

1904

Reports of the Water Committee of the Citizens' League of Bangor, Maine

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REPORTS
OF THE
Water Committee
OF THE
Citizens' League
BANGOR



Bangor, Me. Citizens' League.

THESE REPORTS have appeared
from time to time in the Bangor
Daily Commercial. At the last
meeting of the Citizens' League it
was voted to collect these reports
and publish them in pamphlet form.

FIRST REPORT.

The Typhoid Epidemic of 1904.

The undersigned, members of a committee, "appointed to investigate the water supply and report what, if any bearing it has on the typhoid epidemic now prevailing in this city, and any other facts of interest," submit the following report:

The first duty with which your committee is charged is to get at the facts of the present epidemic as accurately as possible. The board of health having no record of cases, our only source of first-hand information is the physicians, who know, if anybody knows. Accordingly, the chairman of your committee has personally asked every physician in the city to report his cases of typhoid since March 1st, giving the street and number of each case. In making this request the physicians were asked to give only cases they were absolutely sure of as typhoid, and in reporting a given number of cases the statement was added, in most instances, that they had several more cases not yet surely defined.

We wish here to say that we are under obligations to the physicians for their courtesy, all having cheerfully complied with our request except two, who refused.

THE MAP.

As each case was reported by street and number it was plotted on a map of the city by a spot. Each spot on the map represents a case of typhoid since March 1st. Five hundred and forty (540) certified cases are thus indicated on the map. This number does not include one report received since the last case was plotted,

nor the cases of the two physicians who declined to report, nor the new cases of others, since they reported, so that this number, five hundred and forty (540) is certainly a conservative statement of the number of cases from March 1 to the present time (May 24), personally reported by the physicians of the city, and is, we believe, less than the actual number of cases during that time. Our report does not include hospital typhoids from outside of Bangor. All these five hundred and forty (540) cases on the map developed in this city.

It should, of course, be understood that the spots on this map do not represent the number of typhoid cases at any single date. They do represent as accurately as practicable the extent of this epidemic of typhoid between March 1 (about the time it began) and up to May 21, when the last reported case was plotted.

SOME FACTS ON THIS MAP.

Attention is called to some interesting features of this map:

(1). Whole number of cases are within one and one-quarter ($1\frac{1}{4}$) miles of the postoffice. The four or five exceptions are explained on our map.

(2). There is only one spot in the entire Stillwater avenue region, east of Forest avenue, including Stillwater park. Two members of your committee have personally visited this neighborhood. They find no sewers and no domestic water service in this part of the city.

Is it not a striking fact, in itself conclusive, that in a neighborhood where many people live under the most unfavorable sanitary conditions in the city but who are not supplied with river water, we are unable to find more than a single case of typhoid? (and that of a child who had attended the Palm street school).

(3). As to the Hancock street region:

In the Commercial of April 30, the health officer of the city is reported as saying that "there are but few cases of the disease in Ward 1. On Hancock street and the cross streets in that vicinity, there are but very few, if any cases. In this part of the town, city water is used almost exclusively."

To disprove this statement which has passed from mouth to mouth uncontradicted, it is only necessary to glance at the map

where eighty-six (86) spots may be counted in Ward 1, and this probably does not include all the typhoid cases in that ward since March 1st.

A casual glance at our map shows that the cases in this epidemic are pretty generally distributed over the city; the map looks as if the spots had been spattered with a brush almost at random. There is hardly a street in the city that has not had its typhoid case or cases since March 1st.

So much for the extent of this epidemic. We may get some further facts which have a bearing on it by taking groups of people as they are gathered in institutions.

At first our attention is directed to our

PUBLIC SCHOOLS.

Through the courtesy of Supt. Tilton, all the teachers of the city schools reported on May 9th the names and addresses of every child in school who has had typhoid fever during the current school year and has returned, and also each pupil out of school with typhoid at the present time.

Following is the report by schools in detail:

Name of School.	Returned.	Out Now.	Total
Crosbyville		1	1
Valentine	2	4	6
Abbott Square	3	3	6
High	4	6	10
Pearl	2	2	4
Cottage St.	2	2	4
Elm St.,		8	8
Pond St.	2	4	6
Forest Ave.		4	4
Union Sq.	5	11	16
Center St.	10	13	23
Bower St.	1	10	11
Larkin St.	1	6	7
State St.	4	4	8
Palm St.	13	26	39
Unknown	5	2	7
	—	—	—
	54	106	160

making a total of one hundred and sixty (160) pupils of our public schools who have had typhoid fever during this school year.

SUBURBAN SCHOOLS.

A comparison with the suburban schools is suggestive:

Two members of your committee visited nine of the suburban schools on May 23d. The teachers kindly gave us the following facts:

School.	No. Pupils.	Cases of Typhoid during this spring.
Mt. Hope	12	None
Stillwater	26	..
Bagley	24	..
Central	30	I
Fuller	13	..
Avenue	27	..
No. Bangor	21	..
Sherburne	30	..
Odlin	14	..
	—	—
Total	197	I

making a total of nine (9) schools where there are one hundred and ninety-seven (197) children with a single case of typhoid, and in that case it should be added the teacher told us the child had just previously been visiting, where, in drinking infected water, the disease was obtained, in the opinion of the attending physician.

In the case of the other 196 children, of course, it is understood that they live in the suburban districts beyond the city water supply limits, and drink well water.

In answer to our inquiries of the suburban teachers we did not learn of a typhoid case in the families of their districts.

INSANE HOSPITAL.

The drinking water of the hospital is obtained from an artesian well. The last two weeks of September last the pumps of this well got out of order and river water was taken through the pipes and used for all domestic purposes. On October 9th and 10th, following, three men in the hospital were taken with typhoid and between October 10th-13th, one woman. These are the only cases among the inmates of the hospital in the three years since its opening. The artesian pump was promptly repaired and the use of artesian water resumed. There have been no cases since.

There are none now. There were three hundred and twenty-seven (327) patients in 1903.

Where could a slice of three hundred (300) be cut out of the population of this city today in which you will not find a single case of typhoid since January 1st?

THE JAIL.

About seventy (70) prisoners are in the county jail. On the 24th, 25th and 27th of April three cases of typhoid were taken to the hospital. Up to that time the river water had been used. Some time afterward spring water was supplied by the advice of the attending physician. There have been no more cases since.

THE EASTERN MAINE GENERAL HOSPITAL.

Out of forty-two (42) typhoid cases in the general hospital at one time in this present month it was found on careful inquiry that forty-one (41) had been drinking river water.

NEIGHBORING TOWNS.

Your committee has letters of recent date from the physicians and officials of boards of health of Old Town, Orono, Hampden, Brewer, Orrington, Bucksport, Ellsworth and Bar Harbor. These signed letters make clear three facts:

1. That there is practically no typhoid today in towns along the Penobscot which do not use the river water for their water supply, viz: Orono, Hampden, Orrington and Bucksport. In these four towns one typhoid case only was reported at that time.
2. That, on the other hand, places whose water supply is the river, Old Town and Brewer, have typhoid epidemics. Seventy-five (75) cases at that time were reported from Old Town.
3. It is the invariable testimony of leading physicians in towns in the neighborhood of, or along the line of travel from Bangor and Brewer, viz: Orrington, Bucksport, Ellsworth and Bar Harbor, that a large proportion of cases of typhoid they have had in the past have been traced directly to Bangor and Brewer.

CONCLUSION.

In conclusion your committee wishes to say that to the best of its knowledge and belief the above facts have been obtained at

first hand and are here conservatively stated. These facts reveal a grave condition. Our map shows that ONE PERSON IN ABOUT EVERY FORTY (40) OF THE PEOPLE OF BANGOR HAS HAD TYPHOID FEVER SINCE THE FIRST DAY OF LAST MARCH.

Reports with the city clerk show that January 1, there have been thirty-three (33) deaths from typhoid. (It has not been the custom in Bangor to report typhoid cases officially until they are dead). Medical authorities reckon 15 or 20 cases for every fatal one. This rate comes close to our figures.

