Public Document No. 34

FORTY-FIFTH ANNUAL REPORT

OF THE

STATE BOARD OF HEALTH

OF

MASSACHUSETTS.

BOSTON:
WRIGHT & POTTER PRINTING CO., STATE PRINTERS,
32 DERNE STREET.
1914.

Approved by
The State Board of Publication.

MEMBERS OF THE BOARD.

1913.

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MILTON J. ROSENAU, M.D.,	of Boston.
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ROBERT W. LOVETT, M.D.,	of Boston.
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JOSEPH A. PLOUFF,	of Ware.

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MARK W. RICHARDSON, M.D.

Assistant to the Secretary.

WILLIAM C. HANSON, M.D.

Engineer.

X. H. GOODNOUGH, C.E.

Pathologist.

THEOBALD SMITH, M.D.

Analyst of Food and Drugs.

HERMANN C. LYTHGOE, S.B.

Chemist.

H. W. CLARK.

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GENERAL REPORT.

In accordance with the provisions of chapter 211 of the Acts of 1905, the following report of the work of the several departments of the State Board of Health is presented for the fiscal year ended Nov. 30, 1913, on which date the Board was constituted as follows: —

Henry P. Walcott, M.D., Cambridge, *Chairman.*

Milton J. Rosenau, M.D., Boston.	C. E. McGillicuddy, LL.B., Worcester.
Hiram F. Mills, A.M., C.E., Lowell.	Clement F. Coogan, Pittsfield.
Robert W. Lovett, M.D., Boston.	Joseph A. Plouff, Ware.

On March 30, 1913, occurred the death of Dr. Julian A. Mead, member of the Board since October, 1895, concerning whose death it was voted at a meeting of the State Board of Health, held April 3, 1913, that the following minutes be spread upon the records: —

Dr. Julian A. Mead became a member of the State Board of Health in October, 1895. He was a member of the Board at the date of his death, March 13, 1913. He brought to the service of the State the valued knowledge of a well-trained and experienced practitioner of medicine. He possessed qualities of the greatest importance to a member of a Board which has such varied functions as are imposed upon this organization. He had a large acquaintance with public affairs of many sorts, and he willingly gave his time and special knowledge to the work of the Board. Careful in arriving at conclusions, he was firm in maintaining them. Courteous, friendly and just, he leaves with his associates a happy memory and a sincere regret for his loss.

To fill the unexpired term of Dr. Mead, Dr. Milton J. Rosenau was appointed by Governor Foss on April 9, 1913.

At a meeting of the State Board of Health, held Oct. 2, 1913, the resignation of Dr. Elliott Washburn, State Inspector of Health for the South Midland District, was accepted with regret. Dr. Washburn resigned in order to become superintendent of the State sanatorium for tuberculosis at Rutland, Mass.

Antityphoid Inoculation.

The practice of specific inoculation against typhoid fever has made considerable progress in Massachusetts during the past year. Especially noteworthy has been the introduction of this procedure among the members of the Massachusetts Volunteer Militia. During the year 21,014 ampoules of antityphoid vaccine have been distributed for use by the citizens of the Commonwealth, but of this number 10,526 ampoules were utilized by the militia. This immunization of the militia, affecting as it does a large body of young men in the prime of life, at an age peculiarly susceptible to typhoid infection and subject at the time of professional maneuvres, at least, to increased exposure to polluted water supplies, cannot but have an appreciable effect upon the incidence of the disease.

There is every reason to believe, furthermore, that the practice of the inoculation of nurses, inaugurated two or three years ago at a considerable number of training schools throughout the Commonwealth, has become increasingly prevalent, with undoubtedly beneficial effects.

No deleterious effects have been reported as yet from the use of antityphoid vaccine. In one instance a militiaman was said to have died a short time after inoculation with typhoid vaccine, but the autopsy showed that death was due to other causes.

Antityphoid inoculation is compulsory for the troops of the United States army, and the beneficial action produced by this procedure is seen in the fact that during the year 1913 only two cases of typhoid fever occurred in a personnel of over 80,000 men, and neither of these cases died.

Antimeningitis Serum.

On Nov. 1, 1913, the Board was able, after a long period of preparation under the auspices of Dr. Theobald Smith, to furnish to citizens of the Commonwealth, in a manner similar to that employed with the diphtheria antitoxin, a curative serum for cerebrospinal meningitis. With this serum the following circular was sent out: —

State Board of Health, State House,
Boston, Nov. 1, 1913.

Antimeningitis Serum.

The State Board of Health is prepared to furnish free to physicians and citizens of the Commonwealth, in a manner similar to that employed with diphtheria antitoxin, a curative serum for use in cases of cerebrospinal meningitis. This antimeningitis serum is obtained from the horse after prolonged treatment with a number of strains of the diplococcus of meningitis. It is of no service in other infectious diseases. It is administered subdurally and not by the subcutaneous or intravenous route. It is urged, furthermore, that whenever a reliable microscopic examination of the cerebrospinal fluid withdrawn cannot be made at once, the fluid should be sent to the nearest accessible laboratory, or to the laboratory of the State Board of Health. The specific diplococci disappear rapidly from the fluid and may not be found later than six hours after withdrawal from the spinal canal.

1. When lumbar puncture (in fourth lumbar space, or higher if necessary) is performed in a suspicious case, be prepared to inject the serum. If the cerebrospinal fluid withdrawn is cloudy make the injection of serum immediately and without waiting for a bacteriological examination. The subsequent doses of the serum are to be given only if the *Diplococcus intracellularis* has been demonstrated.

2. Always withdraw as much cerebrospinal fluid as possible at each puncture and inject full doses of the serum. Thirty cubic centimeters of serum should be injected in every instance in which this quantity of fluid or less has been removed, unless a distinctly abnormal sense of resistance in the spinal canal is encountered after as much serum has been injected as fluid has been removed. When the amount of fluid withdrawn exceeds 30 cubic centimeters, introduce a large quantity of serum — up to 45 cubic centimeters, or even more. In the very severe or fulminating cases inject from 30 to 45 cubic centimeters of serum without reference to the quantity of fluid removed unless abnormal resistance is encountered.

3. In very severe or fulminating cases repeat the injection of serum within the first twenty-four hour period, as soon as the symptoms intensify, or, where the condition remains stationary, after the lapse of the first twelve hours.

4. In cases of average severity make daily injections of full doses for four days. If diplococci persist after the fourth dose, continue the injections until they have disappeared.

5. If the subjective symptoms, including fever and mental impairment, persist after the diplococci have disappeared, or after the four doses have been given, and improvement is not progressing, wait four days, if the condition is stationary, and then repeat the four injections. Should the symptoms have become worse before the expiration of this period, the injections should be resumed immediately.

6. In relapse, which is indicated either by reappearance of the diplococci in the cerebrospinal fluid or recrudescence of the symptoms, the four doses at twenty-four hour intervals are to be repeated, and the subsequent treatment is to be conducted as for the original attack.

7. This plan of treatment is to be followed until the patient is free of symptoms, the diplococci disappear from the cerebrospinal fluid, or the chronic stage of the disease supervenes. The serum has proven of some benefit in the chronic stages in which the diplococci are still present in the meninges. When the condition of hydrocephalus has been established the injection of serum into the spinal canal offers little of value. It is possible that direct intraventricular injections may be of benefit in this condition.[1]

It is too early as yet to determine accurately the clinical results obtained from this new serum, but as far as the results go they would seem to indicate that this new product of the State Board of Health is, at least, equal to if it does not surpass in efficiency the antimeningitis serums which have preceded it.

[1] From directions issued by the Rockefeller Institute, New York (abstracted from paper by Charles Hunter Dunn, Boston Medical and Surgical Journal, 1908).

Anterior Poliomyelitis.

As a result of a request made by the Board to the last Legislature, a further appropriation of $10,000 was made for the study of anterior poliomyelitis, and this study has been carried on in 1913 along three general lines: —

1. The cases have been studied clinically by Dr. Carl TenBroeck and Dr. Arthur L. Reagh, acting as special investigators for the Board, and also, in a number of instances, by the local State inspectors of health.
2. Animal paralyses have been studied in the laboratory of Dr. Theobald Smith.
3. Experiments looking to a repetition of the positive results obtained in 1912 by Prof. Milton J. Rosenau with the bites of the stable fly (*Stomoxys calcitrans*). (See supplement.)

Ophthalmia Neonatorum.

During 1913 the Board has continued its intensive work for the prevention of blindness occurring as a result of ophthalmia neonatorum. This work, carried out through the State Inspectors of Health, has been of the greatest importance and of a most far-reaching character. In this place it is necessary only to state that as a result of this campaign, carried on since 1909, the announcement could be made in 1913 by Mr. Henry Copley Greene, field agent for the Commission for the Blind, that the cases of blindness in Massachusetts due to ophthalmia neonatorum in 1912 was but one-half of the number due to the same cause in 1911. Further details concerning this campaign will be found in that portion of the supplement dealing with the State Inspectors of Health.

The Maintenance of Isolation Hospitals by Cities and Towns.

The establishment and maintenance of isolation hospitals by cities and towns for the better control of diphtheria, smallpox, scarlet fever and tuberculosis, etc., have been increasing slowly during the past few years. Certain cities, however, having shown themselves negligent in establishing such hospitals, it was voted at a meeting of the State Board of Health, held Dec. 4, 1913, that the following letter be sent to the Attorney-General of the Commonwealth; and as a result of this letter the Attorney-General has inaugurated proceedings against these two cities with the view to compelling them to establish and maintain such hospitals: —

Dec. 4, 1913.

