more than a quart of milk a day was washed into the river, and that in his judgment, practically no pollution was caused by this discharge into the river because it would disappear almost immediately and no trace of it could be found a short distance below the place of discharge; that the creamery complied with all the requirements and regulations of the State Board of Health, which required frequent washings and sterilization; that it would be practically impossible for the creamery to purify its washings, and that the company desired to know what the Commission wished it to do in the matter.

W. Atkinson stated that he represented C. H. Cook, who owned several creameries which were conducted practically as that of the Willswood Farms Dairy Company; that he was practically in the same position as that company in regard to the pollution.

M. K. Thorp stated that he represented H. Quell, who conducted a creamery at which very little washing was done, the washing mostly being done either in New York or at the farms from which the milk was obtained, and that practically no pollution was caused at that creamery.

J. R. Dilts stated that on his farm there were cows and pigs, and that the drainage from the farm ran into the river, and that dish water and wash water was discharged from his farm into the river.

S. Nielenburg stated that he was not polluting the river; that he owned a shoddy mill at Hamden, but that no pollution ran into the river.

James D. Manning, on behalf of Mark Fleming, stated that Mr. Fleming would do whatever was necessary to place his property in a sanitary condition.

H. E. Deats, for himself and for William Burgess and Hiram Deats, Jr., stated that they were ready to comply with the law, and would obey such requirements as were made by the Commission.

George H. Lodge stated that he appeared for several clients; that E. E. Thompson and C. Thompson, called the Thompson Brothers, have a foundry facing mill on the south branch of the Raritan River; that sweepings consisting of anthracite coal, from the floor of the mill, had been dumped into the river, but that they contained no polluting matter of any kind; that this was the first time that this had been done; that they were now having built a new plant in Pennsylvania to do away with the necessity of grinding coal at the Clinton plant, and to grind graphite in its place; that there would be no waste as all waste represented that much loss; that the change would be made in about three months, and that there would be no further pollution of the river by reason of their plant; that in case notice to cease polluting be given to them, at least three months time should be allowed; that he represented Edward Humphrey of Glen Gardner, who keeps a hotel on Spruce Run, a tributary of the South Branch, and who only sewers into the river from one urinal in which water is running all the time, and who has an acetylene gas plant emptying on the banks and possibly causing some pollution, and also a cesspool which does not connect with the stream; that he represented Mrs. William Richards of Flemington, who formerly owned a private sewer discharging into the river, but who has used the town sewer since its construction; that he represented William E. Emery of Flemington, who has ordered his own sewer torn up, and will connect with the town sewer, to do away with all cause for complaint; and that he also represented Edward Able, who owned a hotel at Clinton which sewered into the river.

Dr. Edgar Allen stated that he had an overflow from a cesspool discharging into the river at Pattenburg.

William Holgers stated that he had a cesspool 160 feet from the creek, to which there was no outlet; that he had in his cellar an acetylene gas plant using about 30 pounds of calcium carbide a week; that the waste from this was discharged on the surface of the ground, and was washed into the creek in time of rain, but that he did not think this polluted the water. He stated that there was much pollution from cattle in the stream.

In addition to the personal appearances, twenty of the parties notified to show cause responded by mail.

At a meeting of the Commission held June 20, 1907, the following resolution was adopted:

"Whereas, The State Sewerage Commission has found that the waters of the Raritan River and its tributaries are being polluted to the injury of inhabitants of this State in their health, comfort and property; therefore, be it

Resolved, That pursuant to Chapter 72 of the Laws of 1900, and the supplements and amendments thereto, the State Sewerage Commission hereby gives notice that prior to the first day of September, nineteen hundred and seven, J. M. Apgar, Edward Able, W. E. Apgar, J. Barton Apgar, D. W. Apgar, Dr. Edgar Allen, Dr. J.

E. Anderson, John Burns, A. L. Beavers, George W. Beatty's Sons, William N. Burgess, George Barker, E. M. Bartles, D. W. Bowman, Miss Annie Carson, George H. Cramer, Harry Coll, A. B. Chamberlin, Chester Lodge, I. O. O. F., Henry C. Dart, Hiram Deats, H. Davidson, H. E. Deats, J. R. Dilts, F. A. Estey (E. V. Parry Estate), William E. Emery, Mark Fleming, John Frech, Isaiah Fritts, Flemington Gas Company, J. H. Gardner, Charles Garrison, Edward Humphrey, George Howell, William Holgers, James Hann & Sons, Judiah Higgins, Samuel T. Hall, Marietta Hill, J. S. Harden, Miss Sallie Kline, Mrs. James A. Kline, Lehigh Valley Railroad Company, B. V. Leigh, executor of the Estate of John T. Leigh, Mrs. John Lunger, S. G. Lunger, Henry Layton, John C. Lane, Mrs. E. Lane, William McCrea, Samuel Nielenburg, Neigh Brothers, R. W. Parramore, Frank Pill, John Reading, Miller Kline Smith, S. W. Swaze, M. B. Stevenson, Mrs. E. Sheppard, David Snyder, John T. Scott, Theodore F. Swearer, Thompson Brothers, Taylor Iron and Steel Company, L. H. Taylor, Joseph A. Tiger, Frank Tobb, M. K. Thorp, Mrs. William Weaver, J. W. Weiss and M. T. Welch must cease to pollute the waters of the Raritan River and its tributaries, and make such disposition of their sewage and other polluting matter as shall be approved by this Commission."

The Secretary was directed to have notices in writing served in accordance with the foregoing resolution.

At a meeting of the Commission held May 16, 1907, a complaint was received from A. C. Zvolanek, of Bound Brook, of pollution of New Market and Bound Brook by sewage discharged from a sewer at Lincoln. Commissioner Herbert was appointed a committee to investigate the complaint.

At a meeting of the Commission held June 20, 1907, Commissioner Herbert reported that he had investigated the complaint made of the pollution of Bound Brook by the sewers of Lincoln; that Lincoln was a small village containing about forty residences, four factories and one hotel; that it was part of Piscataway Township; that it was supplied with water by the Watchung Water Company, most of the buildings being supplied with water; that in 1897, about five thousand feet of separate twelve-inch sewers were laid, having one factory and twenty-one house connections, including the hotel; that the system had two outlets; one, at the foot of Sheridan avenue, and the other, near the foot of Mountain avenue, each of which was provided with what was intended to be a large cesspool, the overflow from these passing into small spring runs and thence into Bound Brook about four or five hundred feet distant; that the cesspools were each about ten feet in diameter and eight feet deep, and each contained about forty-seven hundred gallons; that the one at Sheridan avenue was built of brick, but, owing to lack of care, had become useless, the sewage flowing out through holes in the bottom; that the one at Mountain avenue was built of stone, laid dry, and acted merely as a screening chamber; that both of these cesspools could be made water-tight by the use of concrete, and they would then become excellent septic tanks, if properly baffled; that the elevation of the outlet pipes would be four or five feet above the surface of the meadow, giving ample fall for filtration; that a good quality of sand could be obtained within a thousand feet of these tanks; that the drainage area above Bound Brook is about twenty-four square miles, and that the average daily flow of the brook is about 24,700,000 gallons; and during the driest period the daily flow is about 2,000,000 gallons; that the brook is dammed in two or three places, and during the dry season the water is impounded a large part of the day for mill purposes, and that at such times the flow of the stream would scarcely exceed the discharge from the sewers; that in his judgment the complaint was well founded; and that the discharge of crude sewage into Bound Brook caused a nuisance and a menace to the health of the people living along the stream below the point of discharge; that he had received verbally from several persons complaints of pollution of the Raritan River in this vicinity, and that he had inspected the Raritan River and found that crude sewage was being discharged into the river from the Town of Raritan, which had a population of 3,954, and having a separate system with two outlets; from the Town of Somerville, with a population of 4,782, and having a separate system with two outlets; from the Borough of Bound Brook, having a population of 3,389, and having a separate system with one outlet in use and one being constructed, and from the Village of New Bound Brook in Piscataway Township, in which there were twenty-five houses and three factories, and which had a separate system of about two miles of sewers, with one outlet; that he was informed that this system was owned by Hugh C. Pierce; that there were also several minor sources of pollution from individual residences and mills, an inspection of which was being made for the Commission by R. L. Reed; that he recommended that the Commission take action in regard to the pollution of Bound Brook and the Raritan River in order to prevent the nuisance caused by the discharge of crude sewage at the places inspected by him.

The report submitted by Mr. Herbert was received and filed.

The Secretary was directed to notify the authorities of the Town of Somerville, the Town of Raritan, Piscataway Township, and Hugh C. Pierce of the Borough of Bound Brook, to show cause at a meeting of the Commission to be held at Somerville, on Monday, July 1, 1907, why they should not be notified to cease polluting the Raritan River.

At a meeting of the Commission held at Somerville July 1, 1907, there appeared before the Commission in response to notices why the Town of Somerville, the Town of Raritan, Piscataway Township, and Hugh C. Pierce should not be notified to cease polluting the Raritan River, Charles Kenyon, President, and George Vanderveer, W. Durling, Charles Schwed, L. A. Bellis, Joseph Barris and E. E. Stryker, members of the Board of Commissioners of the Town of Somerville, and James L. Griggs, Town Counsel of Somerville; John F. Reger, Town Counsel of Raritan; Arthur R. Tappen, Chairman of the Township Committee of Piscataway Township, and Hugh C. Pierce.

The Chairman announced that the object of the meeting was to hear the statements of the officials and parties who had been notified to show cause why they should not be stopped from polluting the Raritan River, and stated that the policy of the Commission was to prevent the pollution of all the streams in New Jersey, and that an inspection of the Raritan River showed that pollution was being caused by the parties who had been notified.

James L. Griggs, Town Counsel of Somerville, stated that the Town of Somerville had built sewers discharging into the Raritan River about the year 1890; that it had but little time since the receipt of the notice for the collection of data; that there was no use made of the Raritan River below Somerville for potable purposes, and that it did not seem to him necessary to stop the pollution that he knew of no complaint of the pollution; that cattle along the streams caused much pollution, which could not be stopped; that the Town of Somerville was not wealthy enough to build a plant; that it was governed by a Board of Commissioners, which did not have the legal power to build a plant; that he believed that it was a good thing to stop the pollution of water supplies, but that Somerville was not polluting a water supply; that the towns in that neighborhood were small and could not afford the expense of building purification plants; that there were other places which should be attended to first; that the town was now arranging to build a small lateral sewer, and that he requested that the town be left alone until such time as the sewage became a nuisance.

Charles Kenyon, President of the Board of Commissioners of Somerville, stated that there was little boating on the Raritan River, and that the sewage was not a nuisance to those engaged in boating; that every month the Raritan was flooded and washed out because the watershed of the river did not retain the water, and that a heavy storm would cause a flood in the river; that if there is any nuisance or smell at Bound Brook, it is due to the exposed flats in the river and not to the sewage of Somerville.

John F. Reger, Attorney for the Town of Raritan, stated that the town had three or four thousand inhabitants; that about the year 1897, the town built a sewer, and that it had only lately finished making payments for it; that the town government had limited powers, and that there was no power under the present system of government to build a disposal plant without additional legislation, and that he did not think that the discharge of sewage into the river was causing a nuisance.

Arthur R. Tappen, Chairman of the Township Committee of Piscataway Township, stated that he knew little about sewers in the township; that there was a sewer in Lincoln Boulevard; that he believed the boulevard was controlled by the township, but that the township had not built the sewer; that he did not know what could be done or what ought to be done in regard to it; that Mr. H. C. Pierce owned property in that section and knew more about sewers than he did.

Hugh C. Pierce stated that he owned a small property set out in building sites; that there were about eight houses occupied and one factory in operation; that the property was located in Piscataway Township; that his father had built the sewers at his own expense about fifteen years ago, and that the sewers had been kept in repair at his own expense; that it would be a great burden on them to have to purify the sewage at the present time, as he had sold some of the property and expected to sell the rest of it, and therefore did not feel that it was his duty to care for the future of the sewage, but that it should be attended to by the people owning the property, and that he would be glad to be advised as to what ought to be done.

At a meeting of the Commission held July 11, 1907, the Secretary was directed to notify the authorities of the Borough of Bound

Brook to show cause at a meeting of the Commission to be held July 18, 1907, why they should not be notified to cease polluting the Raritan River.

At a meeting of the Commission held July 18, 1907, in response to this notice there appeared before the Commission Richard H. Brokaw, Mayor; George W. Anderson, Borough Attorney, and J. Doughty, Borough Engineer of Bound Brook.

Mr. Brokaw stated that it was doubtful that the Borough of Bound Brook was polluting the Raritan River; that the citizens of the borough thought that the pollution, if it existed at all, was so small that it would do no harm; that the river was not used for drinking purposes below the borough, and that there had been no complaints of pollution caused by the borough; that in his judgment if the borough were required to purify its sewage, five years time should be allowed it to complete such action.

Mr. Doughty stated that a sewer in the western section of the borough was being constructed in accordance with the plans approved by the Commission in 1906, a separate sewer being laid to the river for house sewage, which was so arranged that the sewage could be pumped into the main system of the borough at such time as it became necessary to purify this sewage, and that if purification were required, the borough authorities expect to provide a purification plant in the eastern section of the borough; that he thought that five years should be allowed the borough to complete the work if it were required to purify the sewage.

The Secretary was directed to notify all the parties reported to be polluting the north branch of the Raritan River to show cause at a meeting of the Commission to be held July 25, 1907, why they should not be notified to cease polluting the Raritan River.

At a meeting of the Commission held July 25, 1907, the following resolution was adopted:

"Whereas, The State Sewerage Commission has found that the waters of the Raritan River are being polluted to the injury of inhabitants of this State in their health, comfort and property; therefore, be it

Resolved, That in pursuance of Chapter 72 of the Laws of 1900, and the supplements and amendments thereto, the State Sewerage Commission hereby gives notice to the Town of Raritan, the Town of Somerville and the Borough of Bound Brook and Hugh C. Pierce to cease polluting the Raritan River and its tributaries before the first day of July, nineteen hundred and eleven, and to the Township of Piscataway to cease polluting the Raritan River and its tributaries before the first day of July, nineteen hundred and eight, and to make such other disposition of their sewage and other polluting matter as shall be approved by this Commission."

The Secretary was directed to have notices in writing served in accordance with the foregoing resolution.

At a meeting of the Commission held July 18, 1907, reports of sources of pollution on the north branch of the river having been received by the Commission, the Secretary was directed to notify all the parties reported to be polluting the north branch of the Raritan River to show cause at a meeting of the Commission to be held July 25, 1907, why they should not be notified to cease polluting the Raritan River.

At a meeting of the Commission held July 25, 1907, the Secretary reported that he had sent such notices to eighteen parties, and that communications had been received in response thereto from five parties. There also appeared in response to these notices J. D. Bedle, Attorney for James Brown. He stated that Mr. Brown was ill and unable to be present, and that he had no information in relation to the alleged pollution, and that he therefore desired time in which to investigate the same.

F. W. Farquhar, C. E., appeared for Knox Taylor, and stated that he would submit plans of the private sewerage system built by Mr. Taylor at his residence at High Bridge.

William H. Lyons, of Bernardsville, appeared and stated that the sewage from his property was emptied into a tight cesspool from which it could not escape into the stream; that some time ago there had been a break in the cesspool, and that he received notice from the State Board of Health to repair the cesspool, and that he had done so; that a pipe from an ice-box ran into the stream, but that it discharged nothing but the melted ice.

C. H. Stein, C. E., and M. Apgar appeared on behalf of the Central Railroad Company of New Jersey, and stated that the company would take proper steps to prevent pollution from the North Branch railroad station at as early a date as possible.

At the same meeting, the following resolution was adopted:

"Whereas, The State Sewerage Commission has found that the waters of the Raritan River are being polluted to the injury of inhabitants of this State in their health, comfort and property; therefore, be it

Resolved, That in pursuance of Chapter 72 of the Laws of 1900, and the supplements and amendments thereto, the State Sewerage Commission hereby gives notice to O. B. Davis, Mrs. E. Dufford, P. M. Decker, George W.

Field, Central Railroad Company of New Jersey, Edward J. Harmon, Charles Pidcock, T. C. Bush, James Brown, Ballantine Brothers, Mrs. B. Daly, John Van Doren, Reverend T. A. Conover, Horace J. Subers, and William H. Lyons, to cease polluting the Raritan River and its tributaries before the first day of October, nineteen hundred and seven, and to make such disposition of their sewage and other polluting matter as shall be approved by this Commission."

The Secretary was directed to have notices in writing served in accordance with the foregoing resolution.

At a meeting of the Commission held August 8, 1907, plans of a disposal plant for the sewage from the private residence of Knox Taylor at High Bridge, providing for a septic tank, flush tank and surface irrigation, were submitted to the Commission by Waring, Chapman and Farquhar, engineers, on behalf of Mr. Knox Taylor. These plans were approved by the Commission at the same meeting, subject to such conditions of construction, operation and purification as the Commission may from time to time require; provided, that proper precautions be taken at all times to prevent the direct flow of the effluent into any tributary of the Raritan River.

At the same meeting, the Secretary was directed to have chemical and bacteriological analyses made of the water supply of the towns of Raritan and Somerville. The report on these analyses is printed herewith under the title "Analyses."

At a meeting of the Commission held August 29, 1907, further reports of pollution of the Raritan River having been received by the Commission, the Secretary was directed to notify the parties reported to be polluting the river to show cause at a meeting of the Commission to be held September 20, 1907, why they should not be notified to cease polluting the river. Ninety-six notices were sent.

At a meeting of the Commission held September 20, 1907, responses were received from sixty of these parties.

At a meeting of the Commission held November 27, 1907, the following resolution was adopted:

"Whereas, The State Sewerage Commission has found that the waters of the Raritan River and its branches are being polluted to the injury of inhabitants of this State in their health, comfort and property; therefore, be it

Resolved, That in accordance with Chapter 72 of the Laws of 1900, and the supplements and amendments thereto, the State Sewerage Commission hereby gives notice to W. D. Vanderbeek, Benjamin Harrison, L. A. Apgar, William E. Rockefeller, Flemington National Bank, Stewart Kitchen, Theodore Staats, Burnt Mills Public School District, Thomas Moore, Pottersville Public School District, L. S. Bache, Dr. Hugh Bache, A. Lowande, A. C. Zvolanek, Edward Bauer, Durlop Brothers, Augustus Ramsey, Peter Delrich, Benjamin F. Houston, Asa Applegate, Henry Schlothane, W. H. Arkenburg, B. Myer, Seeley Paper Mill Company, S. E. Garretson, Maud Rehill, executrix of Rehill Estate, G. A. Van Doren, Theodore Ammerman, Mathias Buchanan, Mrs. Cornelia Kinney, Theodore Servis, Charles Connet, executor of Peter Huff, Mrs. D. Bartow, Mrs. Charles H. Ward, Mrs. L. Ford, John S. Gano, Benjamin Gano, Milton Shives, William Weidenmeyer, Louis Streeter, Mrs. S. K. Angle, Stephen Apgar, Miss L. W. Anderson, Miss A. A. Shafer, Mrs. C. M. Hunt, Harry Hunt, Patrick Murray, Robert Miller, William Mowery, George T. Swackhamer, Mrs. Theodore J. Hoffman, William Maxwell, C. A. Speer, I. L. Apgar, Reuben Able, Martin J. O'Brien, Bridgewater Township Committee and David Buist, that prior to first day of February, nineteen hundred and eight, they must cease to pollute the waters of the Raritan River and its branches, and make such disposition of their sewage and other polluting matter as shall be approved by this Commission."

The Secretary was directed to have notices in writing served in accordance with the foregoing resolution.

At a meeting of the Commission held September 12, 1907, the Secretary was directed to notify the authorities of the City of New Brunswick and the Borough of Highland Park to show cause at a meeting of the Commission to be held September 26, 1907, why they should not be notified to cease polluting the Raritan River.

At a meeting of the Commission held September 26, 1907, in response to these notices, E. C. McKaig, Attorney of the City of New Brunswick, appeared before the Commission and stated that he desired that action be deferred in relation to New Brunswick in order to give the city authorities time to investigate into the question of sewage disposal; that the sewarage system of the city was so arranged as to require the reconstruction of all or a large part of it in case purification became necessary, and that the city had issued bonds to a large amount and was not in a position at the present time to issue more bonds for the purpose of sewage disposal; and that if action were deferred on the part of the Commission, the city authorities would investigate the question and report to the Commission. There also appeared Frederick Weigle, Borough Attorney of Highland Park, who stated that that borough was heavily in debt on account of its sewerage system, which had only been constructed a short time before; that the borough had been created a couple of years before; that it was directly opposite the City of New Brunswick, and that action by the borough would depend upon action by that city; that he joined with the representative of New Brunswick in asking for time to investigate the question, and that the matter could be taken up later by the Commission after the local authorities had had time to examine into the question.

At a meeting of the Commission held October 10, 1907, a communication was received from H. E. Deats, of Flemington, enclosing a plan for a sewage disposal plant and a description of proposed method of disposal of sewage on property owned by him at Flemington Junction.

At the same meeting, James Brown, President of the Somerville Manufacturing Company, consulted with the Commission in relation to the disposal of wastes from the mill of that company at Pluckamin, and requested information as to the method of disposal which should be adopted for these wastes.

The Secretary was directed to employ Mr. Earle B. Phelps to report to the Commission what method of purification should be adopted by the Somerville Manufacturing Company for the disposal of the wastes from its mill.

At a meeting of the Commission held October 10, 1907, a communication was received from the Bound Brook Water Company, in reference to possible sources of pollution of the water supply of the Borough of Bound Brook.

The Secretary was directed to have chemical and bacteriological analyses made of the water supply of the Borough of Bound Brook. A report of these analyses is submitted herewith under the title "Analyses."

As an appendix to this report, a table of the individual cases of pollution acted upon by the Commission during the year has been prepared, in which is included the details of the individual cases on the Raritan River referred to in the preceding paragraphs. A number of cases are also included where inspections were made, and the reports received during the fiscal year were too late for action in the same year by the Commission. In many of the cases reinspections of the properties were made, as noted in the list of cases.

The report submitted by Mr. E. B. Phelps on the disposal of the wastes from the factory of the Somerville Manufacturing Company was as follows:

To the State Sewerage Commission:

GENTLEMEN—In accordance with your instructions of recent date I have visited the works of the Somerville Manufacturing Company at Pluckamin, New Jersey.

The mill does a general wool dyeing business, using largely vegetable dyes, logwood for the chief part, and also scours a small amount of raw wool, some rags, and washes and scours finished piece goods. The general character of the waste waters is obvious from the nature of the operation carried on.

No definite data as to the volume of water used are available, and this volume may be estimated at not far from a maximum of ten thousand gallons daily.

The waste waters are at present carried by an open trench through meadow land to a cinder filter, located about a thousand yards from the mill. Flowing through this filter bed, they reach the waters of brook, which later flows into the Raritan River above Somerville.

A more perfect purification of these waters is desirable. Our present knowledge on the subject does not justify us in constructing complete works to carry this out, but an experimental plant has been designed in such a way that, whatever may be the outcome of the experiments, it can be used as a part of a system of complete treatment. These works, of which plans are herewith submitted, will consist of two sedimentation tanks, each twenty by forty feet in plan and ten feet deep, and two filter beds, each twenty feet square in plan, and six feet deep. One of these beds will contain screened cinders; the other fine gravel. These plans have been accepted by the Somerville Manufacturing Company, and work upon the construction of the plant has been begun.

In the operation of the experiments, it is planned, first, to try filtration of the waters after sedimentation, and in case of failure of this process, to try the application of suitable coagulents in the waters before sedimentation.

We cannot hope at best to remove all of the dye stuff, but it is expected however that the entire removal of suspended matter and of a considerable portion of the coloring matter can be accomplished.

The only sanitary significance attaching to this kind of pollution lies in the constant danger from the scouring of wool and rags. Although in this scouring process, the material is raised to the boiling point, there is some slight danger of harmful germs escaping the process, and being discharged into the stream. Well authenticated cases of such result are known. The proposed purification plant will be designed to remove all possibility of such dangerous pollution. Any dye stuff material which may pass through this system of filters will be really quite insignificant in amount and, from a sanitary standpoint, entirely harmless.

Very respectfully,

EARLE B. PHELPS.

At the meeting of the Commission held October 10, 1907, the Secretary was directed to employ Mr. E. B. Phelps to report to it concerning the disposal of sewage from the Bernard's Inn at Bernardsville, and from St. Bernard's School at Gladstone.

His reports on these two cases are as follows:

October 21, 1907.

To the State Sewerage Commission of New Jersey:

Acting upon instructions received from you, I visited Bernardsville, New Jersey, on the 19th instant, to inspect the sewage disposal arrangements of the Bernard's Inn, owned by Ballentine Brothers. The inn has accommodations for about fifty guests, but is never over half full. The dwellings are also connected. A septic tank of ample capacity is in service, and the sewage then passes through about fifteen feet of cinders, underground, to an underground drain. It emerges some one hundred and ten feet away, in a brook. No odor or visible sign of pollution could be detected.

In my opinion, and judging entirely by observation, and not by analyses, this plant is doing satisfactory work for the present, in view of the fact that it discharges into a drinking watershed. Bacteriological analyses of the brook below should be made at rather frequent intervals. In case these analyses should indicate a serious condition in this brook, I would recommend an improved plant for the disposal of the Bernard's Inn sewage.

Owing to the crowded situation in the immediate vicinity of the inn, it would be neccessary to conduct that sewage down stream for a considerable distance, where suitable areas are doubtless available for purification.

Very respectfully,
EARLE B. PHELPS.

October 21, 1907.

To the State Sewerage Commission of New Jersey:

Acting upon instructions from you, I called upon the Reverend Mr. Conover, of St. Bernard's School, at Gladstone. Mr. Conover expressed his entire willingness to do whatever might be suggested. He had started to put in a cesspool, but had struck a rocky ledge. Under the circumstances, I suggested irrigation on his farm land below, and it was agreed that he would take up the matter with his plumber. It was learned that the sewage from this school is largely wash water containing only an insignificant amount of water closet drainage.

Very respectfully,
EARLE B. PHELPS.

RIDGEWOOD.

At a meeting of the Commission held July 23, 1906, notice was given to the authorities of the Village of Ridgewood that the effluent from the Ridgewood sewage disposal plant was unsatisfactory, and that they were requested to take steps to place the plant in proper condition.

At a meeting of the Commission held December 31, 1906, a report was received that plans for a small temporary septic tank proportioned in size to the present flow of sewage had been prepared, but that the Trustees of the village had been advised by their Attorney to make no change in the sewage disposal plant until the differences between them and the contractor, which were being litigated, had been settled.

At a meeting of the Commission held January 14, 1907, the Secretary was directed to notify the authorities of the Village of Ridgewood that the Commission required them to proceed at once to take such steps as would be effective in correcting the present difficulties in the Ridgewood sewage disposal plant, regardless of the litigation now pending between the village and the contractor who had constructed the plant.

At a meeting of the Commission held April 1, 1907, the Secretary was directed to notify the authorities of the Village of Ridgewood to show cause at a meeting of the Commission to be held April 8, 1907, why the Commission should not apply to the Chancellor for an injunction to restrain the Village of Ridgewood from operating its sewage disposal plant.

At a meeting of the Commission held April 8, 1907, in pursuance of this notice, there appeared before the Commission A. J. Lannieuer, President, and G. F. Brackett, William Boyce and F. G. Bogert, members of the Board of Trustees of the Village of Ridgewood, and Cornelius Doremus, Village Counsel.

Mr. Doremus stated that the Board of Trustees was ready and willing to proceed to place the sewage disposal plant of the Village of Ridgewood in proper condition, and for that purpose they desired to construct a septic tank small enough in size to be proportioned to the present flow of sewage, and that they desired also to clean and relay the filtering material of the contact beds, and to replace the lower strata of filtering material in the wave beds with coarser material.