Your committee disclaim any intention to create needless alarm. As citizens and parents, as well as members of this committee, we have no other aim than to get at the facts. We believe that for anybody to pervert or to suppress facts which vitally concern the public health and safety is to assume a grave responsibility.

In the absence of expert testimony furnished the public through the water board or otherwise, we can rely only upon evidence of this sort which is circumstantial evidence. We give it herewith over our signatures. The map which goes with this report speaks for itself; and knowing as we do that the great source of typhoid is infected water, and taking account of the facts in the large which show that the only possible source of infection which is COMMON TO ALL THESE FAMILIES where typhoid is found is the river water used for all other domestic purposes even when not used to drink, the conclusion is inevitable that something is the matter with our water supply.

We do not state that in our opinion every case of typhoid in Bangor can be traced to a single source, but it is our deliberate conclusion in which we severally and unanimously unite that the main cause of the present epidemic of typhoid is the river water.

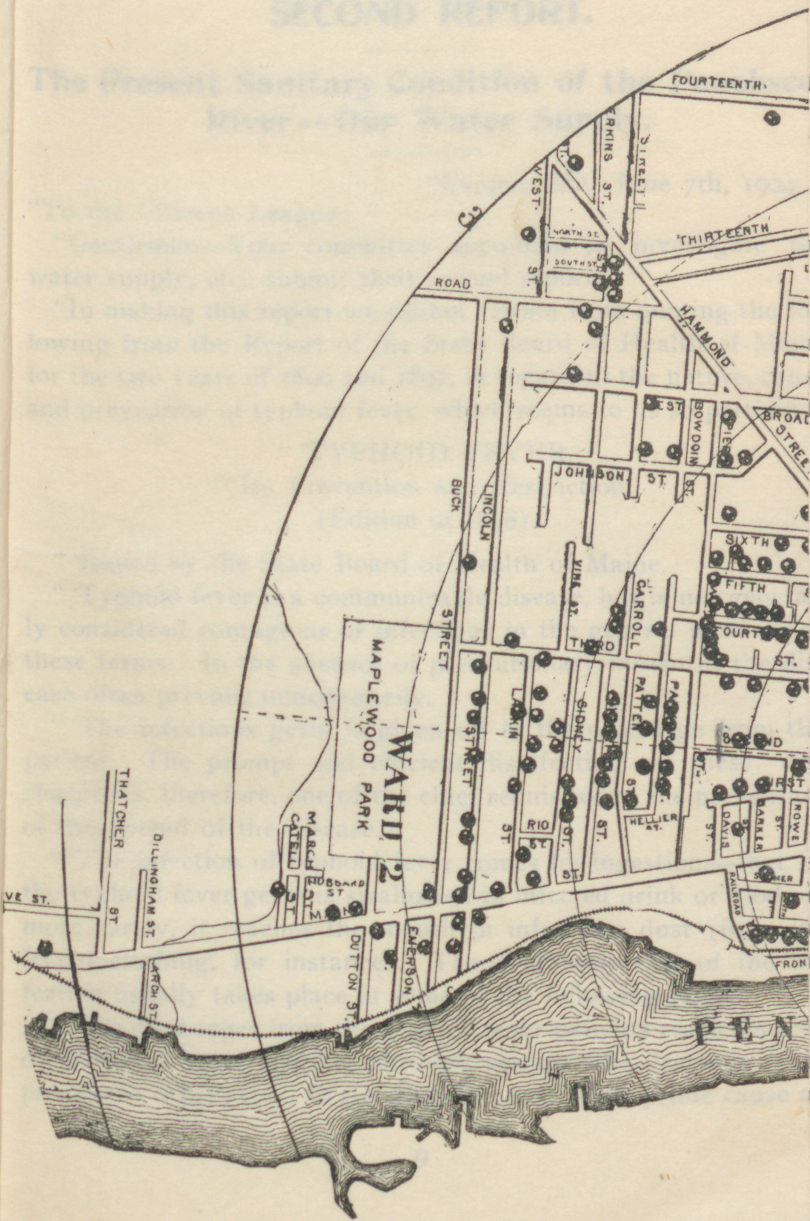
This completes one section of our report. Others will follow.

BERTRAM L. BRYANT,
CHARLES H. BARTLETT,
LINWOOD C. TYLER,
L. S. CHILCOTT,
CHARLES H. CUTLER.

Bangor, May 24. 1904.

SECOND REPORT.

The General Sanitary Committee of the
Board of Health of the City of New York



SECOND REPORT.

The Present Sanitary Condition of the Penobscot River -- Our Water Supply.

"Bangor, Me., June 7th, 1904.

"To the Citizens League:

"Gentlemen—Your committee appointed to investigate the water supply, etc., submit their second report.

"In making this report we cannot refrain from quoting the following from the Report of the State Board of Health of Maine for the two years of 1896 and 1897, in regard to the nature, cause and prevention of typhoid fever, which seems to us so pertinent:

"TYPHOID FEVER.

"'Its Prevention and Restriction.'

(Edition of 1898).

"'Issued by the State Board of Health of Maine.

"'Typhoid fever is a communicable disease, but is not generally considered contagious or infectious in the general meaning of these terms. In the absence of precautionary measures the disease often prevails unnecessarily.

"'The infectious germ is given off in the discharge from the patient. The prompt and efficient disinfection of these discharges is, therefore, one of the chief requisites to the prevention of the spread of the disease.

"'The infection of typhoid fever comes by ingestion,—that is, the typhoid fever germ is swallowed in infected drink or food or, more rarely, it reaches the mouth in infectious dust (from infected clothing, for instance). The communication of the infection usually takes place in some of the following ways:

"'The discharges from the typhoid fever patients reach sources of drinking water supplies through sewage, the drainage from privies, or otherwise. Water thus infected is the prime cause of

typhoid fever. Boil suspicious drinking water; it is thus rendered harmless.'

"In our last report we said that in our opinion 'the main cause of the present epidemic of typhoid is the river water,' and in pursuance of this opinion we have employed Mr. P. H. Coombs, the city engineer, to make an examination of the river between Old Town and Bangor for the purposes of discovering sources of contamination. This has been carefully done and he has made a plan of that part of the basin of the Penobscot river and a short distance above Old Town as far as the Pea Cove region, plotting in all the sewers, drains, privies and the course of the railroad location. Upon his map the sewers and drains appear as round dots and the privies as crosses. He has made a written report to your committee which is hereinafter included and made a part of this report. The numbers refer to those on the plan.

Mr. Coombs' Report.

"To the Committee on Water:

"Sirs—At your request I have made a sanitary survey and examination of the Penobscot river from Old Town to the Bangor waterworks dam, ascertaining as closely as possible the apparent causes of pollution of the water between the above mentioned points, and would most respectfully submit the following report:

"In making this survey only the watershed in the immediate vicinity of the river banks was examined. There are, however, several cases known where certain brooks entering into the river bring pollution from points some distance back from the shore. There are also many instances when at a different season of the year drainage which now is directly absorbed into the ground, readily finds way to the river and would thus greatly augment the present sources of pollution.

"Old Town has quite an extensive system of public sewers, that accommodates about 2,500 people. All their sewerage is discharged through two outlets: (1), one nearly in front of Middle street, the other nearly opposite the lower end of Treat and Webster's island. Besides these there are numerous private

sewers that drain the saw, grist, pulp and woolen mills. This would probably make at least 3,000 people whose sewerage goes directly into the river.

“‘Above the Bodwell Water Power Co.’s dam, (2) from which Old Town’s water is taken, there are two saw-mills (3) whose drains and sewerage goes into the river. The B. & A. shops and settlement at Hartwell (4) there is one sewer here used by about 100 persons, at Pea Cove (5) the river drains indirectly the sewerage of 100 men for certain months of the year. This latter place during the occupancy of the crew is very unclean. Below the Bodwell Water Power Co.’s dam, besides the woolen and pulp mills and public sewers above noted, five open closets (6) were seen which set directly over the river bank, all in close proximity to the bridge leading to Treat and Webster’s island (7).