Hon. James M. Swift, *Attorney-General, State House, Boston, Mass.*

Dear Sir: — The cities of Lowell and Gloucester have been requested by the State Board of Health to establish and maintain hospitals for the reception of persons suffering from diseases dangerous to the public health as defined by the State Board of Health, and have thus far failed to comply with this request, made in accordance with chapter 613 of the Acts of 1911, as amended by chapter 151 of the Acts of 1912. The dates of these requests are as follows: Lowell, on Dec. 9, 1911, and Dec. 9, 1912; Gloucester, on Dec. 9, 1912, and Aug. 12, 1913.

The State Board of Health, therefore, respectfully calls the attention of the Attorney-General to the facts above stated, with the recommendation that such action be taken as will bring about the establishment in these cities of such hospitals.

Your very truly,

Mark W. Richardson,
Secretary.

Venereal Diseases.

During 1913 there has been a marked increase in the interest taken in venereal disease and its relation to the public welfare. It seems highly desirable that such disease should be made reportable under certain restrictions. In fact, such reporting has been inaugurated in the States of California and Vermont, and also in the city of New York.

Chapter 670 of the Acts of 1913 would give the State Board of Health the power to require the notification of such diseases, but before determining whether or not such reporting should be made obligatory it seems essential that laboratory facilities for the proper diagnosis of these diseases should be provided.

The Board therefore recommends that an increased appropriation of $4,000 be made in order that these laboratory facilities for the diagnosis of venereal disease may be installed.

The Work of the State Inspectors of Health and Their Salaries.

The work of the State Inspectors of Health has increased by leaps and bounds during the past few years, but the remuneration for these services has by no means kept pace with the character of the work done.

When originally appointed the State Inspectors of Health were expected to devote approximately one-half of their time to the service of the State. As a matter of fact, however, this service has in practically all instances required their undivided attention.

It seems highly desirable, therefore, that such of these inspectors as are willing to give their entire time to health work should be recompensed accordingly, and it is recommended that for this purpose an increased appropriation of $10,000 be made for the year 1914.

Dangers incurred through Transportation by Common Carriers of Persons afflicted with Contagious Disease.

In two instances, at least, during the past year the notice of the Board has been called to dangers inflicted upon persons transported by common carriers through the almost willful negligence of physicians who have sent patients suffering from diphtheria and scarlet fever to neighboring towns on railroad trains and trolley cars.

A review of the law shows no remedy or penalty for such action. The Board therefore strongly recommends that legislation be enacted which shall protect as far as may be possible the traveling public from persons suffering from contagious disease.

Food and Drug Department.

The work of the food and drug department has increased markedly the past few years, and it seems desirable at this time to increase the number of traveling inspectors to five. To cover the salary and incidental expenses relating to such an extra inspector an increased appropriation of $3,500 is considered advisable.

Food Regulations made by Cities and Towns.

Chapter 448 of the Acts of 1912 (amending section 70 of chapter 56, Revised Laws) makes it obligatory upon cities and towns to submit to the State Board of Health for its approval any regulations they may make as to the control of the sale of food products. As a result of this requirement a considerable number of cities and towns have submitted drafts of food regulations, and these have, in the great majority of instances, been approved. Such food regulations have been submitted by the following cities and towns: —

Boston: milk regulations and ice-cream regulations approved Jan. 2, 1913; regulations concerning foodstuffs approved Feb. 6, 1913.
Brockton: milk regulation approved Sept. 4, 1913.
Fall River: food regulations approved Aug. 7, 1913.
Lawrence: milk regulation approved Aug. 7, 1913.
Lynn: regulation for foodstuffs approved May 1, 1913; amendment to food regulation approved June 5, 1913.

New Bedford: food regulations although submitted in 1913 were not approved until Jan. 1, 1914.
North Andover: food regulations approved June 5, 1913.
Peabody: food regulations approved May 1, 1913.
Pittsfield: food regulation approved June 5, 1913.
Plymouth: food regulation approved June 5, 1913.
Revere: food regulation approved Jan. 2, 1913.
Salem: food regulations approved May 1, 1913; amendment to food regulations approved June 5, 1913.
Waltham: food regulations approved Feb. 6, 1913.
Winchester: food regulations approved July 3, 1913.
Winthrop: food regulations approved Aug. 7, 1913.

New Legislation.

Acts of 1913, Chapter 210.

An Act to provide for the Reporting of Deaths from Diseases Dangerous to the Public Health.

Be it enacted, etc., as follows:

The board of health in cities, and in towns, the board of health, or, where no such board is chosen, the selectmen acting as a board of health, shall send to the state board of health every week a report of the deaths in their city or town, for the week ending Saturday noon, from all diseases declared by the state board of health to be dangerous to the public health, upon forms to be prescribed by said state board. [*Approved February 28, 1913.*

This legislation should be of great assistance to the Board in locating cases of notifiable disease, for it happens not infrequently that the first notification received as to the presence in a locality of communicable disease appears in the death returns.

Acts of 1913, Chapter 328.

An Act to authorize Counties to establish and maintain or to provide Bacteriological Facilities.

Be it enacted, etc., as follows:

Section 1. For the better preservation of the public health and for the purpose of securing greater accuracy in the diagnosis of communicable diseases, county commissioners are hereby authorized to establish and maintain bacteriological laboratories, or to provide such laboratory facilities for their respective counties, from time to time, as may be deemed advantageous by them, and for this purpose may expend such sums as may be necessary from the treasury of the county.

Section 2. No expenditures shall be made under the provisions of this act until the laboratories or the laboratory facilities established or provided in accordance herewith have been inspected and approved by the state board of health.

SECTION 3. This act shall take effect upon its passage. [*Approved March 21, 1913.*

This act has already been made use of in the western part of the State by the establishment of a county laboratory in Pittsfield for the diagnosis of communicable diseases. In this way unavoidable delay incident to the service maintained by the State Board of Health in Boston is eliminated.

ACTS OF 1913, CHAPTER 538.

AN ACT RELATIVE TO THE SALE OF EGGS TAKEN FROM COLD STORAGE.

Be it enacted, etc., as follows:

SECTION 1. Whenever eggs that have been in cold storage are sold at retail, or offered or exposed for sale, the basket, box or other container in which the eggs are placed shall be marked plainly and conspicuously with the words "cold storage eggs", or there shall be attached to such container a placard or sign having on it the said words. If eggs that have been in cold storage are sold at retail or offered or exposed for sale without a container, or placed upon a counter or elsewhere, a sign or placard, having the words "cold storage eggs", plainly and conspicuously marked upon it, shall be displayed in, upon or immediately above the said eggs; the intent of this act being that cold storage eggs sold at retail or offered or exposed for sale shall be designated in such a manner that the purchaser will know that they are cold storage eggs. The display of the words "cold storage eggs", as required by this act, shall be done in such a manner as is approved by the state board of health.

SECTION 2. Violation of any provision of this act shall be punished by a fine of not less than ten dollars nor more than five hundred dollars for each offence. [*Approved April 25, 1913.*

In accordance with this law the Board made, on June 5, 1913 (modified Aug. 7, 1913), and on Oct. 10, 1913, rules and regulations relative to the sale of eggs taken from cold storage. Under this law and the above-mentioned regulations, 72 prosecutions were maintained (from Oct. 6 to Nov. 30, 1913) by the Board with success, so that at the present time persons buying eggs may be reasonably certain as to the character of the goods sold. Details of this portion of the Board's work will be found in the supplement.

At a meeting of the State Board of Health held Aug. 7, 1913, it was voted to modify the regulation made June 5, 1913, to read as follows: —

The sign or placard required by section 1 of chapter 538 of the Acts of 1913 to be placed upon or immediately above cold storage eggs, or upon the basket, box or other container in which cold storage eggs are placed, shall consist of the words "Cold Storage Eggs" printed in uncondensed Gothic type, in letters not less than one inch in height, printed in black on a white background, no other lettering to appear on or to be attached to said sign or placard. (This sign or placard to be used only where eggs are offered or exposed for sale.)

On Oct. 10, 1913, the State Board of Health voted to make the following additional regulation concerning the proper marking of cold storage eggs when sold to a purchaser: —

The marking required by section 1 of chapter 538 of the Acts of 1913, to be placed upon the bag, basket, box or other container in which cold storage eggs are placed, after having been sold to a purchaser, shall consist of the words "Cold Storage Eggs" printed or stamped in uncondensed Gothic type, in letters not less than one-half inch in height, in black, purple or red ink, no other lettering to appear in connection with the words "Cold Storage Eggs". (This method of marking to appear on the bag, basket, box or other container in which eggs are delivered to the purchaser.)

Acts of 1913, Chapter 722.

An Act to prohibit the Manufacture, Sale and Use of Golf Balls containing Explosives.

Be it enacted, etc., as follows:

Section 1. It shall be unlawful to manufacture or sell or knowingly to use in this commonwealth, or to have in possession for the purpose of sale, any golf ball containing any acid, fluid, gas or other substance tending to cause the ball to explode and to inflict bodily injury.

Section 2. Whoever violates any provision of this act shall be punished by a fine not exceeding five hundred dollars for a first offence, and for any subsequent offence by a fine not exceeding one thousand dollars, or by imprisonment for a term not exceeding one year, or by both such fine and imprisonment. [*Approved May 28, 1913.*

This act was made necessary by the fact that a number of persons had been injured, especially as regards their eyesight, from the explosion of these specially prepared golf balls. An investigation of certain golf balls made by the analyst of the Board showed the following results: —

Exploding Golf Balls as a Cause of Accidents.