Mr. Brackett stated that plans had been prepared for the construction of a septic tank proportioned to the present flow of sewage to be located at a point adjoining the present disposal beds, which tank would be used until the flow of sewage were sufficiently great to warrant the use of the present tank; that the Board of Trustees desired to put the plant in proper condition and would have submitted the plans previously if they had understood it was necessary to do so; that a contract had been let for the work and that the contractor was just starting to build the tank; that the Board of Trustees desired to remove the filtering material of the contact beds and clean the same and lay underdrains in the beds and then replace the filtering material; that they also desired to lay coarser material in the bottom of the secondary beds.

Plans for the septic tank to be constructed at a point near the present filter beds for the Village of Ridgewood, together with a certified copy of a resolution of the Board of Trustees of said village requesting the approval of the plans by the Commission, were submitted to the Commission.

At the same meeting the following resolution was adopted:

"*Resolved,* That the plans submitted by the Board of Trustees of the Village of Ridgewood, providing for the construction of a septic tank at the site of the present filter beds of the village, be approved, providing that all of the baffle walls constructed in such tank be four and one-half feet in height instead of three feet, as shown on said plans. Said approval being subject to such conditions of construction, operation and purification as this Commission may from time to time require."

The Secretary was directed to notify the Board of Trustees of the Village of Ridgewood that the Commission approved of the plans submitted by it for the removal of the filtering material of the contact beds, laying underdrains in the beds and replacing the filtering material after cleaning the same, and also of the plan to lay coarser material in the secondary beds; that the Commission recommended the repairing of such defects or breaks in the construction of the floor and walls of the filtering beds as might be disclosed by an examination after the removal of the filtering material.

At a meeting of the Commission held June 10, 1907, a communication was received from George F. Brackett, one of the Trustees of the Village of Ridgewood, stating that consideration had been given by the Engineer who prepared the plans for the new septic tank to the slight fall in the main outlet sewer of the Ridgewood sewerage system, and that it was believed that the fall was sufficient to carry the sewage.

RIVERSIDE.

At a meeting of the Commission held June 27, 1907, plans for a sewerage system and sewage disposal plant for the Township of Riverside were submitted to the Commission by William H. Boardman, C. E.

At the same meeting, the Secretary was directed to request Mr. Boardman to appear before its meeting to be held July 11, 1907, for the purpose of explaining the plans submitted to the Commission for a sewerage system and a sewage disposal plant for the Township of Riverside.

At a meeting of the Commission held July 11, 1907, William H. Boardman, C. E., Township Engineer and Cecil E. Beddoes, C. E., Consulting Engineer, appeared before the Commission and explained the plans submitted for the Township of Riverside for a sewerage system and sewage disposal plant.

At the same meeting, the plans submitted by the Township of Riverside providing for a sewerage system and sewage disposal plant, consisting of a pumping plant, septic tank, contact filters and sand filters, the effluent to be discharged into the Delaware River, were approved by the Commission, subject to such conditions of construction, operation and purification as this Commission may from time to time require, and also subject to the further condition that sufficient land be acquired at the present time to provide for additional sand filters in case they may be found to be necessary.

At a meeting of the Commission held August 1, 1907, plans were submitted to the Commission on behalf of the Township of Riverside by William H. Boardman, C. E., providing for a storm sewer draining part of the Township of Riverside, to discharge into the Delaware River at the foot of Delaware street. These plans were approved at the same meeting.

Under date of November 18, 1907, William H. Boardman, C. E., reported to the Commission that because of the financial stringency, no bid had been received by the Township of Riverside for the bonds to be issued to provide the funds for the construction of the proposed sewerage system, and that further progress would probably be delayed until these could be sold.

ROCKAWAY RIVER.

At a meeting of the Commission held November 26, 1906, a communication was received from Henry Smellie, Secretary of the Board of Health of Jersey City, stating that a resolution had been passed by the Jersey City Board of Health to the effect that it would co-operate with the State Sewerage Commission in relation to the prevention of pollution of the water supply of Jersey City and render it any possible assistance in the matter. The Secretary was directed to request that all reports or information of pollution of the water supply of Jersey City in the possession of the Jersey City Board of Health be submitted to the Commission.

At a meeting of the Commission held February 18, 1907, a communication was received from Robert Carey, City Attorney of Jersey City, stating that a notice had been received by the Mayor of Jersey City that offensive matter was being thrown into a small stream tributary to the Rockaway River at Dover by parties at Dover.

At the same meeting, Commissioner Capstick reported that he had investigated the facts in relation to the pollution of a tributary of the Rockaway River at Dover; that he found that domestic garbage from the Town of Dover was being dumped on a lot lying between McDevitt place, McFarlan street, Lincoln avenue and Mount Hope avenue, the property being owned by Reuben Farr; that on the southerly end of the property, there is a stream discharging into the Rockaway River, the water of which percolated through the garbage and was thereby polluted.

The Secretary was directed to notify the authorities of the Town of Dover and Reuben Farr to show cause at a meeting of the Commission to be held February 25, 1907, why they should not be notified to cease polluting the Rockaway River. The Secretary was also directed to acknowledge the receipt of the communication from Robert Carey and to inform him what action had been taken in the matter.

At a meeting of the Commission held February 25, 1907, W. H. Cawley, Jr., Councilman, and B. W. Ellicott, Attorney of the Town of Dover, Robert Carey, Attorney of Jersey City, and Reuben Farr, of Dover, appeared before the Commission in relation to the complaint of pollution of a tributary of the Rockaway River at Dover.

Mr. Farr stated that he owned the property in question; that he was having it filled in to bring it up to grade; that this was being done by the town authorities who were dumping the garbage there; that formerly a stream ran across the southerly end of the block, draining a swamp in the cemetery lying to the northwest; that the town had laid a storm drain to carry this stream across his land, but that this drain had become partially filled with sand, causing the water to overflow on his land; that he had opened a ditch to carry this water away and that it flowed above the old drain to the Rockaway River; that the filling material consisted of ashes and garbage taken from ash barrels during the winter; that at present it was being dumped at the northerly end of the block about three hundred and forty feet from the stream; that the end of the block near the stream had been filled in only two weeks before, and that to the best of his knowledge and belief this garbage caused no pollution to the water, but that he had stopped dumping near the stream; that when the storm drain was blocked it flooded cellars of houses west of this property, and that he was informed there were drains from these houses running into the outlet drain; that he would have no further dumping done near the stream, and that he would lay a tile pipe with cement joints and banked over with earth to carry the storm water away so that no drainage from the filling on his property would reach the Rockaway River.

B. W. Ellicot stated that the Town of Dover had built a drain under McFarlan street and at the crossing of that street and Lincoln avenue; that the town gathers the garbage and dumps it wherever requested on the property of private owners, and that he did not believe there was any sewage running into the drain crossing the Farr property; that he was informed that Health Inspector Taylor had canvassed the whole section in company with representatives of the water company and of Jersey City in order to discover pollution to the Rockaway River, and that they had visited this section less than a week before, and that he was informed that no sewage pollution was found; that he believed there was very little vegetable matter or matter which would decompose in the garbage dumped on the Farr property.

W. H. Cawley, Jr., stated that the position of the Town of Dover in the matter was that if the State Sewerage Commission believed that the dumping of garbage by the town at any place was improper or was likely to cause pollution to the Rockaway River, the town would cease dumping garbage at that place.

Robert Carey stated that it would be satisfactory to the City of Jersey City if the dumping of garbage near the stream flowing over the Farr property were stopped, or if Mr. Farr should put in a tile pipe, as he had promised, and that he knew of no other cause of complaint at the present time of pollution of the stream running through the Farr property, but that he intended to have investigations made as to whether there was any pollution from the cemetery in Dover, and whether there was any sewage running into the drain laid by the Town of Dover, and in case any cause for complaint should be found it would be laid before the Commission.

At a meeting of the Commission held August 15, 1907, a communication was received from George T. Bouton, Clerk of the Board of Street and Water Commissioners of Jersey City, stating that the Board had referred to the Commission a complaint made by Weldon D. Griffin, inspector, of the dumping of garbage by the Town of Dover which drained into the Jersey City water supply.

At the same meeting Commissioner Capstick reported that he had investigated this complaint and had found garbage dumped in such a place that it would drain to the Rockaway River at Dover, thus menacing the water supply of Jersey City; that he recommended that the Town of Dover be requested to cease dumping garbage and to cover the garbage already dumped. He also reported that he had been assured by the authorities of the Town of Dover that action had already been taken by them to abate the nuisance caused by the dumping of garbage.

The Secretary was directed to notify the Board of Street and Water Commissioners of Jersey City that the Commission had been assured by the authorities of the Town of Dover that the dumping of garbage had been stopped and measures taken to prevent any further danger of contamination of the Jersey City water supply.

The Secretary was also directed to communicate with the authorities of the Town of Dover, suggesting that precautions be taken to avoid the deposit of garbage in such a manner as to threaten the Jersey City water supply, and requesting information as to what action had been taken by the Town in relation to the matter.

At a meeting of the Commission held August 29, 1907, a communication was received from B. W. Ellicott, Town Attorney of Dover, enclosing a copy of an ordinance which had been adopted by the Council of the Town of Dover prohibiting the dumping of garbage along the Rockaway River, and stating that the town had taken steps to stop the dumping of garbage complained of by the City of Jersey City.

The Secretary was directed to transmit a copy of the communication to the Board of Street and Water Commissioners of the City of Jersey City.

At the same meeting a communication was received from George T. Bouton, Clerk of the Board of Street and Water Commissioners of Jersey City, thanking the Commission for its prompt action in relation to the dumping of garbage along the Rockaway River by the Town of Dover.

ROEBLING.

At a meeting of the Commission held September 24, 1906, a report of a sanitary inspection at Roebling was submitted to the Commission showing that a sewerage system was being installed at that place by the John A. Roebling's Sons Company, plans for which had not been submitted to the Commission for its approval. A notice was sent to the Company requesting that the plans be submitted. The plans not having been received a further request for them was sent, and at a meeting of the Commission held December 31, 1906, a communication was received from the Company stating that it was not prepared to submit plans until the work had been completed. By direction of the Commission, the Secretary was directed to call the attention of the company to the law requiring the submission of plans before a sewerage system be constructed, and to inform the company that plans should be submitted at once.

At a meeting of the Commission held May 16, 1907, the Secretary was directed to request the Attorney General to take such legal steps as might be necessary to secure a compliance with section 6 of chapter 72 of the laws of 1900 by the John A. Roebling's Sons Company in relation to its sewerage system at Roebling. Suit was instituted by the Attorney General in accordance with this request.

At a meeting of the Commission held July 11, 1907, a communication was received from E. R. Walker, solicitor for the company, requesting that a meeting be arranged between the representatives of that company and the Commission for the purpose of discussing the sewerage system at Roebling. The Secretary reported that he had suggested that the representatives of the company attend the meeting of the Commission.

At the same meeting Charles G. Roebling, President; E. R. Walker, Solicitor; I. Harby and F. W. Bunn, representing the John A. Roebling's Sons Company, consulted with the Commission in relation to the sewerage system at Roebling.

Mr. E. R. Walker stated that the company had built a model town at Roebling, and had laid sewers in ignorance of the law requiring the approval of the State Sewerage Commission.

Mr. C. G. Roebling stated that he did not understand that the Commission wanted the plans of the present sewers, and regretted that they had not been submitted to it; that the company was not prepared to submit plans of the disposal of the sewage because it did not know what plans should be adopted, although considerable attention had been given to the matter.

The Chairman stated that the Commission had been ignored by the company, and called attention to the correspondence between the Commission and the company in relation to the submission of the plans. He stated that if the company desired engineering advice, the Commission, when requested, would send an engineer to advise the company in relation to the disposal of the sewage.

Mr. C. G. Roebling stated further that the plans of the sewers laid by the company would be filed within a few days, and that the company would request engineering advice as to the disposal of the sewage.

At a meeting of the Commission held July 18, 1907, plans of the sewers laid at Roebling by the John A. Roebling's Sons Company, and two communications from the company stating that the plans had been forwarded, and requesting that an engineer be sent by the Commission to consult with the company in relation to the best location and method of treatment of the sewage at Roebling, were received. The Secretary was directed to acknowledge the receipt of the plans and communications, and to engage George W. Fuller, C. E., as Engineer to advise with the John A. Roebling's Sons Company, and report to the Commission in relation to the disposal of the sewage at Roebling. At the same meeting the Secretary was directed to inform the Attorney General that the company had consulted with the Commission in relation to the disposal of sewage at Roebling, and had submitted plans of the sewers constructed by the company at Roebling, and to suggest that the suit pending against the company be left in abeyance in such shape that in case of necessity it could be prosecuted.

At a meeting of the Commission held August 8, 1907, a communication was received from George W. Fuller, C. E., stating that at the request of the Commission he had held a conference with the representatives of the John A. Roebling's Sons Company in relation to the sewerage system at Roebling, and had advised the Company as to the most suitable site for a sewage disposal plant and had recommended the installation of a plant consisting of septic tanks, contact beds, settling basin and sand filters.

At a meeting of the Commission held October 31, 1907, a communication was received from the John A. Roebling's Sons Company stating that the submission of plans by it was being delayed to await the receipt of a written report from Mr. George W. Fuller as to the kind of disposal and place of discharge of the sewage.

At a meeting of the Commission held November 14, 1907, the following communication was received from George W. Fuller, C. E., in relation to the disposal of sewage at Roebling, and the Secretary was directed to transmit a copy of the same to the John A. Roebling's Sons Company:

November 8, 1907.

To the State Sewerage Commission of New Jersey:

Pursuant to the instructions of your Commission I recently visited Trenton and had a conference with the Messrs. Roebling and their Engineer, Mr. Harby. With them I visited the new village of Roebling near Kinkora where the John A Roebling's Sons Company is building a model town for the operatives of their new mills.

I found there was some misunderstanding and uncertainty on the part of the Roebling Company as to details of what is required of them in order to carry out the directions of the Commission which preclude the discharge of sewage in an unpurified state from all new sewerage systems built in the Delaware Valley above the City of Philadelphia in the State of New Jersey.

I found that the new village of Roebling contains houses for some 300 families and also stores, hotels, etc. A separate system of sewers has recently been built and from the houses already occupied there is now a sewage flow estimated at about 75,000 gallons daily. On the completion of the present improvements, it is expected that the population will increase so that the sewage flow from this village will be about 150,000 gallons daily.

At present the sewage flows by gravity through a small catch basin and screen chamber, and thence through a recently constructed outlet pipe leading some 600 feet across wet marshy land to the low-water shore of the Delaware River.

There is no suitable sand in this neighborhood, so that it is necessary to provide purification works of artificial construction.

In regard to providing a purification plant which would serve its purpose in a manner satisfactory to your Commission, in view of the different methods of treatment found at different places in this country, I explained at some length to the Roebling representatives the practical successes which have been obtained in scores of places in this country and in hundreds of places in Europe. I dwelt especially upon the advisability of providing septic tanks in which to remove the coarser solids in the crude sewage and then stone filters in order to oxidize the organic matter in the septic effluent to a point where the effluent from these stone filters would be non-putrescible. Such a plant, when carefully operated, would effect a removal on an average of about 85 to 90 per cent. of the bacteria originally present in the sewage.

I have given considerable study to the question of the degree of purification which should properly be required under the existing local conditions at Roebling, in view of the small size of this village and the large size of the Delaware River at this point, and also in view of the water works intakes at Burlington and Philadelphia, some 5 and some 20 miles, respectfully, below Roebling.

For a plant of this size it is my judgement that, under the existing conditions, it will be best to provide septic tanks, double contact filters filled from below, a small settling basin and a sand filter plant. For a large plant, where attendents would be regularly present to watch operations, I believe that other methods which would not include sand filters would be thoroughly practicable and provide a satisfactory effluent, particularly as the water supplies drawn from the Delaware River below should be filtered and the final effluent could be later treated with a germicide, if found neccessary or desirable.

With a plant of a daily capacity of not over 150,000 gallons, I am clearly of the opinion that, all things considered, it would be most suitable to provide sand filters rather than to go to the expense of such close supervision as would be necessary if they were omitted. Accordingly, I recommended a plant as above outlined, substantially the same in arrangement as the one designed for Madison, N. J. I explained the general arrangement of such a plant to the Roebling representatives and looked for a site suitable for the erection of such a plant.

I advised septic tanks, having a capacity of not less than 50,000 gallons; double contact filters filled from below and having a total area of not less than one-quarter of an acre; a settling basin to receive the flow from the contact filters, and having a capacity of not less than 15,000 gallons; and, finally, sand filters which should have an area of not less than one-quarter of an acre. The contact filters should have a minimum effective depth of 3.5 feet and the sand filters, 2.5 feet.

I explained the relative elevations of the inlet and outlet connections of such a plant and that there would be a total head required of some 13 to 14 feet. The most suitable site for the location of such a plant, to be operated by gravity, is found in the vicinity of the old brick yard at the lower end of the Roebling property near the river. This site is sufficiently isolated and can be readily availed of by extending the present gravity outfall sewer.

Very truly yours,
GEORGE W. FULLER.

At a meeting of the Commission held December 12, 1907, a plan of the complete sewerage system of Roebling, including the disposal plant, was submitted to the Commission by the company, together with a communication stating that the disposal plant was to be constructed in accordance with the recommendations made by G. W. Fuller, C. E., and that detailed plans of the disposal plant were being prepared and would be submitted to the Commission as soon as they were completed.

RUMSON.

In connection with the inspection of the Shrewsbury River made during the summer of 1907, a notice was sent to the Rumson Land and Development Company to show cause at a meeting of the Commission to be held September 12, 1907, why it should not be notified to cease polluting the Shrewsbury River.

A reply was received from the company to the effect that it had a small sewerage system at Rumson, which was discharging crude sewage into the Shrewsbury River opposite Seabright, and requesting information in relation to what action would be taken by the Commission in the matter.

At a meeting of the Commission held October 10, 1907, a communication was received from Frederick W. Hope, Attorney for the company, requesting advice as to the purification of the sewage from its sewerage system.

The Secretary was directed to employ an engineer to report to the Commission what action should be taken by the company in relation to the purification of its sewage.

Alexander Potter, C. E., was employed for this purpose.

At a meeting of the Commission held October 31, 1907, the following report as to the disposal of the sewage from the sewerage system of the Rumson Land and Development Company was received from Alexander Potter, C. E., and a copy forwarded to the company:

November 7, 1907.

State Sewerage Commission, Jersey City, N. J.:

GENTLEMEN—I have the honor to present the following report upon certain sewers and a sewage outfall in the Borough of Rumson, owned by the Rumson Land and Development Company, together with recommendations as to the relief of the present polluting influence of the discharge from these sewers upon the waters of the Shrewsbury River.

In pursuance of your request, I proceeded on October 16th, 1907, to make an inspection of the sewers belonging to the Rumson Land and Development Company located in the Borough of Rumson.

The territory tributary to the present sewerage system owned by this Company is restricted to a small portion of Rumson Neck, which can discharge by gravity through the outlet located about 1,000 feet south of the Sea Bright bridge. This Company owns and maintains sewers in the Rumson Road from the Shrewsbury River westerly for a distance of approximately 3,000 feet to Blackpoint Road, which is also called Navesink Avenue. A branch line extends along Blackpoint Road for a distance of 1,000 feet to near Hartshorn Lane. A branch also extends along Ward Avenue, which is the first public road leading off from the Rumson Road to the north after crossing the Shrewsbury River from Sea Bright. Sewers have also been laid by this Company along certain streets lying south of Rumson Road near the Shrewsbury River, including Waterman Avenue along which is constructed an outlet from the above mentioned sewers, the sewer in Waterman Avenue extending from Rumson Road to Grant Avenue. Sewers are also laid in Lincoln Avenue and Washington Avenue, and Grant Avenue, these three streets being south of, and parallel with, Rumson Road, and extend from the Shrewsbury River westwardly for 800 or 900 feet. In all there are about 6,000 feet of sewers constructed, and at the present time there are 25 to 30 homes and country places which are connected with these sewers.

The excavation for these sewers has been made through water-bearing sand. Water is encountered at an average of 3 feet below the surface of the ground, and through certain parts of the territory the water is within a foot of the surface. This accounts for the relatively high flow at the outlet at a time when there was little contributary sewage flow.

The ground-water infiltration as nearly as could be estimated, was at the rate of 60,000 gallons per mile per day, which is above the average flow from ground-water infiltration. The sewers were constructed in the usual manner; i. e., without that great care requisite in all localities subject to ground-water infiltration. This ground-water can be practically eliminated from the sewers, but it adds to the first cost materially, and heretofore the exclusion of ground water from sewers has not been considered important. As treatment works become compulsory, the necessity of excluding ground-water infiltration will become more important, and the additional cost of rendering the sewers proof against ground-water will be considered a legitimate and economic expense.

At the time of my visit the majority of the houses had been closed for the season, and the character of the effluent therefore was not offensive, although in volume it amounted to approximately 75,000 gallons per day, most of which was ground-water infiltration. I am of the opinion that during the wet season of the year this ground-water flow will be considerably increased.

The topography of the territory served by this sewer is such that the present system cannot be much further extended excepting by the use of some pneumatic or other mechanical device for raising the sewage and delivering it to the present point of discharge into the Shrewsbury River.

While investigating this work, I visited the outlet on two occasions, in order that observations might be made at different stages of the tide. During the summer at low tide the conditions must become quite unsanitary, because the present location of the outlet is such that it is necessary for the sewage to run over the exposed flats outside of the bulkhead for 25 or 30 feet. The sewage has made for itself a channel in these flats, in which is deposited all the filth and solid matter from the sewage, which lies exposed until the return of the tide.

The present sewage outlet discharges into the Shrewsbury River at the narrowest part. The average width of the river one mile north and south of the point of outlet being 800 feet while the width at the outlet is 250 feet. The depth of the water in the Shrewsbury River is greatest at the point opposite this outlet. This insures at all stages of the tide the thorough dispersion of the sewage once it reaches the channel of the river. The water at this point is quite brackish at all stages of the tide, and considering the small territory that is tributary to outlets in this location either from Sea Bright or Rumson Neck it is my opinion that the sewage treatment necessary need not have any great refinement.

I would therefore recommend that a septic tank capable of holding an 8 hour flow for double the present tributary population with a proper allowance for ground-water which finds its way into the sewers be provided for, or in other words a tank capable of holding about 50,000 gallons. In addition to this septic tank I would recommend a small plant for sterilizing the effluent from the septic tank along the lines of the experiments recently conducted under the guidance of the Commission at Red Bank, or some other secondary treatment which could be installed inexpensively. The surroundings at the outlet make it impossible to install either sand beds or contact filters without adding to the cost disproportionately to the benefits which can be derived from such an expenditure. It is my opinion that the installation of a sterlizing plant will always provide ample purification for this sewage.

Such a plant will require a minimum of care. As the Company have in their employ a man who looks after the sewers they will not be compelled to go to any additional expense and consequently there is every reason to believe that they will give to this plant the care that it requires. While the sterilization of the effluent cannot be counted upon to destroy all the bacteria in the water it will deaden them for a sufficient length of time until they are so thoroughly dispersed in the brackish water of the River that they cannot again become harmful.

I would also recommend that the present outlet be extended from the bulkhead line out into the channel for at least eightly feet. This will carry the sewage far enough into the channel so that at no stage of the tide will there be any accumulation of sewage.

With these improvements installed I am satisfied that the conditions will be entirely satisfactory, and that so far as this particular system is concerned the purification of the sewage will be complete.

I think it is of sufficient importance to advise your Commission that the officers of the Company have expressed themselves as willing to cooperate with your Commission to carry out any reasonable plans for the elimination of the present unsanitary outlet, and that in their judgment the plan outlined herein is such that they are willing to undertake it without delay.

Respectfully submitted,

ALEXANDER POTTER.

SALEM CREEK.

During the year 1905 complaints were received by the Commission of pollution of Salem Creek at Woodstown. These complaints were investigated by the Commission, but no action was taken upon them because of the proposed organization of a private sewerage company to provide sewerage facilities for Woodstown. This company was organized by citizens of Woodstown during the year 1905, and a sewage disposal plant was constructed to care for the sewage complained of.

At a meeting of the Commission held December 31, 1907, a communication was received from Franklin Flitcraft of Woodstown, complaining of the continued pollution of Salem Creek at Woodstown by about twenty individuals.

The Secretary was directed to have an investigation made of this complaint.

At a meeting of the Commission held March 11, 1907, a communication was received from Josiah Miller, Engineer of the Woodstown Sewer Company, in relation to the continued pollution of Salem Creek by parties at Woodstown.

At a meeting of the Commission held April 22, 1907, a report of inspection of these cases was received by the Commission, showing that a number of parties who had been communicated with in 1905 were still polluting Salem Creek.

At the same meeting the following resolution was adopted:

"Whereas the State Sewerage Commission has found that the waters of Salem Creek are being polluted to the injury of inhabitant of this State in their health, comfort and property: therefore be it

Resolved, That under the authority conferred upon it by Section 5 of

Chapter 72 of the Laws of 1900, the State Sewerage Commission hereby gives notice that prior to the first day of Nevember, 1907, Curtice Brothers and Davis & Lippincott must cease to pollute the waters of Salem Creek, and make such disposition of their sewage and other polluting matter as shall be approved by the Commission; and that prior to July 1, 1907, Lydia A. Dickinson, C. French Moore, Mrs. James Sharp, the First National Bank of Woodstown, Aldona L. Dickeson, Elwood Peterson, George W. Crothers, the estate of John H. Morris, deceased, L. H. Miller, William H. Weatherby, Ernest Becker, Lavinia Conover, Benjamin Patterson and Buzby and Miller must cease to pollute the waters of Salem Creek, and to make such disposition of their sewage and other polluting matter as shall be approved by this Commission."

The Secretary was directed to have notices in writing in accordance with the foregoing resolution served.

At a meeting of the Commission held September 26, 1907, a further communication from Franklin Flitcraft, in relation to these cases of pollution, was received, and the Secretary was directed to have a re-inspection made of Salem Creek at Woodstown.

As an appendix to this report there is printed a list of the individual cases of pollution acted upon by the Commission during the year, which includes the details of the cases of pollution of Salem Creek at Woodstown.

SEABRIGHT.

At a meeting of the Commission held August 1, 1907, a communication was received from John S. Applegate & Son, Attorneys of Red Bank, stating that several parties interested in the South Shrewsbury River desired them to notify the Commission that the river was being polluted by sewage, and requesting the Commission to meet the parties interested and make a personal investigation.

The Secretary was directed to reply that a committee of the Commission would meet the interested parties.

At a meeting of the Commission held August 8, 1907, Commissioners Jacobson and Herbert were appointed a committee for the purpose of investigating complaints of pollution of the Shrewsbury River.

At a meeting of the Commission held August 15, 1907, this committee reported that on August 10, 1907, it had inspected the sewers in the Borough of Seabright, and found that sewage was being discharged into the Shrewsbury River, causing an injury to inhabitants of this State in their health, comfort and property, and recommending that the authorities of the Borough of Seabright be notified to show cause why they should not be notified to cease polluting the Shrewsbury River.

At the same meeting the Secretary was directed to notify the authorities of the Borough of Seabright to show cause at a meeting of the Commission to be held August 29, 1907, why they should not be notified to cease polluting the Shrewsbury River.

At a meeting of the Commission held August 29, 1907, in response to this notice, John W. Eyles, Mayor of the Borough of Seabright, appeared before the Commission and stated that the waters of the Shrewsbury River were being polluted at Seabright by the borough sewerage system and by private owners; that the borough was free from debt and in a position where it could take action in the matter, and that, in his judgment, a new sewerage system could be built, with proper provision for purification, by the first day of June, 1908, and that he requested that the borough be given at least until that time in which to comply with any order to cease polluting the Shrewsbury River which the Commission might make, and that if it were impossible to complete the work by that time, further time might be asked for.