“‘Going down the river from the Maine Central railroad station, no drainage of an objectionable nature was noticed until the mill (8) run by William Engel was reached; there is a closet here directly over the river and is used by about 40 men. Half way between Old Town city proper and Great Works there is a brook (9) that serves as a sewer for several families, and also gets more or less surface water from a cemetery which is quite near the river.

“‘At Great Works the Penobscot Chemical Fibre Co. has a small saw-mill with a closet (10) directly over the river above the dam, and also a sewer (11) for its pulp mill which discharges below the dam. These are used by about 200 persons. The village of Great Works has one public sewer (12) which discharges just below the Penobscot Chemical Fibre Co.’s dam and accommodates about 25 families or at least 100 people. Then there are a few private drains besides which would make probably 325 people at Great Works whose sewerage is discharged into the river near the dam of the Penobscot Chemical Fibre Co. A short way below the village there is one brook (13) that serves for a drain for several houses, and at present it has a very dirty appearance. From here nothing was noticed along the shore of the river until Webster was reached, the houses being scattering and far from

the bank and not liable to be a source of pollution at this season of the year.

“‘Indian island has about 325 inhabitants with no public sewers or drains. All drainage and sewerage goes directly into the ground except perhaps in case of heavy rains when a little may find its way to the river. One closet (14) only was noticed near the bank of the river.

“‘On Treat and Webster’s island there is one short sewer (15) that discharges into the river just below the bridge. This does not accommodate more than six families. On the west side eight open closets (16) were noticed which hung over or drained directly into the river. And also several sink drains which find their way to the water. On the east shore of the island there are at present no closets near the bank, but noticed several drains which in heavy rains and when the ground is frozen, are carried to the river; but at dry times the most of this drainage soaks into the ground.

“‘Milford has no public drains or sewers and all sewerage naturally soaks into the ground. There is one saw-mill (17) just above the Bodwell Water Power Co.’s dam whose waste and sewerage goes into the river. On the east shore of the river from Milford to Bradley there appears to be nothing that goes into the river which would cause any serious pollution to the water.

“‘At Bradley, there are two large streams (18) that drain considerable territory, and probably more or less sewerage is carried by them. From this point on the east shore of the river to Blackman Stream, the houses are some distance from the shore and scattering and all sewerage soaks into the ground. Blackman Stream flows through a sparsely settled region and is a source of purity rather than pollution.

“‘Stillwater has no public sewers. There are four private sewers (19), which accommodate about sixty persons. There are also two saw-mills (20) whose waste and sewerage goes into the river. The Orono Pulp and Paper Co. has one closet (21) that dumps directly into the river below their dam. This closet is used by about six persons. Between the dam and the University of Maine grounds, there are no drains or sewers that reach

our river. At the University of Maine, the sewerage is discharged through seven outlets (22). There are about five hundred persons including members of faculty, students, attendants, etc., who have at certain seasons of the year free use of the sewers.

“‘Nothing objectionable was noticed between the University of Maine grounds and the Orono bridge, excepting several brooks that contained more or less stagnant water.

“‘Orono has no public sewer and most of its drainage is taken care of by the ground. There are some cases, however, as below noted where houses along the water front make free use of their location. Below the Orono bridge on the Webster side, there are four closets (23) which discharge into the Stillwater besides more or less polluted surface water. The Engel mill (24) at Webster employs about one hundred and fifty men with closets and waste directly into the water. Just below the International paper mill (25) has about fifty men with sewerage to the river. In Webster along the river bank five closets (26) were noticed which were directly over the water.

“‘In Orono below the bridge seven closets (27) were noticed, the sewerage and drainage from which went into the river. At the dam the International Paper Co. has a barking mill (28) which causes considerable waste and just below the dam the pulp mill (29). Near the barking mill is a large cantdog factory (30) employing about 16 men with sewer into the river. The International Paper Co.’s barking mill and pulp mill employ about 60 men whose sewerage goes into the river. Between the upper dam above the Maine Central railroad bridge and the railroad bridge there are three closets (31) on the water’s edge. South of the International Paper Co.’s mill three closets (32) drain into the river. Basin Mills has no public sewers. There are seven closets (33) on or quite near the water. The J. P. Walker (34) mill employs about 250 men; all sewerage and water goes directly into the river.

“‘The Orono Pulp and Paper Co. has a private sewer system with four outlets (35); these accommodate about 100 persons. The company uses a disinfectant, however, which is claimed to

kill all germs. From Basin Mills to Veazie nothing obnoxious was noticed, except in Eddington at Blackman brook, a small cemetery (36) is on the edge of the brook within a few hundred feet of the river bank.

“Veazie has no public sewers or drains. Dry vaults are used and all sink drainage soaks into the ground, except perhaps in time of heavy rains, some might be carried into the river. There were bad places observed a short distance above the Public Works Co.'s dam, a sort of low swampy hole, discharging quantities of filthy looking water into the river. The Public Works has one closet (37) which dumps directly, just below their dam, into the river. This accommodates about 25 persons. At Eddington Bend the land is low and sloping to the river and must cause more or less pollution from the numerous houses that are situated there. Then following the river down through Veazie there is nothing that would be a source of pollution until the Mount Hope cemetery is reached.

“At the Red bridge the brook (38) there affords sewerage for seven houses indirectly and one directly, the closet of which hangs over the water. There is a moccasin factory here just north of the brook which while not now in use has lately employed a considerable number of men, and has been in the past a source of more or less pollution. One branch of the brook also runs through and drains part of Mount Hope cemetery. In front of the Hogan road between State street and the Maine Central railroad track there is quite an extensive basin which at most times of the year contains considerable stagnant water.

“In addition to the above mentioned sources of pollution all drainage from about four miles of the road-bed of the Maine Central railroad is carried directly into the river. The nature of this can be easily seen between the Bangor waterworks' dam and the old river road, there being nine culverts that run to the river.

“Concerning the matter of river currents between Old Town and the Bangor waterworks' dam, the stage of water at present is so high that the course of the channel is not clearly defined, but it is known that the channel and resulting currents crosses

from near one side to near the other side several times between the above named points. The course of the currents as observed by floats at the present stage, shows this without a previous knowledge of the course or the location of the channel or the effect of the several artificial dams and natural obstructions on the river.

“P. H. COOMBS,

“Bangor, Maine, June 7, 1904.”

“Civil Engineer.

TABLE OF RESULTS.

LOCATION.	No. Persons		No. Persons		No. Sewers Direct.	Persons. Total.
	Outlets.	Sewer.	on Indirect.	Sewers		
Pea Cove .....	...	.....	100	.....	.....	100
Hartwell	1	100	...	.....	.....	100
Old Town.....	2	2500	...	.....	.....	2500
Old Town.....	...	.....	500	.....	.....	500
Old Town.....	...	.....	...	5 Open closets,	25	.....
Old Town.....	...	.....	...	1 Open closet,	40	.....
Indian Island.....	...	.....	...	1 Open closet, Engel's mill,	5	.....
Treat and Webster's Isl'd	1	30	...	.....	30	.....
Treat and Webster's Isl'd	...	.....	...	8 Open closets,	40	140
Milford.....	...	.....	...	Mill,	40	40
Bradley.....	...	.....	...	.....	.....	.....
Great Works.....	2	300	...	1 Mill,	25	325
Great Works.....	...	.....	...	.....	.....	.....
Stillwater.....	4	60	...	.....	.....	.....
Stillwater.....	...	.....	...	1 Closet,	6	.....
Stillwater.....	...	.....	...	2 Mills,	75	141
U. of M.....	7	500	...	.....	75	500
Webster.....	...	.....	...	9 Closets,	48	.....
Webster.....	...	.....	...	2 Mills,	200	248
Orono.....	...	.....	...	13 Closets,	65	.....
Orono.....	...	.....	...	2 Mills,	60	.....
Orono.....	...	.....	...	1 Foundry,	16	.....
Basin Mills.....	...	.....	...	7 Closets,	35	.....
Basin Mills.....	...	.....	...	1 Mill,	250	526
Basin Mills.....	4	100	...	.....	.....	.....
Veazie.....	...	.....	...	1 Closet,	25	25
Bangor.....	...	.....	*35	1 Closet,	5	40
*1 brook.	21			47		5185

“In addition to this, two of your committee have visited Thompson's Point just below the Veazie dam, and have observed the trend of the current and the course of logs and floats as they pass around this point, also the course of the river below down to the Bangor dam. They have also visited the country on the Edginton side and made some examination of the Eaton Brook

region which empties into the river near Eddington Bend on the Eddington side.