Two cases of injury to eyesight have come to the notice of the State Board of Health recently through the explosion of certain varieties of golf balls. It seems that in the manufacture of these balls a small rubber bag about 1 inch in diameter is filled with solutions of differing type. The bag is then wound with rubber thread until it has become nearly as large as is desired in the finished product. It is then placed in the gutta-percha cover. The rubber windings cause great pressure upon the bag, and if this pressure is relieved at one point by cutting, the bag bursts and in the bursting the contained solution is scattered into the face of the person holding it. In view of these accidents the chief analyst of the Board has examined a number of golf balls, and those thus far discovered with liquid centers are given in the list below: —

Name.	Manufacturer.	Nature of Center.
The Colonel (Star), . .	St. Mungo Manufacturing Company, . .	Zinc chloride solution.
The Colonel (Arch), . .	St. Mungo Manufacturing Company, . .	Zinc chloride solution.
Water Core, ...	St. Mungo Manufacturing Company, . .	Water.
Zodiac, ...	Martins, England, ...	Soft soap and talc.
Bantam, ...	Goodrich Company, ...	Soft soap and red lead.

Acts of 1913, Chapter 272.

An Act relative to the Adulteration of Drugs.

Be it enacted, etc., as follows:

The first paragraph of section eighteen of chapter seventy-five of the Revised Laws is hereby amended by striking out the words "falls below", in the eleventh line, and inserting in place thereof the words: — differs materially from, — so that the said first paragraph will read as follows: — A drug shall be deemed to be adulterated: 1. If, when sold under or by a name recognized in the United States pharmacopœia, it differs from the standard of strength, quality or purity prescribed therein, unless the order therefor requires an article inferior to such standard or unless such difference is made known or so appears to the purchaser at the time of the sale. 2. If, when sold under or by a name not recognized in the United States pharmacopœia but which is found in some other pharmacopœia or other standard work on materia medica, it differs materially from the standard of strength, quality or purity prescribed in such work. 3. If its strength, quality or purity differs materially from the professed standard under which it is sold. [*Approved March 8, 1913.*

This change in the law was made necessary because of the fact that certain morphine tablets were found to contain more morphine than was stated upon the label, with the result that acute opium poisoning occurred in one instance.

Water Supply and Sewerage.

The State Board of Health presents herewith a report of its doings for the year ending Nov. 30, 1913, under the provisions of laws relating to the protection of the purity of inland waters, as required by chapter 75, section 115, of the Revised Laws.

The Board has received during the year 211 applications for advice with reference to water supply, sewerage, sewage disposal and matters relating thereto, a much larger number than in any previous year. Of these applications, 139 were in relation to water supply, 19 to sources of ice supply, 34 to sewerage, drainage and sewage disposal, 4 to the pollution of streams, and 15 to miscellaneous matters.

Water Supplies.

Public water supplies were introduced during the year in the towns of Agawam, East Longmeadow, Egremont (village of South Egremont), Mattapoisett, Warren (village of West Warren) and West Brookfield.

Of the 353 cities and towns in the State, 207, containing by the census of 1910 a population of 3,205,835, are provided with public water supplies. The remaining towns, 146 in number, contained by the census of 1910 a population of 160,581. There are only 6 towns in the State, having a population in excess of 2,500, which are not provided with public water supplies, viz., Dartmouth, Somerset, Sutton, Templeton, Tewksbury and Westport.

Of the 207 cities and towns having public water supplies, 164 are supplied wholly or in part from municipal or district works, while 43 are supplied by water companies.

The sources of supply used during the last year included 63 natural lakes, 78 artificial storage reservoirs, and 110 systems of ground water supply, the total number of separate sources used being approximately 300. Temporary sources of water supply were used in several places, under the provisions of chapter 25, section 35, of the Revised Laws, during the dry weather of the summer and autumn.

A severe epidemic of gastroenteritis, traced to the municipal water supply, occurred in the town of Peabody in the early part of October, 1913. As many as 500 cases were investigated by the inspectors of the Board, and doubtless a very much larger number of persons was affected by the disease. The cases were most numerous in the early hours of October 4, and an investigation was begun at once.

Bacterial analyses of the water supply on that day showed the presence of an unusual number of bacteria in Spring Pond and in the water from taps in the town, including those characteristic of sewage.

An examination showed the presence of polluting matter on the shores of the lake, especially about the ice houses, but also at other points, and that the shores of the lake were frequented by fishermen and others, as well as by employees about the ice houses.

In accordance with the recommendations of the Board, the water of Spring Pond was shut off, the pipe system flushed, and the town supplied from Suntaug Lake. The shores of Spring Pond and the region about it were then carefully cleaned, traces of pollution removed, and a thorough inspection instituted to prevent further contamination. The epidemic quickly subsided and, though a great number of persons was affected, no deaths occurred, and there was no sickness at any later time traceable to this cause.

This epidemic illustrates the great danger that may result from using a pond, from which water is supplied directly for drinking, for the purpose of fishing and ice supply.

Rainfall and Stream Flow in 1913.

Judging from the records of the Sudbury River watershed, the rainfall for the year 1913 was less than the normal in January, February, June, July, August and November; it was considerably in excess of the normal in March and October and differed but little from the normal in April, May, September and December. Owing to the low rainfall of the summer months, the flow of the streams was very low, the flow in July and August being slightly lower than in the corresponding months of the previous year, though not as low as in the summer of 1910.

Sanitary Protection of Public Water Supplies.

Under the authority of chapter 75, section 113, of the Revised Laws, regulations have been made during the year for the sanitary protection of Asnebumskit Brook, used as a source of water supply for the city of Worcester. Up to the present time, the Board has made rules and regulations for the sanitary protection of the sources of water supply of the following cities and towns: —

Abington and Rockland.
Amherst.
Andover.
Attleborough.
Braintree.
Brockton and Whitman.
Cambridge.
Chicopee.
Concord.
Danvers and Middleton.
Easthampton.
Fall River.
Falmouth.
Fitchburg.

Gardner.
Great Barrington (Housatonic).
Greenfield.
Haverhill.
Hingham and Hull.
Holyoke.
Hudson.
Lincoln and Concord.
Lynn.
Marlborough.
Maynard.
Montague.
Northampton.
North Andover.
Northborough.
Norwood.
Peabody.
Pittsfield.
Plymouth.
Randolph and Holbrook.
Rockport.
Russell.
Salem and Beverly.
Springfield.
Springfield and Ludlow.
Stockbridge.
Taunton.
Wakefield.
Westfield.
West Springfield.
Weymouth.
Winchester.
Worcester.

In making such regulations, it has been the custom, acting under the provisions of chapter 467 of the Acts of the year 1907, to delegate to local authorities the granting or withholding of permits for boating, fishing and ice cutting upon the ponds and reservoirs used as sources of domestic water supply; but the act provides that in case of complaint as to the granting or withholding of such permits, the Board may, upon appeal of any aggrieved party, make such orders relating thereto as the public health requires.

Supervision of Water Companies.

Under the provisions of chapter 319 of the Acts of the year 1909, entitled "An Act to provide for the supervision of water companies by the state board of health," the Board is authorized to investigate complaints in writing relative to the service furnished in any city or town, or the charges therefor, etc., and to make "such recommendations concerning the reduction, modification or continuation of such charges for service, or concerning improvements in the quality of the service or extensions of the same, or concerning other matters in the premises, as the board shall deem just and proper." In 1913 a further act was passed, entitled "An Act relative to the regulation and supervision of water companies," which requires that the Board shall furnish advice to the Commissioner of Corporations for his guidance in proceedings relating to the petition of any water company for authority to issue capital stock or bonds.

Under these laws the Commissioner of Corporations has been advised as to the issue of bonds by the Cohasset and the Weston water companies.

Early in the year a petition was received from the board of selectmen of the town of Great Barrington protesting against the condition of the water supplied by the Housatonic Water Works Company in the village of Housatonic in that town, and after an examination the Board recommended an investigation to determine a practicable plan for improving the quality of the water. Subsequently a plan was presented, but after consideration of the plan further time for the study of the problem seemed desirable, the results of which had not been completed at the end of the year. The action of the Board in the matters presented is as follows: —

April 3, 1913.

To the Board of Selectmen of the Town of Great Barrington.

Gentlemen: — In response to your petition for an examination of the water supplied by the Housatonic Water Works Company with a view to improving its condition and making it satisfactory for domestic purposes, the Board has caused the source of supply of the company to be examined and has investigated the ability of the company to construct works necessary for improving the quality of the water.

It is probable, in the opinion of the Board, that the water of Long Pond, now used for the supply of Housatonic, can be improved and rendered satisfactory by filtration through sand, and it is likely that this plan would prove the most economical and otherwise satisfactory one for securing a good water supply for the village. The Board has recommended that investigations be made by the company to determine the cost of such improvement. A copy of this recommendation is appended.

As soon as this information has been received, the Board will consider what changes, if any, may be required in the charges for water by the company to enable it to carry out the necessary improvements.

April 3, 1913.

To the Housatonic Water Works Company, Housatonic, Mass.

Gentlemen: — In response to a petition from the selectmen of the town of Great Barrington protesting against the present condition of the water supplied by the Housatonic Water Works Company, the Board has caused the source of water supply used by the company to be examined by one of its engineers and samples of the water from these works to be analyzed.

The results of the examination show that the condition of this supply is much the same as at the time of the previous investigation. The water of Long Pond, the source from which the supply is taken, is affected by the presence of considerable numbers of microscopic organisms of a kind which impart to the water a disagreeable taste and odor, and it is to the presence of these organisms that the objectionable condition of the water in the past few months has been due. The conditions are much the same as at the time of the previous examination in 1911, when the Board suggested that you investigate the condition of the bottom and shores of the pond in order to determine the practicability of improving the condition of the water by cleaning the shores and bottom or by lowering the level of the water, and also that you investigate the probable cost of purifying the water by filtration. A copy of the recommendations made by the Board at that time is appended hereto.