At the same meeting the following resolution was unanimously adopted:

"Whereas the State Sewerage Commission has found that the waters of the Shrewsbury River are being polluted to the injury of inhabitants of this State in their health, comfort and property: therefore be it

Resolved, That pursuant to Chapter 72 of the Laws of 1900, and the supplements and amendments thereto, the State Sewerage Commission hereby gives notice that prior to the first day of June, nineteen hunderd and eight, the Borough of Sea Bright must cease to pollute the waters of the Shrewsbury River, and make such disposition of its sewage or other polluting matter as shall be approved by this Commission."

The Secretary was directed to have a notice in writing served in accordance with the foregoing resolution.

At a meeting of the Commission held October 3, 1907, a communication was received from Edmund Wilson, Borough Solicitor of Seabright, stating that the Mayor and Council of the Borough of Seabright requested advice from the Commission in relation to the disposal of the sewage of the borough.

The Secretary was directed to employ an engineer for the purpose of advising the Borough of Seabright as to the disposal of its sewage.

Alexander Potter, C. E., was engaged for this work, and his report follows:

"November 13, 1907.

State Sewerage Commission, Jersey City, N. J.:

GENTLEMEN—I have the honor to report upon the present sewerage system of the Borough of Sea Bright, together with recommendations for the redesign of the system so as to eliminate the discharge of the crude sewage into the waters of the Shrewsbury River.

The present system of sewerage at Sea Bright has been installed for many years, constructed, I believe, in the year 1890, and additions have been made to this system from time to time. Besides the public sewers built through the main portion of the Borough, practically all of the homes along Ocean Avenue have separate systems of sewerage with outlets leading into the Shrewsbury River. All public sewers in Sea Bright perform the double function of removing household wastes and of affording relief from street water through the medium of catch basins located at low points throughout the central portion of the Borough.

The Borough of Sea Bright is about 9,250 feet long, but in general only one street wide. On one side of the Borough is the Atlantic Ocean; on the other side is the Shrewsbury River. Throughout the central portion of the Borough for a distance of 2,000 feet, this narow tract of land widens and through this part streets extend at right angles from Ocean Avenue to the Shrewsbury River. The average length of these streets is about 550 feet. Ocean Avenue runs through the center of this long stretch of land.

The sewerage system through the Borough consists of a number of independent sewers running from Ocean Avenue to the Shrewsbury River, with here and there a connection leading across the track to take care of the hotels and private homes on the ocean side of the railroad. On Ocean Avenue, between River Street and Peninsula Street, sewers have been constructed leading into sewers on River Street and Peninsula Street; but these sewers are not used the properties being served by access of the sewers on the side streets. The river outlets of these public sewers are at various elevations, some of them being near the low-water mark, the others being near the high-water mark. There is no uniformity as to the elevation of the outlets.

For all practical sewer construction purposes the Borough of Sea Bright is practically level west of the railroad tracks. The greatest differences in elevation between any two parts of the Borough west of the railroad is not over two feet. Between the railroad and the ocean the ground attains an elevation of 10 feet above mean sea level. I have made inquiries from various citizens at Sea Bright as to the effectiveness of the sewers during a storm, and found no citizen who had been inconvenienced by reason of flooded streets due to the inability of the sewers to act as drains through which to carry off the water accumulating upon the surface of the streets. These sewers vary in size from 6 to 12 inches, most of them being 10 inches in diameter.

Public sewers are constructed as follows: On Peninsula Street 10-inch and 6-inch pipe sewers; on River Street 10-inch sewers; on South Street 10-inch pipe sewers; on Church Street 10-inch pipe; on New Street a 10-inch pipe sewer; on Beach Street a 12-inch pipe sewer; on Center Street a 10-inch pipe sewer. This last mentioned sewer is the only public sewer crossing the track. Besides these public sewers there are four or five private sewers within the limits of the built-up portion of the Borough, and in nearly every case the private homes along the beach have sewerage outlets extending into the Shrewsbury River. The size of these private sewers is almost invariably 6 inches. The grades of the sewers both public and private are very flat, as they needs must be when the topography of the ground is considered, but seem to be sufficient to secure fairly clean sewers, as I have not been able to learn that there has been any serious stoppages in the sewerage system already constructed.

The Outlets.

An examination of the outlets of these sewers will clearly indicate that the continuation of their discharge into the Shrewsbury River is unsanitary and some method should be adopted to secure relief therefrom. Two or three schemes suggest themselves as to the best method of handling this problem, but while all of these methods have certain advantages, there is only one that can be adopted that will for all time satisfactorily handle the problem.

The first and simplest method which presents itself for consideration is the construction of an intercepting sewer along the river front, and the construction of a pumping station at the economic point of convergence of these sewers. From this pumping station the sewage should be led to a point favorable for the construction of a sewage disposal plant of ample size and capacity for all requirements of the Borough. On account of the fact that the sewers of Sea Bright are used for storm water as well as sewerage, provision must be made in the pumping station and disposal plant for not only the handling and treatment of sewage, but also for the storm water; the expense in first cost and maintenance would be considerably greater than by the adoption of some other method of treatment that will be referred to hereafter.

As stated above, I could secure no evidence that the present pipes are not large enough to take care of the storm water. I would, therefore, recommend that the present system of piping be retained just as it is for the purpose of fulfilling the function of a system of storm water drains, and that a new system of piping be constructed throughout the Borough capable of handling in a perfectly sanitary manner exclusively the sewage of the Borough. On account of the comparatively level nature of Sea Bright, these sanitary sewers can be brought to a common outlet without crossing private property for the sewers can be laid from the river to Ocean Avenue, and the main sewer laid down Ocean Avenue.

On account of the level nature of the ground it will be impossible, except at an enormous expense, to lead the sewage from each end of the Borough to one central point. The total length of the Borough is 9000 feet, and by starting at either end of the Borough and bringing the sewage to the center and adopting a minimum grade such as would produce a self-cleansing velocity of the sewage, we would reach a depth at the pumping station of 18 feet. When we consider that water will be encountered within an average of 3 feet of the surface of the ground, it will be seen that the idea of conveying all of the sewage to one common point of outlet is prohibitive. It will be far cheaper to construct a series of lifts beginning at the upper end of the Borough and running on a descending grade until a depth of sewer is reached below which the expense is prohibitive. At this point a lift station, operated either by electric power or by pneumatic pumps, or by a combination of electric power and pneumatic pumps should be installed, the sewage being lifted vertically to a high level sewer. The main sewer continues on a descending grade until a prohibitive depth is again reached. Lateral sewers from the side streets enter into this main sewer at their proper points of ingress, the number of these stations and their location depending upon the ultimate point to be reached for the disposal of the sewage.

The population of Sea Bright is 1,166 according to the census of 1905. The present population is estimated at 1,250. The summer population is probably between 3,000 and 4,000. It is a well known fact that the dilution in tidal streams is a question of the upland waters entering the stream and gradually pushing out into the ocean. It is also accepted that three and one-half cubic feet of water per second will render the sewage of 1,000 people inoffensive.

The minimum flow in the Shrewsbury River at the Sea Bright bridge is 8 cubic feet per second, while the average flow is 47 cubic feet per second.

The summer season is the period of lowest flow and largest population. On the above assumption there is sufficient flow in the Shrewsbury River to render inoffensive the sewage of 2,300 people. If, therefore, Sea Bright was the only municipality using the Shrewsbury River as a sewage outlet most of its sewage would be rendered inoffensive even during the period of lowest flow.

Just as long, however, as shell fisheries are permitted in the Shrewsbury River it is not sufficient to render the sewage inoffensive but the sewage must be relieved of practically all of its bacterial content. This can only be accomplished by means of some form of sewage treatment.

Sewage Disposal Plant.

The location of the disposal plant for Sea Bright has been considered carefully.

The existence of marsh islands in the channel of the Shrewsbury River a short distance from the shore affords the Borough a location for the sewage disposal plant which the objection of depreciation of the value of property cannot be made against. These islands are large enough to permit of the construction of a disposal plant ample to meet all the requirements of the Borough for sewage disposal purposes.

A similar plant to this was designed by the writer two years ago for the Monmouth Beach Protective Association and afterwards adopted by the Borough Council of Monmouth Beach as the official plan of sewering the

Borough. As the island above referred to lies off the south portion of the Borough of Sea Bright it is quite possible that a combined plan of each disposal plant would present economies both for the Borough of Sea Bright and for the Borough of Monmouth Beach. These economies would embrace not only the first cost of construction but also the cost of maintenance. The environment of the disposal site is such that the simplest form of disposal plant can be constructed, one in which the highest degree of purification need not be required because it is possible at no great expense to lead the effluent from such disposal plant across the Borough and discharge the final effluent into the ocean. As the economic location of the disposal plant of Monmouth Beach and that of Sea Bright must lie within one-half mile of each other, it is readily seen that there will be but a small additional expense if these disposals should be located at a common point or merged into one.

I would recommend that the present public sewers in the Borough of Sea Bright be used as storm sewers and that a system of separate sewers be laid to the disposal plant, and that this plant consist of a septic tank of a capacity to retain the sewage of the Borough of Sea Bright for 8 hours. Also that some secondary method of treatment be applied to reduce the bacteria in the sewage to a reasonable degree of purification, and that the effluent from this treatment works be conveyed into the Atlantic Ocean, a distance of 300 feet from the shore.

Respectfully submitted,

ALEXANDER POTTER."

SEWAGE DISPOSAL PLANTS.

At a meeting of the Commission held August 29, 1907, the Secretary was directed to have an inspection made of the sewage disposal plants in the State. Mr. Earle B. Phelps, of Boston, was employed for this purpose, and his report of inspection follows:

November 1, 1907.

To the Honorable the State Sewerage Commission of New Jersey:

I send you herewith the results of my recent tour of inspection of the sewage disposal plants of New Jersey, during the month of October, 1907.

In addition to these special reports of inspection, I have two general recommendations to make; first, that all by-passes by which unpurified sewage can escape to the streams be done away with. In certain cases, these by-passes are wilfully misused, while they are always a constant source of danger. If storm overflows are necessary, they should lead to extra irrigation fields or sand filters.

The second point is in regard to a campaign of education among the works attendants. In general, the grossest ignorance prevails among these otherwise intelligent men as to what they are actually doing.

A brief pamphlet gotten up for their special benefit, explaining the fundamental principals of sewage purification and the proper way to operate the various types of filter, ought to do much for improved conditions.

ASYLA.

The plant at Asyla, consisting of a septic tank, siphon chamber and primary and secondary coarse stone trickling filters, is on the whole a well designed plant, but lacks certain essential features necessary for its satisfactory operation. At the time of inspection, the siphon was inoperative and sewage was flowing to the beds continuously. The difficulty was pointed out in the report on the plant last year. The siphon is too small to carry off the full incoming flow at the lowest head. Increasing the size of the siphon or elevating the cut off point another foot suggest themselves as remedies. The latter plan would probably be the simpler. The distribution system is very poor. The sewage should either be sprayed into the air by fixed sprinkler heads, or distributed by allowing it to drip from overhead pipes into concave disks, so called gravity distributors. The effluent was not well purified. The privy built out on the brook just below the filter, apparently for use by the employees in the pumping station, is hardly in keeping with the satisfactory general appearance of the grounds.

BURLINGTON.

The sewage of Burlington is delivered at the disposal works, located about a half mile below the city, into a receiving well, from which it is pumped during a portion of each day. It then passes to a large circular septic tank, and from this to the purification areas.

This plant is not properly kept up and is not doing its best work. The sewage is flowing over the ground instead of through it, and finds its way to a considerable extent to the underdrain by way of large holes made by burrowing animals. The entire field should be plowed and harrowed at sufficient intervals to prevent the growth of weeds. The beds should be leveled and separated by embankments, and the sewage systematically distributed over the beds and prevented from flowing laterally.

Owing to the large area available, a very little care will make this plant a thoroughly satisfactory one for some years to come.

COLLINGSWOOD.

The system in use at the Borough of Collingswood includes a septic tank, circular in plan, at the center of which is a pump well. From this well, the sewage is pumped to primary coke contact beds, and from these beds it flows through intermittent siphons to secondary wave beds.

At the time of inspection, the plant was not in operation. Since the storage capacity of this tank cannot far exceed the daily flow of sewage, the continuous operation of the system would seem to be highly desirable. The alternate rising and lowering of the level of the liquid in the tank undoubtedly reacts unfavorably upon the tank by stirring up its solid contents. The result of this will be the rapid clogging of the coke filters. If intermittent operation is necessary or desirable, a separate storage reservoir should be provided and so arranged that the level of the water in this reservoir will not affect that in the tank.

CALDWELL.

The system in use for the disposal of the sewage of the County Penitentiary at Caldwell is one of subsurface irrigation following treatment in the sedimentation tank and operated by a flushtank. The sedimentation tank is virtually a septic tank, it being cleaned out on the average of two or three times a year. There were no visible signs that the plant was not working satisfactorily. The area in use is entirely ample, considering the nature of the soil, and the plant seems to be well cared for.

DELFORD.

The only purification undertaken by the Borough of Delford is treatment in a small septic tank, which directly discharges into the Hackensack River, a sort distance below the dam of the East Jersey Coast Water Company at New Milford. The septic tank is of ample capacity for the sewage treated, There seems to be ample head available above high water to avoid all necessity of a varying head with the tide. If such an effect is noticed, it indicates too low a position of the overflow. This should be remedied. Considering the small size of the stream at this point, it is probable that some further treatment of the sewage will be necessary in the near future.

ESSEX FELLS.

A septic tank and a double system of contact and sand filtration is here installed. Septic sewage is delivered to the contact beds, which are operated automatically. The effluent from the beds is passed to a sand filter. The entire plant is well kept and properly managed, and the effluent is of excellent quality. An especially valuable feature is an extra bed for storm water.

FLEMINGTON.

Intermittent filtration is being practiced at Flemington upon a very unsuitable soil. The system includes a sedimentation tank, which was not in operation at the time of inspection and apparently had not been for some time previous. The material of the beds is, in its present state, quite unsuitable for purification purposes. The raw sewage passes laterally over the rocky ground and finally soaks away into the marsh below or finds its way out through crevasses and animal burrows.

The difficulty due to the rocky soil is aggravated by the discharge upon the beds of raw sewage containing much suspended matter. The surface is badly clogged with paper and other material which readily passes the screens.

This plant must be entirely remodeled for efficient purification. A good septic tank should be the first consideration. It should be about three feet deeper than the present tanks, to allow a flow depth of five feet. It should have a capacity of at least 60,000 gallons.

For the filters, two alternative plans are presented. The present beds may be retained and put in condition by deep plowing and frequent harrowing. They should be properly graded, and those at the lower grade supplied by separate supply pipes, not by lateral flow over the others. Such land as cannot be plowed is unsuited for this purpose and should be cut out. There would seem to be an ample area of proper soil. The beds should be separated from each other by embankments, and especially should the lower end be carefully banked to prevent the sewage from being washed into the stream during storms. More complete underdraining will be necessary.

The second alternative involves the use of contact beds. Suitable beds can be constructed of crushed trap-rock, which is available in that region, or slag may be used. Beds four feet deep may be used and still leave fall enough for supplementary filtration on land below. In this way, much higher rates of treatment can be maintained with less difficulty from clogging, and a better effluent, will be secured. The supplementary treatment should be included in the plan and used if found necessary, but it is quite possible that, as at Moorestown, a satisfactory purification can be had on the contact beds alone.

Attention might also be called to a serious pollution of the same brook by the gas house located near the sewage filters. The present works are being abandoned for new ones, and some provision is being made for the separation of the tar and oils. A trench connects the works with the brook, and waste liquors will probably find their way out in that direction. The water may then be seriously damaged as a domestic supply.

FREEHOLD.

The system of irrigation, filtering and sedimentation, for a short period, has been installed at Freehold. A very large area of suitable land is available, and the plan of operation consists in irrigating one-half of this land for one year and growing crops upon it for the succeding year. The sedimentation basin is cleaned out at frequent intervals. The works are admirable in every way, and the effluent appears to be remarkably well purified.

HADDONFIELD.

The system at Haddonfield includes a well designed septic tank, which is covered by a wooden structure. The septic effluent flows to sand filter beds located below.

This plant requires radical improvement. Although very favorably situated as regards available head and suitable sand areas, it is apparently in disuse through lack of care. One bed had recently been cleaned and was at the time of inspection out of commission. The other beds were badly clogged and practically water-tight. The water on them had apparently been there many days, if not weeks, and the entire flow of sewage was being by-passed into the stream. Such seems to be the normal conditions of these beds. So far as a casual inspection can determine, nothing is necessary here but ordinary care and systematic dosing. Whenever a bed will not handle its dose and carry it away inside of an hour, it shows a clogging which should be removed. Additional underdrains may be found advantageous. Beds should never stand covered as these do, for long periods, as the nitrifying organisms upon which purification depends are thereby killed. If, with ordinary care, these beds cannot handle the sewage of the town, another set of beds may be placed upon a higher level without great expense. The present overflow arrangement, by which all sewage in excess of that passing to the beds is discharged into the stream, should be cut out entirely. If necessary, a storm overflow, leading to some special storm beds, may be substituted.

JAMESBURG.

The sewage from the State Reform School at Jamesburg, which has about 575 inmates, is disposed of by screening, sedimentation and finally by irrigation upon adjacent fields. The irrigation fields are unfortunately composed of very poor soil for the purpose. They bear evidence of overwork and of lack of care. Much improvement could be realized by frequent plowing and harrowing. In this way the soil would gradually become more porous owing to the incorporation of the sand and mineral matter from the sewage. If this plan were followed, it would not be advisable in my estimation to install a septic tank. There is an advantage in depositing all the coarse material on such a clay soil as this. The present effluent is noticeably bad.

LAKEHURST.

At Lakehurst, the Pine Tree Inn has constructed a system of sewers and a disposal plant for its own use and the use of the few cottages nearby. The plant includes a small sludge bed and flushtank located on the hotel grounds. From this, the sewage flows a distance of several hundred yards to sand filters located near the railroad. The plant is of ample capacity for the amount of sewage to be treated. The effluent is of satisfactory appearance.

LAWRENCEVILLE.

The Lawrenceville Preparatory School, a school for boys located in the village of Lawrenceville, has constructed a system of sewers and a sewage disposal plant for its own use. The total flow is estimated to be about 35,000 gallons per day. The plant consists of two sets of underground septic tanks, which are used alternately. From these tanks, the sewage flows to a pump-well, from whence it is pumped a distance of about a quarter of a mile to a large irrigation field, situated on sloping ground to the eastward. The disposal fields are not being operated in a manner calculated to get the maximum amount of work out of them, but as there is ample area, the crude methods employed are quite satisfactory. It was suggested to the engineer in charge that a furrow should be plowed around the field at the edge of the brook to prevent any escape of unfiltered sewage during a rain. This change will be made at once. Instructions were also given for the alternate operation of the two septic tanks. By this means it is hoped to get a better septic action on the solids than now prevail.

MANASQUAN.

The disposal system adopted for the Borough consists merely of a septic tank. This tank is located on the line of the sewer, about 1,800 feet from shore. It is 50 by 20 feet in plan, and a tidal gate prevents the backing up of tide water. It is divided into three sections, so that its capacity can be adjusted to the flow of sewage, and is properly baffled. The entire tank is covered, and no odors were noticeable in the vicinity. No nuisance was apparent in the waters surrounding the outlet.

MERCHANTVILLE.

The proposed sewerage system and disposal works are not yet installed. Sewers are being laid.

MOORESTOWN.

The disposal plant at Moorestown is located at a point about three-eighths of a mile from Leonia Station and on the banks of the north branch of Pensauken Creek. It consists of a sedimentation chamber ten feet square and ten feet deep; three septic tanks, twelve by thirty feet in plan and so arranged that one, two or three may be used as desired. The tanks are uncovered. There is also a dosing chamber twelve by thirty feet, from which the sewage flows to four contact beds. These beds are each eighty by forty feet and four feet deep. In three of them, the material is broken slag, and in the fourth screened cinders. The distribution is accomplished by a system of open jointed whole sewer pipe, and the beds are made to fill up and empty with each dose, by leaving the outlet valve partially open at all times. In this way, the effect of the contact beds is partially obtained without the necessity of manual control. As operated, each bed is used for one day and rested for three days.

The plant was found to be in a commendable condition of cleanliness and general neatness. It is apparently doing first class work. The beds do not show serious clogging.

MORRIS PLAINS.

Sewage disposal of two kinds is illustrated at the State Hospital for the Insane at this place. During the day a large portion of the sewage is applied to irrigation fields, while the remainder of the sewage passes through a settling tank and thence to filters. At night all the flow is diverted to the tank and filters. The irrigation fields are satisfactory. They are properly graded, well kept and carefully operated. As a result, there is no evidence to the sense of the nature of the fields except a small stream of sewage which rapidly finds its way into the soil through the clean open trenches. The filters are equally well managed, and the effluent appears to be well purified as far as can be determined by inspection.

NEW LISBON.

The plant at the county asylum, consisting of a septic tank and contact filters, shows utter lack of care, and even under more favorable conditions, could not deal with the present flow of sewage. A continuous stream of sewage flows from the septic tank to the overgrown surface of the filter, and passes out of the underdrain in almost its original state. At least two beds are necessary to deal with sewage on the contact principal. They should preferably be operated automatically by an air-lock system and should have constant and careful oversight. No suggestion can be made for a change in the present filter. It is badly clogged and must be completely rebuilt, and made twice as large. Conditions are suitable here for irrigation, and that plan might well be considered.

NEWTON.

The two disposal plants at Newton are exactly similar in design and operation and differ only in size. Each consists of a small sedimentation chamber, a septic tank, a dosing chamber, sand filters and a sludge bed. These are fully described in the last report of the Commission, and are excellent examples of up-to-date sewage purification works. Only one of the plants is in actual operation with sewage, the other being run largely on a small flow of storm water. It is too early as yet to form any opinion of the actual working results of the plants.

OVERBROOK.

The hospital for the insane maintained by Essex County is located at Overbrook on Peckman River, a tributary of the Passaic. The total number of inmates at the hospital at present is about seven hundred. This number will be doubled in the near future on the completion of the new buildings now in course of erection.

The sewage disposal system in use at this institution has heretofore consisted of a septic tank and some small sand filters. The tank is covered and is fifty feet long and eighteen feet wide and ten feet deep. This tank is now the oldest septic tank in the country, having been constructed in 1896, and is still doing good work. Recently there have been added to the system four new sand filters and the old beds have been thrown out of commission. The new filters are located on the opposite side of Peckman River and the sewage is conducted to them from the old tank. These new filters have just been put into operation. The beds are admirably designed and constructed and of ample area for the present flow of sewage. The effluent is clear and sweet. Further additions to the plant will be necessary with the completion of the new buildings now being constructed.

PEMBERTON.

The sewage of this borough is conducted to a home-made septic tank consisting simply of an excavation in the ground from which it overflows to a system of irrigating ditches. From these ditches the sewage soaks away into the ground. This plant is a very primitive one, but owing to the small volume of sewage discharged and the large area of land available, it is quite satisfactory. There is no overflowing and no nuisance. Proper care has been taken to prevent any washing of the sewage into the nearby stream. No improvement can be suggested.

PLAINFIELD.

The sewage disposal works at Plainfield are the largest in the State. They include two rectangular covered septic tanks, each 100 feet long and 50 feet wide, with a working depth of 6 feet. Their combined capacity is about 450,000 gallons. In addition to these tanks, there are two other tanks, each 200 feet long and 50 feet wide. All of these tanks are so arranged that they may be used in series, if desired. In addition to the above, there are eight primary contact beds and eight secondary beds, each bed being 92 feet by 106 feet in area and 5 feet deep. Over the tile underdrains, a six-inch layer of coarse broken stone has been placed, and upon this rests the main body of the filtering material. This material consists of broken slag, from a quarter to an inch and a half in size. The beds are operated in rotation. Considerable difficulty has been experienced in the past with the formation of scum in the tanks and it has been found necessary to clean them out frequently. The beds are working satisfactorily. Judging by the results of putrescibility tests made by the health office, the beds are doing all that can be expected of them. The effluent is free from turbidity and serious odor and appears to be well purified.

The experiment is being tried of breaking up the scum on the surface of the septic tank and mixing it with the sewage in the tank. The object of this is to encourage a more vigorous liquefaction of the material forming the scum. The results of this work will be of value in other parts of the State where similar difficulties of excessive scum formation are encountered.

PRINCETON.

The sewage of Princeton is discharged upon three disposal fields, known respectively as the West, College and Northeast Fields. On the west field a flushtank is in service and the soil is well adapted for irrigation. The results are satisfactory. On the college field the system of double irrigation on two levels gives a satisfactory result. At the time of inspection the entire flow was properly disposed of. It may be that during heavy rains there will be a considerable surface wash into the lake below. To prevent this, an embankment is needed all around the lower end of the field. The northeast field has been much overworked. A new septic tank and five sand filter beds have just been installed and will no doubt remedy the situation. It is as yet too early to make any comment upon their action.

RED BANK.

The septic tank at Red Bank is performing its work satisfactorily, but in view of the importance of the oyster industry along the Shrewsbury River, it has been deemed best to attempt further purification of this effluent by disinfection. To that end, experiments have been conducted during the past summer. It has been found that the addition of chloride of lime in sufficient amount to yield from 12 to 15 parts of available chlorine per million parts of sewage will remove 99.9 per cent. of the bacteria, including the intestinal organism, B. Coli. We may safely infer an equal or greater removal of any typhoid organism which may be present. Since this process is found to be so successful at a reasonable cost, it is recommended that it be installed permanently at Red Bank.

For this purpose, there will be required one mixing tank and two settling tanks. The mixing tank should be circular in plan, with a conical bottom, as shown in the accompanying sketch. The cylindrical upper portion should be 8 feet in diameter and 5 feet high; the conical bottom also 5 feet high and tapering from 8 feet to a 2 inch pipe. The total height of the tank will be 10 feet. From the bottom a 2 inch pipe leads to a centrifugal pump, whose outlet rises and enters the tank near the top and tangentially to the periphery. By this means, an efficient mixing of the bleaching powder can be obtained. The piping should also be connected with the settling tanks, so that after mixing, the solution can be pumped into one of these tanks and allowed to settle.

The settling tanks should each be 6x6 feet in plan and 10 feet deep. They should be provided with an outlet pipe and the bottom for drawing off the sludge and with a 1-inch pipe entering about one foot from the bottom for withdrawing the settled liquor. One tank will be used each day while the other is settling. The dosing apparatus should be modeled after the one used this summer. By using a large volume of water for the solution, a weir may be substituted for the orifice and there will then be no possibility of a stoppage. This weir should be fixed in a concrete box, and the level of the liquid in the box regulated by a ball cock. This ball cock regulator should be raised or lowered by the movement of the float in the sewage tank. In this way the dose of solution will be always proportioned to the flow of sewage. The apparatus will require but little attention, except each morning when a new solution is being prepared.

The tanks should be of brick or concrete, and the pipes, valves and pump of lead or special bronze, to be had of dealers in paper mill machinery. A superstructure will be necessary over the mixing tank with a platform upon which a man can stand, and tackle for hoisting up the bleach. From 75 to 100 pounds per day of bleach will be required, depending upon the season.

RIDGEWOOD.

At Ridgewood the purification of the sewage is accomplished by passage through a septic tank, primary contact filters and secondary wave beds. The original septic tank was found to be very much too large for the system, which has never worked in a satisfactory manner. A new tank has just been installed, which is divided into several compartments, any of which can be thrown out of service if desired. In this way, it is hoped to be able to properly adjust the time of septic treatment to the flow of the sewage. As a result of the poor action of the old tank, the beds became clogged. At the present time, these are being cleaned and restored to their original state. At the time of inspection, the filter was out of commission, undergoing these changes and also certain repairs to the filter bottoms which had developed leaks. New underdrains are also being installed. With these changes, there is reason to believe that the plant will give satisfactory service.

VINELAND.