"They found some houses where there might be a possible source of contamination to this brook, although to what extent they cannot say.

"Your committee calls attention to the large number of drains, sewers and privies shown upon the plan and the large number of persons using the same, all of which are contaminating our water supply.

"We also call attention to the railroad embankment running along the river from which the wash of rain water would take the urine and dejections of travelers on the cars into the river.

"At Pea Cove a large number of men are engaged in working on the logs during part of the year, and their dejections pass into the river.

"One of your committee knows of several cases of typhoid among these men, due to drinking water in a spring into which this contamination has been floated.

"We do not know how far a live typhoid germ will be carried in the river, but experts say they will live from three to ten days or longer in water without food.

"We conclude that it is not unreasonable to suppose that they will be a danger to persons below on the river at points at which they reach within that time after leaving the human body.

"A river is a natural drain. It inevitably drains the basin through which it flows. If there are growing towns along a river its water is sure to grow worse rather than better. The notion that running water purifies itself every few miles is an exploded theory.

"Now the facts which we submit with the map show that within about 12 miles of the water works, all along the river from Pea Cove to the Red bridge, the water of the river is being polluted by drains, sewers and backhouses, emptying directly into our water supply, the daily excrement of some 5,000 persons. We believe that the currents of the river which flow over dams and through sluice-ways mix the river water pretty thoroughly before it reaches the water works dam.

"Now we do not find it necessary to find a typhoid bacillus in

our water supply in order to prove that it is not fit to drink. It is enough for us to know that it is being polluted with sewage every day of the year.

"We show how and where the pollution gets into the river as far as we have yet observed, and we know that the 'colon bacillus' is found in our water after passing through the filter, which proves that the contamination is still there after the water is filtered.

"The water may be better at some seasons of the year than at others; but polluted water is a constant menace; diluted sewage is not fit to drink.

"Nobody would think for a moment of taking the city's water supply from any lake upon the shores of which were to be found 21 drains and sewers, 47 backhouses and four miles of railroad track—such sources of contamination as we have shown exist above the city upon the Penobscot river, and yet we are convinced that there would be less danger in taking our supply from the middle of a lake large enough to supply the city and so contaminated, than from our river. We believe that the still water of a lake purifies itself better than the running water of a river as the currents, eddies, dams, falls and sluices of the river dissipate the contamination over a greater area, while in still water the contamination has a better opportunity of settling without diffusing.

"The first section of our report gave warning enough; the above facts of this section give reason enough for demanding a new and clean water supply. We must be satisfied with no half-way measures. We realize that to seek a new water supply is a serious undertaking; that it will take time and money, and the best expert advice. If, meanwhile, anything can be done to better our present supply, and so to lessen the risk of disease and death, we believe it certainly should be done, but as a temporary measure solely.

"But it is the unanimous conclusion of your committee, that the facts we herewith present, make it imperative to seek a clean water supply at the earliest practicable day.

"In a personal letter from a member of the state board of

health to a member of your committee, the writer says: 'I very much hope that such counsel will prevail as will result in an entirely new source of water supply. A polluted supply of water is a constant menace, and the river will grow worse rather than better, as time goes on. What all good citizens of Bangor should do is to push, and to push hard for a new source of water and not let anything befog or conceal the real issue. It will prove financially even the best policy.'

"We intend to make a further report in regard to the river water.

"BERTRAM L. BRYANT,
"CHARLES H. BARTLETT,
"CHARLES H. CUTLER,
"LINWOOD C. TYLER,
"LANGDON S. CHILCOTT."

THIRD REPORT.

The Condition of Water of the Penobscot River From the Report of Prof. Robinson.

To the Citizens' League:

Gentlemen—Our last report had not entirely completed our investigations in regard to the Penobscot river water which, we are convinced, has been the main source of the recurring cases of typhoid fever, in this city, for many years past.

We now have the long expected report of Prof. Robinson of Brunswick to the Bangor water board, recently published in the daily papers, which shows such results from his analysis of the water and contains such information on the subject that further independent investigation in that line, already begun on our part, is unnecessary.

While we regard the river water responsible for a larger proportion of our typhoid fever than the water board seems to do, and are by no means convinced that filtration of this water is the best remedy to pursue to prevent the future typhoid epidemics, yet we think this timely report of Prof. Robinson will do much to arouse our citizens to the necessity of taking immediate action to relieve the existing condition which has been continued so long that apparently the people have become accustomed to the idea that typhoid is not a preventable disease.

We have shown that the location of the cases of typhoid in the city during this last epidemic was almost wholly confined to the district supplied by the river water and we have shown the contaminated condition of the river and we have stated that, in our opinion, the main source of the disease was in the river water. We think this was a deduction which everyone, who has made even a superficial investigation of the subject of typhoid and its causes, would have made, under the circumstances, even if not

confirmed by the opinion of the entire medical profession of the city, with possibly one or two exceptions, and also the opinion of the Penobscot County Medical association as expressed by the resolve of that body recently adopted and published in our daily papers.

Bangor has typhoid every year to such an extent that it is among those cities in the United States having the highest percentage of deaths from that disease.

In searching for the cause of typhoid fever we must accept the results of scientific inquiry into the subject and the opinion of those who are best qualified by learning and experience to judge of the matter.

Scientific investigation has shown that typhoid is caused by the "typhoid bacillus" entering the mouth and thence getting into the intestines. The "typhoid bacillus" is found in the dejections and urine of the typhoid patient and although, as stated by Prof. Robinson, "it is almost the rarest thing in the world to find typhoid bacillus even in a water to which a given case of the disease has been very certainly traced," yet when we know that the dejections and urine of the typhoid patient pass into the water we know that the "typhoid bacillus" is there.

As Prof. Robinson says, "The colon bacillus is significant because it comes especially from the intestines of the human species and shows that fecal matter is present in the water."

If human feces are found in the water supply and there is an epidemic of typhoid in the city using that water and confined almost entirely to the persons using that water, and further, if the severity of the epidemic varies with the amount of contamination, the conclusion follows that the water is the source of the disease and that the "typhoid bacillus" is there.

Allen Hazen, one of the leading experts in this country, who testified at the recent water hearings on the Kennebec, says in his book on *The Filtration of Public Water Supplies*, (Page 218): "The broad fact that cities, with polluted water supplies, as a rule, have high typhoid fever death rates, and cities with good water supplies do not (except in the occasional cases of milk epidemics, or where they are overrun by cases contracted in neighboring cities with bad water, as is the case with some of

Chicago's suburbs), is at once the best evidence of the damage from bad water and measure of its extent."

As the full significance of Prof. Robinson's report seems to have been somewhat misunderstood, we will further refer to it briefly.

He found animal, vegetable and mineral matter in the water. The vegetable and mineral matters were not in objectionable quantities.

He found the water from January 25 to June 1, 1904, was polluted (with animal matter) and not suitable for drinking.

He found in the sample of filtered water of June 3, 1903, the "colon bacillus" which "comes especially from the intestines of the human species and shows that fecal matter is present in the water."

He says that "there is at all times only the filter to protect the city from having its pipes constantly filled with polluted water. And in my judgment experience shows that the filter cannot be relied upon as perfect protection at all times, however carefully it be managed." * * * "It removes upon an average upwards of 90 per cent. of the bacteria in the water filtered which is a very good degree of efficiency for a filter of that kind."

Prof. Robinson has given no opinion as to the cause of our typhoid epidemics because, as he says, "I have made no investigation in that line," but he does say in his report, "I have no doubt but what if you had the analysis of the water of the Penobscot for several years past they would correspond quite closely with the ones I have made," and that "such water (as he analyzed) may cause such diseases," ("typhoid fever and various kinds of 'bowel complaints')."