A further examination of the condition of the pond indicates that it is shallow, that the bottom is covered largely with mud, and it is probable that the best practicable and least expensive plan of improving the quality of this water will be by filtration through sand. The income of the company, judging by the examinations made by the Board, appears to be sufficient to enable it to construct suitable works for the satisfactory purification of this water, provided it shall be found that such works can be constructed at reasonable cost, and at the same time enable the company to pay interest upon its bonds, a reasonable dividend on the stock, and provide a proper depreciation fund.

The Board recommends that you cause an investigation to be made and plans prepared by an engineer of experience in such matters, to determine the practicability and the probable cost of purifying the water of Long Pond by filtration through sand. The Board further recommends that the investigation be made at the earliest practicable time and that as soon as plans and estimates of cost are available, they be submitted for the consideration of the Board. In the opinion of the Board, the time required for the necessary investigations and the preparation of plans under the existing circumstances should not exceed two months. Upon receipt of this information, the Board will consider what changes, if any, may be advisable in the charges for water to enable the company to improve satisfactorily the quality of its supply.

Nov. 6, 1913.

To Hon. William D. T. Trefry, *Commissioner of Corporations.*

Dear Sir: — The State Board of Health has considered your application for advice as to the amount of stock and bonds which is reasonably requisite to be issued by the Weston Water Company, and has caused the works to be examined by its engineers.

According to the information presented, it appears that the petition of the water company requests authority to issue capital stock amounting to $32,500, in addition to the present capital stock of the corporation amounting to $17,500. They also petition for authority to issue $50,000 worth of bonds, making the total issue of stock and bonds $100,000.

The statement of the assets of the company, eliminating items not pertaining to the physical plant, show a value slightly exceeding $107,000. An examination of the various items making up this value indicates that they are reasonable, and the valuation of the pipe lines, which make up more than half of the total, is low for present conditions, especially if considerable ledge was encountered in the construction of the works. The items of pumping station and machinery at the Warren Avenue works appear to be high under present conditions.

As a result of the investigations by its engineers, the Board is of the opinion that, making allowance for the greater cost of the Warren Avenue pumping station and machinery than would be required for present needs, the present value of the physical plant is $95,000.

BOSTON, Aug. 8, 1913.

To Hon. WILLIAM D. T. TREFRY, *Commissioner of Corporations.*

DEAR SIR: — The State Board of Health has considered your application for advice as to the amount of stock which is reasonably requisite to be issued by the Cohasset Water Company for certain purposes named in its petition for authority to increase the capital stock of the said company, a copy of which was submitted with your application, and in response to your request has caused the locality to be examined by its engineer and has considered the information presented as to the purposes for which the new issue of stock is to be used and the probable cost of the proposed works.

According to the information presented, it appears that the petition of the water company requests the authority to issue capital stock to the additional amount of $19,600 "for the purpose of paying for new construction work, for new piping and for the purpose of installing a new filtration plant to remove excess of iron and impurities from water."

The information as to the filtration plant indicates that it is designed to filter the water pumped from the well at Beechwood Station through a sand filter, designed by Mr. R. S. Weston, for the purpose of removing the excess of iron from the water. The capacity of the filter will differ little from similar filters already constructed at two other places in the State, and the estimated cost of the works, $17,710, should be sufficient for the purpose and is not excessive. The new construction work referred to in the petition appears upon inquiry to be the cost of laying a pipe in King Street, Cohasset, carried out last year at a cost of $5,000. This pipe was 5,000 feet in length and, considering its size and the probable character of the excavation, the work appears to have been done at a reasonable cost.

The new pipe referred to in the petition is a main pipe constructed in Pond Street, the estimated cost of which, for a length of 1,600 feet, is $3,400. Considering the character of the street in which this pipe is to be laid, the estimate appears to be a reasonable one.

As a result of the investigation by its engineers, the Board is of the opinion that the cost of the items indicated, including the 5,000 feet of pipe laid last year, is likely to exceed the amount of capital stock which the petition requests authority to issue, assuming that the work will be done in a thorough and satisfactory manner, which appears to be the intent of the company from the preparations being made for carrying out the work.

EXTENSION OF PUBLIC WATER SUPPLIES.

In the cities and larger towns of the State where water supplies were introduced many years ago, the works have been extended until the public water supply has become available to practically all of the inhabitants. In the smaller places such complete extension of the public works is very rarely the case. It is the common rule in towns supplied from municipal works, as well as those supplied from water companies, to provide water works service only in the more thickly settled areas and to extend the works in the more sparsely settled districts only to such streets and sections as are likely to furnish sufficient income to pay for the cost of construction and maintenance. Frequently, such extensions are secured through agreement with the prospective water takers that the latter will pay an aggregate amount sufficient to cover the interest on the cost of construction of the works. It sometimes happens that disagreements arise over the reasonableness of making extensions in districts in which there is a doubt as to whether the income will pay the interest on the cost of the works, and, in the cases of towns supplied by private companies, appeal is sometimes made to the Board.

In cities and towns supplied by private companies, the Board is authorized by law to advise as to the service rendered, and has in one or two cases recommended extensions where the circumstances seemed to warrant such recommendations. In the case of municipally owned works, however, no authority has been delegated to the Board by the Legislature either as to the rates or service, and in cases where extensions are desired, unless deemed reasonable by the water department of the city or town, appeal can be had only to the city council or to the authority of the town in town meeting.

It sometimes happens that water works extensions seriously needed for the protection of the public health are not made by the town when required, and in such cases there is no redress except such as may be had through appeal to the Legislature. A case of this sort, in the town of Saugus, was brought to the attention of the Board and the Board made the following recommendation: —

BOSTON, Aug. 8, 1913.

To the Baker's Hill Improvement Association, Saugus, Mass., Mr. R. J. MURPHY, *Secretary.*

GENTLEMEN: — Referring to your request for assistance in an effort to get a supply of water necessary for the daily use of the inhabitants of Baker's Hill, the State Board of Health has examined the locality and finds that a public water supply is greatly needed for the health and comfort of the inhabitants of Baker's Hill, where no public water supply is at present available.

It appears from information furnished by the Saugus water board that the elevation of Baker's Hill is such that it is impracticable to supply water from the present pipes of the town without pumping. Such cases are not uncommon among the cities and towns of the State, and in a number of such cases a water supply has been furnished by establishing a small pumping station and stand-pipe, pumping water from the mains already laid to a sufficient elevation to supply the houses above the level reached by the existing pipe system.

In order to provide such a system in this case, it will be necessary for the town to appropriate a sufficient sum of money for the purpose and to construct and operate the works.

In the cases of cities and towns supplied with water by private companies, the Legislature has given power to the State Board of Health to regulate the service, but no powers have been granted to this Board by the Legislature to regulate the service furnished the cities and towns where the water works are owned and operated by the municipality. In case of the neglect of the town to provide a water supply in the district in question, the Legislature is the only power that can supply relief. In case an appeal to the town fails, it is possible that an appeal to the Legislature would secure the necessary action.

The only action possible for this Board in the existing circumstances is a presentation of the facts to the Legislature, which the Board will make in its annual report in January, unless relief is afforded by the town before that time.

Examination of Sewer Outlets.

Under the provisions of law requiring an annual examination of main outlets of sewage and drainage and the effect of sewage disposal, the sewer outlets of the various cities and towns have been examined during the year.

The most important main sewer outlets in the State are those of the Boston main drainage and the north and south metropolitan sewerage districts, which include in the aggregate about one-third of the population of the State.

The sewage of the Boston main drainage district is discharged into tide water at Moon Island in the southwesterly part of the harbor. The total quantity of sewage discharged from this outlet amounts to about 90,000,000 gallons per day. The sewage from the Boston main drainage district is passed first through a settling tank or grit chamber before reaching the pumping station at Calf Pasture, and is subsequently stored in basins at Moon Island and discharged on the first two hours of the outgoing tide. In consequence of its storage before disposal, the sewage is given far greater opportunity for decomposition than the sewage discharged at the main outlets of the metropolitan systems.

The conditions about the Moon Island outlet have been subject to frequent and regular examination for many years. From time to time chemical and bacterial examinations are made of the waters into which this sewage is discharged, both during the period when the sewage is being discharged and in the intervening periods between discharges. The tidal current into which this sewage is discharged is of no great volume and velocity, and the rate of discharge, amounting to 20,000,000 gallons per hour, is from six to ten times as great as at the outlets of the metropolitan sewerage districts, where the discharge is continuous throughout the twenty-four hours. Very little change has been noted in the conditions about this outlet since it was first put in operation thirty years ago.

The sewage of the north metropolitan sewerage district is discharged at Deer Island Light, on the northerly side of the entrance to Boston harbor, at all stages of the tide, the quantity discharged there in 1913 amounting to an average of about 56,000,000 gallons per day. The tidal currents passing this outlet are much larger in volume and have a considerably higher velocity than those passing the outlet at Moon Island, while the rate of discharge is much less, amounting to only about 2,300,000 gallons per hour. The sewage is much fresher, and the area affected by the discharge at this outlet much smaller, than at Moon Island. The outlet is located very close to Deer Island Light and, while the sewage ordinarily disappears very quickly within a short distance of the outlet, the odors are, nevertheless, objectionable to the keepers of the light. There is no question that such objection could be removed, and the disposal of the sewage confined to an even smaller area than at the present time, by extending the outlet into deep water, which can be reached by a short extension of the main outfall sewer.

The Deer Island outlet has been in constant use for over twenty years, and frequent examinations of the locality and analyses of the water of the harbor in its neighborhood show that no material change in the conditions has taken place there.

The sewage of the south metropolitan district is discharged into the great channel known as Nantasket Roads, north of Peddock's Island, at all stages of the tide. Here also the tidal volumes and velocities are much greater than at Moon Island, and, while the total quantity of sewage discharged in 1913 amounted to about 50,000,000 gallons per day, or about 60 per cent. of the amount discharged at Moon Island, the actual rate of discharge is only about 2,100,000 gallons per hour, and the area of sea water visibly affected by the sewage is comparatively insignificant. The outlet is a very satisfactory one, and nowhere else in the State is so great a quantity of sewage disposed of effectually and without objection in so small an area.