One new bed is being put down in place of one of the old ones. More suitable underdraining is being provided. All the other beds are covered with sewage and have apparently remained so for a long time. The process is thus one of mere straining. The effluents have a strong odor of sewage. A good septic tank is greatly needed here to save the surfaces from clogging. More efficient underdraining is needed and more frequent cleaning. Each dose should disappear in an hour and water should not be allowed to stand on the surface. If, with a tank and better drains, the beds will not handle the sewage, additional beds are called for, not overworking the present ones to the detriment of the effluent. If possible, a coarser sand should be sought for and used in all new beds.

WESTFIELD.

The system employed at Westfield includes a septic tank and sand filters. The septic tank is not working properly, owing doubtless to its small capacity. The effect of the crude sewage is noticeable on the beds. Large quantities of paper and rags are clogging the surface. The upper beds are now in good condition, but the others are very foul and overworked. They should be put in condition by plowing and harrowing, and should be more frequently cleaned. The effluent from most of the beds was good, but one stream was very foul, and the brook shows evidence of gross pollution.

Very respectfully,

EARLE B. PHELPS.

SHREWSBURY RIVER.

At a meeting of the Commission held October 15, 1906, the Secretary reported that Charles H. Ivins, Special Counsel to the Township of Shrewsbury in Monmouth County, had consulted with him, stating that the Board of Health of Shrewsbury Township desired to make complaint of the pollution of the Shrewsbury and Navesink Rivers, and that it requested that a representative of the Commission attend its meeting to be held October 18, 1906, at Red Bank, for the purpose of explaining to it what action should be taken. The Secretary was directed to attend this meeting.

At a meeting of the Commission held October 29, 1906, the Secretary reported that he had attended the meeting of the Board of Health of Shrewsbury Township on October 18, 1906, and had explained to it the power of the Commission with reference to the pollution of the Shrewsbury and Navesink Rivers.

At the same meeting a complaint was received from the Board of Health of the Township of Shrewsbury of pollution of the Shrewsbury and Navesink Rivers. The Secretary was directed to have this complaint investigated, and an inspection of these rivers made.

During the months of December, 1906, and January, 1907, an inspection of the Navesink River and its tributaries was made in pursuance of the direction of the Commission, and also an inspection of part of the Shrewsbury River.

At a meeting of the Commission held January 21, 1907, a report of this inspection was received by the Commission. It was found that many of the properties in this section consisted of summer residences that were not occupied in winter; that for this reason it was impossible to learn of the disposal of the wastes from the same, and that snow and ice prevented the inspection being made thoroughly.

The further inspection of the Shrewsbury River was delayed until the summer of 1907.

The inspection of the Navesink River and its tributaries did not show any pollution of the tributaries of that river west of Red Bank. Practically no pollution was found in the Navesink River west of Oceanic Bridge. This section was inspected by the Commission in the summer of 1900. At that time two hundred and forty-four notices were served on parties reported to the Commission to be polluting the river to cease such pollution. The orders of the Commission appeared to have been generally complied with.

During the latter part of July, the whole of August and part of September, 1907, the Commission continued the inspection of the Shrewsbury River.

At a meeting of the Commission held August 1, 1907, a communication was received from John S. Applegate & Son, of Red

Bank, stating that several parties represented by them, who were interested in the Shrewsbury River, desired to notify the Commission that the river was being polluted by sewage, and requested that the Commission meet the parties interested, and make a personal inspection of the river. The Secretary was directed to reply to this communication.

At a meeting of the Commission held August 8, 1907, a further communication was received from John S. Applegate & Son in relation to the inspection of the Shrewsbury River.

At the same meeting Messrs. Jacobson and Herbert were appointed a committee for the purpose of consulting with the Messrs. Applegate and other parties in relation to the pollution of the Shrewsbury River.

At a meeting of the Commission held August 15, 1907, this committee reported that on August 10, 1907, it had met with John S. Applegate, Jr., and B. H. Borden, and in company with them had made an inspection of the Shrewsbury River and the adjacent portion of New York Bay, and had observed numerous sources of pollution from private residences and other properties along the shores of the Shrewsbury River, which would be included in the inspection of the Shrewsbury River being made by the Commission; that it had inspected the sewers in the Boroughs of Seabright, Atlantic Highlands and Highlands, and found that sewage was being discharged from the sewerage system of the Borough of Seabright into the Shrewsbury River, and from the Borough of the Atlantic Highlands into lower New York Bay, and that sewers principally owned by private parties in the Borough Highlands were discharging sewage into the Shrewsbury River, all causing an injury to inhabitants of this State in their health, comfort and property. The committee recommended that the Boroughs of Seabright, Atlantic Highlands and Highlands be notified to show cause why they should not be notified to cease polluting the waters of the Shrewsbury River and the New York Bay, and that the Commission cause an inspection to be made in the Boroughs of Highlands and Atlantic Highlands for individual sources of pollution.

This report was received and filed and the Secretary was directed to notify the authorities of the Boroughs of Seabright, Atlantic Highlands and Highlands to show cause at a meeting of the Commission to be held August 29, 1907, why they should not be notified to cease polluting New York Bay and the Shrewsbury River.

The action in regard to these municipalities is reported in this report under the names of the respective municipalities.

At a meeting of the Commission held August 29, 1907, the Secretary was directed to notify all of the parties reported to be polluting the Shrewsbury River to show cause at a meeting of the Commission to be held September 12, 1907, why they should not be notified to cease polluting said river.

Reports of 154 cases of pollution of the river were made to the Commission.

In response to the notices sent out communications were received from fifty-nine parties, and fifty-seven parties were present or represented at the meeting held on September 12 1907.

C. S. Houghton stated that he represented the Monmouth Beach Clubhouse Company; that a cesspool had been installed to accommodate the sewage from this property and to clarify the effluent which was discharged into the river; that he did not believe that it would be possible to put in a purification plant which would accomplish better results. He submitted plans of the tank and outlet pipe and of the property of the company, and requested further advice.

George Holmes stated that he appeared for himself and for practically the entire district known as Highland Beach; that he has been a summer resident of this property for eighteen years, and that the sewage from about twenty or twenty-five houses was discharged into the Shrewsbury River; that he believed the pollution was so small as to be of no importance, and that the ground water was so close to the surface at Highland Beach that any attempt to dispose of the sewage in the ground would cause it to be washed to the surface and so create a greater nuisance than that at present caused by the discharge into the Shrewsbury River.

Pierre Garven stated that he represented the Central Railroad Company of New Jersey, and would be glad to have the Commission inspect the property of the railroad, and that the company would take such action to prevent pollution as may be necessary.

Mrs. J. S. Hollingshead stated that she is the Vice-President of the Brooklyn Home for Aged Men, which has a cottage at Seabright; that they have a cesspool on the property which she believes disposed of the sewage, and that the drain from the stable on the property might run into the river, although she was not certain about the matter, and that she would like to have any notice of what the Commission desired sent to her.

F. C. Miller stated that he has two houses at Oceanic, which have a cesspool with an overflow into the river.

James McCauley stated that his property on the Rumson road has a closed cesspool, and that only storm water was piped to the river.

B. Lichtenstein stated that he has property on the bluff at Highlands and has a cesspool seventy-five feet from the river. He requested advice as to what the Commission desired.

William H. Walsh stated that he has property at Gooseneck, and that his cesspool overflowed to a creek which empties into the river. He stated that he could dispose of his sewage and waste water on his own property.

F. A. Dennis stated that he represented Peter Schlichter, who owned a hotel at Pleasure Bay; that he desired to be advised by the Commission what was necessary to be done in order to dispose of the sewage satisfactorily.

W. A. Seaman stated that he owns twenty-five acres of oyster land in the Shrewsbury River, which has been destroyed by refuse from the Atlantic Coast Sanitary Company and the Consolidated Gas Company of New Jersey; he stated that he was building a house on property owned by him at Branchport, and desired advice as to the disposition of the wash water, as he was not able to construct a cesspool.

Frank Englefried stated that he owns a hotel on Branchport avenue, Branchport, a district recently annexed to Long Branch; that he would like to have a sewer laid to accommodate his property, if possible; that if this were not possible, he would be glad to be advised what he should do in respect to the disposal of the sewage.

Harry Foster stated that he was in the same position on Branchport avenue as Frank Englefried.

Meyer Strasburger stated that his property was at Branchport, and that he would either connect with a sewer if one were laid in that section, or would dispose of his sewage in some other way.

J. M. Richard stated that he would either connect with a sewer if one were constructed at Branchport, or would build a cesspool, and that he had employed a plumber to arrange for a cesspool.

Sheppard Knapp stated that on his property at Little Silver he has a cesspool which did not connect with the river, but that there was an overflow pipe discharging into the ground, from which overflow the sewage percolated.

F. W. Bowen, General Superintendent of the Consolidated Gas Company of New Jersey, stated that he doubted whether there was any pollution from the plant of his company at Long Branch; that separators were used to separate the tar and oil from the waste water because they were valuable and in order to prevent pollution; that he would examine into the question, and, if any pollution were found he would be glad to do anything to stop it, and would be glad to have advice as to what should be done.

Edward F. Wheeler stated that he represented a number of owners at Highlands who would join together in the disposal of their sewage unless a municipal sewer were constructed.

J. M. Logan stated that he was the secretary and treasurer of the Adam Hoch Leather Company at Eatontown; that he did not believe that any waste matter from its factory reached the Shrewsbury River, but that he would cause an examination to be made, and if any pollution was found going into the river from its property, it would be cared for.

On motion the Secretary was directed to employ Earle B. Phelps to advise the Commission in relation to the disposal of sewage from the individual properties in the neighborhood of Pleasure Bay and Branchport and at Highland Beach and Normandie Beach and from the properties of the Consolidated Gas Company of New Jersey and the Atlantic Coast Sanitary Company at Long Branch.

At a meeting of the Commission held September 20, 1907, Charles R. Snyder, Attorney of the Borough of Highlands, consulted with the Commission in relation to the disposal of sewage at Highlands.

At a meeting of the Commission held September 26, 1907, a report on the methods of the disposal of sewage in cases of individual properties along the Shrewsbury River was received from Earle B. Phelps. The report is as follows

The Honorable, the State Sewerage Commission of New Jersey:

GENTLEMEN—I beg to submit the following report of my inspection of certain properties in the vicinity of Long Branch, with recommendations for the construction of sewage disposal plants.

On the east side of Pleasure Bay, in close proximity to one another, are situated the Pleasure Bay House, the Avenel Hotel and Price's Hotel. All these sewer into the bay.

They are too crowded here for satisfactory disposal by cesspools. I recommend a tight septic tank of a capacity for a maximum eight hour flow, an overflow tank of twenty-four hours' flow capacity and suitable sand beds in the area to the north of the Pleasure Bay House. Sewage would have to be pumped from the overflow tank to the beds once or twice a day in summer, and less frequently as the season passes. Corn could be raised on the beds if desired. The most satisfactory arrangement would be a joint plant for the three hotels. I estimate the size of the tanks at about four thousand gallons, 6x16 feet in plan by five feet deep, for the septic tank, and twelve thousand gallons, 16x20 in plan and five feet deep for the collecting tank. No overflows from these tanks should be permitted. The sand filters should be at least four feet deep and have an area of two thousand square feet, if no crops are grown or double that amount if crops are to be grown. These figures are based upon an assumed population of two hundred people.

At Monmouth Beach is located the Monmouth Beach Club House.

The sewage from this establishment passes through two septic tanks and thence about a thousand yards to the river. The tanks have sufficient capacity for the present buildings and are properly designed. If properly cleaned they will remove the solid matter satisfactorily. Sand filtration should be provided for on the lowland near the outlet.

For this purpose it will be necessary to collect the sewage in a receiving tank located either near the hotel or at the beds. This tank should provide for a maximum twenty-four hour storage, probably about fifteen thousand gallons. Sewage would then be pumped once a day to the beds. About 2,500 square feet of filters will be required. They should contain four feet of sand laid over not less than two feet of coarse stone.

The Mannahasset Lodge is located in this same region and conditions there are similar. I understood that no tank has been installed here. A tank of eight hours' capacity should be installed here and the sewage pumped daily from a collection tank to sand beds.

I am not informed as to the number of guests at this house, but judge that it would require a plant of about the same size as that recommended for the Monmouth Beach Club.

On the narrow stretch of beach from Normandie to Highland Beach there is a single row of dwellings, sewering for the most part into the river. For all these dwellings I recommend cesspools with fairly tight sides and open bottoms. Such cesspools will accumulate material in the bottoms and should be cleanded regularly. If properly cleaned the liquid matter will readily pass into the ground and be removed by the tidal flow. Overflows should not be provided, and frequent cleaning, perhaps every winter, should be insisted upon. During the winter season the contents of the tank might be disposed of on the shore front without danger of nuisance.

The Consolidated Gas Company at Long Branch is discharging a large volume of water which must seriously pollute the river. It must be said, however, that they are doing all that can be done mechanically to purify this water. This is to their own advantage, since the recovered tar is valuable. On looking up the matter, I find that attempts to treat such liquors have not hitherto been very successful. The most efficient method has been straining through fine coke breeze, the coke being frequently renewed and burned.

I suggest that this matter be held in abeyance and that it be included in the work upon factory wastes which you are planning to undertake in the near future. One decided improvement can be made at once. A large volume of clear water, apparently from the condensers, is being run into and through the water seals of the gas holders. When it leaves these holders it is saturated with the gas and adds to the nuisance. The object of this arrangement is obviously to prevent freezing up of the seals during cold weather. The same result is obtained at most plants by use of a line of steam pipe. The water can certainly be cut off during the summer when the nuisance is greatest, and it would be much better to cut it off entirely.

The plant of the Atlantic Coast Sanitary Company was not visited, but I am quite familiar with their process as carried out at other places. The only nuisance aside from bad odors arises from the difficulty of separating the extracted grease and oil from the water. These oils are vegetable and animal and can be saponified and precipitated by boiling with lime. The lime soaps thus formed will settle out and have a considerable market value, being used as a base in belt and other leather dressings. I suggest that this matter also be made the subject of experiment in connection with the general subject of industrial wastes.

Respectfully submitted,
EARLE B. PHELPS.

Boston, Mass., Sept. 23, 1907.

At the same meeting a communication was received from Charles Townsend in relation to the disposal of sewage on his property on the Shrewsbury River, outlining the plan of a cesspool. The Secretary was directed to inform Mr. Townsend that the plan proposed by him for the disposal of sewage on his property on the Shrewsbury River would be satisfactory to the Commission, provided care were taken that there be no direct overflow or leakage to the river, and to state that the Commission appreciated the prompt action taken by him in caring for the sewage on his property.

On September 28, 1907, the Commission inspected the plants of the Consolidated Gas Company and the Atlantic Coast Sanitary Company at Long Branch, the railroad station of the New York and Long Branch Railroad Company at Branchport, the Monmouth Beach Clubhouse, all of the private properties along the Shrewsbury River and Atlantic Ocean from Monmouth Beach to Highlands, the station of the Central Railroad Company of New Jersey at Highlands and properties in the Borough of Highlands.

At a meeting of the Commission held October 3, 1907, a communication was received from Rufus Blodgett, General Superintendent of the New York and Long Branch Railroad Company, enclosing plan of the sewer at the Branchport railroad station.

At a meeting of the Commission held October 24, 1907, a communication was received by Mr. Blodgett, submitting plans for the filtration of the sewage from the railroad station at Branchport by the use of a septic tank and a sand and gravel filter. The Secretary was directed to suggest that the plan be altered to provide for a siphon discharging from about the center of the depth of the septic tank, and that the box provided to contain the filtering material be constructed of concrete.

At a meeting of the Commission held November 14, 1907, a further communication was received from Mr. Blodgett, stating that the filter for the sewage at the Branchport station would be constructed in accordance with the suggestion of the Commission.

At a meeting of the Commission held October 10, 1907, the Commission received a request for advice as to the purification of the sewage from the sewerage system of the Rumson Land and Development Company at Rumson. The action taken in pursuance of this request is reported in this report under the name "Rumson."

The Secretary was directed to employ an engineer for the purpose of advising the Commission in regard to the disposal of sewage on the few properties in the neighborhood of Branchport, the owners of which had made requests for advice at the hearing of the Commission in regard to the pollution of the Shrewsbury River.

G. E. Hill, C. E., was engaged for this purpose, and his report to the Commission was as follows

October 31st, 1907.

To the Honorable, The State Sewerage Commission of New Jersey:

GENTLEMEN—You recently instructed me to visit Branchport, examine the local conditions and advise you concerning disposal of sewage from the house of Mr. W. A. Seaman and from neighboring properties. I have made the examination, and I now submit the following report:

Mr. Seaman's property (225x80) lies on low ground fronting on Pleasure Bay and its tributary Branchport Creek. Throughout the district the ground is peaty and sandy. Ground-water lies within a few inches of the surface, and the fall to high tide is too slight to make underdrainage effective. When the time comes for the installation of general sewer system, purification will doubtless involve pumping of the sewage from a gravity-fed pump-well to filters on a higher level.

Mr. Seaman's house is small, and his household consists of but four people. As the volume of sewage will not exceed 400 gallons a day, treatment will not be difficult, even under the exceptionally adverse conditions. I advise the installation of a small septic tank, two small lateral-flow straining chambers, filled with screened cinders, and two small lateral-flow sand-beds, delivering their effluent to Branchport Creek. The septic tank should be watertight. It will not be difficult to construct it, above ground, of reinforced concrete, and to sink and anchor it after completion. For the filters a trough can be built of cypress, closed at one end, with a longitudinal partition to separate the two sets intended for alternate use, and with a perforated transverse partition near the upper end of each side to separate tthe cinders from the sand. If the entire trough were four feet wide and twenty-four feet long ample accommodations would be given. One-sixth of the length could be used to advantage for the cinder sections. The filtering material should be carried above the flow-line and to the surface of the ground, so that aeration will be thorough and the beds readily accessible for cleaning. Alternation in the use of these beds should be frequent, and the resting bed, which will never drain thoroughly because of the ground-water level, should be flooded occasionally with fresh water, for the sake of carrying dissolved oxygen into the interior. From time to time, the cinders in the straining compartments should be renewed and the sand-filters spaded over. Two or three times a year fresh sand should replace the old. Such a system will require care; but it will cost little, and it will prove effective *in very small installations.*

Similar systems can be constructed for other houses subject to the same topographical limitations.

Two hotels face the bay near the entrance of Branchport Creek. One of them has been closed for a long time, and there is no prospect of reopening. The other, the "Norwood," (Frank Engelfried, proprietor) has been in active service throughout the summer, accommodating as many as forty people at a time. A 5-inch sewer runs directly to the bay. The building lies high enough to be well above the ground-water level; and there is ample room between it and the bay for disposal by sub-surface irrigation, after the solids have been eliminated by septic tank treatment.

Across the bay from the Norwood Hotel lies the estate of Mr. M. Strasburger. His household consists, at the maximum, of twelve people. The wastes are carried directly to the bay. Elevation and location favor the introduction of a septic tank and sub-surface irrigation system, and Mr. Strasburger expressed to me his willingness and his intention to install a plant of this kind.

Facing the bay and across the road from Mr. Strasburger's house, is the summer home of the Fifth Avenue Presbyterian Church of New York. For eight weeks each summer this home shelters ninety people. During the rest of the year it is occupied only by the caretakers.

At the time of my visit an attempt was being made to reform the facilities for sewage disposal. From an old circular cesspool, six feet in diameter and seven feet deep, three overflow outlet pipes were led; and connected with these were trenches, in which drain tile was being laid. No flush-tank was provided; there was no distributing chamber or other means of diverting the constant trickling flow from one line to another; only 330 feet of tile were to be laid, and these without broken stone jackets or any similar device for increasing the storage voids or the absorptive perimeter of the trenches.

I advised the change of the location of some of the trenches, making a better division of the land, amending the grade and keeping the sewage further away from the bay; and I suggested that at least 500 feet of tile be laid. To this the caretaker agreed.

Considering that the field is used for less than two months each year, the plant *may* work without offense; but it is likely to fail if overloaded even slightly. Considering the avowed purpose of the institution,—the building up of the physique of children who are in particular need of fresh air, pure food and exercise in healthful surroundings,—it seems well worth while that the managers improve materially the sanitary condition of their own grounds.

Respectfully submitted,

G. EVERETT HILL.

The Commission took no further action during the fiscal year just ended in relation to the pollution of the Shrewsbury River, excepting to determine a general policy that all parties found to be polluting the river should be notified to cease such pollution prior to the summer of 1908. Many of the individuals took action in the matter without waiting for formal notice from the Commission, and many notified the Commission that they would take such action before opening their summer residences for the season of 1908.

The Commission notified the Borough of Atlantic Highlands and the Borough of Seabright to cease polluting New York Bay and the Shrewsbury River respectively. Many of the cases of individual pollution were located in the Borough of Seabright, and these will be included in any scheme for the disposal of the sewage of that borough. Action in these individual cases would not be necessary if proper action should be taken by the Borough of Seabright. The authorities of that borough have assured the Commission that such action will be taken.

A list of the individual cases of river pollution reported to this Commission in connection with the inspections made by it during the year 1907 is made in an appendix to this report, including the cases on the Shrewsbury River.

SLUDGE DISPOSAL.

Many questions arise in connection with sewage purification concerning the disposal of sludge. In some cases particular difficulties are met with in handling the solid matter of sewage. This was the case in Plainfield, where the accumulation of scum in the septic tanks has caused much difficulty. George W. Fuller, C. E., was called in consultation by the Plainfield authorities, and has given the matter careful consideration in other places. Through his courtesy the

Commission is enabled to print the following comments on the disposal of sludge, written by Mr. Fuller. This subject is one on which there is very little information to be had, and which is very important in sewage disposal:

NOTES ON SLUDGE DISPOSAL.

By George W. Fuller.

Visits to sewage disposal works in England and in this country quickly show one striking difference, namely, in this country sewage disposal plants are apt to become more or less neglected with a corresponding diminution in efficiency, while in England this is seldom the case. The cause of this difference is readily found in the character of the management of the disposal works.

While there are numerous disposal plants in this country that have been and are managed with reasonable success, there are comparatively few which would not do better work with such management as found in many places abroad. In part, this is accounted for by the fact that the majority of the disposal plants in this country are much smaller than scores of plants abroad which have set the pace as to efficiency of maintenance. It is also due, in part, to the lack of appreciation by the local authorities in America of the importance of operating sewage works so as to get a proper degree of purification and without objectionable odors.

The history of water purification plants in America during the past ten years shows a very gratifying increase in the recognition of good operation. Practically all of the larger water filter plants within the last few years have been provided with a laboratory and are operated under intelligent supervision. Careful records and data are taken so as to insure good efficiency. There is every reason to believe that sewage purification works will follow similar foot steps, although at this date it is evident that progress will be rather slower.

After a municipality has made an investment in sewage disposal works capable of giving satisfactory results in every way, it seems incredible that the authorities should allow the works to be neglected, with consequent unsatisfactory results, either as to quality of effluent, the production of odors or both. In fact, the writer is firmly of the opinion that there should be a supervising authority, suitably provided with funds and a technical staff, to see that the plants are not only properly designed and built, but operated in a faithful and intelligent manner. This does not mean that a skilled engineer or a skilled chemist must be employed for constant supervision, but that some one of experience and familiar with local conditions shall prescribe simple effective rules for the operation of the plant and the collection of the results of laboratory tests to show just exactly what the plant is doing day by day and week by week.

With such a program carried out there is no room for doubt that satisfactory results will be obtained both as to quality of effluent from a properly designed plant and as to freedom from objectionable odors to the neighborhood in which the plant is located.

One of the principal features in the design and also in the operation of sewage disposal works which deserves attention both from the standpoint of cost of maintenance and the prevention of odors in the immediate neighborhood is that of sludge disposal. This branch of the plant deals with the treatment of the solid matters suspended in the sewage.

Experience in the treatment of these matters shows that it is difficult to lay down laws or procedures which are capable of universal application with perfectly satisfactory results. There is an individuality to local sewage which must be recognized and properly dealt with. These notes are prepared with a view to emphasizing the importance of good management in general and of *due care* to the question of sludge disposal in particular.

The total suspended matters in sewage usually approximate some ten or twelve grains to the gallon, roughly about 200 parts per million, or something less than one ton per million gallons.

This suspended matter, when applied to intermittent sand filters, is not a serious burden when the beds are new and if the material is porous. Even under these conditions there is formed a scum which requires removal by raking or scraping from time to time in order that air may freely enter the pores of the sand. Ultimately the pores near the surface become sufficiently closed with fats and fine suspended matters removed from the sewage so that the upper portion of the sand layer acts like much finer material than when new.

When the sand bed is composed of material which is fine when new the surface layer of sand requires more frequent removal than in the case of coarse sand. If not frequently removed the clogged surface sand would cause the pooling of the sewage applied to the filter. This in turn would result during warm weather in putrefaction of the sewage standing on the filters, as was the case with the original sewage disposal plant at Plainfield, N. J.

In winter clogging of sand is serious as it is difficult promptly to remove the surface layer or rake it. Consequently before spring comes the sand layers as they grow old are apt to show much diminution in efficiency. Where the management is lax there is a strong temptation to by-pass the filters.

Filters of stone or slag, like contact or sprinkling filters, are dependent for their efficiency upon bacterial action in the presence of air. In these filters too, it is necessary that the suspended matter be handled intelligently, otherwise the process will be of questionable efficiency at times.

Obviously it is helpful to keep as much as possible of the suspended solids or sludge in the sewage from reaching the filters regardless of their type. There may be some special cases where this is not so urgent, but as a general proposition much benefit has been derived from the use of preparatory treatments, particularly the septic tank. With this treatment some two-thirds of the total suspended matters are deposited in tanks under conditions where bacterial agencies cause the removal in the form of a liquid or gas of about one-half of the deposited sludge.

This elimination of suspended solids by septic action has proved very helpful as witnessed by the fact that at quite a number of places, such as Saratoga, N. Y., and Mansfield, O., septic tanks have been in continuous use for some two or three and even four years without any necessity of removing the sludge deposited in the tanks.

At Birmingham, England, the disposal of sewage sludge has been accomplished for a population of some 900,000 people with strikingly satisfactory results. Several times each year the sludge is removed from the bottom of the septic tanks and applied to land where it air-dries without any nuisance, although applied to fields adjoining a prominent railroad and within less than one-eighth of a mile of several residences, including that of the manager of the works.

In some cases the wet sludge is applied to land to a depth of eight to ten inches and allowed to air-dry without any further attention. In other cases it is plowed into the land after it is dried to about one-third or one-half of its original depth. In still other cases the wet sludge is applied to deep furrows and then the ridges are turned back with a plow to fill the trenches and cover the sludge.

The secret of success in the disposal of sludge from the septic treatment lies in the removal of the material only after it has undergone bacterial action to a point where there is no further putrescible organic matter for the bacteria to live upon. This shows at once that sludge removal should take place following periods of maximum activity of the bacteria and not during the winter months when they are at a minimum and when there is present in the septic tanks the greatest percentage of organic matter still undergoing putrefaction. The warmer months of the year are the times for the emptying of septic tanks for the purpose of cleaning. Then the sludge will contain nothing to putrefy after its removal.

Experiences at Birmingham, England, are perhaps explained in part by the character and age of the sewage when it reaches the septic tanks. The age of the sewage is measured by the time elapsing after it leaves the house connections and before it reaches the disposal works. This requires attention in designing the size of the septic tanks. It is also quite possible with certain characters of sewage for a very small sum of money to add certain chemicals which will artificially produce substantially the same composition of the sewage as obtained at places, such as Birmingham, England, where no trouble whatever has been experienced from sludge odors.

It is certain that septic tanks should be arranged into several compartments, so that the particular tank from which sludge is to be removed will have no sewage applied to it for some little time previous to cleaning. If this is not done there will be some fresh sludge removed which is bound to putrefy after removal.

Experiences at Columbus, O., in working with the sewage from the main city outfall sewer show results very similar to those obtained in the large plants in England. On the other hand, there are a number of small sewage disposal plants in this country where the sewages from residential districts have behaved quite differently from those of the large cities. This is strikingly true of a number of New Jersey disposal plants.