In short, he says that on June 3, 1903, he found the "colon bacillus" in the filtered water, that that bacillus is constantly present in the unfiltered water and that the filter is not a perfect protection at all times; that from Jan. 25, 1904, to June 1, 1904, the water was polluted and not fit to drink and that such water may cause typhoid; and that he has no doubt but that the water for several years past would correspond in analysis quite closely with the samples he examined.

We search his report in vain for any intimation that our water

supply is safe or could be made safe by filtration. We regard his report as an endorsement of our opinion that our water supply is contaminated and unsafe. He does say that it may cause typhoid, but that he has made no investigation in that line.

We have made such an investigation and believe the results, already given, show, as clearly as it is possible to show, that the prevalence of typhoid in this city is due mainly to our polluted water supply.

In later reports we will give statistics in regard to typhoid in different cities showing how they compare with Bangor and will investigate as far as we can the subject of filtration and of possible sources for a new water supply.

(Signed),

BERTRAM L. BRYANT,
CHARLES H. BARTLETT,
LINWOOD C. TYLER,
CHARLES H. CUTLER,
LANGDON S. CHILCOTT,

Committee on Water.

Bangor, Maine, June 21, 1904.

FOURTH REPORT.

Typhoid History of the City of Bangor==Statistics of Comparison With Other Cities.

Bangor, Maine, July 7, 1904.

To the Members of the Citizens' League:

Gentlemen—Your committee appointed to investigate the water supply of the city of Bangor herein present to you their fourth report.

Our first report dealt with the present typhoid epidemic from which the city is now recovering. The second and third with the present condition of the river which furnishes our water supply, from a sanitary standpoint. The first report showed that there existed in Bangor, beginning about March 1st an epidemic of typhoid fever, confined for the most part to the users of city water. The second showed you the river polluted by the water-closets used by over five thousand people besides the natural drainage of the whole Penobscot valley. The third, taken from the report of Prof. Robinson, clearly demonstrated that the river is at all times polluted by fecal matter as is shown by the constant presence of the colon bacillus above the filters, and that it was especially dangerous during the time of the typhoid epidemic as shown by the constant presence of the colon bacillus in the filtered water, and the increase in vegetable and animal pollutions.

It now remains for your committee to show to you that this condition, appalling as it is, is not peculiar to this year or season, but that for many years Bangor has been scourged by epidemics more severe as regards the death rate, than this one from which we are just recovering. We find no mention of these facts made in the city reports of the last 28 years, excepting the reports of the city undertaker. In fact, in one report, we are assured that

this city compares favorably with any of its size in New England, as regards health and freedom from epidemic, and yet, turning but a few pages in the same report, we find under the report of the undertaker, recorded that 31 persons buried at Mt. Hope and Mt. Pleasant died of fever. Thirty-one deaths, which means at a very conservative estimate at least 300 cases of fever during that municipal year. In making out this report we have had to depend almost entirely upon the undertaker's report for our facts and statistics. This officer buried so many people which the physicians' certificate informed him died of such a disease. He had no personal interest in the matter, he simply chronicled the facts as they were given him.

These records have been kept for the past 35 years. The whole number of persons buried in the Bangor cemeteries is given and then follows a table of the cause of death and the number of persons brought to the city and sent out for burial. The number carried from the city, as a rule, exceeds those brought in. He reports a certain number of deaths each year under the heading, "fever." As there is no other fever prevalent in this region that would cause death excepting possibly scarlet fever which during this period has been extremely light with few deaths, we are justified in considering that he means typhoid. But to make ourselves doubly sure, as we wish to make no statement which cannot be backed by indisputable facts, we have obtained from Dr. Young of the State Board of Health, all the reports upon vital statistics issued by the state, and we find, that, for the same period, covering the last 11 years, they substantiate the undertaker's reports, so we have the right to presume that for the years preceding the publication of these reports of Vital Statistics, those of the undertaker are correct.

But to avoid all possibility of error in this report, we have deducted in every case ten per cent. from the actual figures given in the undertaker's report. All our averages are figured upon this basis. According to these corrected reports, from 1876 to 1903 we have had four years when the death rate from fever equaled or exceeded that of the present year. In the municipal year '76-'77, there were 52 deaths from fever; '79-'80, 36 deaths;

'89-'90, 54 deaths; '91-'92, 43 deaths. There were ten other years during this period when the rate was above 20. The average yearly death rate from fever for that period, which does not include this year's 40 deaths, is 20 deaths. Multiplying these figures by ten, gives us approximately the number of fever cases or an average of 200 cases of fever for each year covered by this period of 28 years. One death for every ten cases is very conservative, as during this present year it has been about 1-15. So then, we have had an average of 200 cases of fever each year for the last 28 years. When we made our first estimate of perhaps 200 cases during the present year we were called "alarmists." The true number was above 600.

These figures are bad in themselves. But how did we really compare with other cities in New England when that optimistic statement was made. It happens to be our good fortune to have at hand statistics covering that period. We present in the following table for comparison, the statistics of the cities in the Merrimac valley, covering the five municipal years, 1888-1893.

Death rate from typhoid fever in the principal cities on the Merrimac river and Bangor, for the five years, April 1, 1888-March 31, 1893. Per 10,000 inhabitants, census 1890:

	1888 to 1889	1889 to 1890	1890 to 1891	1891 to 1892	1892 to 1893	Average Five Years.
Concord, N. H.,.....	7.05	2.95	5.30	2.94	1.18	3.88
Manchester, N. H.....	2.99	4.18	4.36	1.15	2.07	2.95
Nashua, N. H.....	6.89	4.25	5.3	8.98	3.18	4.77
Lowell, Mass.....	8.63	8.39	19.5	8.17	8.56	10.6
Lawrence, Mass.....	12.5	11.8	18.7	9.16	11.4	12.7
Haverhill, Mass.....	2.28	3.03	3.39	3.02	6.4	4.63
Newburyport, Mass...	1.44	2.88	5.76	2.88	5.04	3.60
Bangor, Me.....	8.1	26.6	14.0	21.2	8.90	16.00.

During this period, Lowell and Lawrence obtained their water supply, unfiltered, directly from the sewerage polluted Merrimac. The water supplies, on the other hand, of Concord, Nashua, Haverhill and during most of the time of Newburyport, were derived from other sources, as a rule, entirely unobjectionable.

Bangor took hers from the Penobscot before the new filters were put in.

In the fall of 1890 the great epidemic of typhoid broke out in Lowell, and one even of greater severity appeared soon after in Lawrence, nine miles further down the river. This is shown in the tables of 1890-'91.

A careful study of this table makes comment unnecessary. Of the three cities in the table taking their water from polluted rivers, Bangor heads the list with an average mortality of 16 per 10,000 for the five years. Lawrence comes next with 12.7, then Lowell with 10.6, while the average in those cities having a clean water supply was 3.9. Lowell long ago changed her supply to artesian wells. Lawrence is still experimenting with filters and unhappy with the results would gladly abandon them for a clean supply if it were possible. Bangor put in a new filter system in 1896-'7, a costly experiment with the lives of its citizens as this epidemic well shows. A needless risk and one that should not be longer tolerated when a safe supply can be so easily obtained.

We wish to present one other table covering a longer period, and giving in comparison death rates from typhoid of other representative cities. We give below :

Death rate per 10,000 inhabitants from typhoid in Chicago, New York, Philadelphia and Bangor for 17 years, 1875-1891, inclusive. This is reckoned on a basis of 20,000 inhabitants for Bangor, when the average population was but 17,980.