No material change has occurred during the year in the conditions affecting the outlets of sewers at New Bedford and Fall River. At New Bedford the main sewerage works are rapidly approaching completion, and it is expected that they will be put in operation during the coming year. When these works have been completed they will afford a means for diverting the sewage from the numerous outlets into New Bedford harbor and Clark's Cove which now cause most serious nuisances in those waters. At Fall River the sewage continues to discharge into the Taunton River and Mount Hope Bay from several independent outlets, which are located upon or very near the shores of the river or bay. The conditions about many of these outlets are objectionable and could be relieved by the construction of extensions which would discharge the dry-weather flow of sewage at a reasonable distance from the shore.

Plans for the improvement of the sewage-disposal system of the city of Lynn were rejected by vote of the inhabitants of the city toward the end of the year, and new plans will be required before it will be practicable to prevent the serious nuisance in Lynn harbor caused by the present main sewer outlet of the city.

No change has been made during the year in the sewer outlet at Beverly, though the question of improving the conditions at this outlet has been under consideration by the city for several years.

The sewage of the city of Salem and town of Peabody is discharged into the sea near Great Haste Island in Salem harbor and, as the outlet is close to the surface of the sea, the sewage spreads at times over a wide area. Such objectionable conditions as are noted about this outlet could undoubtedly be prevented by extending it to deep water, which can be reached at a point about half a mile east of Great Haste Island.

One of the most satisfactory sewer outlets in the State is that of the town of Swampscott, sewage from which is discharged into the sea at Dread Ledge at a point where the water is 60 feet in depth. It is very difficult to find any traces of sewage in the water immediately over this outlet.

The conditions about the sewer outlets into the principal rivers of the State have been examined during the year and will be referred to in describing the condition of the rivers.

Sewage-disposal Systems.

There are 32 cities and towns in the State which have provided works for purifying their sewage or subjecting it to some form of treatment for the removal of organic matters before final disposal. These cities and towns are the following: —

Amherst.	Clinton.
Andover.	Concord.
Attleborough.	Easthampton.
Billerica.	Framingham.
Brockton.	Franklin.

- Gardner.
- Hopedale.
- Hudson.
- Leicester.
- Lenox.
- Longmeadow.
- Marion.
- Marlborough.
- Maynard.
- Medfield.
- Milford.
- Natick.
- North Attleborough.
- Northbridge.
- North Brookfield.
- Norwood.
- Pittsfield.
- Southbridge.
- Spencer.
- Stockbridge.
- Westborough.
- Worcester.

The sewage-disposal systems have been examined from time to time during the year, and recommendations have been made and advice given in cases where the condition of the works was found to require improvement.

Great improvement has been effected in recent years in the operation of the works for purifying the sewage at Marlborough, Clinton, Hudson, Natick and Westborough, and these improvements have been maintained throughout the past year. There has also been an increase in efficiency in the operation of the works for the disposal of the sewage at Hopedale, and considerable work has been done in reconstructing underdrains at the disposal works of the town of Andover.

On the other hand, there has been a material deterioration in the efficiency of the disposal works of the town of Framingham, one of the oldest plants in the country, where for many years the sewage was well purified. The deterioration is due to lack of care in the maintenance of the works, and recommendations of the Board as to securing more satisfactory operation of the filters have not been followed.

At several of the other works, namely, those at Amherst, Gardner, Leicester, Lenox, Longmeadow, Medfield and Southbridge, the efficiency is low on account of lack of attention in the operation of the works or of lack of funds for maintenance.

The new works for the purification of the sewage at Fitchburg were under construction during the year, and it is expected that they will be available for use in 1914. The works under construction consist of a system of settling tanks and trickling filters, followed by sedimentation of the effluent, with provision for ultimate filtration through sand if found necessary.

A trickling filter has also been added to the purification works at Brockton and was first operated near the end of the year.

Unsanitary Conditions due to Lack of Sewerage.

In the annual report of the State Board of Health for 1911 a table is given, showing the cities and towns having and not having systems of sewerage at that time. From that report it appears that there were then 10 towns, having populations in excess of 6,000, in which no provision for the collection and disposal of sewage had been made. These towns are the following: —

Town.	Population in 1910.	Town.	Population in 1910.
Weymouth,	12,895	Bridgewater,	7,688
Amesbury,	9,894	Marblehead,	7,338
Danvers,	9,407	Whitman,	7,292
Braintree,	8,066	Rockland,	6,928
Saugus,	8,047	Stoughton,	6,316

During the past year the town of Amesbury has completed a system of sewerage, and steps have also been taken looking to the construction of a sewerage system in the town of Braintree, but in most of the other towns conditions, caused by lack of sewerage, are in many cases very objectionable. The most notable of these are the conditions at Rockland, Stoughton, Danvers and Weymouth, in all of which towns there are serious nuisances which are difficult and in most cases impracticable of removal until a sewerage system has been provided.

The attention of the town of Rockland has been called repeatedly to the extremely objectionable conditions existing in the thickly settled portions of that town on account of overflow of cesspools and other serious nuisances which it is impracticable to relieve. In other places — notably Stoughton and Danvers — the streams and water courses flowing through the towns, and other waters adjacent thereto, are badly polluted with sewage. There is no practicable way of maintaining proper sanitary conditions in the thickly populated portions of these towns unless sewers shall first be provided.

Pollution of Streams.

Assabet River.

The chief pollution of the Assabet River at the present time is caused by the discharge of manufacturing waste from the woolen mills at Maynard. The Board has repeatedly urged the construction of works for the purification of wastes from this establishment, and a beginning has at last been made on this important improvement. During the year large tanks for the collection and sedimentation of the wastes have been constructed, and plans have been made to construct drains to convey the various wastes to the tanks. The work has progressed slowly, and no improvement in the river has yet been effected, its condition during the past year being about the same as in other recent years.

Charles River.

The Charles River receives at the present time comparatively little pollution. One of its tributaries, flowing through the town of Franklin, is considerably polluted, but plans have been prepared for the collection and proper disposal of the sewage and objectionable wastes that enter the stream in that town, and preparations are being made for constructing the works in the near future. With the removal of the pollutions in this town, the river will be quite free from contamination throughout the greater part of its course.

Small amounts of polluting matter find their way into the stream from factories in Newton, Waltham and Watertown, and from the overflows of sewers in Brighton, Cambridge and Boston, but in general the pollutions are local in character and the general condition of the river is good.

Chicopee River.

The Chicopee River, formed by the junction of the Ware, Quaboag and Swift rivers in the westerly part of the town of Palmer, is used as a place of disposal for the sewage of Ludlow and portions of the cities of Springfield and Chicopee.

Objectionable conditions have been created at three or four points along the river by local sewer outlets, but action by the local authorities, especially in Chicopee, has already relieved the more objectionable conditions in this stream, and its condition as a whole is not objectionable.

Concord River.

While two of the main tributaries of the Concord River, the Assabet and Sudbury rivers, are considerably polluted at one or two points, the main river receives no important pollutions between Concord and the city of Lowell. In the course of the river through the latter city, however, it receives much pollution from sewage and manufacturing waste, and its condition is at times objectionable.

The stream has been carefully examined, the sources of pollution located, and plans for the prevention of these objectionable conditions have been recommended to the authorities of the city of Lowell, within the limits of which these objectionable conditions were found.

Connecticut River.

This stream is the largest river in the State and receives directly the sewage of all of the cities and most of the towns on its banks, including Turners Falls in Montague, Hatfield, South Hadley, Holyoke, Chicopee, Springfield and West Springfield, and sewage is also discharged into a number of its tributaries very close to the main stream. Notwithstanding the large amount of sewage which the river receives, the quantity is small as compared with the flow of this large river, and its effect on the condition of the water is noticeable only in the neighborhood of some of the sewer outlets in the cities along its course.

While considerable improvement has been made in recent years in sewerage systems along the river, notably at Chicopee, where the principal sewer outlet has been extended into the stream so as to relieve a serious nuisance in this neighborhood, further improvement is desirable at a number of other places along the river where sewage is discharged either upon the banks or in their immediate neighborhood, causing the fouling of the shores at times of low water.

French River.

This stream is badly polluted, chiefly by manufacturing waste, at several points along its course, the most objectionable condition being found below Webster, where the river is polluted both by the sewage of the town and by a very large quantity of manufacturing waste from the large woolen mills at this place. The condition of the river below Webster, and as it crosses the State line into Connecticut, has become objectionable.

Hoosick River.

This river is one of the most seriously polluted streams in the State, and its condition in 1913 has remained about the same as in former years. Its pollution is caused chiefly by sewage from Adams, North Adams and Williamstown, and its condition is most objectionable below the main sewer outlet of the city of North Adams.

Housatonic River.

The results of chemical analyses of samples of water from this river at various points show a marked increase in the pollution of the stream below Pittsfield in 1913 as compared with former years.

The sources of pollution of this river were carefully investigated during the year, the results showing that the chief source of pollution is the sewage of the city of Pittsfield, a large part of which has been discharged untreated directly into the stream. The pumping works for conveying the sewage of this city to a filtration area in the valley of the river 2 miles below are inadequate for the purpose, and an enlargement of the filtration area will be necessary to care properly for all of the sewage. As a result of its investigations, the Board made the following recommendations to the city of Pittsfield: —

Sept. 22, 1913.

To the Board of Public Works, Pittsfield, Mass.