The sewage from small residential communities usually reaches disposal works in a fairly fresh condition with the suspended matters broken up only to a limited degree and with a considerable portion of coarse particles capable of being removed readily by screens. If the water supply is fairly hard and such as to require the use of much soap considerable quantities of fats, or what might be called soap suds, appear in the sewage.

Where such a sewage is allowed to go without screening into a septic tank where the depth, arrangement of baffles and general dimensions have not been carefully considered, there is likely to result a difficulty in securing satisfactory bacterial decomposition of the solid matters retained in the tanks. The deposits undergoing rapid bacterial decomposition, with the consequent formation of gas, cause the suspended matters to rise to the surface and form a thick scum. Much of this scum with its entrained gas floats upon the surface and if allowed to remain undisturbed will rise above the sewage level on account of its low specific gravity. Here it seems to dry out and to get beyond the reach of active bacterial decomposition. The result is that there is very little diminution in the amount of sludge due to bacterial activities, and there arises the necessity for removing this suspended matter at far shorter intervals than should be the case. There is also the consequent result that the removed sludge contains much organic matter of a putrefying nature and which putrefaction takes place after the sludge has been removed from the tanks.

This state of affairs ought not to exist. The writer is firmly convinced from numerous practical observations that these difficulties are capable of effective control, and that the bother and expense of disposing of undecomposed sludge with consequent risks of troubles from odors can be corrected by following out certain lines of improvements.

Observations at Plainfield, N. J., led the writer to believe for a time that the absence of suitable kinds of bacteria might be a factor in explaining the small amount of sludge decomposed in the septic tanks where there is naturally a very thick scum with but little deposit. However, careful studies along that line lead to the conclusion that the bacteria will do their part if the suspended matters are kept where the bacteria may thrive.

To dispose of sludge from septic tanks without producing odors the sewage from suburban areas reaching the disposal works in a fresh and practically undecomposed condition should have attention most carefully directed to the following features:

1. The works should receive faithful attention from intelligent operators who should work under the directions of persons capable of recognizing the individuality of the local sewage in its relation to practical treatment.

2. The sewage before it enters the septic tank should be passed through screens to remove all the coarser suspended matters such as have a tendency to float and increase the volume of scum at the surface of the septic tank.

3. The septic tanks should be provided with baffles to keep the scum from reaching the outlet. Where the scum persists in remaining at the surface steps should be taken to subject it to bacterial action. This may be done by manual labor by breaking up the scum and causing it to deposit. It is practical, and cheaper, to effect this by special arrangement of the baffles.

Aid may also be derived from flooding the floating scum, after partially emptying the tank, with sewage.

4. The greatest accumulation of solid matter in a septic tank appears near the inlet end and arrangements should be made for keeping this compartment separated from the other portions so that it may be emptied and its contents applied to land or pumped into portions of the tank.

5. No sludge should be discharged until it has been freed from putrescible suspended manner. In this way objectionable odors may be avoided.

SOUTH ORANGE.

At a meeting of the Commission held September 5, 1907, plans for a system of sewers for the Township of South Orange, to discharge into the joint outlet sewer emptying into Arthur Kill at Bayway, Elizabeth, were submitted to the Commission on behalf of the township by Alexander Potter, C. E.

At a meeting of the Commission held September 12, 1907, on motion of Mr. Herbert, the plans submitted by the Township of South Orange, providing for a sewerage system for the township, to discharge into the joint outlet sewer discharging into the Arthur Kill at Elizabeth, were approved, subject to such conditions of construction, operation and purification as this Commission may from time to time require.

STATE HOSPITAL AT TRENTON.

At a meeting of the Commission held July 25, 1907, Cornelius S. Hoffman, a member of the Board of Managers of the New Jersey State Hospital at Trenton, and Scott Scammell, Secretary of the Board, appeared before the Commission on behalf of the Board of Managers, and complained that a spring situated on the property of the State Hospital at Trenton, which was a source of supply of part of the water used at the State Hospital, was being polluted, and that the Board of Managers believed that the source of pollution was a sewer laid by the City of Trenton in Asylum road, and that the Board requested the Commission to investigate the pollution of the spring and to take such action in regard to the same as might be proper.

At the same meeting, Commissioners Herbert, Capstick and Jacobson were appointed a committee to investigate the complaint made by the Board of Managers of the State Hospital at Trenton of the pollution of the spring on the property of the State Hospital.

At a meeting of the Commission held August 8, 1907, the Secretary was directed to suggest to the authorities of the City of Trenton that the sewer laid by the city in Asylum road be immediately repaired so as to prevent leakage in the neighborhood of the State Hospital, and that the flushtank at the end of the sewer be placed in operation so that the sewer could be properly flushed to prevent stoppages.

At a meeting of the Commission held August 15, 1907, a communication was received from Frederick W. Gnichtel, Mayor of the City of Trenton, stating that the city authorities had taken up the matter of making repairs to the sewer laid in Asylum road in accordance with the suggestions of the Commission.

At the same meeting the committee appointed to investigate the complaint of the pollution of the spring on the hospital grounds submitted a report of its investigations, together with reports made to the committee by E. B. Phelps, Dr. R. N. Connolly and J. C. Harding, C. E.

The Secretary reported that he had forwarded a copy of the report of the committee appointed to investigate the pollution of the spring on the grounds of the State Hospital at Trenton to the Board of Managers of the hospital.

A communication was received from Scott Scammell acknowledging the receipt of the copy of the report of the committee sent to the Board of Managers, and expressing the appreciation of the Board of Managers for the prompt action of the Commission.

The report of the committee is as follows:

To the State Sewerage Commission:

Your committee, appointed July 25, 1907, to investigate the complaint made on that date by the Board of Managers of the State Hospital at Trenton, that a spring on the hospital grounds, which had been used for part of the water supply of the institution, was polluted by sewage, respectfully submits the following report of its investigation:

The committee examined the spring and its surroundings on July 26, 1907. The spring is situated on the hospital property, in close proximity to a laundry building and near a stable. Nothing was noted to indicate pollution from these sources.

The hospital grounds are divided by Asylum Road. In this road is an eight-inch tile sewer laid about two years ago by the City of Trenton. The sewage from most of the hospital buildings formerly ran through a sewer crossing the road. The city sewer was laid to intercept this sewage, and only sewage from the hospital enters it until it has passed the hospital property.

The city sewer begins to the northeast of the hospital, near a small creek.

At its extremity is a flush tank which has never been placed in operation. Its feed pipe is blocked with cement at the end. It could be fed from the creek, or from the hospital water system. Manholes are placed about two hundred feet apart along the sewer. For about eight hundred feet the grade of the sewer is flat, the road rising over a small hill. The next two manholes beyond the flush tank showed no unusual conditions. Manhole No. 4 showed signs of having been partly filled with sewage, the walls to a considerable depth having been coated with sewage scum. Manhole No. 5 had evidently been filled to the street level, about twelve feet above the sewer. It is at the crest in the rise of the road.

Between manholes Nos. 4 and 5 the sewer from the main hospital buildings crosses the road probably about eight feet above the city sewer, and runs into a small sludge tank a few feet from the road. Here the old line is cut off and an eight-inch tile sewer was laid to connect with manhole No. 5, running probably one hundred and twenty-five feet at an angle to the street sewer, and at an elevation to avoid rock excavation. Within three feet of the manhole it turns down about six feet and discharges into the manhole about a foot above the city sewer. A heavy flow of sewage enters by this pipe.

An excavation had been made at this manhole, exposing one side of the manhole and the two sewers entering it. The city sewer lies in an excavation in porous sand stone rock having many crevices, which lies about four feet below the road surface. The rock and earth showed traces of sewage. Manhole No. 6 showed traces of sewage to a height of three feet.

The spring is a circular well about twenty feet in diameter and ten feet deep, walled in, and water has been pumped from it by pumps in the laundry building and at the hospital mill. It is about three hundred feet from manhole No. 5 down a steep and regular grade, the surface fall being about eighteen feet.

W. P. Hayes, warden, and Horace B. Warner, mason, of the hospital, stated that on June 16th last sewage had been noticed overflowing from manhole No. 5. They removed the cover and the sewage lifted the drip pan, under which was found much greasy scum. Some rags were removed from the outlet of the manhole and some sand dislodged, and the sewage washed out the pipe and had since run freely.

The sewer was blocked by this committee. Sewage leaked from the exposed joints and from the bottom and sides of the manhole. The plug was removed and such sewage as did not escape into the ground flowed back into the sewer. The leaks were cemented. Another trial developed more leaks. The sewer was then blocked at manhole No. 6. It rose to a depth of five or six feet in No. 5 and then remained stationary, although the flow of sewage from the hospital was steady. Water was turned into the excavation from the hospital water system while the sewer was filling and the excavation filled. Much earth washed down from the sides of the excavation, preventing any considerable flow of water into the sewer. The sewer was blocked and the manhole kept filled for about twenty-four hours. Probably one hundred thousand gallons of sewage and more than twenty-five thousand gallons of water entered the sewer and excavation, all of which soaked away into the ground.

About an hour after the water was turned into the excavation and the sewer blocked, at 5 o'clock in the afternoon, July 26th, about four ounces of permanganate of potassium in solution was placed in the excavation, and three hours later the dose was repeated. About 9 o'clock the flow of water in the spring increased in volume. No trace of the chemical was observed during the night. The following morning the spring was slightly clouded, and refracted sunlight showed particles not visible in direct light. The committee considered that instead of reaching the spring direct, the water had flowed to the point from which the sewage was escaping from the sewer, that owing to the action of the sewage the chemical had been altered and that the particles in the spring were reduced oxide of manganese. These tests were considered inconclusive.

On the afternoon of Saturday, July 27th, the plug was removed from the sewer and the excavation filled. On Sunday, the 28th, the spring became more cloudy and a piece of the road about five feet long and three wide and about thirty-five feet back from the manhole No. 5 along the city sewer sank from six inches to a foot.

On Monday, July 29th, Dr. R. N. Connolly, for the committee, took samples of water from the spring and from the two artesian wells from which water was drawn for the hospital on that date. His report is submitted herewith. It shows the spring water to contain thirty-five thousand seven hundred bacteria per cubic centimetre and colon bacilli were isolated and identified in cultures made from 1-100 C. C. No typhoid bacilli were isolated. The artesian well samples showed a total count of forty bacteria per cubic centimetre for well No. 1 and sixty for No. 3. No trace of colon bacilli was found and he finds this water beyond suspicion.

On the same day, J. C. Harding, C. E., associated with the firm of Hering & Fuller, for the committee, made a second test of the sewer. His report is submitted herewith. It shows that on July 29th, at 4 o'clock in the afternoon, he caused the sewer to be again plugged at manhole No. 6 to reproduce the condition existing prior to June 16th. In three hours the sewage had reached a depth of seven feet in manhole No. 5. Between 8 and 10 P. M. he placed four pounds of red aniline dye in solution in manhole No. 4. No dye appeared all night in the spring. On July 30th, between 8 and 12 A. M., ten pounds more of dye were placed in manholes Nos. 4 and 5 and in the grease trap of the hospital sewer. Dye was plainly observed in the spring at 10:45 A. M., July 30th, issuing from a crevice in the rock in the bottom of the spring. From that time until 3 P. M. it was clearly noticeable, the deepest color being at about 1:30 P. M. The level of water in the spring rose one-half inch during and after the blocking of the sewer.

During the test by Mr. Harding the committee noted distinctly in the spring water the earthy odor characteristic of sewage partially filtered.

This committee considered that these tests showed that there was a direct contamination of the spring by sewage from the city sewer in Asylum Road previous to June 16th, 1907. The committee believes that the spring should be permanently condemned as a source of water supply. The State Sewerage

Commission has already requested the City of Trenton to have the sewer repaired and the flush tank placed in operation. This will probably prevent further blocking of the sewer, which should be regularly inspected. The presence of the sewer on the slope above the spring is enough to condemn the spring in the judgment of this committee, even were the ground between not saturated with sewage. It is doubtful if the removal of the sewer would accomplish any good end, as the location of the spring below buildings having a population of from twelve hundred to fourteen hundred would render it a questionable source of water supply were there no sewage.

For the committee, Earle B. Phelps, of Boston Institute of Technology, made an examination to determine the nature of the flow of sewage from the city sewer to the spring and the relation, if any, between such pollution and an epidemic of typhoid fever which has existed in the hospital since April, 1907. His report is included herewith in full.

H. M. HERBERT,
JOHN H. CAPSTICK,
FREDERICK C. JACOBSON.

REPORT OF E. B. PHELPS.

To the Honorable the State Sewerage Commission of New Jersey:

GENTLEMEN—I submit herewith a report on the results of my investigations at the New Jersey State Hospital, Trenton, relative to the possible pollution of the water supply of that institution by its own sewage. Although many of the facts relative to the case are well known to you, it seems proper at this time to review and officially record all facts which have any immediate bearing upon the case.

The State Hospital for the Insane is situated on the northern boundary of the City of Trenton and about three miles from the centre of the city. Reference to the accompanying blue print will facilitate the description of the grounds. The main highway divides the property into two portions. To the northeast of the highway are the buildings and grounds of the hospital, consisting of the main asylum building, the new building or annex, engine and boiler houses, and other buildings and residences. To the southwest are situated the laundry and pump house, and some stables. Near the laundry is a spring which was largely responsible for the selection of the present site for the asylum. It is virtually a shallow well, circular in plan, 20 feet in diameter and about 10 feet deep from the curb to the bottom. Normally it contains about 5 feet of water, but this may be drawn down by the removal of a plug at the bottom, when the entire contents can be drawn out upon low land below. This spring is about 300 feet from the highway. Its curb is 18 feet and its bottom 28 feet below the street grade.

Ordinarily water is pumped from this spring by pumps in the adjacent laundry building and also by water power pumps located at the mill below. The force mains from these two sets of pumps join near the spring and pass as a single main across the road and up to the main building. Taps and service pipes are taken off from this main at various places, first in the men's exercise yard, then for the men's wards, then for the central portion of the main building, and finally for the women's wards. For many years this was the sole source of water supply. The supply becoming insufficient was reinforced in 1895 and succeeding years by the addition of three driven wells, 260 feet deep, located northeast of the main building near the boiler house at the new annex. Water is pumped from these wells directly to the mains and also to a standpipe near by. This standpipe is 140 feet high and 25 feet in diameter and has a capacity of half a million gallons. The water from these wells is piped to the annex building and also runs into the main from the spring to the main building. The arrangement of the piping is shown on the plan. It will be plain that by this arrangement if the pumps from the spring are pumping more water than is demanded in the main building, this water can pass to the annex and to the standpipe. On the other hand, if the spring supply is insufficient for the needs of the main building, well water would in general be flowing toward that building and no spring water could pass beyond. Moreover, as there is always considerable fluctuation in the demand there will always be near the centre of the system a mixed sample of water flowing now one way and now the other, and the nearer any given point is to the spring the more spring water and less well water will be likely to reach that point. The significance of these facts will soon be shown.

The sewer from the annex passes down to the street as indicated in the plan, at such a distance from the spring and water works as to render its further discussion unnecessary. The sewers from the main building join in a common outfall sewer which originally passed to a septic tank on the canal bank as shown. Later the city put down an 8-inch tile sewer in the street up to a point somewhat beyond the asylum. The grade being very flat, at the upper end a flush tank was provided, but has never been operated. The asylum drain was intercepted by a sludge tank at a point shown on the plan, and from the tank connection was made to the street sewer.

For many years previous to April last there had been practically no typhoid at the hospital. On the 8th day of April a case was reported in one of the male wards, Ward 4, and there followed on the 11th and 13th two other cases in the same ward, one being that of an attendant. On the 13th there was also a fourth case reported in Ward 12 on another floor. There is nothing to indicate the origin of these cases. The first and second cases were those of patients who had been admitted in February, 1907, and in 1901, respectively, and who had never been outside of the grounds since.

No new case developed for 23 days, except that on May 3 an attendant was taken sick who had been at work for but two days and had recently come from Baltimore. On May 6 a case was reported in Ward 7 and on May 12 another in Ward 6. On May 19 the first case appeared in the women's wing. During June there were four new cases, coming down on the 8, 24, 25 and 26, in four different men's wards, 1, 7, 11 and 4, respectively. During July the epidemic reached its height, with 52 cases in the men's wards and 10 in the women's. For convenience of reference these cases are recorded in diagramatic form on the accompanying chart, and are tabulated in the accompanying summary. All the cases thus far recorded were located in the main asylum building and the majority of them, 63 out of 74, in the men's wards. During June and July there also occurred 16 other cases located outside of this building. Every one of these persons either worked about the hospital grounds or had the water of the lower spring to drink. One of these cases was that of one of the assistant physicians, living at the annex, but frequently visiting the main building on business. With this exception there were no cases reported from the annex.

The wide distribution of the cases, particularly in the men's wards, showed that this was not a case of personal infection, and the remarkable periodicity noticed in the earlier cases strongly indicated a pollution of the water supply by the institution's sewage. Weight is given to such a theory by a study of the food supply and other possible sources of infection. One-half of the milk is produced on the premises and the remainder purchased from one man. The hospital milk was considered superior to the other and was served pro rata among the men's and women's kitchens of both buildings and the central kitchen where the cooking is done for the staff and certain employees. Each kitchen therefore received about half its milk from the asylum dairy and the remainder from the outside. In all other respects also the food furnished the various kitchens was practically identical. Green uncooked vegetables are rarely served. Shellfish are used only for soups. The only commodity which was not distributed equally among the various wards was the water of the suspected spring. This, as has been explained, was furnished quite unmixed to the men's wards, where there were 63 cases among about 400 persons, partially mixed with well water in the women's wards, where there were 11 cases among about 400 persons, while in the annex with not one case among 400, the water of the spring was probably not served at all. Furthermore, as has been stated, all the 16 outside cases either drank the spring water regularly at home or worked about the hospital grounds or kitchens.

On June 16 an investigation of the sewers showed that the city sewer along the highway was completely choked up and overflowing slightly at one of the manholes. The point of the stoppage is located approximately on the plan by a star just below manhole No. 5. On the following day, June 17, the use of the spring water was discontinued and has been discontinued ever since.

When the writer undertook his part of the investigation your Commission had already been at work several days and had succeeded in demonstrating satisfactorily a direct flow of water between the sewer, which had been again plugged up for the purpose of experiment, and the spring. A quantity of fuchsine, a red analine dye, had been added to the sewage and a marked pink coloration had appeared later in the spring. It seemed desirable further to investigate the matter and determine if possible whether this passage of water from sewer to spring was one of ordinary percolation through soil or a more rapid flow through fissured rock. At best this would be an undesirable and unsafe condition of affairs, but in the former case it might very readily be that in slowly passing through 300 feet of soil the sewage would be robbed of all infectious material and rendered inocuous, while in the latter of course the pollution of the spring would be inevitable.

It was planned to imitate as far as possible the conditions existing previous to June 17 and then to secure data upon the following points:

(1) The differences in the discharge of the spring when under normal conditions and when the sewer is blocked up and leaking.

(2) The shortest time in which water can pass from the sewer to the spring.

(3) The bacteriological condition of the spring at the conclusion of the above mentioned experiments.

Meeting the approval of Mr. Herbert, of your Commission, the plans were immediately put into execution.

I. AMOUNT OF WATER FLOWING INTO SPRING FROM SEWER.

A weir was constructed at a point just below the outfall of the spring near the canal. The crest of the weir was one foot long and suitable end and bottom contractions were provided for. An upright stake driven into the ground at a distance of two feet upstream from the crest served as a gauge. A hook gauge was raised and lowered against the face of this stake to give the elevation. The zero point was determined with a spirit level.

At 10 A. M., July 31, a plug was inserted in the sewer at manhole 6, so that all the institution's sewage was held above that point. At 11 A. M. the manholes above were nearly filled. At 12 M. water was also turned in from a 3-inch fire hose and the level in the sewer raised nearly to the street grade. The entire flow of sewage from the institution, together with a stream of water from a 3-inch fire hose, was now escaping into the ground from the sewer and continued so to escape for 24 hours, during which the experiment was continued. From some rough measurements made in the sludge basin the sewage flow was estimated at 100,000 gallons per day. At 10 A. M., August 1st, the plug was removed from the sewer and normal condition restored. During this time the flow of the spring was found to be as follows:

Time.	Flow—Gals. per hour.
July 31, 10 A. M.	2,290
July 31, 11 A. M.	2,290
July 31, 12 M.	2,290
July 31, 2 P. M.	2,420
July 31, 3 P. M.	2,540
July 31, 4 P. M.	2,580
July 31, 6 P. M.	2,670
Aug. 1, 7 A. M.	3,040
Aug. 1, 9 A. M.	3,040
Aug. 1, 12.45 P. M.	2,580
Aug. 1, 2 P. M.	2,330

It is thus plainly shown that a stoppage of the sewer and consequent passage of the entire sewage flow into the ground through leaks or a broken pipe gives rise to an increase in the flow of the spring, which reached a maximum value of 750 gallons per hour or 18,000 gallons per day, and that the resulting spring water contained therefore about 25 per cent. sewage. Weather conditions were such as to have no bearing on these tests.

2. VELOCITY OF FLOW BETWEEN THE SEWER AND THE SPRING.

To determine this point about 4 oz. of uranine, a powerful dye of the fluorescein series, was added to the sewage at manhole 5 and well stirred in. This was done at 11:20 A. M. The rocky bottom of the spring was then kept under constant observation for 5 hours and samples of water drawn from the bottom at those points where the flow was found to be strongest were constantly examined. The first observation of the bottom showed fine streams of pink water coming from the crevasses, this being the remainder of the dye added the day before to the sewer. This red soon cleared away and at 2 P. M. the greenish fluorescence of the uranine was faintly but distinctly detected. This color rose to a maximum at 3 and had all disappeared at 4. The time of passage was therefore determined to be 2.7 hours.

3. BACTERIOLOGICAL CONDITION OF THE SPRING WATER.

At 4 o'clock samples of the water were taken for bacteriological examination. There samples were subjected to the usual tests with the following results:

Total bacteria growing at 37 C.	1,020
Total bacteria growing at 20 C.	5,300
B. coli present in 0.01 C. C.	

The spring is thus shown to be grossly contaminated. We are now in a position to consider the question at issue, which is, direct connection having been shown between the sewer and the spring, is the flow from the one to the other a case of ordinary percolation, or are there direct passages through fissures in the rocks?

The bacteriological evidence is almost conclusive on this point. Ordinary sand or loam is itself an efficient purifying agent and the passage of sewage through 300 feet of such material would remove from it the majority of the bacteria. The fact that the water of the spring contains over 5,000 bacteria to the cubic centimeter, of which over 100 are the typical sewage organism B. coli, is strong evidence for the theory that the passage is through cracks and fissures in the rocks. More conclusive, however, are the hydraulic data. The distance between the sewer and the spring is 300 feet, and under the condition of the experiment there was a difference of 28.5 feet in head from the water level of the sewer to that of the spring. This represents a hydraulic gradient of 9.5 per cent. The rate of flow of water through various [illegible] of soil and stone has been carefully investigated by Slichter.*

[illegible]ter, C. S. The rate of movement of underground water. U. S. G. S. [illegible]Supply Paper, No. 140, 1905.

Using the results of this investigation we can determine what kind of soil would be required to allow the velocity of flow observed, namely, 2 feet per minute under a head of 28.5 feet in 300 feet. A new factor must be taken into account in this calculation, namely, the porosity of the soil. A fine porous soil will have the same transmission constant of a coarser but more compact one. It is therefore not possible by this method to determine just what kind of a soil we are dealing with, but the general character of the intervening soil or rock can be roughly estimated by a comparison with the conditions given in the following table:

Sands and gravels which under a head of 28.5 feet in 300 feet will allow water to flow through at a velocity of 2 feet per minute (Slichter).

Porosity.	Effective Size.*	Discharge.
45 per cent.	2.8 mm.	0.9 ft.
40 per cent.	3.2 mm.	0.8 ft.
35 per cent.	3.7 mm.	0.7 ft.
30 per cent.	4.5 mm.	0.6 ft.
25 per cent.	5.5 mm.	0.5 ft.

*10 per cent. by weight is less in diameter than.

So far as velocity is concerned, any of the above conditions are in conformity with our results. Let us now consider discharge. In the last column are given the rates of discharge in cubic feet per minute per square foot of cross-section for the various porosities.

Now taking the maximum rate of passage of sewage into the spring, 750 gallons per hour, or 1.67 cubic feet per minute, and assuming a height of the water table just above the spring of 5 feet over the bottom, this gives a flow of .0167 cubic feet per minute through each of the 100 square feet of cross section at that point.

A study of the table will show that we are not dealing with any of the sands or gravels given, since the corresponding flows per square foot are much greater than the value determined. It will be noticed also that as the porosity decreases and the size of material increases the volume of flow decreases for the same velocity of 2 feet per minute. Now we can imagine this process to continue until we have a very low porosity, a very large size of material and a corresponding low discharge. Such a condition is called for to explain our experimental results. This material is no longer gravel, but loose rock, composed of very large pieces with open cracks between them and is well illustrated by the fissured red sandstone of that part of New Jersey. No other kind of material can possibly be made to combine this high velocity and small discharge found experimentally.

It may therefore safely be said that not only is there a direct passage of water from the sewer to the spring, but that the sewage finds its way not through sand or loam but through crevasses and fissures in the rock; that a considerable amount of sewage, 750 gallons per minute, thus reaches the spring in a very short space of time, 2.5 hours, and that bacteriologically it is comparatively unchanged.

CAUSE OF THE EPIDEMIC OF TYPHOID AT THE HOSPITAL.

With the conditions as above described we have not far to seek for the cause of the epidemic. Of the origin of the first three cases we have no knowledge. After that the regularity with which each new group of cases appeared and the gradual increase in their number, together with the slow decline of the epidemic about the proper time after cutting out the suspected water, all point conclusively to the water of the spring as the primary and main source of infection.

A careful inspection of the grounds and barns of the hospital wards and kitchens was made. The measures that are being taken to combat the disease seem all that modern science can suggest. The typhoid wards are carefully screened, all cups, dishes and bed pans are thoroughly sterilized, and the dejecta are properly disinfected. The wide distribution of the cases precludes the theory of any local causes of contagion. The dairy barn was, when I saw it, a model of cleanliness and can safely be disregarded. The distribution of the cases is also against the theory of milk or other food infection, as already shown. The water of two of the deep wells was examined bacteriologically and each was found to contain but three bacteria per cubic centimeter and no B. coli.

With such a large number of patients of this class it is hardly possible to prevent more or less direct contagion, and in my opinion that is the method by which the latter cases have been transmitted.

If this is the true view of the matter, we may expect to see a speedy diminution of cases, since the possibility of infection decreases with each case removed.

In conclusion, I wish to express my appreciation of the many courtesies received at the hands of Dr. J. C. Felty, Acting Medical Director, and his associates, Doctors W. C. Sandy, F. S. Hammond and W. A. Taylor, and of the Warden, Mr. W. P. Hayes. Every facility was given me for getting at the facts in the case and assistance was freely given in every way possible.

Respectfully submitted,

EARLE B. PHELPS.

Boston, Mass.,
Aug. 6, 1907.

Newark, N. J., August 7, 1907.

To the State Sewerage Commission:

Bacteriological examination of three samples of water obtained on July 29, 1907, at the State Asylum at Trenton, New Jersey, gave the following results:

1907	Origin of sample.	Bact. Per C C.	Amount of sample causing fermentation in 5 C. C. glucose bouillon.					
			1/100	1/20	1/10	1/5	1/2	1 CC
July 29	Water from spring near overflow pipe.	35,700	x	x	x	x	x	x
" "	Water from Artesian Well No. 1.	40	-	-	-	-	-	-
" "	Water from Artesian Well No. 3.	60	-	-	-	-	-	-

Sign x means fermentation produced.
Sign - means no fermentation produced.

The water from the spring is very badly contaminated with sewage, as the colon bacilli were isolated and identified in cultures made from 1-100 C. C. of the water. Have carefully searched for typhoid bacilli in cultures made from the sample, but could find none.