	Chicago.	New York.	Philadelphia.	Bangor.
1875	5.09	3.60	5.25	10.35
1876	4.00	3.02	9.22	25.65
1877	3.61	3.10	6.37	6.3
1878	3.24	2.81	4.61	8.9
1879	4.38	2.26	3.82	17.55
1880	3.40	3.08	5.88	12.15
1881	10.52	4.77	7.43	8.55
1882	8.24	4.02	7.33	11.8
1883	6.22	4.72	6.33	8.9
1884	5.62	3.49	7.13	8.1
1885	7.46	2.88	6.42	15.75

	Chicago.	New York.	Philadelphia.	Bangor.
1886	6.86	2.99	6.36	11.8
1887	5.01	2.82	6.25	2.25
1888	4.52	2.37	7.72	8.1
1889	4.70	2.51	7.07	26.6
1890	3.40	2.16	6.30	14.00
1891	16.64	2.26	6.27	21.2
Average	6.90	3.19	6.20	12.80

Chicago and Philadelphia during this period had notoriously bad water supplies, the former taking its supply from the lake into which their own sewerage was returned, the latter from the polluted Schuylkill. New York has a clean supply. Yet during that period Bangor had about twice as much typhoid per number of inhabitants as either of these infected cities and over four times as much as New York.

To complete the statistics for Bangor we give in the following the death rate from typhoid to date. We have no figures of comparison for other cities.

Number of deaths from typhoid in Bangor per 10,000 inhabitants, 1893-1904, inclusive:

1893-94	9.5
1894-5	9.5
1895-6	6.0
1896-7	5.0
1897-8	3.0
1898-9	3.5
1899-00	6.5
1900-01	6.0
1901-02	8.5
1902-03	4.0
1903-04	8.0
1904-05, (for six months)	20.0

After the filter was first installed, 1897, the next two years show a decided falling off in the typhoid death rate. Taking the five years immediately preceding the filter the death rate per 10,000 was 8.0, for the five years following, 5.5. There can be no doubt but what the filter has saved a great many lives during this

period. But that it cannot be relied upon is well shown by this year's first six months' mortality of 40 deaths, with our 600 cases of typhoid. The large amount of spring water used in the city during this time may also be a factor in reducing the fever rate.

We do not wish to be alarmists, but we believe the time has come when regardless of the cry of injury to business and civic pride we should look the facts as they are squarely in the face. We have confidence in the people of Bangor that when the facts are known, and we have endeavored to give nothing but facts, they will no longer tolerate a condition which is a disgrace to our fair city and so fearfully expensive in the mortality of its citizens.

In our next report we shall show to you the cost to the city of its polluted water. We also hope to have by that time some facts and figures upon a possible new water supply.

BERTRAM L. BRYANT,
CHARLES H. BARTLETT,
LINWOOD C. TYLER,
CHARLES H. CUTLER,
LANGDON L. CHILCOTT.

FIFTH REPORT.

Some Estimates and Suggestions Upon a New Water Supply.

To the Citizens' League of Bangor:

Your committee on water and water supply herewith present their fifth report.

We have shown to you in our previous reports that the majority of the cases of typhoid fever are directly traceable to the city's water supply. Prof. Robinson has told us in his report that the water is polluted and never can be made safe for domestic purposes. Our statistics in our last report placed us among and almost in the lead of the worst typhoid cities in New England. Having shown that this condition exists it now remains for your committee to point out a remedy as far as it can within its limited power. We consider a new and safe water supply the only solution of the problem. We wish to say in the beginning that no member of this committee has a water franchise to sell or any interest in any system we may propose. We believe that no supply should be decided upon without competent expert investigation and advice. We have not selected any one source of supply to recommend to the citizens of Bangor. It has been our simple endeavor to collect facts about the lakes and ponds that may become an available source and we present these facts to you with the sources from which they were obtained.

We wish at this point to express our appreciation for the interest which the local office of the U. S. Hydrographic Survey has taken and the assistance they have given us in this investigation. This office has furnished us a map of the ponds and lakes about Bangor available for a water supply; approximate elevations for a pipe line from Phillips lake; drainage areas, water surfaces and approximate storage capacities; chemical analysis of the water

of Phillips lake and Cold Stream by Prof. Robinson. In addition to all this this office has also established gauging stations at these places to determine the actual flow and available supply of these lakes and ponds. We also give you an estimate by City Engineer Coombs of the cost of a 24-inch pipe line from Phillips lake to Bangor. We give no further facts in regard to Cold Stream water as it is over 35 miles from Bangor and has no better water or higher elevation than some of the ponds near the city.

Analysis of water from Phillips lake and Cold Stream pond.
Results in parts per 100,000.

	Phillips Lake, July 7 '04.	Cold Stream, July 9, '04.
Total solids dissolved	2.76	2.44
Organic and volatile.....	1.15	1.16
Fixed mineral	1.60	1.28
Free ammonia .....	.0024	.0017
Albumenoid ammonia .....	.008	.0109
Nitrites	0	0
Nitrates	trace.	trace.
Chlorine .....	.26	.2
Carbonates of lime and magnesia.....	.63	.52
Sulphates .....	.34	.31
Silica .....	.20	.12
Required oxygen .....	.15	.25

From a chemical standpoint both waters are unobjectionable in my judgment for a municipal water supply.

FRANKLIN C. ROBINSON.

A biological examination of these waters will be made in the near future.

PROPOSED PHILLIPS LAKE WATER SUPPLY SYSTEM.

Names.	Area Drainage Basin. Sq. Miles.	Area Water Surface. Sq. Miles.	Approximate Storage at 10 ft. Depth. Gallons.
Phillips lake	11.43	1.38	2,880,000,000
Goose pond	2.21	.36	750,000,000
Mud and Second ponds.....	a	.10)	
Hurd pond	a	.05)	540,000,000
Moulton and Mitchell ponds..	a	.11)	
Total	13.64	2.00	4,170,000,000

SUPPLEMENTARY RESERVOIRS.

Holbrook and Davis ponds...	11.16	1.20	2,500,000,000
Fitts pond	1.73	.15	310,000,000
Hatcase pond	2.88	.25	520,000,000
<hr/>		<hr/>	
Total	15.77	1.60	3,330,000,000
First total	13.64	2.00	4,170,000,000
<hr/>		<hr/>	
Grand total.....	29.41	3.60	7,500,000,000

a. Included in Phillips Lake Drainage Basin.

Report of City Engineer Coombs, estimating the cost of a pipe line from Phillips lake to Bangor:

"At your request the following estimate is given for a contemplated water supply pipe line, assuming the distance or length will be ten miles and the head about two hundred feet. The supply required is taken at seven million gallons per twenty-four hours, and the size of pipe adopted is twenty-four inches.

A survey for a final location for an actual pipe-line might necessitate a change in the size adopted in this calculation; also a change in the actual cost from any estimate which I am able to make at this time.

"Cast iron pipe, delivered in this vicinity, has varied since 1883 from about \$36.00 per ton down to \$18.00 per ton. In 1903, it was from \$32.00 to \$35.00, and at present it is probably about \$25.00 per ton.

"For present purposes I have considered pipe at \$30.00 per ton, estimating the probable cost of other materials, such as lead, hemp, and the items for excavating, laying and carting, superintendence, etc., necessary to such work, and place the probable cost at \$250,000.

"I have not examined the contemplated source of supply or the route available for the pipe line. The estimate does not include anything for acquiring rights at or around the lake, rights for location of pipe or way, construction work at intake, or any other expense beyond the probable cost of ten miles of 24-inch pipe and laying.

"It must be distinctly understood that some expenditures for

items above mentioned, and probably many others necessarily contributing to the cost of such work, can only be determined by a proper survey, and no attempt is here made to estimate the cost of a complete plant in running order.

“Very respectfully,

“P. H. COOMBS.”

Phillips lake has an elevation of about 200 feet above the pumping station at Bangor, sufficient to bring the water to that place by gravity and through the filters ready to be pumped by the present plant. The same pumping station could be used with very little change to distribute the water through the present service. Two of your committee spent a day with two engineers going over the lake looking at sites for dams, etc. At very little expense the surface of the lake could be kept at high water mark. This would give sufficient storage capacity and no damage for flowage. The basin is almost completely surrounded by wild land, with no possible source of contamination beyond a few summer cottages at one point and the railroad track which runs along the shores. Both could be regulated at very little expense. The toilets of the cars could be closed between Green lake and Holden and the sanitation of the cottages regulated or they could be removed altogether. The basin is of granite and white sand practically free from vegetable matter.