Gentlemen: — Recent examinations of the Housatonic River show that through increasing pollution its condition is becoming offensive, especially below the city of Pittsfield. The chief and most objectionable pollution of the river is sewage from the city of Pittsfield, a large quantity of which was being discharged untreated into the river at the time of a recent examination, contrary to the provisions of chapter 433 of the Acts of the year 1909. The growth of the city has been rapid in recent years, and the available capacity of the works for pumping the sewage to the filter beds is inadequate, under existing conditions, to care for and remove all of the sewage and prevent the pollution of the river.

The filtration works of the city have been well maintained and have produced an effluent of good quality, but the area of the filter beds is limited, and when provision is made for preventing the further overflow of sewage into the river in the neighborhood of the pumping station or above, and discharging all of the sewage upon the filter beds, the improvement of these works will be necessary for the effective treatment of all of the sewage.

The Board recommends that steps be taken at once by the city to make the necessary enlargements of its sewerage and sewage-disposal works to provide for removing all of the sewage of the city at all times to the filtration area and for its efficient purification there before discharge into the Housatonic River. The additional works should include a pumping capacity of at least 1,000,000 gallons per day in excess of the quantity cared for by the present pumps, and it is not unlikely that a still larger capacity will be necessary in order to provide for the removal of all of the sewage at times of maximum flow. The capacity of the pumping plant should be sufficient for the removal of all of the sewage at all times, and the filtration works should be enlarged sufficiently to care for the additional quantity of sewage.

While the chief pollution of the river at the present time is due to the sewage of Pittsfield, it is also polluted seriously at Dalton, in the valley of the east branch above Pittsfield, and by the sewage of the towns of Lenox, Lee and Great Barrington, together with manufacturing waste in these and other towns.

Merrimack River.

The results of a very thorough examination of the sources of pollution of the Merrimack River, together with plans and recommendations for removing the objectionable conditions found in this stream, were reported to the Legislature of 1912, and printed as House Document, No. 2050.

The investigations show in brief that the chief causes of the objectionable condition of the river are the sewer outlets in the various cities and towns along its banks and the pollution caused by wool-scouring waste in the city of Lawrence. The excessive fouling of the bed, banks and waters of the river about the sewer outlets in the cities of Lowell, Lawrence and Haverhill can readily be prevented by an improvement of these outlets, plans for which were presented in the report of last year, and these improvements can be carried out by the municipalities themselves whenever they may see fit to begin this work.

The city of Lowell has already made an excellent beginning on the work of improving its sewer outlets, and during the past year has completed the extension of the very objectionable sewer outlets at West, Fulton and Colburn streets on the north side of the river above Central bridge, so that the dry-weather flow of sewage is now discharged well beyond the low-water shore line and beneath the surface of the water at all times.

The objectionable conditions caused by the discharge of wool-scouring waste into the river from various mills in the city of Lawrence were brought to the attention of the proprietors of these mills at a conference with the Board in December, 1912. While works for treating wool-scouring wastes have already been installed at a number of wool-scouring mills in the State, no works have as yet been installed by the mills along the river at Lawrence.

During the past year experimental works were installed at one or two of the mills, and the Board is informed that further experiments are soon to be begun with a view to designing a method for removing the objectionable properties from the wool-scouring wastes. These wastes can be treated in a general system which would require collecting sewers on both sides of the river laid within the channel of the stream, and a treatment works near the river below the city, plans for which were described in the report of the Board last year and are on file in the office of the Board.

It appears to the Board advisable that a limit be placed upon the time in which these objectionable wastes shall be allowed to discharge into the stream, and that a limit of time should also be specified within which the work of improving satisfactorily the condition of the sewer outlets in the cities and towns along the river shall be completed.

Nashua River.

No improvement has taken place in the condition of the north branch of the Nashua River, which is very foul for many miles below the sewer outlets of Fitchburg and Leominster.

The construction of sewers for the removal of the sewage of Fitchburg and of works for its purification has advanced considerably during the past year, but from present appearances they are not likely to be completed before the end of 1914.

The Board has already notified the town of Leominster of the necessity of the construction of purification works by that town as soon as practicable, but, while plans of sewage-disposal works have been prepared, no further action has been taken toward removing the sewage of the town from the river and its tributaries.

Nemasket River.

This stream, a tributary of the Taunton River, is badly polluted by the sewage of Middleborough. Plans for the purification of the sewage of this town were made many years ago, but the town has never authorized the construction of the works.

Sudbury River.

This river continues to receive a large amount of pollution from the woolen mills at Saxonville, and, although plans have been prepared for the relief of this nuisance, no works for this purpose have yet been constructed.

Taunton River.

The chief pollution of the Taunton River is caused by the sewage of the city of Taunton which is discharged directly into the river in the lower part of the city. Permission to continue the use of this outlet has been extended from time to time, but, while the most recent limit expired on Dec. 1, 1913, works have not yet been constructed by the city, and a petition has been presented to the Board by the city authorities for a further extension of the period within which the river may be used for the disposal of the sewage. This petition is now under consideration. The Taunton River also receives considerable pollution by sewage in Bridgewater and several of the other towns within its watershed.

Ten Mile River.

The condition of this stream shows considerable improvement, and no doubt a much greater improvement will be effected with the extension of the sewerage systems in Attleborough and North Attleborough within the near future. During the past year its condition has been less objectionable than in earlier years.

Three Mile River.

This stream, one of the principal tributaries of the Taunton River, flowing through the towns of Dighton, Foxborough, Mansfield and Norton, and a portion of the city of Taunton, receives a large amount of pollution, and its condition below Norton, where it is seriously fouled by wool-scouring waste from a large woolen mill, has been very objectionable in recent years.

Ware River.

No material change has taken place during the past year in the condition of this stream, which is badly polluted at many points, especially in and below the town of Ware.

Other Rivers.

No material change has been noted in the condition of the other principal rivers in the State as compared with former years. Some of them receive considerable pollution, notably the Westfield River below Westfield, the Quaboag River below Spencer and at Palmer, and the Deerfield River below Greenfield, but in no case is the pollution so serious as to have caused objectionable conditions up to the present time.

North River in Salem and Peabody.

A very large amount of work has been done in the examination of manufacturing wastes from various establishments situated along the North River and its tributaries in Salem and Peabody. The main trunk sewer in this valley is designed to receive both the sewage of the municipalities and the manufacturing waste from the various factories which discharge waste of objectionable character. Soon after the construction of this sewer, a great improvement took place in the condition of the North River, but more recently there has been a serious deterioration, and the examinations of the past year show that large quantities of manufacturing waste find their way into the stream either directly or through overflows from sewers or connections.

Authority to make rules and regulations for the trunk sewer has been given the Board under the provisions of chapter 104 of the Acts of the year 1901, and authority is given to the sewer boards of the municipalities to regulate the entrance of matters into their sewers under the provisions of chapter 433 of the Acts of the year 1909.

The greater part of the manufacturing wastes are very foul in character and contain excessive quantities of suspended matter which tend to form deposits in the sewers. To prevent such deposits, settling tanks have been installed at most of the factories, but many — if not most — of these are inadequate and unsatisfactory, or inefficiently operated, so that they are of little value.

It has been necessary to examine the wastes from each process in practically all the factories and to determine the character and the means of treatment necessary to prevent deposits in the sewers. It is evident that measures must be taken to prevent the further pollution of the river, and that the collection and treatment of the manufacturing wastes and their admission to the sewers must be regulated closely if the serious pollution of the North River is to be prevented without causing excessive and unnecessary labor in the maintenance of the trunk sewer. Studies for a practicable plan of regulation have been carried on as rapidly as possible, but the problem is a difficult and complicated one on account of the great number of factories discharging foul wastes, the difficulty of collecting those which are objectionable, and the great difficulty of securing adequate and suitable areas for treatment works in a densely populated district.

Improvement of the Neponset River.

The condition of the Neponset River, judging from the averages of chemical analyses, has been somewhat less objectionable in 1913 than in the previous year, this slight improvement very likely being due largely to the reduction in the amount of business carried on at some of the factories on the river. Considerable further progress has been made in the construction of purification works at several of the factories, but some of the largest works continue to discharge great quantities of polluting matter into the river as in previous years.

In cases where there has been continued neglect either to build works or to consult with the Board concerning them, an information has been filed with the Attorney-General. Up to the end of the year nine such cases had been referred to that department.

Rapid progress has been made during the year in the deepening and improvement of the channel of the Neponset River for the purpose of draining the great area of wet meadows in the central part of its watershed, as authorized under the provisions of chapter 655 of the Acts of the year 1911. A dredging machine was installed in Hyde Park and began work Jan. 28, 1913, and later a second dredging machine was set up farther downstream. About half of the work necessary for the improvement of the river has already been completed, including a large part of the work to be done in the lower reaches of the river. The material dredged from the stream has been disposed of along the banks of the river, and no objectionable conditions have thus far arisen from this method of disposal. Comparatively little objectionable matter had deposited in this section of the river, the material removed being for the most part sand and gravel or hardpan. The inhabitants along the river, and the municipalities and corporations concerned in the structures in and about it, have in nearly all cases cordially co-operated in the work of improvement and adjusted their structures to meet the needs of the new channel. At the present rate of progress, the work is likely to be completed within the time allowed in the contract.

Pollution of the Blackstone River.

By the provisions of chapter 133 of the Resolves of 1913 an appropriation of $7,500 is made for a new sewer pipe line for the Worcester State Hospital, with the proviso "that no part of the amount authorized for a new sewer pipe line at the Worcester state hospital, to connect said hospital with the Worcester system of sewerage, shall be used or expended unless the state board of health, after making a thorough investigation of the sewerage conditions of the Blackstone river, the results of which shall be reported to the general court in January, nineteen hundred and fourteen, shall certify to the auditor of the commonwealth that the area of filter beds for the purification of the sewage of the city of Worcester has been enlarged to an extent necessary to filter the additional sewage to be discharged from the said Worcester state hospital, and that in their opinion the city of Worcester has taken or is taking such action in relation to the purification of its sewage that it is desirable from the point of view of the public health that the Worcester state hospital shall be connected with the sewerage system of the city of Worcester."