The result, however, is not surprising, as the difficulty of finding these bacilli in water is well known. The amount of bacterial contamination in the spring water is so great as to make it unfit for use.

The water from the artesian wells was almost free from bacterial life and the absence of fermenting germs of any kind is sufficient, in my judgment, to place this supply above suspicion.

I am,

Very respectfully,
R. N. CONNOLLY,
Bacteriologist.

At a meeting of the Commission held October 3, 1907, Commissioner Herbert reported that he had visited the State Hospital at Trenton, and found that no action had been taken in accordance with the suggestions of the Commission to place the flushtank at the end of the Trenton city sewer in Asylum road in operation, or to repair the sewer.

The Secretary was directed to communicate with the authorities of the City of Trenton, suggesting that action be taken in accordance with the recommendations of the Commission in relation to repairing the city sewer in Asylum road.

At a meeting of the Commission held October 10, 1907, a communication was received from Mayor F. W. Gnichtel, stating that the City Engineer had taken action in reference to the sewer in Asylum road as suggested by the Commission, and enclosed a copy of the report of the City Engineer, Abraham Swan, Jr., stating that he had been unable to find any breaks in the Asylum road sewer, and that he had made application to the hospital authorities for permission to connect the flushtank at the end of the sewer with the hospital water supply or with the creek on the hospital property.

At a meeting of the Commission held October 24, 1907, a communication was received from Scott Scammell, stating that notice had been given by the State Board of Health to the Board of Managers of the State Hospital at Trenton to close the spring on the hospital grounds, and asking for the advice of the Commission in the matter.

The Secretary was directed to reply that it was not within the jurisdiction of the Commission to pass on the question of closing the spring, and suggesting the consideration of such questions in relation to closing the spring as had come under the observation of the committee of the Commission which had investigated the pollution of the spring.

STATE TUBERCULOSIS SANITORIUM.

At a meeting of the Commission held February 4, 1907, plans and specifications for a sewage disposal plant for the State Sanitorium for Tuberculous Diseases at Glen Gardner were submitted to the Commission, together with an application for their approval from the Board of Managers of the New Jersey Sanitorium for Tuberculous Diseases, by James S. Greene, M. D., Chairman of the Committee of that Board on Sewage Disposal.

At a meeting of the Commission held February 11, 1907, Charles McMillan, C. E., Engineer of the Board of Managers of the New Jersey Sanitorium for Tuberculous Diseases, consulted with the Commission in relation to the plans for the disposal of the sewage of the State Sanitorium at Glen Gardner.

At a meeting of the Commission held February 25, 1907, Commissioners Herbert and Capstick were appointed a committee to consult with George W. Fuller, C. E., in relation to the plans for the disposal of the sewage from the State Sanitorium at Glen Gardner.

At a meeting of the Commission held March 4, 1907, this committee reported that it had consulted with George W. Fuller, C. E., in relation to the plans for the disposal plant at the State Sanitorium, and a communication in relation to the plans was received from George W. Fuller.

At the same meeting the Secretary was directed to return the plans submitted on behalf of the Board of Managers of the New Jersey Sanitorium for Tuberculous Diseases for a sewage disposal plant at Glen Gardner, without the approval of the Commission, and to state the objections to the plans.

At a meeting of the Commission held March 11, 1907, the Secretary was directed to invite the members of the committee on sewage disposal of the Board of Managers of the State Sanitorium for Tuberculous Diseases and their Engineer, Mr. Charles McMillan, to meet with the Commission on March 18, 1907, for the purpose of consultation in relation to the disposal of sewage at the State Sanitorium.

At a meeting of the Commission held March 18, 1907, Dr. James S. Greene, Chairman of the Committee on Sewage Disposal of the Board of Managers of the New Jersey Sanitorium for Tuberculous Diseases, and Charles McMillan, C. E., consulted with the Commission in relation to the disposal of the sewage from the sanitorium at Glen Gardner.

The Secretary was directed to suggest to Mr. Charles McMillan that the plans for the disposal of sewage from the sanitorium at Glen Gardner be so modified as to provide first for a septic tank sufficient in size to hold at least eight hours' flow of the sewage; second, that a sprinkling or contact filter be built without a roof or with a roof so arranged as not to interfere with the free passage of air, and in case of the use of a sprinkling device, to have such device of a more permanent form than the use of wood will permit, and third, a filter bed constructed either of sharp clean sand or of some equivalent material, proportioned in area to the flow of the sewage and of a sufficient depth to insure against the washing of channels in the filtering material.

At a meeting of the Commission held April 8, 1907, revised plans for the disposal of the sewage from the sanitorium at Glen Gardner were submitted to the Commission by Charles McMillan, C. E., and at the same meeting the following resolution was adopted:

"*Resolved,* that the revised plan submitted to the Commission for its approval by the Board of Managers of the New Jersey Sanitorium for Tuberculous Diseases, providing for the disposal of the sewage from the sanitorium at Glen Gardner by a septic tank, sprinkling filter and filter beds, the effluent to discharge temporarily upon the surface of the lower field of the sanitorium grounds, be approved, subject to such conditions of construction, operation and purification as this Commission may from time to time require."

At a meeting of the Commission held June 20, 1907, Commissioner Herbert reported that he had visited the New Jersey Sanitorium for Tuberculous Diseases at Glen Gardner on June 12, 1907, and had inspected the sewage disposal plant of that institution.

At a meeting of the Commission held November 14, 1907, the following report was received from Charles MacMillan, C. E.:

"Princeton, N. J., Nov. 13, 1907.

Boyd MacLean, Esq., Sec'y, New Jersey State Sewerage Commission, Jersey City, N. J.:

DEAR SIR—In compliance with your request for information respecting the present condition of the sewage disposal system of the New Jersey Sanitorium for Tuberculous Diseases at Glen Gardner, N. J., I have the honor to report that the system was completed in the past summer substantially in accordance with the plans approved by your Commission, and that reports from the sanitorium indicate that it is operating satisfactorily. But, of course, it must be borne in mind that, owing to the lateness of the formal opening of the sanitorium, the amount of sewage dealt with cannot, as yet, be much more than a small fraction of the full capacity of the works (20,000 gallons per day), and therefore the system cannot be regarded as having been sufficiently tested to render the expressions of satisfaction which have been received of conclusive significance as to its ultimate efficiency, yet my belief is that, if it were possible to test the system to its full capacity, it would justify its installation.

The disposal plant consists of a septic plant, followed, in the order given, by a flush tank, two sprinkling filters, a settling basin and a finishing filter made of coal ashes.

The septic tank is circular in plan. Its internal diameter is 16 feet and 6 inches, its effective depth is 6½ feet, and its capacity is therefore about 10,000 gallons. Three parallel baffle walls with ample submerged openings at alternate ends cross the tank and cause the liquid to pursue a winding course on the way from inlet to outlet.

In order to reduce expense, a light roof of boards was substituted for the concrete roof originally suggested. The tank is provided on the west side with a bottom outlet, controlled by a valve, leading to a sludge-pit, for use whenever it may be deemed necessary to clean the tank.

The flush tank receives the effluent from the septic tank, and is merely a meter whereby a fixed amount of the septic effluent is periodically delivered, with a gush, to the two sprinkling filters situated further down the slope, each charge being applied to them through suitable nozzles, in the form of spray, well distributed over the surface of the filtering material of macadam stone which the filters contain. The distribution has been tested in a small way, and appears to be satisfactory. The two sprinkling filters are to be used simultaneously, and when thus acting to the full capacity of the plant will be receiving septic liquid at the mean rate of about 1,300,000 gallons per acre per day. Therefore, whenever it may become necessary to interrupt the action of one of the filters for a short time, the filter remaining in action will not be dosed at a rate greater than twice the above rate.

The effluent from the sprinkling filters will pass to the finishing filter after dropping about 75 per cent. of its sediment in the small settling basin provided for the purpose, and when the system is working to its full capacity of 20,000 gallons per day, it will be applied to the finishing filter at the rate of 500,000 gallons per acre per day. The surface of the latter is divided into three approximately equal divisions, each of which is designed to deal, in rotation, with one-third of the daily flow.

The drains of the finishing filter deliver their effluent upon the surface of a field at a distance of at least 800 feet from the stream at the foot of the field, measured along the line of natural descent, that is to say, in a southeasterly direction from the disposal works.

Hoping that I have satisfied your inquiry, I am,

Very truly yours,

CHARLES McMILLAN."

SWEDESBORO.

At a meeting of the Commission held November 12, 1906, plans for the purification of the sewage from two of the three outlets of the system of the Swedesboro Sewer Company at Swedesboro were submitted to the Commission.

At a meeting of the Commission held January 28, 1907, the Secretary was directed to return to the Swedesboro Sewer Company the plans submitted by it for the purification of the sewage from its system, without the approval of the Commission, because the plans did not provide for the purification of the sewage from the entire system, and because in the judgment of the Commission the period of detention of the sewage in the septic tank as provided in the plans would be too long for the proper purification of the sewage. The Secretary was also directed to notify the Swedesboro Sewer Company that the Commission would require the prompt submission of proper plans for the disposal of the sewage from its system, and that the Commission would further require that within a reasonable time a disposal plant should be built.

At a meeting of the Commission held May 16, 1907, a communication was received from Charles E. Lippincott, president of the Swedesboro Sewer Company, stating that the company had completed plans for a sewage disposal plant, but that the conditions would require a change in the location of the plant, and that the company hoped to submit the matter to the Commission at a later date.

The Secretary was directed to notify the Swedesboro Sewer Company that unless plans for a disposal plant to purify the sewage being discharged from its sewerage system into Raccoon Creek at Swedesboro were submitted to the Commission at its meeting held at Jersey City on Thursday, June 6, 1907, it would request the Attorney General to institute proceedings for an injunction to restrain the discharge of the sewage from its system into Raccoon Creek.

At a meeting of the Commission held June 10, 1907, a communication was received from Charles E. Lippincott, president of the Swedesboro Sewer Company, acknowledging the receipt of the notice from the Commission that plans must be submitted, and explaining the reasons why the plans had not been submitted earlier, together with plans for the disposal of the sewage from the system of the company.

The Secretary was directed to employ an engineer to advise the Swedesboro Sewer Company in relation to the plans for the disposal of its sewage.

James Owen, C. E., of Newark, was engaged to advise the Swedesboro Sewer Company in relation to the disposal of its sewage.

At a meeting of the Commission held July 18, 1907, the following report was received from Mr. Owen in relation to the disposal of the sewage of the Swedesboro Sewer Company, and the Secretary was directed to return the plans submitted by the Swedesboro Sewer Company, for the purification of the sewage from its system, without the approval of the Commission, and to forward to the company a copy of the report made by Mr. Owen, and to notify the company that plans for the proper disposal of its sewage must be submitted to the Commission not later than September 1, 1907:

To the State Sewerage Commission of New Jersey:

GENTLEMEN—In accordance with your request I have made an examination of the sewerage system now in use in the Borough of Swedesboro, Gloucester County, and would report as follows:

Swedesboro has a population of 1,500 people, and is a purely residential town with a business center; there is a glass factory, but there is no special character in its discharge, except the oil and grease from the engine. Otherwise the effluent of the town is the ordinary domestic sewage.

There is a system of sewerage constructed by a private corporation, legally organized, with three discharges of the crude sewage into Raccoon Creek. The system has been built on extreme economical lines with shallow depths varying from three to six feet, very few manholes, and no attempt at purification. There is in all about three miles of pipe, and the major part of the Borough is fairly well accommodated.

There are 175 connections at present with the system, and there are about 220 more houses that can connect, but have not done so. There are about four hundred houses in the town, which leaves thirty houses still without provision for sewerage. Fifteen of these are practically in the center of the town, but cannot be accommodated by the present system, as the sewers now built are at too high an elevation; this is particularly noticeable at the corner of Grant and Second Streets.

The water supply is by a private corporation and every tap is metered, the consumption being estimated at about 50,000 gallons per day. The present discharge into the sewers is about 32,000 gallons per day. This rate of consumption may be expected to increase somewhat, and assuming 50 gallons per head with 1,500 population, the ultimate discharge will be 75,000 gallons per day. As the Borough increases slowly in population, a final estimate of 100,000 gallons will be all sufficient.

The company charges $5 per annum per house, giving an income of $625, which has paid a fair interest on the total expenditure which amounts to about $7,000. The maintenance account is low, the principal expenditure being due to stoppage in the pipes, as the pipes have to be dug up in such cases, due to the absence of manholes. I examined the three outlets and found, as stated, that crude sewage runs into Raccoon Creek. The first, from Mill Street, is from five houses. The flow is small and is hardly perceptible as it runs out of the pipe, which is six inches in diameter.

The second and most important, is on Main Street close to the bridge, and takes the large portion of the sewage discharge. The effluent is apparent by the odor and is within 100 feet of a dwelling house.

The third is from Broad Street, and only takes a small amount of sewage, but the volume of discharge is almost equal to Main Street, due to the percolation of underground water.

The pipe system is as follows:

	10-in.	8-in.	6-in.
Discharging at Mill Street No. 1..........			2,150
Discharging at Mill Street No. 2..........	1,700	1,800	7,997
Discharging at Broad Street No. 3..........		2,683	1,850
	1,700	4,483	11,997

The problem of handling the system and making it an up-to-date plant is somewhat difficult to determine with due regard to the adaptation of present conditions. It has grown from small inception for the accommodation of the few houses to its present status. The local citizens have put their money in, and have relieved the territory from cesspools and open discharges into the streams, and have realized a profit upon their investment.

The difficulty of the present situation is apparent when it is considered that quite a number of houses fronting on the sewer prefer not to pay rental and have their discharge into a small brook, which is of course illegal and a menace to the community. There seems to be no power to compel a connection except by positive action of the Board of Health, who so far seemingly have declined to act.

The result is that there are three conditions in effect. Cesspools, individual discharges into water courses, and the free discharge of the sewers into the creek, all of which is contrary to the law and seemingly should be eliminated. To do this effectively requires a comparatively large expenditure of money, and no probable increase of income; at the present time, the stockholders of the company, in view of their future obligation, talk seriously of abandoning their plant entirely rather than incur such an outlay. The detailed arrangement of the present plant for future requirement can be divided under two heads:

First: The treatment of the effluent so that no pollution can reach the creek.

Second: The readjustment of the present system for future requirements.

As to the treatment of the sewage itself, Mr. C. D. Lippincott, C. E., of Swedesboro, has submitted plans to your Commission for your consideration, and these plans provide for three separate plants, one for each effluent, and I am of opinion that if these plants were constructed as designed a proper and satisfactory effluent can be assured. The advisability of three plants, however, is open to grave consideration, both in first cost of construction and in subsequent maintenance. It is, therefore, proper to examine further into the question and see if these extra plants can be eliminated and the whole discharge treated at one point. Effluent Nos. 1 and 2 both discharge close to the built-up section of the Borough, and naturally grave objection will be made to a disposal plant at this point, and it would be advisable, if possible, to select a site removed from the present and future thickly inhabited district. Such a place can be found near Broad Street and Locke Avenue. It is remote from present development and no objection can be made as to its being near a settled district.

To accomplish this it will first be necessary to take the discharge of effluent No. 1 at Mill Street and insert a small gasolene plant and pump the sewage into the Main Street sewer. The Main Street flow can then be carried by a separate main through Church and Broad Streets to the point of discharge. The elevation at Church and Main Streets is 28.59 and at Broad and Locke Streets 21.50, giving seven foot fall in the surface itself, besides the twenty-one foot drop to tide water. Part of this main can be used for local service on Church Street and the present system can be tapped at convenient points. The length of this main will be about 3,000 feet and it can be used for every part of the Borough. The advantage of the one outlet is obvious, and the security from objection to the location of separate plants practically compels its construction, even though the first cost may be greater.

A disposal plant constructed at the locality mentioned, based on a flow of 100,000 gallons per day, with a septic tank of twenty-four hours' capacity and a single filter bed for three-hour discharges, as outlined in Mr. Lippincott's plans, would undoubtedly give an effluent entirely satisfactory to your Commission and also be within legal requirements.

As to the treatment of the present pipe system, it is hard to suggest any modification that would not be radical. As far as the system extends, it fills the requirements of the citizens, and is, therefore, satisfactory to them. Localities such as cited at Grant Avenue and Second Street will have to be treated independently, either by local pumping plants or separate mains, but seemingly there is no present demand for them.

The main point of consideration for your Commission at present is upon whom the suggestions for the elimination of the nuisance and improvement of the existing plant devolve. The present company has under consideration the purification of the effluent, but if to their minds the cost should be burdensome and they abandon the plant and let their ownership lapse, in whom would be vested the control of the whole system? The matter then assumes a legal aspect and the question of the authority of the Borough government, or whether each individual user is responsible, is not an engineering function. The sentiment of the inhabitants is seemingly now in favor of the present annual payment by the user rather than for municipal ownership, but, as has been noted, the incompleteness of the system as at present arranged bids fair in the future to compel radical changes, whether unanimously acceptable or not.

The company has under consideration propositions from private parties to construct a plant for the treatment of the discharge.

I would, therefore, suggest that a copy of this report be sent to the representative of the company, asking immediate compliance with the wishes of the Commission in removing the pollution of the creek, and suggesting that they take the necessary steps to prepare plans and submit propositions to achieve that end.

Yours respectfully,

JAMES OWEN."

Further action in relation to the Swedesboro Sewer Company was postponed at the request of John Boyd Avis, counsel to the company, in order that he might have an opportunity to examine into the facts and consult with the Commission in relation to the disposal of the sewage from the sewerage system of the company.

VENTNOR.

At a meeting of the Commission held June 27, 1907, Commissioner Herbert reported that he had inspected the sewerage system of the Ventnor Sewerage Company of the City of Ventnor, and found that the outlet of the sewerage system in Inside Thorofare had been laid to a sufficient depth to cover the same, and that there was no sign of nuisance.

During the year 1907 a considerable part of the proposed sewerage system of the Ventnor City Sewerage Company was constructed in accordance with the plans approved by the Commission. Some deviation from the plans in details were made, but these details are planned to be changed in conformity with the original plans when the system is extended as contemplated. The work was planned and is supervised by F. H. Snow, C. E., who reported as to progress made, to the Commission.

VINCENTTOWN.

At a meeting of the Commission held July 25, 1907, a communication was received from William T. Joyce, Clerk of the Township of Southampton, in Burlington County, requesting engineering advice in relation to the provision of sewerage facilities at Vincenttown.

The Secretary was directed to employ an engineer to consult with the authorities of the Township of Southampton in relation to the provision of sewerage facilities. James Owen, C. E., of Newark, was engaged for this work.

At a meeting of the Commission held August 15, 1907, a report of a proposed system of sewers for the Village of Vincenttown, together with a map, was received from Mr. Owen, and the Secretary was directed to forward a copy of the report and map to Mr. Joyce.

The report submitted by Mr. Owen is as follows:

"Newark, N. J., August 15, 1907.

To the State Sewerage Commission:

GENTLEMEN—In accordance with your request, I submit herewith a report of the sanitary conditions at Vincenttown, N. J., with suggestions as to the disposal of the sewage.

Vincenttown is a village with a population of about 800 people. It has no local government, but is a part of the Township of Southampton, which has a population of about 1,900, with no particular tendency to increase. There is a water supply in the village, furnished by a private corporation, and there are about 125 consumers who pay a flat rate, as there are no meters used. The consumption is estimated at 30,000 gallons per day. There are also about 100 wells in use, mostly for drinking water, and these wells are all shallow, varying from 12 to 15 feet in depth.

There is no system of sewerage in the village, most of the houses having cesspools, which are all built dry, allowing the sewage to percolate through the soil. About 16 houses have, however, a direct discharge into the two streams that flow through the village.

The condition of the village is, therefore, open to criticism on two points: First, the direct contamination of the streams; and, second, the pollution of the drinking water drawn from the wells.

After a careful examination of the whole territory, I find that there is no practical difficulty in installing a complete system of sewerage at a very reasonable outlay, the peculiarity being that inasmuch as there is no local government, the credit of the whole township will have to be pledged to raise the money for the improvement. This will naturally cause objections from the outlying districts, but when it is specifically understood that the total cost of the sewerage may be assessed on and paid for by the property owners particularly benefited, these objections may be overcome.

I herewith submit a map of Vincenttown showing a suggested system of piping with a proposed purification plant, consisting of a septic tank 50 feet by 20 feet and two sand filter beds each 100 by 50 feet. This I think will give the desired purity in the effluent.

The location of the disposal plant may be a matter for later consideration. Two places were examined, each available for the purpose, one more desirable as to distance from the center of population, but entailing more cost.

There will be in some cases deep trenching for the sewers to get the necessary grade, but only for short distances, so not much extra expense will be entailed.

The main outlet as shown on the map is on the right of way of an abandoned railroad and is especially available for the purpose.

The following is the estimate of the cost of the work:

Street.	10-in. pipe. Feet.	8-in. pipe. Feet.	Manholes.
Main Street	700	2,400	12
Pleasant Street		1,100	3
Bank Street		860	3
Zelly's Alley		400	2
Plum Street		760	2
Mill Street	500	750	4
Race Street	400	500	5
Red Lion Street		1,000	3
Main on old railroad	1,800		4
Totals	3,400	7,770	38

3,400 feet 10-in. sewer at $1.25	$4,250 00
7,770 feet 8-in. sewer at .80	6,216 00
38 manholes at $30	1,140 00
400 Y connections at $1	400 00
	$12,006 00

Septic tanks and filter beds	$8,000 00
	$20,006 00
Add 10 per cent	2,000 00
	$22,006 00

If the location of the disposal plant is in the more remote place the amount of $3,000 should be added to the above for the increase in the length of sewer and right of way.

Yours respectfully,

JAMES OWEN."

VINELAND.

At a meeting of the Commission held December 3, 1906, the Commissioner notified the authorities of the Borough of Vineland that it required the reconstruction of three of the filter beds in the Vineland disposal plant and the increasing of the depth of sand in one of the filter beds which had been constructed.

At a meeting of the Commission held December 17, 1906, a communication was received from H. C. Himes, Chairman of the Committee on Public Works of the Borough Council of Vineland, stating that the Council had instructed him to notify the Commission that it delayed action in complying with the requirements of the Commission because a new Mayor and Council would go into office on January 1, 1907, and also because the Council considered it would be better to await the final decision of the Court of Errors and Appeals in a suit for injunction brought against the borough by the State Board of Health before expending much money on the disposal plant, especially as the borough would find it a financial strain to rebuild the disposal beds; that the Council was trying to obtain the best results possible at the sewage disposal plant, and that it requested that the Commission would consider its present situation and communicate further with the new borough administration.

At a meeting of the Commission held January 14, 1907, a communication was received from E. L. Newcomb, director of the sewage disposal plant at Vineland, stating that the new administration of that borough desired to meet the requirements of the Commission in relation to the sewage disposal plant, but that it considered that the operation of the present plant would be more expensive and less satisfactory than the construction of a new plant at a place where the natural advantages were greater, and requesting the opinion of the Commission as to the advisability of a change.

The Secretary was directed to reply that the Commission would approve of any plans for the disposal of the sewage of Vineland which, in its opinion, would accomplish a purification sufficient in view of the location of Vineland in the watershed of the water supply of the City of Millville.

At a meeting of the Commission held February 11, 1907, the Secretary was directed to have chemical and bacteriological analyses made of samples taken from the sewage disposal plant at Vineland.

Reports of those analyses are printed in this report under the head of analyses, with the other work of this nature done during the year.

At a meeting of the Commission held February 21, 1907, a communication was received from E. L. Newcomb stating that the proposition to change the location of the Vineland sewage disposal plant would probably be submitted to the voters of that borough during the spring of 1907; that the new filter and the old filters were being used alternately; that he intended to divide the new filter into four sections as soon as the snow thawed in order to be able to clean one section while the others were working; that the filters had been kept active and free from ice; that copper sulphate had been used, and that the effluent, though not as good as during the fall, was such as would not injure the water supply of the City of Millville.

At a meeting of the Commission held April 1, 1907, a communication was received from E. L. Newcomb, inquiring whether there would be any objection to the discharge of waste dye water from a hosiery dye works into the Vineland sewerage system, and requesting that the Commission have an inspection made of a proposed site for the construction of a new sewage disposal plant for the Borough of Vineland.

The secretary was directed to request further information in respect to the nature of the dye wastes which it was proposed to discharge into the sewerage system of the Borough of Vineland, and to inform Mr. Newcomb that the Commission would have an inspection made of any site proposed for the construction of a new sewage disposal plant.

At a meeting of the Commission held April 22, 1907, a communication was received from E. L. Newcomb, stating that the hosiery dye factory which was to be started at Vineland proposed to discharge wastes from the use of direct colors only into the sewerage system of the borough, and reporting that the new filter bed of the disposal plant had been divided into four parts, which were used alternately.

The Secretary was directed to reply that waste liquors from a dye factory using only direct colors would probably have no effect on the sewage disposal plant.

At a meeting of the Commission held June 10, 1907, a communication was received from Mr. Newcomb, reporting that examinations of the effluent of the Vineland disposal plant showed better results than heretofore; that sand was being added to the sand filter, and that as soon as this had been accomplished, the work of constructing a new sand filter would be started.

At a meeting of the Commission held August 29, 1907, a communication was received from Mr. Newcomb enclosing copies of monthly reports on the working of the sewage disposal plant at Vineland made by him to the Mayor and Council of that borough.

The following report on the condition of the sewage disposal plant at Vineland was submitted to the Commission by Edwin L. Newcomb, director of the plant, under date of December 4, 1907:

"The Vineland sewage disposal plant consists, as was described in last year's report, of eleven beds, covering an area of about five acres. Of these, three are not underdrained and are used as settling basins or septic tanks for the crude sewage; their capacity is about 500,000 gallons each; it has not been necessary to clean them for the past two years; an average reduction of 75 per cent. of the total suspended solids is effected by their operation. Six of the remaining beds are underdrained with porous drain tile and very few cinders; the filtering material is the natural soil, which in no case runs over 50 per cent. of sand suitable for filtration. These six beds have been in operation as slow sand filters since the construction of the plant and are now practically useless as such, silt having collected and been worked in to such an extent; they are used at present, however, as sedimentation or bacteria beds. The two remaining beds are clear sand filters, one constructed during the fall of 1906 and the other this fall (1907).

The first sand filter was built with a depth of only 15 inches, of white sand which seemed to be insufficient, and hence an additional 5 inches was placed upon the surface this past spring. The filter has also been divided into four separate parts by means of plank partitions and embankments, which has facilitated very much its operation, making it possible to use one or two quarters while the others are being scraped and the silt removed. This filter has an area of about one-half acre or one-eighth acre per quarter, and will filter 100,000 gallons per quarter in from 24 to 48 hours, according to the amount of silt collected. The bacterial reduction brought about by the filter varies somewhat with climatic conditions and length of operation. The last test (December 1, 1907) showed a reduction of total number of organisms of 98.6 per cent., and of bacillus coli (as determined by the Litmus Lactose Agar Plate Method) 99.4 per cent. No copper sulphate has been used with the sand filter, except at certain times to eradicate or prevent the development of various forms of algae which seemed to retard filtration or produce objectionable odors.

The method of operating for the past year and at present is briefly as follows: The crude sewage is first run into the septic or settling basins, where it remains for a period of 12 hours. The clarified sewage is then run into the bacteria or sedimentation beds, where it is allowed to stand for two or three days. As much as possible is then filtered through the sand filters, and the remaining portion is treated with copper sulphate and filtered through two of the old beds which are kept cultivated up rather loosely. The average daily flow of sewage for the past year has been about 250,000 gallons.

The sand filter which has been built this fall is supplied with two 8-inch porous tile underdrains and 4-inch porous tile laterals every ten feet. These are covered with coarse cinders, 4 inches of coarse red sand and 20 inches of white filtering sand of a fine degree of uniformity. A plank division has been constructed through the center, which divides the filter into two equal parts, so that they may be used as desired. The filter has not yet been put into commission, but will be used this winter.