From the estimates of the hydrographic survey the water shed of Phillips lake alone could be depended upon to furnish a water supply of ten million gallons per day and a storage capacity at ten feet depth of 3,000,000,000 gallons or a storage of water counting for evaporation and with none coming into the basin sufficient to supply 10,000,000 gallons a day for 200 days, or enough to tide over any time of drought. This amount can be more than doubled by bringing in other lakes and ponds in the region. We are at present on an average using about 3,000,000 gallons per day or less than a third of this supply. Cost.—Engineer Coombs estimates the cost of ten miles of 24 inch pipe line at \$250,000. In addition to this would be the land damages, intakes, dams and changes in the present pumping station. The

cost of this can be merely guess work depending entirely upon the land and rights necessary to acquire about the lake. For convenience we will consider \$100,000 in our estimate with the understanding that it may cost considerably more or less. This would make a total of \$350,000.

Bangor has reached its debt limit. To raise this amount it would be necessary to form a water district including Bangor and possibly some surrounding territory. This district could furnish water bonds to the necessary amount. Bangor's water bonds of \$500,000, upon which we are paying 6 per cent. interest come due July 1, 1905. These prominent bankers tell us can be refunded at 3½ so with the additional \$350,000 water bonds the citizens of Bangor would not pay one cent more interest than at the present time, and we should have pure water for drinking purposes and all other uses in every faucet in the city.

Can the city afford to do this?

Rating every life lost from typhoid \$2,000, the courts allow \$5,000, and for every person sick with typhoid, loss of wages, doctors' and nurses' bills \$100 each, at this rate for the past few months our polluted water supply has cost the citizens of Bangor

40 deaths at \$2,000.....	\$80,000
600 cases of typhoid at \$100.....	60,000

A grand total of.....\$140,000

Less than three epidemics would pay for a new water supply.

Our average yearly deaths from typhoid are 20, our average number of typhoid cases 200.

20 deaths at \$2,000.....	\$40,000
200 cases of typhoid at \$100.....	20,000

Total\$60,000

One of the members of your committee has been collecting facts and figures upon the amount of spring water sold in Bangor each year. A conservative estimate is \$15,000. So the aggregate annual tax upon the citizens of Bangor for their polluted water supply \$75,000.

Gentlemen of the league, this completes our first series of reports.

Your committee started into this investigation to find out the

facts. We have spared neither time nor money to get at the bottom of things. We have given these facts to you in these five reports. It is now up to you and to every citizen of Bangor to decide what is to be done about it.

We still have some matters under investigation, and from time to time other reports will follow.

BERTRAM L. BRYANT,
CHARLES H. BARTLETT,
LINWOOD C. TYLER,
CHARLES H. CUTLER.
LANGDON S. CHILCOTT.

August 11, 1904.

APPENDIX.

REPORT OF
**Penobscot County
Medical
Association.**

REPORT OF
**Prof.
F. C. Robinson.**

Report of Penobscot County Medical Association.

"The members of the Penobscot County Medical association consider it fitting at this time to express their opinion to the public concerning the cause of the large number of cases of typhoid in Bangor and vicinity and the means that should be taken to ameliorate the present conditions.

"The opinion is unanimous that the majority of all cases of typhoid can be traced to those cities and towns taking their water supply from the Penobscot river. In the present epidemic all cases in the lower Penobscot valley are confined to Millinocket, Old Town, Bangor and Brewer, while Orono, Hampden, Winterport, Bucksport, Ellsworth and Bar Harbor have no cases at the present time; and it is the universal opinion of the physicians of these surrounding towns that the majority of their few cases of typhoid in the past can be traced to Bangor, Brewer or Old Town.

"It has been the misfortune of Bangor for the past 25 years to have an annual or semi-annual epidemic of typhoid fever, the cases numbering from 50 to several hundred. Again and again individuals in the profession have pointed out the one great source of infection and have succeeded in convincing many of the thinking people; but the majority seem still indifferent to danger.

"Water analyses and bacteriological examinations are of value only when positive results are obtained. A negative result is of no value whatever and is apt to be misleading. It is so difficult to demonstrate the presence of the typhoid germ in water that all eminent sanitarians agree that that method of procedure at the present time is of little value against the evidence of recurrent epidemics and open pollution of water supplies.

"The primary cause of all typhoid is infected drinking water.

Boiling it is a sure way to destroy the germs. All drinking water should be boiled unless one can be certain that the supply comes from a source where there is no possible chance of contamination. Not only should the drinking water be boiled, but all of that used for washing vegetables, lettuce, fruit and whatever is used for food, uncooked. Many people are very careful to use spring water for drinking but brush their teeth, rinse their dishes and milk jars in unboiled water. This may be a frequent source of infection.

"Flies are great carriers of infection. Not only should typhoid patients be screened, but all the urine and stools should be thoroughly disinfected and at the same time kept where flies cannot get at them. Going from the patient they contaminate the food, carrying typhoid germs to whatever they touch. If the present epidemic continues it would be well to have all the screens put on the houses earlier than usual, and use extra care to keep all flies out. The danger from typhoid is not from contact as in the contagious diseases, since the germ is taken into the system through the mouth. So, if all water is boiled, if reasonable precautions are taken in the care of patients, and in the disinfection of the excreta, and flies are kept from the houses, the chances of typhoid infection will be very small.

Daniel McCann, D. A. Robinson, Bertram L. Bryant, C. P. Thomas, Lewis Hodgkins, A. B. Hagerthy, Harold H. Crane, W. P. McNally, D. Hennessy, C. D. Edmunds, Atwell W. Swett, William C. Mason, George E. Hilton, H. A. King, C. L. McCurdy, T. J. Murphy, J. B. Thompson, Luther S. Mason, H. F. Hanson, Harry Butler, J. Albert Lethiecq, C. M. Thomas, W. H. Simmons, W. L. Hunt, C. H. Burgess, O. I. Bemis, Carlotta Swett, E. T. Nealey, E. B. Sanger, J. F. Starrett, Blanche Mansfield, W. H. Briggs, P. C. Page, Burt F. Howard, G. B. Tibbetts, H. L. Jewell.

Report of Prof. F. C. Robinson.

Brunswick, Maine, June 6, 1904.

Hon. C. F. Bragg:

Dear Sir—On the first day of April, 1903, I began, at your request, a series of chemical and bacteriological analyses of the water supplied to the city of Bangor. Samples were taken every month approximately, until March 29th, 1904. From that time until the present they have been taken oftener.

Some of the samples I took personally, but the most of them were sent to me by Mr. Sinclair the superintendent of the works.

Understanding that you wished to get all the information you could about the chemical condition of the water I had samples taken, and took some myself, from the water before it was filtered as well as after, also a few samples from the river at low tide below the city, at the region called Crosbyville.

Altogether I have analyzed 24 samples and the results are shown in tabular form on the enclosed sheet.

In my comments on some of the analyses as they were sent to you I have indicated the general condition of the water at different times as shown by such analyses, but now that the work has been carried on for a little more than a year it will help you to have something of a general report.

The past year has been peculiar in certain respects undoubtedly, especially in having a low average rainfall until the spring of 1904. But yet the rivers have gone through the same general changes that they always do, being high in the spring and low in the fall and winter, and I have no doubt but what if you had the analyses of the water of the Penobscot for several years past, they would correspond quite closely with the ones I have made. That is when the river is low the dissolved solids are about twice what they are when it is high. They may not be actually more,

or less in quantity, but are in a more dilute or concentrated solution according to the amount of the water.

The dissolved matter in the water is in general of three kinds, mineral, vegetable and animal. The mineral is that small amount of matter which the water dissolves from the rocks and soil, mainly carbonates of calcium and magnesium, and common salt. In the analysis this is shown by the permanent hardness, the chlorine, and the difference between volatile and total solids. These are very small in the Penobscot river at any season of the year, so small as to be unobjectionable.