In accordance with the provisions of this resolve, the condition of the Blackstone River has been carefully investigated during the year and samples of the water of the river and of the sewage and manufacturing waste, discharging into the stream at various points, have been analyzed.

The results of the examination show that the river is polluted to such an extent as to be objectionable below the Cherry Valley district in Leicester and for a distance of several miles below the sewage treatment works in the city of Worcester. The causes of the objectionable pollution of the river are sewage and foul wastes from factories and mills. Sewage is discharged into the river at numerous places along its course and into the tributaries of the river at various points. The most important of the pollutions of the river is that which is caused by the sewage and effluent from the sewers and sewage treatment works of the city of Worcester. These works were first put into operation in 1890 in accordance with the provisions of an act of 1886 requiring the purification of the sewage of the city before its discharge into the river. The original works provided for the chemical precipitation of the sewage, the effect of which was to remove about half of the organic matter from the sewage treated, including nearly 90 per cent. of the suspended matter, but the works treated only the dry-weather flow of sewage, and the excess at times of storm continued to discharge into the river. Subsequently, in 1893, the precipitation works were enlarged, and in later years sand filters were added from time to time until they comprise at present an area of 73 acres.

In 1886, at the time the law was passed requiring the treatment of the sewage, the total length of sewers in the city of Worcester was 56.41 miles, while in 1913 the mileage of sewers and surface drains had increased to 222.2 miles. In earlier times the sewers were constructed on the combined plan, but the separate system has been employed for many years, and at the present time approximately 70 per cent. of the sewers are operated on the separate plan. The combined sewers, which receive both sewage and rain water, had an aggregate length in 1913 of 68.7 miles, and are provided with overflows into Mill Brook and the Blackstone River, through which a part of the mingled sewage and rain water overflows at times of storm and is not treated at the purification works. The quantity of sewage discharged directly into the river in this way cannot be definitely stated, but it is probably a small percentage of the total quantity.

The works are carried on under expert supervision, and careful records of their operation are maintained and published. The following information has been supplied relative to the quantity of sewage treated at the purification works in 1913: —

	Million Gallons. Total.	Million Gallons. Daily.	Per Cent. of Total.
Chemical precipitation,	5,170	14.16	78.2
Sand filtration,	1,408	3.86	21.3
Experimental treatment,	32	0.09	0.5
Total,	6,610	18.11	100.0

It further appears that the strongest sewage was treated by sand filtration, as far as the area was capable of receiving it, because that method of treatment gives the highest degree of purification. The remaining sewage was treated by chemical precipitation, with the exception of the small quantity used in the experimental works.

The results of the treatment of the sewage are carefully observed by means of numerous analyses and are recorded in the reports of the department having charge of the work. The results of the analyses as presented in the last published report show that the combined sewage treatment in 1912 was as follows: —

[Parts in 100,000.]

	Ammonia.				Chlorine.	Oxygen consumed.			Average Flow per Day in Million Gallons.
	Free.	Albuminoid. Total.	Albuminoid. Dissolved.	Albuminoid. Suspended.		Total.	Dissolved.	Suspended.	
Average sewage,	2.299	.873	.374	.499	12.42	14.20	7.58	6.62	15.74
Average effluent,	1.972	.369	.305	.064	12.32	5.64	4.71	0.93	-
Per cent. removed,	14.22	57.73	18.45	87.18	-	60.29	37.86	85.94	-

The preliminary figures for the year 1913 show the following results of the treatment of sewage: —

[Parts in 100,000.]

	Ammonia.				Chlorine.	Oxygen consumed.			Average Flow per Day in Million Gallons.
	Free.	Albuminoid. Total.	Albuminoid. Dissolved.	Albuminoid. Suspended.		Total.	Dissolved.	Suspended.	
Average sewage,	2.123	.721	.349	.372	11.70	13.66	6.95	6.71	18.02
Average effluent,	1.733	.368	.300	.068	11.15	5.57	4.68	0.89	-
Per cent. removed,	18.37	48.96	14.03	81.74	-	59.26	32.68	86.74	-

The per cent. of organic matter removed from the sewage has been calculated by the sewer department of the city from year to year for many years, and the results indicate that the per cent. of organic matter removed during the year 1913, judging from the albuminoid ammonia, was less than in any previous year. The results as calculated by the sewer department of the city are shown in the following table: —

Per Cent. Organic Matter removed from Sewage.

December to July.

	1909.	1910.	1911.	1912.	1913.
Total amount (by albuminoid ammonia),	53.3	58.3	58.1	55.6	45.5
Amount in suspension (by albuminoid ammonia),	85.0	89.9	90.0	86.4	81.5
Total amount (by oxygen consumed),	57.0	60.1	61.4	56.7	43.8
Amount in suspension (by oxygen consumed),	87.8	90.9	91.0	85.4	85.6
July to December.					
Total amount (by albuminoid ammonia),	61.0	58.5	57.9	60.9	54.7
Amount in suspension (by albuminoid ammonia),	88.1	87.1	88.4	88.5	82.3
Total amount (by oxygen consumed),	69.7	62.4	61.7	64.9	65.1
Amount in suspension (by oxygen consumed),	92.5	88.5	85.8	86.6	87.9
December to December.					
Total amount (by albuminoid ammonia),	56.4	58.4	58.0	57.7	49.0
Amount in suspension (by albuminoid ammonia),	86.4	88.7	89.3	87.2	81.7
Total amount (by oxygen consumed),	61.7	61.1	61.5	60.3	59.3
Amount in suspension (by oxygen consumed),	89.8	89.7	88.8	85.9	86.7

The above figures comprise the results of both the chemical treatment and treatment by filtration.

The table indicates clearly that the efficiency of the purification has decreased materially in the past year. The necessity for enlarging the plant and improving its efficiency was referred to in the report of the superintendent of sewers for 1912 as follows: —

. . . So far as known, there have been no complaints, formal or otherwise, from the residents of the town of Millbury. From observations and tests, it is believed that the condition of the Blackstone River during the last few years has been materially better than formerly. With continued rapid growth of population and manufacturing industry, however, it is perfectly evident that it will be a matter of only a short time, when the river will show marked deterioration and afford just cause for complaint by the town of Millbury. It is therefore imperative that early steps be taken towards enlarging the plant along the lines of greatest efficiency, as indicated by the results of experiment. Meanwhile, it is highly important that the annual appropriation be made sufficient to maintain the present plant at its highest efficiency.

The annual appropriation last year was no greater than it was ten years ago, but during this time the population has increased more than 25 per cent., wages have been advanced from 15 to 20 per cent., and the price of stock and tools has likewise increased materially. It is, therefore, unreasonable to expect the plant to be operated in a most efficient manner without a decided increase in the annual appropriation. . . .

The only sewerage system of notable size in the Blackstone valley in Massachusetts, aside from the works of the city of Worcester, is that of the town of Northbridge, where the sewage of the village of Whitinsville, containing approximately 5,000 inhabitants, is collected and disposed of upon sand filters, and the effluent, which has thus far been reasonably well purified, is discharged into a tributary of the Blackstone River. While there are no systems of public sewers in the valley of the Blackstone River in Massachusetts other than those mentioned above, there are sewers serving small populations in Millbury, Grafton and Uxbridge, which discharge directly into the river.

The principal remaining sewage which finds its way into the Blackstone River or its tributaries is that which is discharged from factories and mills at widely scattered points throughout the valley, the amount of which in the aggregate is probably equivalent to the sewage from a town of 5,500 inhabitants.

Aside from the sewage of cities, towns and factories, the most important pollutions of the Blackstone River are the manufacturing wastes discharged into the stream from the numerous factories and mills located along the river and its tributaries from Cherry Valley, several miles above Worcester, to the point where the river flows out of the State at Blackstone. The manufacturing wastes are as a rule discharged into the stream at somewhat widely separated villages, and the most serious nuisance in the river, caused chiefly by these wastes, is in the village of Cherry Valley, where woolen mill waste, mingled with a small quantity of sewage, makes the river objectionable and offensive in the drier part of the year.

The causes of the nuisance were investigated by the Board in 1911, and the manufacturers advised of the necessity of taking measures to remove the objectionable conditions in this stream.

In other districts the effect of this sort of pollution is usually noticeable only for short distances in the immediate vicinity of the point at which the manufacturing waste is discharged, but, upon the main stream of the Blackstone River below Worcester, the effect of the manufacturing waste no doubt tends materially to maintain objectionable conditions in the river in that part of its course. Statistics as to the quantity and the character of the manufacturing wastes discharged into the Blackstone River and its tributaries from the mills in various towns have been summarized in the appended table.

A very rough calculation of the comparative quantities of organic matter discharged into the river from the sewage-disposal works of the city of Worcester, with the aggregate quantity of organic matter, as indicated by the albuminoid ammonia in the effluents of the various mills throughout the valley of the Blackstone River and its tributaries, indicates that the wastes from manufactories in the aggregate contribute a quantity of organic matter to the river equivalent to about one-half that discharged from the treatment works of the city of Worcester. This calculation takes no account of the sewage discharged into the river from factories and mills, nor from the sewers in Whitinsville, Millbury, Grafton or Uxbridge, nor of the quantity which overflows from the combined sewers in Worcester at times of storm.

The condition of the Blackstone River has been observed at several points for many years by means of chemical analyses, and the results of the analyses of samples collected in the months of June to November, inclusive, in 1913, as compared with those of the past six years, 1908–13, are presented in the following tables: —

Blackstone River, below Cherry Valley.