During the past year, Mr. Beckwith, of the United States Department of Agriculture, has carried on a number of bacteriological tests in connection with the Vineland plant, in which he has shown a very high degree of purification in the old filters with copper sulphate. With the new sand filters, however, little reduction of total organisms was shown, without doubt due to the fact that the samples were taken immediately after the filter was put into operation. Frequent later tests, however, have shown a reduction of 96 to 99 per cent. of total organisms with this filter."

WASHINGTON.

At a meeting of the Commission held September 24, 1906, the Commission notified the Borough of Washington to cease polluting the waters of Shattecong Creek prior to the first day of October, 1907.

At a meeting of the Commission held December 31, 1906, a communication was received from Dr. Charles B. Smith, Mayor of the Borough of Washington, stating that a sewerage committee had been appointed by him, which was considering what action should be taken by the borough.

At a meeting of the Commission held May 16, 1907, a communication was received from Alexander Anderson, of Washington, stating that action was being taken by the borough in relation to the disposal of sewage.

At a meeting of the Commission held June 10, 1907, Commissioner Jacobson reported that he had visited the Borough of Washington and had consulted with the borough authorities in relation to the sewage of that borough on May 25, 1907, and that the authorities were taking steps to prepare plans a disposal plant.

At a meeting of the Commission held September 5, 1907, Commissioner Capstick reported that an informal application had been made to him by the authorities of the Borough of Washington for an extension of time in which to cease polluting the Shattecong Creek to April 1, 1908.

The Secretary was directed to suggest to the authorities of the Borough of Washington that when a formal application in writing for an extension of time were submitted to the Commission, it would take action upon the same.

At a meeting of the Commission held September 12, 1907, a request for an extension of the time in which the Borough of Washington must cease to pollute the waters of Shattecong Creek, was received from J. D. Groff, Secretary of the Sewerage Committee of that borough.

The Secretary was directed to notify the authorities of the borough that the Commission would take no action for the enforcement of its notice to cease polluting Shattecong Creek until April 1, 1908, upon the statement made by the authorities of the borough that the matter would be attended to.

WATER WITCH.

At a meeting of the Commission held October 24, 1907, W. McDougall, President of the Water Witch Club, and Lyman A. Ford, C. E., consulted with the Commission in relation to the disposal of sewage from the property of the club at Water Witch.

The Secretary was directed to employ an engineer to make a report to the Commission as to the best method of disposing the sewage from the property of the club. G. E. Hill, C. E., was employed for this purpose.

At a meeting of the commission held October 31, 1907, a report as to the disposal of sewage from the property of the Water Witch Club was received from G. E. Hill.

The Secretary was directed to suggest to the club that plans be prepared providing for the treatment of the sewage from its property by septic tank and some secondary treatment, and that the effluent be discharged at least two hundred feet from shore but not near the main channel.

The report made by Mr. Hill is as follows:

October 31st, 1907.

To the Honorable, the State Sewerage Commission of New Jersey:

GENTLEMEN—A few days ago you transmitted to me a small map of Water Witch, New Jersey, a letter containing certain physical and social statistics of the community, a sketch plan showing a septic tank for treatment of sewage, and you instructed me to examine the local conditions and their relation to sewage disposal. I beg to return these papers and to submit the following report:

Water Witch is a residential park of about fifty-five acres, located high on the virgin soil of the Navesink Highlands, underlaid, even at the highest point, with beach sand. The settlement contains thirty-seven residences, one Club House, capable of entertaining about a dozen guests, and a Casino used only for social purposes. Its population in summer ranges from two hundred and fifty to three hundred. In winter it is practically deserted. All land is restricted, and no development is probable save along the lines now laid down.

That the community enjoys exceptional sanitary advantages cannot be questioned. Its natural drainage is superb; its soil is unpolluted by cesspools; its water supply is beyond suspicion. It has never had a case of enteric fever which could be charged against local conditions.

The Park itself lies above Navesink Avenue, which parallels the shore line of the Lower Bay (approximately) at a distance of about fifteen hundred feet. The roads within the Park are owned by the Park residents. Below Navesink Avenue the land is controlled by the Highlands of Navesink Improvement Company, whose interests are closely allied to those of the Park Association (Water Witch Club). But few houses have been built in this tract, but the site is an advantageous one and early development is very probable. Water Witch Drive, which passes through this section and leads to the railroad station, is a Township Road.

The railroad skirts the lower edge of the high land. Northeast of it lies a flat sandy area, covering about forty acres, part of it salt-meadow, traversed by a small winding tide-water drainage channel, which empties into a canal dug as a harbor for small boats. At the eastern end of the tract a bulkhead has been built, and filling of the space behind this has begun. A few camps are pitched upon this property in the summer season.

The shore is very shoal. For a distance of seven-eighths of a mile toward the hook of Spermaceti Cove the depth at low water does not exceed three feet, save in a few pockets. (Of these pockets, which have no outlet, one is the "Channel C" mentioned in the enclosed letter. Its maximum depth at low water is 7.5 feet). The normal tidal rise is 4.6 feet. The "main channel," which is the outlet of the Shrewsbury and Navesink Rivers, lies about one-third of a mile to the east. The bottom of the bay, opposite Water Witch, is sand, hard and fairly clean. The shore is used as a bathing beach. A little to the north the bottom is sticky mud.

There are no cultivated oyster beds in the vicinity of Water Witch. The nearest lie in the Shrewsbury and Navesink Rivers. Northwest there is none nearer than Keyport. A few natural (untransplanted) oysters are dredged between, but the quantity is very small. Many clams, however, are dug from the flats bordering the shore.

The Park is completely sewered, on the strictly separate system. Three 8-inch sub-mains converge at Navesink Avenue and Water Witch Drive, and a single pipe (supposedly 10-inch) leads thence, down the Township Road, under the railroad, to an outlet in the small tide-water drainage channel close by the railroad station. The sewers above Navesink Avenue seem reasonably tight; but some ground-water enters the main below this point, and the flow at the outlet, when the Park is without inhabitants save a few caretakers, is roughly estimated at 20,000 gallons per day,—not a very serious amount.

The brook, at the outlet of the pipe, shows some small accumulation of toilet paper and other telltale solids, but its condition is not offensive. The boat canal, into which the stream empties, shows no visible fouling.

The water supply of the Park comes from artesian wells and is somewhat impregnated with iron. Consumers are charged a flat rate, and the records of pumpage indicate a daily consumption of perhaps 125 to 150 gallons per head, including carriage-washing, lawn-sprinkling and other uses which do not add to the burden of the sewers. It is probably safe to assume, as a basis of estimate, a daily sewage flow of 100 gallons per head. The water-service ceases at the end of the season, and those who remain throughout the year depend in the winter upon cistern-water.

Realizing that the present method of disposing of the sewage is subject to grave criticism, the Water Witch Club has proposed the introduction of a septic tank, for the clarification of the sewage from the Park only, and has asked for definite instructions concerning the discharge of the effluent

(a) Into the ditch which serves as the present outlet;

(b) Into the pocket of deeper water indicated as "Channel C;" or

(c) Into the "main channel."

The points to be considered in determining the degree of purification to be attained are:

(1) The fouling of the shores and silting of the bathing beach with sewage deposits.

(2) The danger of infection of bathers by the swallowing of sewage-polluted water.

(3) The possibility of the transfer of disease-germs by sewage-infected oysters, clams or crabs.

The first of these evils can be prevented by the use of a well-designed and well-operated septic tank. The second and the third cannot be entirely eliminated without some secondary treatment of the sewage.

Fortunately, such secondary treatment will not be difficult. Land and fall are abundant, sand and gravel can be had for the taking, and small filters, which will reduce the bacterial contents of the effluent to a point of safety, can be installed and operated at an expense far from prohibitive.

As an alternative, sterilization of the septic effluent is possible; but because of the fact that the efficiency of this method depends upon the purchase, shipment and hauling of chemicals and upon unswerving fidelity on the part of the man entrusted with their use, and especially in view of the fact that effective filters, almost automatic in action, can be easily installed, I do not advise its adoption in this case.

I recommend, therefore, for Water Witch, the installation of:

(a) A septic tank, carefully designed with a view to suitable detention, sludge storage space, velocity, colonizing area, cleaning facilities, etc., etc. In view of the probable early development of the tract northeast of Navesink Avenue, I advise that the tank be located near the railroad station, rather than at the point indicated on the plan submitted by the owners.

(b) High rate sand-fillers, coarse and deep, fed intermittently. It will facilitate the operation of these sand-filters, and minimize the labor expended, if the sewage, before entering, be passed through small roughing filters of gravel, coke or broken stone, to remove the gelatinous and albuminous matters which otherwise make the care of sand-filters burdensome.

Respectfully submitted,
G. EVERETT HILL.

WENONAH.

At a meeting of the Commission held October 15, 1906, the Secretary was directed to notify Stephen Greene, of Wenonah, to show cause at a meeting of the Commission to be held October 22, 1906, why he should not be notified to cease polluting the waters of Mantua Creek.

At a meeting of the Commission held October 22, 1906, William C. Cattell, Engineer for Stephen Greene, submitted plans of two purification plants at Wenonah, one at Mantua avenue and one at Princeton avenue, and stated that the same should have been submitted to the Commission, but that the matter had been neglected, and that complete plans of the two systems would be submitted to the Commission for its approval.

At a meeting of the Commission held March 4, 1907, a further plan of filtering beds for the purification of the sewage from the sewers at Mantua and Princeton avenues in Wenonah were submitted to the Commission by William C. Cattell, C. E., on behalf of Stephen Greene.

The Secretary was directed to suggest the submission of a map showing the exact location of the sewerage systems in Mantua and Princeton avenues in Wenonah.

At a meeting of the Commission held April 1, 1907, further plans showing the location of the proposed sewage disposal plants at Wenonah, plans of which had been submitted to the Commission by William C. Cattell, C. E., on behalf of Stephen Greene, were received and filed.

At the same meeting the plans submitted by Stephen Greene providing for two sewage disposal plants at Wenonah to care respectively for the sewage now being discharged from the sewers laid in Mantua avenue and Princeton avenue, providing for the treatment of the sewage by septic tanks, coke filters and sand filters, the effluent to discharge into Mantua Creek were approved, subject to such conditions of construction, operation and purification as this Commission may from time to time require.

WEST CAPE MAY.

At a meeting of the Commission held March 18, 1907, a communication was received from Samuel F. Eldridge, of Cape May, in reference to plans for sewers for the Borough of West Cape May.

The Secretary was directed to suggest to Mr. Eldridge that a representative of the Borough of West Cape May attend a meeting of the Commission and consult with it in relation to the sewerage of that borough.

At a meeting of the Commission held March 25, 1907, S. F. Eldridge, Attorney of the Borough of West Cape May, consulted with the Commission in relation to the proposed sewerage system for that borough. The Commission informed Mr. Eldridge that it would not approve of the discharge of crude sewage into Cape Island Creek, but that it would approve of the discharge of a purified effluent into Cape Island Creek, or the discharge of the sewage from the borough into the main outlet of the sewerage system of the City of Cape May.

WEST COLLINGSWOOD.

At a meeting of the Commission held April 8, 1907, plans for a system of sewers for part of the Borough of Collingswood, together with a copy of an ordinance pending before the Borough Council of Collingswood, consenting to the construction of the sewers, were submitted to the Commission by H. A. Drake, Attorney for the West Collingswood Sewerage Company.

The Secretary was directed to acknowledge the receipt of the communication, and to inform Mr. Drake that the Commission could not pass on the plans submitted because they did not provide for the disposal of the sewage from the system; that in case a separate disposal plant were adopted, plans should be submitted to the Commission for its approval; that in case it was proposed to connect the sewerage system with the present plant of the Collingswood Sewerage Company, the Commission would not approve of such connection unless the Collingswood plant were enlarged and placed in a condition satisfactory to the Commission, for the reason that that plant was not able or in condition to care for the sewage now being delivered to it.

WESTFIELD.

At a meeting of the Commission held May 6, 1907, a communication was received from A. W. Vars, Town Surveyor of Westfield, stating that a change in the place of discharge of the effluent from the sewage disposal plant at Westfield was proposed for the benefit of the Consumers Aqueduct Company, which is constructing a reservoir for a water supply on Robinson's Branch of the Rahway River, inquiring whether such a change would require the approval of the Commission.

The Secretary was directed to reply that plans showing the work to be done should be submitted to the Commission.

At a meeting of the Commission held June 10, 1907, plans for a change of the outlet of the sewage disposal plant of the Town of Westfield to a point on Robinson's Branch of the Rahway River near the Madison Hill road, together with a certified copy of a resolution of the Town Council directing the submission of the plans to the Commission for its approval, were submitted to the Commission by A. W. Vars, Town Surveyor of Westfield.

At the same meeting the plans submitted by the Town of Westfield were approved, subject to such conditions of construction, operation and purification as this Commission may from time to time require.

At a meeting of the Commission held June 20, 1907, further plans for the proposed change of outlet in the Westfield sewage disposal plant were received from A. W. Vars.

At a meeting of the Commission held July 11, 1907, a communication was received from F. V. Dobbins, City Attorney of Rahway, inquiring what action had been taken by the Commission in relation to the proposed change of the place of discharge of the effluent from the Westfield sewage disposal plant, and the Secretary was directed to reply.

At a meeting of the Commission held August 29, 1907, a communication was received from Charles H. Lambert, Secretary of the Board of Health of the City of Rahway, notifying the Commission that that board protested against the action of the Town of Westfield in carrying the effluent from the sewage disposal plant to a point on Robinson's Branch near the City of Rahway, which action had been approved by the Commission.

WILDWOOD CREST.

At a meeting of the Commission held February 21, 1907, plans for a sewerage system for Wildwood Crest, part of the Township of Lower, in the County of Cape May, providing for the direct discharge of sewage at two outlets into Beach Thorofare, were submitted to the Commission by L. M. Rice, C. E., of Wildwood, on behalf of the Wildwood Crest Company.

The Secretary was directed to request L. M. Rice to be present at a meeting of the Commission for the purpose of explaining the plans of the sewerage system at Wildwood Crest.

At a meeting of the Commission held March 11, 1907, L. H. Rice, Engineer of the Wildwood Crest Company, consulted with the Commission in relation to the plans submitted by him on behalf of that company, providing for a sewerage system in part of the Township of Lower in Cape May County, next south of the Borough of Holly Beach, with two outlets to discharge directly into Beach Thorofare.

At the same meeting the following resolution was adopted:

"*Resolved,* That the plans submitted by the Wildwood Crest Company, providing for a sewerage system for part of the Township of Lower in the County of Cape May, consisting of the southerly section of Five Mile Beach, below the Borough of Holly Beach, said sewers to discharge through two outlets into Beach Thorofare, without purification, be approved, subject to such conditions of construction, operation and purification as this Commission may from time to time require; and with the further provision that when in the judgment of the Commission it becomes necessary to prevent the pollution of Beach Thorofare, such purification plant shall be installed as this Commission shall then approve."

WOODBURY.

At a meeting of the Commission held December 3, 1906, the secretary was directed to suggest to the authorities of the City of Woodbury that the tidal tank at the outlet of the sewerage system of Woodbury be reconstructed for use as a septic tank.

At a meeting of the Commission held April 8, 1907, the secretary was directed to employ an engineer for the purpose of reporting as to what changes would be necessary to convert the tidal tank of the Woodbury sewerage system into a septic tank.

Joseph P. McLean, C. E., of Jersey City, was employed for this purpose.

At a meeting of the Commission held April 22, 1907, a report of an examination of the tidal tank of the sewerage system of the City of Woodbury, and the changes necessary to convert the tank into a septic tank, was received from Joseph P. McLean, C. E.

The secretary was directed to transmit a copy of this report to the authorities of the City of Woodbury, and to notify them that the Commission required the alteration of the tidal tank at the outlet of the sewerage system of Woodbury into a septic tank, and to adopt the recommendations made in said report for that purpose.

At a meeting of the Commission held May 16, 1907, a communication was received from John E. Estell, City Clerk of Woodbury, stating that he had been directed by the Council of the City of Woodbury to inform the Commission that it had instructed its sewer committee to prepare plans for altering the tidal tank of the city sewerage system into a septic tank in accordance with the recommendations of the Commission.

The report submitted by Mr. McLean is as follows:

April 10, 1907.

To the Honorable, The State Sewerage Commission of New Jersey:

GENTESMEN—On April 9, 1907, an examination was made by me of the tidal tank at the outlet of the sewerage system of the City of Woodbury, on Woodbury creek.

The tank is built of reinforced concrete and is divided longitudinally into two chambers by a partition wall of similar construction, sufficiently strong to sustain the lateral pressure when one chamber is empty. The chambers are each eighty feet long, forty feet wide and six and one-half feet deep, and are of similar construction.

The inlet is a twenty-inch main sewer, with a valve chamber set into the tank at one end of the partition wall, so that the flow may be turned into either chamber, or both. The inlet is at the top of the tank, a manhole in the roof giving access to the valves.

A small chamber is set in to the tank at the other end of the partition wall for the control of the outlet. This has a small shed built over it, with a roof higher than the top of the tank. An eighteen-inch pipe runs from the bottom of each chamber where an automatic device was installed to empty the tank when the tide was high. This did not work, and the discharge is now accomplished by hand. From the outlet chamber, an eighteen-inch pipe discharges into Woodbury Creek above meantide level. The outlet pipe is protected from ice by a wooden guard.

The daily flow of sewage was approximately 150,000 gallons. This does not quite fill one chamber in 25 hours. On each alternate ebb tide the chamber in use is emptied by hand. Every 12 days the routine is varied by emptying on two consecutive tides so that night emptying is obviated. Each tank is used for about a month and then cleaned. Only a small amount of sludge remains to be flushed out.

The sewage, being retained for a period of 25 hours and then discharged in bulk, is putrescent and offensive. It discolors the stream for the time of discharge, about forty minutes.

The discharge of the sewage in bulk with the putrescent solids is a nuisance. It can be easily remedied at comparatively little expense. The present tank is of good construction and well adapted for use as a septic tank. By this change, a non-putrescent clarified sewage would be discharged into the stream at the rate of a hundred gallons per minute. The continuous discharge would permit the carrying of some sewage up-stream, which is not the case at present, but it would be clarified and diluted to an extent which would render it unobjectionable.

The present flow of sewage is such that one of the two chambers would be ample for its care. The only changes necessary would be such as would diffuse the current within the tank at the inlet and the outlet. This could easily be accomplished by the installation of two submerged perforated pipes, one for the inlet and one for the outlet.

At the inlet end this could be accomplished by carrying the sewage down and across the tank by a twelve-inch pipe with six four-inch circular perforations spaced three feet apart in the horizontal section of the pipe. The pipe would be supported by brick piers at a height of three feet above the floor of the tank and would be about twenty feet long, the perforations being on the under side to prevent accumulation of sludge in the pipe. Two ninety degree elbow joints would be necessary to connect it with the present inlet. A swing valve set at an angle of about twenty degrees from the perpendicular against the flow on the end of this pipe would allow of uninterrupted flow in case the perforations should become obstructed, or if the amount of sewage entering the tank should be greatly augmented. This valve would also provide easy access to the pipe for cleaning, should necessity arise.

At the outlet end of the tank, the diffusion of current could be accomplished by installing a twelve-inch outlet pipe laid horizontally across the end of the chamber at a height of thirty inches from the floor, supported by brick piers and bent upward at the present outlet chamber, the bottom of the pipe to be sixty inches above the floor of the tank at the highest point, and then turned down and laid to a point below low water in Woodbury creek. This pipe should be carried about thirty feet across the tank and should have twelve two-inch perforations spaced thirty inches apart along its horizontal section, and drawing horizontally from the tank.

This installation would change the chamber into a septic tank forty by eighty feet with a working depth of five feet. Its capacity would be approximately one hundred and twenty thousand gallons. Allowing for sludge storage, the working capacity would be little more than one hundred thousand gallons, or about eighteen hours flow of sewage. This would be ample capacity for some time to come until the flow of sewage was much greater when the other chamber could easily be altered for similar use. The combined capacity of the two chambers would probably be ample for the next half century.

In case of necessity of further purification, there is ample fall for the further treatment of the sewage, but at present and for some time to come it is probable that the clarification of the sewage by passing it through a septic tank would be sufficient treatment for that locality.

I respectfully recommend that the changes outlined in this report be made in the present tank at Woodbury.

Respectfully submitted,
JOSEPH P. McLEAN.

WOOD-LYNNE.

At a meeting of the Commission held December 31, 1906, Commissioners Jacobson and Herbert were appointed a committee to make investigations in relation to the sewerage system of the Borough of Wood-lynne, which had been constructed without the approval of the Commission.

At a meeting of the Commission held January 7, 1907, this committee reported that it had examined the place of discharge of the sewerage system of the Borough of Wood-lynne, which had been constructed without the approval of the Commission, and that in the judgment of the committee, the discharge was injurious and created a nuisance; that it recommended that the Commission should require the purification of the sewage from Wood-lynne.

At the same meeting, the following resolution was adopted:

"*Resolved,* That this Commission notify the Borough of Wood-lynne that it must at once submit plans providing for the purification of the sewage discharged from its system into Newton Creek."

At a meeting of the Commission held June 27, 1907, no reply having been received from the Borough of Wood-lynne, the secretary was directed to request the Attorney General to take such legal steps as might be necessary to secure a compliance with section 6 of chapter 72 of the laws of 1900 by the Borough of Wood-lynne.

This suit was commenced by the Attorney General and is now pending in the Court of Chancery.

A record of the individual cases of pollution of streams acted upon by the Commission during the year is annexed hereto as an appendix.

Respectfully submitted,

BOYD MAC LEAN,

Secretary.

Appendix.

Appendix.

The following is a list of cases of pollution of streams by individuals or corporations, which were inspected by the Commission during the past fiscal year, showing the nature and approximate location of the pollution and the action taken by the Commission, and the report of re-inspection, if any. The numbers used in this list are those under which the cases are filed in the office of the Commission, the first number in each case being used to indicate the stream polluted, and the second number the individual case on that stream.

The course of procedure of the Commission in these cases was to send an inspector along the streams to be inspected to observe and report every source of pollution which could be discovered. These reports were received by the Commission, and notices sent to the parties reported to be polluting to show cause why they should not be notified to cease polluting the stream. In those cases where it seemed proper to the Commission, notices were served upon the parties in accordance with the statute to cease polluting the stream.

Re-inspections were made where necessary, and every effort made to secure a compliance with the orders of the Commission. In most of the cases, it was found that the parties were ready and willing to take the proper sanitary steps when the matter had been explained to them.

In those cases where notices to cease polluting were served, notices to show cause were first sent.

RARITAN RIVER.

1-1. Privy draining into the South Branch near Flemington Junction; notified to cease polluting; re-inspection showed that the privy had been removed and that the premises were in good condition.

1-2. Factory wastes discharged into the South Branch near Hamden; notified to cease polluting; re-inspection showed that the notice had been partially complied with, but that the action was not satisfactory.

1-3a. Privy on Cakepaulin Creek at Pittstown; notified to cease polluting.

1-3b. Creamery wastes discharged into the South Branch at Jutland.

1-3c. Privies polluting Mulhockaway Creek at Pattenburg; notified to cease polluting.

1-3d. Creamery wastes polluting the South Branch at Flemington.

1-4. Creamery wastes polluting Cakepaulin Creek at Pittstown.

1-5. Kitchen wastes and refuse polluting Cakepaulin Creek at Pittstown; notified to cease polluting; reply received from owner that pollution had been stopped.

1-6. Sewer from hotel polluting the South Branch at Pittstown; notified to cease polluting. When attempt was made to serve notice, it appeared that the ownership of the property had been changed. Notice served on new owner.

1-7. Refuse from mill dumped into the South Branch at Clinton; notified to cease polluting; report received that dumping had been discontinued.

1-8. Creamery wastes polluting the South Branch at Clinton.

1-9. Sewer from hotel polluting the South Branch at Clinton; notified to cease polluting; re-inspected; arrangements being made to connect with cesspool.

1-10a. Privy polluting the South Branch at Clinton; notified to cease polluting; re-inspected; privy removed and premises in good condition.

1-10b. Washings from barnyard polluting the South Branch; notice served.

1-11. Sewer and barnyard drainage polluting Beaver Brook at Clinton; notified to cease polluting.

1-12. Sewer polluting Beaver Brook at Clinton; notified to cease polluting; re-inspected; nothing done.

1-13. Two privies polluting the South Branch at Clinton; notified to cease polluting; property sold; new owner notified to cease polluting; re-inspected; cesspools constructed with concrete walls; premises in good condition.

1-14. Two privies polluting the South Branch at Clinton; notified to cease polluting; re-inspected; privies removed; cesspools constructed with concrete walls.

1-15. Privy and refuse polluting the South Branch at Flemington; notified to cease polluting; reply received that notice would be complied with; re-inspected; work had been ordered, but it had not been possible to obtain mechanics.

1-16. Privy and refuse polluting the South Branch at Clinton; notified to cease polluting; re-inspection; nothing done.

1-17. Privy, refuse and slaughter house wastes polluting the South Branch at Clinton; notified to cease polluting; re-inspected; cesspool constructed preventing pollution from refuse and privy; nothing done as to slaughter house wastes; re-inspected as to slaughter house; property cleaned up each day after slaughtering; to prevent pollution requires changes in slaughtering plant; extension of time requested.

1-18. Privy polluting the South Branch at Clinton; notified to cease polluting; re-inspected; privy removed and property in good condition.

1-19. Refuse and barnyard wastes polluting the South Branch at Clinton; notified to cease polluting; reply received that notice would be complied with; re-inspected; refuse removed and property in good condition.

1-20. Refuse and manure polluting the South Branch at Clinton; notified to cease polluting; reply received that notice would be complied with; re-inspected; refuse removed and property in good condition.

1-21. Privy and sink drain polluting the South Branch at Clinton; notified to cease polluting; reply received that notice would be complied with; re-inspected; privy and drain removed; cesspool constructed with concrete wall; property in good condition.

1-22. Privies, drains, factory wastes and sewers polluting the South Branch at High Birdge; notified to cease polluting; re-inspected; changes being made as rapidly as possible to comply with notice.

1-23. Sewer from hotel polluting the South Branch at High Bridge; notified to cease polluting; re-inspected; sewer removed and cesspool installed; premises in good condition.

1-24. Sewer polluting the South Branch at High Bridge; notified to cease polluting; re-inspected; cesspool installed and premises in good condition.

1-25. Sewer polluting the South Branch at Glen Gardner; notified to cease polluting; re-inspected; cesspool installed and premises in good condition.

1-26. Two sewers from hotel polluting the South Branch at Glen Gardner; notified to cease polluting; reply received that pollution would be stopped; re-inspected; nothing done.

1-27. Sewer polluting the South Branch at Glen Gardner; notified to cease polluting; reply received that pollution would be stopped; re-inspected; premises in good condition.

1-28. Creamery wastes polluting the South Branch near Califon; no action taken.

1-29. Refuse polluting the South Branch at Califon; notified to cease polluting; reply received that pollution would be stopped; re-inspected; premises in good condition.

1-30. Refuse polluting the South Branch at Califon; notified to cease polluting; re-inspected; premises in good condition.

1-31. Privy and refuse polluting the South Branch at Califon; notified to cease polluting; re-inspected; course of stream near privy changed to prevent drainage into stream; concrete wall constructed along the stream to protect it from pollution; premises in good condition.

1-32. Refuse from privy polluting the South Branch at Califon; notified to cease polluting; re-inspected; cesspool constructed; privy removed; premises in good condition.

1-33. Creamery wastes polluting the South Branch at Califon; notified to show cause; no further action taken.

1-34. Refuse polluting the South Branch at Califon; notified to cease polluting; re-inspected; premises in good condition.

1-35. Abattoir wastes polluting the South Branch at Califon; notified to cease polluting; re-inspected; nothing done.

1-36. Tenant of above property (1-35) notified to cease polluting re-inspected; nothing done; tenant stated that owner had been notified and had done nothing.