The vegetable matter is derived from the forests and swamps and the saw-mill and pulp waste thrown into the river. It is what gives the brown color to the water, and a large part of "volatile solids" is of this nature. The "oxygen required" is largely because of this also. It is not regarded as a dangerous material unless present in larger quantity than the analyses made show, but when present in water to the extent it is in many swamps, it has a distinctly bad effect upon those drinking such water.

The animal matter is the most significant as regards pollution. There is always a certain amount of this present in the water of rivers and ponds, coming chiefly from the animal life in them, but it increases largely when the waste products of human life are carried into such waters to any considerable extent. The chief danger from such substance to those drinking the water is because of certain bacteria called disease germs which may accompany them. These are the principal causal agents in typhoid fever, cholera and various kinds of "bowel complaints."

In the analyses the "free and albuminoid ammonia," "nitrites and nitrates," and the "colon bacillus," indicate animal matter. As some animal matter is always present in river water, the question of its amount in a given case is of the greatest importance. It is also of the greatest importance to determine if possible the presence or absence of the distinctive bacteria of the diseases mentioned, but experience has shown that in a large body of water this latter result is very rarely accomplished, owing to the small amount of water necessarily used in the test. It is for example, almost the rarest thing in the world to find the typhoid

bacillus even in a water to which a given case of the disease has been very certainly traced.

As to the allowable amount of animal matter in drinking water, as represented in an analysis by ammonia, nitrites, and nitrates, there is no general agreement among chemists, because conditions vary greatly, and what may be allowed in waters of one kind may not be proper for another. I am accustomed to regard a river or pond water which contains .017 or over, parts of ammonia in one hundred thousand, of which the free ammonia is one-tenth or more of the whole, as not safe for drinking, and if in addition nitrites are present, and the colon bacillus, the danger from such water is increased.

The colon bacillus is significant because it comes especially from the intestines of the human species and shows that fecal matter is present in the water.

If the analyses be inspected in the light of what has been said, it is seen that from April 1, 1903, to January 25, 1904, the filtered water was in a satisfactory condition with the exception of the sample of June 3, 1903, when the colon bacillus was present as a single, though important bad feature. But with January 25th, there suddenly developed a change for the worse which continued unabated for more than a month and then gradually declined through March, April and May, but even on June 1, when the last sample examined was collected, the condition of the water was not as good as it was a year ago, although apparently approaching that condition.

It is, of course, no part of my duty to trace any prevalence of intestinal disease to the water, because I have made no investigation in that line. I can only state that during the time mentioned the water was polluted and not suitable for drinking, and that such water may cause such diseases.

It is important to notice that during the time when the filtered water was satisfactory in analysis the unfiltered was not, as the colon bacillus was constantly present in the river. That is, there is at all times only the filter to protect the city from having its pipes constantly filled with polluted water. And in my judgment experience shows that the filter cannot be relied upon as perfect protection at all times, however carefully it be managed, and in

my various visits to it I saw nothing to criticise in its management. It removes upon an average upwards of 90 per cent. of the bacteria in the water filtered, which is a very good degree of efficiency for a filter of that kind.

I may add, that by far the larger number of bacteria present in this as in other waters, are perfectly harmless, when taken into the human system. They live upon the animal and vegetable matter in the water, tending to remove this and so purify the water. A large number of bacteria present in water is mainly significant, as confirming the other tests which show excessive amount of polluting matter present.

I was asked by the Water Board to investigate as well as I could in a single day the question which had arisen, whether or not the water on the east side of the river was freer from pollution than that on the west. I did this June 4th, starting in at Old Town, and following down the bank of the river, mostly on foot, and determined the currents by inspection aided by floating matter and the use of certain powerful dyes. The result of my inspection convinced me that, at the water works, the east side of the river is full more impure than the west, and hence it would be no gain to extend the intake to that side. In the first place any pollution the water receives at Old Town is about equal in amount on both sides of the river. In addition before the water reaches Orono the current crosses and recrosses the river several times, and there the Stillwater branch carries the main current to the east side. From Orono down there is a repeated change of current from side to side again, until finally, not far above the water works dam it makes strongly to the east side again as was plainly demonstrated.

Respectfully submitted,

FRANKLIN C. ROBINSON.

SUMMARY

— OF —

Analysis of Penobscot River Water

By F. C. ROBINSON.

The results are expressed in parts per hundred thousand. They can be changed to parts per million by moving the decimal point one place to the right.

Date.	Place and Condition.	Dissolved Solids.	Volatile Solids.	Free Ammonia.	Albumenod Ammonia.	Nitrites.	Nitrates
1903.							
Apr. 1	*Water W. filtered...3.6		1.9	.0016	.013	o	Trace
"	Not filtered.....3.68		2.	.0012	.0148	o	Trace
May 2	Water W. filtered...3.44		1.88	.0012	.0134	o	Trace
"	Not filtered . ....3.46		1.94	.0012	.0182	o	Trace
"	Crosbyville.....5.16		2.9	.001	.035	Strong T.	Trace
June 3	Water W. filtered...4.64		2.8	.0024	.0135	o	Trace
"	Not filtered.....4.68		2.9	.0024	.012	o	Trace
"	Crosbyville.....5.34		3.01	.0015	.0234	Strong T.	Trace
July 18	Water W. filtered...4.8		2.7	.0028	.012	o	Trace
"	Not filtered.....4.85		2.75	.0028	.013	o	Trace
"	Crosbyville.....8.88		4.92	.0042	.019	o	Trace
Oct. 2	Water W. filtered...5.2		2.44	.0011	.010	o	Trace
Nov. 18	Water W. filtered...7.18		4.1	.003	.013	Trace	Trace
"	Filt'd City Faucet..7.18		4.1	.0032	.013	Trace	Trace
Dec. 22	Water W. filtered...8.01		4.38	.004	.011	Trace	.037
"	Filt'd City Faucet...8.		4.37	.004	.012	Trace	.036
1904.							
Jan. 25	Water W. filtered....8.04		4.16	.002	.0164	Trace	.025
Feb. 26	Water W. filtered....7.8		4.7	.003	.014	Trace	.027
Mar. 29	Water W. filtered....4.7		2.74	.0018	.0152	Trace	.023
Apr. 15	Water W. filtered....3.68		2.04	.004	.0152	o	.015
" 26	Water W. filtered....4.16		2.40	.0018	.0172	o	.015
May 5	Water W. filtered....3.84		2.08	.0025	.0186	Trace	.01
May 20	Water W. filtered....4.08		2.24	.0024	.018	o	.011
June 1	Water W. filtered....4.28		2.32	.0006	.017	o	.01

* "Water W." means sample taken at Water Works pumping station.

Clorin.	Oxygen Required.	Temporary Hardness.	Permanent Hardness.	Bacteria per Cubic Centimeter.	Colon Bacillus.
.25	Not determined.	Not determined.	Not determined.	475	o
.25	"	"	"	1,500	Present
.2	"	1.8	1.3	240	o
.2	"	1.88	1.32	420	Present
.26	"	1.89	1.38	1,020	Present
.25	"	2.1	1.5	180	Present
.25	"	2.13	1.5	8,000	Present
.26	"	1.97	1.42	12,500	Present
.19	"	1.95	1.43	200	o Absent
.2	"	1.95	1.43	1,200	Present
.25	"	2.09	1.55	20,000	Present
.21	"	2.8	1.9	Not determined	o Absent
.33	1.9	2.26	2.05	190	o Absent
.33	1.9	2.26	2.05	200	o Absent
.34	2.21	2.54	2.21	100	o Absent
.34	2.21	2.55	2.22	100	o Absent
.3	2.27	3.2	3.	140	Present
.32	2.18	2.9	2.8	1,100	Present
.32	1.15	1.92	1.86	1,700	Absent
.22	1.05	1.59	1.48	1,560	Absent
.27	1.	1.86	1.66	310	Absent
.25	1.02	1.75	1.62	260	Present
.25	1.06	1.65	1.56	140	Present
.26	1.1	1.83	1.64	70	Not yet determined