1-37. Sewer polluting the South Branch near Flemington Junction; notified to cease polluting; re-inspected; nothing done.

1-38. Sewer from hotel polluting the South Branch at Clinton; notified to cease polluting; property sold and new owner notified to cease polluting.

1-40. Privy polluting Mulhockaway Creek at Pattenburg; notified to cease polluting; re-inspected; premises in good condition.

1-41. Privy polluting Mulhockaway Creek at Pattenburg; notified to cease polluting; re-inspected; cesspool had been built to prevent pollution.

1-42. Privy polluting Mulhockaway Creek; notified to cease polluting; re-inspected; new cesspool being constructed; second re-inspection showed premises in good condition.

1-43. Sewer from hotel and wastes from acetylene gas plant polluting Mulhockaway Creek at Pattenburg; notified to cease polluting; re-inspected; cesspool installed and premises in good condition.

1-44. Privy polluting Mulhockaway Creek at Pattenburg; notified to cease polluting; re-inspected; privy removed and premises in good condition.

1-45. Drainage from slaughter house polluting the South Branch at Clinton; notified to cease polluting; re-inspected; premises in good condition.

1-46. Sewer polluting the South Branch at High Bridge; notified to cease polluting; re-inspected; cesspool constructed and premises in good condition.

1-47. Refuse from slaughter house polluting the South Branch at High Bridge; notified to cease polluting; notice was not served because party had sold premises and removed; re-inspected; premises not being used.

1-48. Privy polluting the South Branch at German Valley; notified to cease polluting; reply received that notice would be complied with.

1-49. Two privies polluting the South Branch at German Valley; notified to cease polluting; re-inspected; cesspool constructed, and premises in good condition.

1-50. Privy polluting the South Branch at German Valley; notified to cease polluting; re-inspected; premises in good condition.

1-51. Slaughter house wastes polluting the South Branch at German Valley; notified to cease polluting; reply received that pollution would be stopped; re-inspected; premises in good condition.

1-52. Privy and hog pen polluting the South Branch at German Valley; notified to cease polluting; re-inspected; premises in good condition.

1-53. Privy polluting the South Branch at German Valley; owner and tenant notified to cease polluting; report received from owner that notice had been complied with; re-inspected; premises in good condition.

1-54. Creamery wastes polluting the South Branch at Middle Valley; notified to show cause; no further action taken.

1-55. Creamery wastes polluting the South Branch at Nanwright; notified to show cause; no further action taken.

1-56. Creamery wastes polluting the South Branch at Flanders; notified to show cause; no further action taken.

1-57. Creamery wastes polluting the South Branch at Flanders; notified to show cause; no further action taken.

1-58. Refuse from hog and cow yards polluting South Branch at Flanders; notified to cease polluting.

1-59. Sewer polluting the South Branch at Flemington; notified to cease polluting; re-inspected; connection being made with Flemington sewerage system.

1-60. Refuse from foundry polluting the South Branch at Flemington; notified to cease polluting; re-inspected; dumping of refuse in stream had been stopped; party promised to clean up the bed of the stream.

1-61. Sewer polluting the South Branch at Flemington; notified to cease polluting; reply received that town sewers would be connected with; re-inspected; nothing done; party stated that work had been ordered.

1-62. Gas wastes polluting the South Branch at Flemington; notified to cease polluting; reply received that new plant was being constructed; re-inspected; new plant was in operation; no pollution from new plant.

1-63. Open sewer polluting the South Branch at Three Bridges; notified to cease polluting; re-inspected; cesspool installed and premises in good condition.

1-64. Drain polluting the South Branch at Three Bridges; notified to cease polluting; re-inspected; cesspool constructed; premises in good condition.

1-65. Sewer polluting the South Branch at Three Bridges; notified to cease polluting; re-inspected; no changes made; but party stated that nothing of a polluting nature was being thrown into the drain.

1-66. Sewer polluting the South Branch at German Valley; notified to cease polluting; re-inspected; cesspool installed; premises in good condition.

1-67. Sewer polluting the South Branch at Flemington; re-inspection showed that this sewer came from property owned by another party, who was notified to cease polluting.

1-69. Wastes from acetylene gas plant polluting the South Branch at Three Bridges; notified to cease polluting; re-inspected; cesspool constructed; premises in good condition.

1-70. Wastes from fertilizer mill polluting the Neshanic River at Copper Hill; notified to cease polluting; re-inspected; premises in good condition.

1-71a. Creamery wastes polluting the South Branch at Reaville; notified to show cause; no further action taken.

1-71b. Creamery wastes polluting the South Branch at Montgomery; notified to show cause; no further action taken.

1-71c. Creamery wastes polluting the South Branch at South Branch Village; notified to show cause; no further action taken.

1-71d. Creamery wastes polluting the South Branch at Flemington; notified to show cause; no further action taken.

1-74. Drain and privy polluting the South Branch at Neshanic; notified to cease polluting; re-inspected; cesspool installed; premises in good condition.

1-75. Privy polluting the South Branch at Neshanic; owner and lessee both notified to cease polluting; re-inspected; cesspool installed; premises in good condition.

1-76. Privy and drain polluting the South Branch at South Branch village; notified to cease polluting; re-inspected; cesspool installed; premises in good condition.

1-77. Privy and refuse polluting the South Branch at South Branch village; notified to cease polluting; re-inspected; cesspool constructed; premises in good condition.

1-78. Sewer polluting the South Branch near Raritan; notified to cease polluting; re-inspection; nothing done; instructions requested.

1-79. Refuse and sewer polluting the South Branch at South Branch village; notified to cease polluting; re-inspected; drain removed; cesspool constructed; premises in good condition.

1-80. Refuse from livery stable and drain polluting the South Branch near Raritan; notified to cease polluting; re-inspected; nothing done.

1-82. Sewer polluting the Neshanic River near Flemington; notified to cease polluting; re-inspected; nothing done.

1-83. Privy polluting the South Branch near Centreville; notified to cease polluting.

1-84. Privy polluting the North Branch at North Branch Depot; notified to cease polluting; re-inspected; premises in good condition.

1-85. Creamery wastes and privy polluting the North Branch at North Branch Depot; notified to cease polluting; re-inspected; nothing done.

1-86. Sewer polluting the South Branch at Middle Valley; reply received that pollution would be stopped.

1-87. Sewer polluting the North Branch at North Branch Depot; notified to cease polluting; re-inspected; premises unoccupied; party had removed.

1-88. Sewer polluting the North Branch at North Branch Depot; notified to cease polluting.

1-89. Sewer polluting the North Branch at North Branch Depot; notified to cease polluting; plans for double cesspool submitted and approved.

1-90. Creamery wastes polluting the North Branch at Lebanon; notified to show cause; no further action taken.

1-91. Refuse and drainage from cow yard polluting Rockaway Creek at Whitehouse Station; owner and lessee notified to cease polluting; re-inspected; laborers were engaged in making changes to prevent pollution.

1-92. Privy polluting the North Branch at Pluckamin; notified to cease polluting.

1-93. Creamery wastes polluting the North Branch at Whitehouse Station; notified to show cause; no further action taken.

1-94. Sewer and factory wastes polluting Chambers Brook at Pluckamin; notified to cease polluting; plans submitted and approved for a filtration plant; re-inspected; plant being installed.

1-95. Sewer polluting the North Branch at Pluckamin; notified to cease polluting; reply received that the premises were vacant, and provision would be made for the polluting matter before the premises were re-opened.

1-96. Refuse and sink drainage polluting the North Branch at Bedminster; notified to cease polluting.

1-97. Sewer polluting the North Branch at Far Hills; notified to show cause; reply received that sewers were used for storm drain only; re-inspected; report verified.

1-98. Sewer polluting Mine Brook at Bernardsville; notified to cease polluting; reply received that sewage was purified; re-inspected; report that purification was satisfactory; analysis made, showing little, if any, pollution.

1-99. Sewer polluting Mine Brook at Bernardsville; notified to cease polluting; re-inspected; cesspool constructed; premises in good condition.

1-100. Refuse from hog yard polluting the North Branch at Peapack; notified to cease polluting.

1-101. Kitchen drain and refuse polluting Peapack Brook at Gladstone; notified to cease polluting.

1-102. Sewer polluting Mine Brook at Bernardsville; notified to cease polluting; re-inspected, and advice given as to the disposal of the sewage; reply received that the advice would be followed.

1-103. Drain from factory at Kenville discharging into the Black River; inspection showed no pollution.

1-104a. Refuse from shoddy mill near Milldale polluting the Black River; notified to cease polluting; reply received that the matter would be attended to.

1-104b. Privies at Milldale polluting the Black River; notified to cease polluting; reply received that notice would be complied with.

1-104c. Privies at Hacklebarney polluting the Black River; notified to cease polluting; reply received that notice would be complied with.

1-105. Refuse from farm yard polluting Rockaway Creek near Lebanon; amount of polluting small; no action taken.

1-106. Refuse polluting Black River at Milldale; amount of pollution small; no action taken.

1-107. Privy polluting Lamington River at Pottersville; notified to cease polluting.

1-108. Privy polluting Bound Brook near Bound Brook; notified to cease polluting.

1-109. Sewer polluting Green Brook near Bound Brook; notified to cease polluting.

1-110. Sewer polluting Green Brook near Bound Brook; notified to cease polluting.

1-111. Kitchen drain polluting Green Brook near Bound Brook; notified to cease polluting.

1-112. Sewer polluting Green Brook at Dunellen; notified to cease polluting.

1-113. Refuse polluting Green Brook near Dunellen; notified to cease polluting.

1-120. Refuse from factory polluting Green Brook at Scotch Plains; amount of pollution small; reply received that pollution would be prevented; no action taken.

1-121. Factory wastes at Scotch Plains polluting Green Brook; notified to cease polluting.

1-122. Sink drain polluting Bound Brook near Bound Brook; notified to cease polluting.

1-123. Sink drain polluting Bound Brook near Bound Brook; notified to cease polluting.

1-124. Sink drain polluting Bound Brook near Bound Brook; notified to cease polluting.

1-125. Drain from stable polluting Vossler Brook at Bound Brook; notified to cease polluting.

1-126. Sewer polluting Vossler Brook at Bound Brook; notified to cease polluting.

1-127. Privy polluting Vossler Brook at Bound Brook; notified to cease polluting.

1-128. Sewer polluting Middle Brook near Bound Brook; notified to cease polluting.

1-129. Kitchen drain to Middle Brook near Bound Brook; property closed and parties removed.

1-130. Refuse from factory polluting the Raritan River at Bound Brook; factory closed; company out of the business; no action taken.

1-131. Sewer polluting the Raritan River at Somerville; notified to cease polluting.

1-132. Sewer polluting the Raritan River at Somerville; notified to cease polluting.

1-133. Sewer polluting the Raritan River near Raritan; case held pending action for the prevention of pollution by the Towns of Raritan and Somerville.

1-134. Sewer polluting the Raritan River at Raritan; case held pending action for the prevention of pollution by the Towns of Raritan and Somerville.

1-135. Sewer polluting the Raritan River at Raritan; case held pending action for the prevention of pollution by the Towns of Raritan and Somerville.

1-136. Sewer polluting the Raritan River near Raritan; case held pending action for the prevention of pollution by the Towns of Raritan and Somerville.

1-137. Sewer polluting the Raritan River near Raritan; case held pending action for the prevention of pollution by the Towns of Raritan and Somerville.

1-138. Sewer to Raritan River at Raritan; case held pending action for the prevention of pollution by the Towns of Raritan and Somerville.

1-139. Sewer and refuse polluting the Raritan River at Raritan; case held pending action for the prevention of pollution by the Towns of Raritan and Somerville.

1-140. Dye wastes and sewer to Raritan River at Raritan; case held pending action for the prevention of pollution by the Towns of Raritan and Somerville.

1-141. Sewer and mill wastes polluting the Raritan River at Raritan; case held pending action for the prevention of pollution by the Towns of Raritan and Somerville.

1-142. Sewer polluting the Raritan River at Raritan; case held pending action for the prevention of pollution by the Towns of Raritan and Somerville.

1-143. Sewer polluting the Raritan River at Raritan; case held pending action for the prevention of pollution by the Towns of Raritan and Somerville.

1-144. Refuse polluting the Raritan River at Raritan; case held pending action for the prevention of pollution by the Towns of Raritan and Somerville.

1-145. Sewer polluting the Raritan River between Raritan and Somerville; case held pending action for the prevention of pollution by the Towns of Raritan and Somerville.

1-146. Sewer polluting the Raritan River at Finderne; notified to cease polluting.

1-147. Sewer and creamery wastes polluting the Raritan River at Finderne; notified to cease polluting.

1-148. Sewer and factory wastes polluting the Raritan River at Bound Brook; case held pending action for the prevention of pollution by the Towns of Raritan and Somerville.

1-149. Sewer polluting the Raritan River at Bound Brook; case held pending action for the prevention of pollution by the Towns of Raritan and Somerville.

1-150. Refuse polluting the Raritan River at Bound Brook; refuse removed; re-inspected; premises in good condition.

1-151. Sewer polluting the Raritan River at Bound Brook; case held pending action for the prevention of pollution by the Towns of Raritan and Somerville.

1-152. Sewer polluting the Raritan River at Bound Brook; case held pending action for the prevention of pollution by the Towns of Raritan and Somerville.

1-153. Sewer polluting the Raritan River at Bound Brook; case held pending action for the prevention of pollution by the Towns of Raritan and Somerville.

1-154. Sewer polluting the Raritan River at Bound Brook; case held pending action for the prevention of pollution by the Towns of Raritan and Somerville.

1-155. Sewer polluting the Raritan River at Bound Brook; case held pending action for the prevention of pollution by the Towns of Raritan and Somerville.

1-156. Sewer polluting the Raritan River at Bound Brook; case held pending action for the prevention of pollution by the Towns of Raritan and Somerville.

1-157. Wastes from gas plant polluting Peters Brook at Somerville; plant not operated.

1-158. Sewer polluting creek to Raritan River at Somerville; notified to cease polluting.

1-159. Sewer polluting creek to Raritan River at Somerville; notified to cease polluting.

1-160. Privy polluting the South Branch at South Branch; notified to cease polluting.

1-161. Sewer polluting the South Branch at Flemington; notified to cease polluting.

1-162. Kitchen drain polluting the South Branch at Flemington; notified to cease polluting.

1-163. Kitchen drain polluting the South Branch at Three Bridges; notified to cease polluting.

1-164. Kitchen drain polluting the South Branch at Three Bridges; notified to cease polluting.

1-165. Kitchen drain polluting the South Branch at Three Bridges; notified to cease polluting.

1-166. Kitchen drain polluting the South Branch at Three Bridges; notified to cease polluting.

1-167. Kitchen drain polluting the South Branch at Three Bridges; notified to cease polluting.

1-168. Kitchen drain polluting the South Branch at Three Bridges; notified to cease polluting.

1-169. Slaughter house wastes polluting Mulhockaway Creek at Pattenburg; notified to cease polluting.

1-170. Kitchen drain polluting Mulhockaway Creek at Pattenburg; notified to cease polluting.

1-171. Refuse polluting Mulhockaway Creek at Pattenburg; notified to cease polluting.

1-172. Kitchen drain and privy polluting Mulhockaway Creek at Pattenburg; notified to cease polluting.

1-173. Privy polluting Mulhockaway Creek at Pattenburg; notified to cease polluting.

1-174. Kitchen drain polluting the South Branch at Clinton; notified to cease polluting.

1-176. Kitchen drain polluting the South Branch at Clinton; notified to cease polluting.

1-177. Sewer polluting the South Branch at Clinton; notified to cease polluting.

1-178. Kitchen drain polluting the South Branch at Clinton; notified to cease polluting.

1-180. Sewer to creek to South Branch at Glen Gardner; notified to cease polluting.

1-181. Sewer polluting the South Branch at Flemington; notified to cease polluting; re-inspected; nothing done; party stated that cesspool would be constructed as soon as possible.

1-182. Sewer polluting Spruce Run at Glen Gardner; notified to cease polluting.

1-183. Kitchen drain polluting Spruce Run at Glen Gardner; notified to cease polluting.

1-184. Kitchen drain polluting Spruce Run at Glen Gardner; notified to cease polluting.

1-185. Barnyard refuse polluting Spruce Run at Glen Gardner; notified to cease polluting.

1-186. Sewer polluting the South Branch at Califon; cesspool was being installed; no action taken.

1-187. Kitchen drain and privy polluting the South Branch at German Valley; notified to cease polluting.

1-188. Refuse from barnyard polluting the South Branch at German Valley; amount of pollution small; no action taken.

1-189. Two kitchen drains polluting Peters Brook at Somerville; notified to cease polluting.

1-190. Sewer polluting Peters Brook at Somerville; notified to cease polluting.

1-191. Sewer polluting Peters Brook at Somerville; notified to cease polluting.

1-192. Overflow from cesspool polluting Peters Brook at Somerville; notified to cease polluting.

1-193. Sewer polluting Peters Brook near Somerville; notified to cease polluting.

1-194. Kitchen drain polluting creek to Raritan River at Bound Brook; notified to cease polluting.

1-195. Overflow from cesspool polluting the Raritan River near Bound Brook; reply received that the overflow would be taken out; property sold and new owner in possession; re-inspected; nothing done.

1-196. Kitchen drain polluting Mine Brook at Bernardsville; notified to cease polluting.

1-197. Refuse polluting Mine Brook at Bernardsville; notified to cease polluting.

1-198. Sewage leakage from cesspool polluting Mine Brook at Bernardsville; notified to cease polluting.

1-199. Sewer polluting Mine Brook at Pluckamin; notified to cease polluting.

1-200. Sewer polluting the South Branch at Three Bridges; notified to cease polluting; re-inspected; nothing done; party stated that nothing of a polluting nature was being discharged into the stream from the sewer; alterations were required to prevent future possible pollution; party promised to make alterations as soon as possible.

1-201. Privy and refuse polluting Mulhockaway Creek at Pattenburg; notified to cease polluting; re-inspected; nothing done.

1-202. Kitchen drain polluting Mulhockaway Creek at Pattenburg; notified to cease polluting; re-inspected; cesspool being constructed.

1-203. Sewer polluting the South Branch near Flemington Junction; notified to cease polluting; plans for purification of sewage submitted and returned without approval of the Commission; reply received that new plans were being prepared.

1-204. Sewer polluting the North Branch at Gladstone; notified to cease polluting.

1-205. Refuse polluting the North Branch at Gladstone; notified to cease polluting.

1-206. Refuse polluting the North Branch at Gladstone; notified to cease polluting.

1-207. Refuse polluting Middle Brook at Martinsville; notified to cease polluting; reply received that notice would be complied with.

1-208. Sewer polluting Middle Brook near Martinsville; notified to cease polluting; reply received that notice would be complied with.

1-209. Sewer from private residences at High Bridge; plans for the disposal of sewage submitted and approved.

The following cases were reported by the inspector too near the end of the fiscal year for action in the time covered by this report:

1-210. Sink drain polluting Ambrose Brook.

1-211. Sewer polluting South Branch at Flemington.

1-212. Overflow from cesspool polluting Raritan River near Bound Brook.

1-213. Sewer polluting canal near South Bound Brook.

1-214. Sewer polluting canal near South Bound Brook.

1-215. Sewer polluting Raritan river near Bound Brook.

1-216. Sewer polluting canal near South Bound Brook.

1-217. Privy polluting river at Landing Bridge.

1-218. Sink drain polluting Raritan River near Bound Brook.

1-219. Sink drain polluting South Branch at Three Bridges.

1-220. Sewer polluting Bound Brook at Newmarket.

1-221. Sewer polluting Bound Brook at Newmarket.

1-222. Sink drain polluting Bound Brook at Newmarket.

1-223. Sink drain polluting Bound Brook at Newmarket.

1-224. Sewer polluting Bound Brook at South Plainfield.

1-225. Sewer polluting Neshanic River at Neshanic.

1-226. Sink drain polluting Neshanic River at Neshanic.

1-227. Refuse and drainage from barnyard polluting the Neshanic River at Neshanic.

1-228. Sewer polluting Bergen Brook near Belle Mead.

1-229. Sewer polluting Millstone River near Weston.

1-230. Sewer polluting Bergen Brook near Belle Mead.

1-231. Overflow from cesspool polluting Royce Brook near Hamilton.

1-232. Sink drain polluting Royce Brook near Weston.

1-233. Sink drain polluting Bedens Brook near Belle Mead.

1-234. Sink drain polluting Millstone River near Belle Mead.

1-235. Sink drain polluting Bedens Brook near Griggstown.

1-236. Overflow from cesspool and sink drain polluting Rock Brook at Skillman.

1-237. Cesspool polluting Rock Brook at Skillman.

1-238. Sewer polluting Bedens Brook at Belle Mead.

1-239. Overflow from cesspool polluting Millstone River and Stony Brook at Pennington.

1-240. Sewer and refuse from slaughter house polluting Stony Brook at Pennington.

1-241. Sewer polluting Millstone River at Griggstown.

1-242. Overflow from cesspool polluting Stony Brook at Pennington.

1-243. Sewer polluting Millstone River at Weston.

1-244. Sewer polluting Millstone River at Weston.

RAHWAY RIVER.

2-1. Factory wastes discharged into the Rahway River at Springfield; nothing harmful found in the waste water; no action taken.

2-2. Refuse polluting the Rahway River at Milburn; notified to cease polluting.

2-3. Sewer polluting the Rahway River at Milburn; notified to cease polluting.

2-4. Drain discharging into the Rahway River at Milburn; inspection showed no pollution.

2-5. Factory at Milburn; inspection showed no pollution.

2-6. Refuse polluting the Rahway River at Maplewood; amount of pollution small; no action taken.

2-7. Factory at Maplewood; inspection showed no pollution.

2-8. Kitchen drain polluting the Rahway River at South Orange; notified to cease polluting.

2-9. Refuse polluting the Rahway River at South Orange; amount of pollution small; no action taken.

2-10. Refuse polluting the Rahway River at South Orange; notified to cease polluting.

2-11. Refuse polluting the Rahway River at South Orange; notified to cease polluting.

2-12. Wastes from factory at Orange polluting the Rahway River; notified to cease polluting.

2-13. Wastes from factory at Orange polluting the Rahway River; notified to cease polluting.

2-14. Wastes from factory at Orange polluting the Rahway River; notified to cease polluting.

2-15. Wastes from factory at Orange polluting the Rahway River; notified to cease polluting.

2-16. Wastes from factory at Orange polluting the Rahway River; notified to cease polluting.

2-17. Refuse polluting the Rahway River at West Orange; amount small; no action taken.

2-18. Privy polluting the Rahway River at Orange; pollution stopped; no action taken.

2-19. Sewer polluting the Rahway River at West Orange, notified to cease polluting.

2-20. Sewer polluting the Rahway River at Orange; notified to cease polluting.

2-21. Kitchen drain polluting creek to the Rahway River at Short Hills; reply received that pollution would be stopped; no action taken.

2-22. Storm drain polluting the Rahway River at Orange owned by the City of Orange; notified to cease polluting.

2-25. Factory wastes running into swamp at Kenilworth no pollution reported running into the Rahway River; notified to show cause; reply received that care was taken to prevent pollution; no action taken.

2-26 to 2-38. Properties inspected on Rahway River and no pollution reported.

SHARK RIVER.

3-1 to 3-9. Sewers and privies reported polluting the Shark River near Belmar. Notices to show cause were sent in these cases, but no final action taken.

MANASQUAN RIVER.

4-1 to 4-23. Sewers, overflows from cesspools and kitchen drains reported to be polluting the Manasquan River near Brielle. Notices to show cause were sent in these cases and hearings held, but no final action was taken.

DEAL LAKE.

5-1 to 5-5. Refuse and sewers reported to be polluting Deal Lake. Notices to show cause were sent in these cases and hearings held, but no final action was taken.

SHREWSBURY RIVER.

6-1 to 6-154. Sewers, overflows from cesspools, kitchen drains, refuse, gas wastes and factory wastes reported to be polluting the Shrewsbury River, covering the entire shore line of the river. Notices to show cause were sent in these cases and hearings held, but no final action was taken.

SALEM CREEK.

27-1. Creamery wastes polluting Salem Creek at Woodstown; notified to cease polluting; re-inspected; nothing done.

27-2. Sewer polluting Salem Creek at Woodstown; notified to show cause; connection made with sewerage system.

27-3. Sewer polluting Salem Creek at Woodstown; notified to show cause; notified to cease polluting; reply received that sewer would be connected with the sewerage system.

27-4. Sewer polluting Salem Creek at Woodstown; notified to cease polluting; reply received that connection would be made with sewerage system as soon as sewers were laid to property.

27-5. Creamery wastes polluting Salem Creek at Woodstown; notified to cease polluting; reply received that alterations would be made to prevent pollution.

27-6. Sewer polluting Salem Creek at Woodstown; notified to show cause; connection made with sewerage system.

27-8. Sewage running over surface and polluting Salem Creek at Woodstown; notified to cease polluting; re-inspected; nothing done.

27-9. Sewer polluting Salem Creek at Woodstown; notified to cease polluting; re-inspected; nothing done.

27-10. Notified to cease polluting; re-inspected; nothing done.

27-11. Sewer polluting Salem Creek at Woodstown; notified to show cause; connection made with sewerage system.

27-12. Sewer polluting Salem Creek at Woodstown; notified to cease polluting; re-inspected; nothing done.

27-13. Sewer polluting Salem Creek at Woodstown; notified to show cause; connection made with sewerage system.

27-14. Notified to cease polluting; re-inspected; nothing done.

27-15. Sewer polluting Salem Creek at Woodstown; notified to cease polluting; reply received that connection would be made with sewerage system.

27-16. Sewer polluting Salem Creek at Woodstown; notified to cease polluting; connection made with sewerage system.

27-17. Sewer polluting Salem Creek at Woodstown; notified to cease polluting; reply received that only storm drainage ran to creek.

27-19. Sewer polluting Salem Creek at Woodstown; notified to cease polluting; re-inspected; nothing done.

27-20. Sewer polluting Salem Creek at Woodstown; notified to cease polluting; reply received that notice would be complied with.

27-21. Sewer polluting Salem Creek at Woodstown; notified to show cause; connection made with sewerage system.

27-22. Sewer polluting Salem Creek at Woodstown; notified to show cause; connection made with sewerage system.

27-23. Sewer polluting Salem Creek at Woodstown; notified to show cause; connection made with sewerage system.

27-24. Sewer polluting Salem Creek at Woodstown; notified to show cause; connection made with sewerage system.

27-25. Sewer polluting Salem Creek at Woodstown; notified to show cause; connection made with sewerage system.

27-26. Sewer polluting Salem Creek at Woodstown; notified to show cause; connection made with sewerage system.

27-27. Wastes from canning factory polluting Salem Creek at Woodstown; notified to cease polluting.

27-28. Wastes from canning factory polluting Salem Creek at Woodstown, notified to cease polluting.

27-29. Sewer polluting Salem Creek at Woodstown; notified to show cause; connection made with sewerage system.

27-30. Sewer polluting Salem Creek at Woodstown; notified to show cause; connection made with sewerage system.

27-31. Sewer polluting Salem Creek at Woodstown; notified to show cause; connection made with sewerage system.

27-32. Sewer polluting Salem Creek at Woodstown; notified to show cause; connection made with sewerage system.

27-33. Sewer polluting Salem Creek at Woodstown; notified to show cause; connection made with sewerage system.

27-34. Sewer polluting Salem Creek at Woodstown; notified to show cause; connection made with sewerage system.

HAYNES CREEK.

56-1 to 56-24. Sewers discharging into main sewer leading to double cesspools near Haynes Creek at Medford. Cesspools were out of order and the sewage flowed into and polluted Haynes Creek. Notices to show cause were sent. The cesspools were thereupon placed in proper condition and the pollution stopped.

56-25. Privies polluting Haynes Creek at Medford; notified to cease polluting; reply received that notice would be complied with.

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