[Parts in 100,000.]

Date of Collection.	Color.	Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Iron.
					Albuminoid.							
		Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Suspended.		Nitrates.	Nitrites.		
1908, . . .	–	20.57	3.83	.1531	.0624	.0508	.0116	5.76	.0020	.0007	.99	–
1909, . . .	.35	13.93	3.34	.0681	.0470	.0334	.0136	3.70	.0125	.0003	.80	–
1910, . . .	.32	16.42	3.92	.0633	.0489	.0387	.0102	4.02	.0146	.0002	.85	–
1911, . . .	–	21.02	4.40	.1277	.0726	.0559	.0167	5.70	.0080	.0005	1.15	–
1912, . . .	–	44.10	11.04	.2514	.2884	.1023	.1861	10.70	.0002	.0004	3.08	–
1913, . . .	–	32.32	6.52	.2591	.1628	.1122	.0506	8.18	.0015	.0004	2.06	–

Blackstone River, above Worcester Sewage-disposal Works.

Date of Collection.	Color.	Residue Total.	Loss on Ignition.	Free.	Alb. Total.	Dissolved.	Suspended.	Chlorine.	Nitrates.	Nitrites.	Oxygen Consumed.	Iron.
1908, . . .	.16	23.67	5.55	.0990	.0291	.0153	.0138	3.23	.0134	.0014	.83	3.327
1909, . . .	–	52.97	18.55	.1865	.0381	.0239	.0142	4.80	.0033	.0010	2.09	8.440
1910, . . .	.15	50.92	18.97	.1933	.0545	.0309	.0236	4.07	.0023	.0009	2.19	11.850
1911, . . .	.11	44.64	15.70	.1920	.0449	.0212	.0237	4.03	.0170	.0009	2.05	8.167
1912, . . .	.10	40.05	10.91	.2047	.0352	.0225	.0127	3.58	.0027	.0011	1.69	6.667
1913, . . .	.10	35.17	10.34	.2767	.0491	.0285	.0206	3.18	.0003	.0008	1.31	4.933

Blackstone River, below Entrance of Chemically Treated Sewage.

[Parts in 100,000.]

Date of Collection.	Color.	Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Iron.
		Total.	Loss on Ignition.	Free.	Albuminoid.				Nitrates.	Nitrites.		
					Total.	Dissolved.	Suspended.					
1908, . . .	.30	38.80	7.63	.9407	.1490	.0781	.0709	5.34	.0040	.0033	1.31	4.017
1909, . . .	–	53.79	12.12	1.0567	.1282	.0792	.0490	6.92	.0067	.0075	1.72	6.333
1910, . . .	–	52.15	12.52	1.0090	.1654	.0817	.0837	5.68	.0015	.0034	2.17	5.683
1911, . . .	.21	53.25	13.15	.9967	.1608	.0651	.0957	6.54	.0152	.0072	2.26	6.067
1912, . . .	.23	48.90	10.08	1.1700	.1673	.0904	.0769	6.12	.0137	.0096	2.40	4.017
1913, . . .	.28	40.68	10.46	.9320	.1286	.0719	.0567	4.49	.0158	.0084	1.79	2.960

Blackstone River, below Worcester Sewage-disposal Works.

1908, . . .	.46	37.70	6.82	1.1317	.1362	.0919	.0443	6.80	.0078	.0040	1.28	1.383
1909, . . .	–	48.82	9.29	1.2200	.1072	.0777	.0295	8.20	.0140	.0069	1.49	3.533
1910, . . .	–	52.38	11.13	1.3033	.1265	.0892	.0373	8.07	.0108	.0046	1.85	3.867
1911, . . .	.20	48.98	7.93	1.2633	.1150	.0709	.0441	8.88	.0255	.0123	1.74	2.550
1912, . . .	.32	52.23	7.77	1.7985	.1223	.0777	.0446	8.14	.0118	.0098	1.82	3.317
1913, . . .	.27	45.67	9.64	1.1267	.1228	.0788	.0440	6.41	.0195	.0078	1.61	2.242

Blackstone River, at Millbury.

1908, . . .	–	40.63	6.34	1.3424	.1642	.0980	.0662	9.31	.0040	.0016	1.64	.946
1909, . . .	–	44.57	8.05	1.3500	.0957	.0740	.0217	8.59	.0026	.0066	1.27	1.056
1910, . . .	.23	46.98	9.93	1.2177	.1037	.0609	.0428	8.16	.0027	.0030	1.36	1.817
1911, . . .	.61	46.70	8.72	1.2283	.0990	.0602	.0388	7.82	.0077	.0016	1.24	.990
1912, . . .	–	42.25	7.77	1.4633	.1632	.0880	.0752	7.21	.0006	.0025	2.23	1.397
1913, . . .	–	60.32	11.85	1.0610	2085	.0852	.1233	6.07	.0155	.0151	2.53	2.668

Blackstone River, at Uxbridge.

1908, . . .	.31	16.33	4.07	.2387	.0253	.0196	.0057	3.05	.0408	.0071	.32	–
1909, . . .	.22	18.31	4.35	.3473	.0273	.0216	.0057	3.64	.0325	.0066	.36	–
1910, . . .	.26	22.53	4.69	.4963	.0356	.0302	.0054	4.62	.0498	.0043	.41	.090
1911, . . .	.26	23.10	3.85	.3717	.0293	.0225	.0068	4.15	.0558	.0173	.44	.074
1912, . . .	.21	21.91	3.06	.4897	.0345	.0288	.0057	4.06	.0497	.0137	.45	.093
1913, . . .	.29	19.48	3.70	.3880	.0355	.0281	.0074	3.34	.0382	.0107	.49	.096

Blackstone River, at Millville, in Blackstone.

[Parts in 100,000.]

Date of Collection.	Color.	Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen Consumed.	Iron.
					Albuminoid.							
		Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Suspended.		Nitrates.	Nitrites.		
1908, ...	.33	9.85	2.53	.1295	.0232	.0185	.0047	1.78	.0258	.0024	.34	-
1909, ...	.24	11.87	3.17	.1595	.0267	.0220	.0047	2.27	.0225	.0019	.38	-
1910, ...	.30	13.94	3.32	.2350	.0277	.0234	.0043	3.01	.0290	.0013	.37	.087
1911, ...	.33	14.35	2.79	.1787	.0268	.0222	.0046	2.94	.0355	.0051	.43	.054
1912, ...	.29	15.20	2.18	.2433	.0283	.0249	.0034	2.91	.0421	.0064	.43	.074
1913, ...	.37	12.92	2.38	.1631	.0281	.0237	.0044	2.44	.0345	.0063	.42	.065

It will be seen from these tables that the quantity of organic matter as shown by the albuminoid ammonia has varied considerably from year to year, being slightly less in 1913 below Cherry Valley, and slightly greater between Mill Brook channel and the sewage precipitation works of the city of Worcester than in the year 1912. Below the precipitation works, the quantities of free and albuminoid ammonia are less than for several years. Farther down the river, at Uxbridge and Millville, the conditions have differed but little from those of last year. Samples were also collected for analysis at various stations along the river in the drier part of 1913, the more important results of which are summarized in the following table: —

Results of the Analyses of Samples taken on Sept. 11, 1913.

[Parts in 100,000.]

	Ammonia.		Chlorine.
	Free.	Total Albuminoid.	
Just above Worcester sewage-disposal works, . . .	.2260	.0335	2.74
Above Millbury, ...	1.3400	.1080	8.45
At Millbury below entrance of Dorothy Brook, . .	1.0600	.0630	6.88
Just below Millbury line, ...	1.0500	.0625	7.05
Below Farnumsville, ...	.5650	.0340	3.45
Above entrance of Mumford River, ...	.2760	.0278	3.75
Below entrance of Mumford River, ...	.1260	.0296	3.00

The foregoing tables show that the river is greatly polluted in Cherry Valley but that the pollution largely disappears before reaching the disposal works of the city of Worcester. Below that point the river shows the highest degree of pollution found anywhere along its course. The effect of the pollution greatly diminishes below the point of junction with the Quinsigamond River and diminishes rapidly below other important affluents farther downstream. It is evident from these tables that by far the most serious pollution of the Blackstone River is caused by the sewage and effluent discharged from the sewage purification works in the city of Worcester.

Very thorough experiments have been conducted under the direction of the sewer department of the city of Worcester, covering a period of several years, for the purpose of obtaining information as to the most efficient method of providing for the further purification of the sewage, and the results of these investigations have been published from time to time, especially in recent reports. These experiments and investigations have shown very definitely the lines along which the further purification of the sewage can be effected and the objectionable pollution of the river relieved. They indicate that the cost of the necessary additional works, to effect a very great improvement in the efficiency of the purification of the sewage, may amount to an addition of from 30 to 40 per cent. of the amount thus far expended for the construction of the disposal and purification works.

The question of the disposal of the sewage of the Worcester State Hospital was the subject of consideration by a commission appointed by the Legislature of 1909 (chapter 128 of the Resolves of 1909), which found that the method of disposal of the sewage of the Worcester State Hospital was a nuisance, and that the public interests required that the nuisance should be prevented as soon as possible and a proper method of disposing of the sewage of that institution provided. The commission recommended that the sewerage system of the Worcester State Hospital be connected with the sewers of the city of Worcester and that the sewage of the hospital be disposed of thereafter in connection with the Worcester system. Under the Resolve of 1913, already quoted, connection of the hospital sewer with the Worcester sewerage system has not yet been made, as the conditions of the resolve relating to the enlargement of the Worcester sewerage system have not yet been fulfilled.

Pollution of the Blackstone River.

(Parts in 100,000.)

City or Town	Location Number	Finished Product	Waste Manufacturing Liquors: Kind	Gallons per Day on Day Measured	Disposal	Analyses of Various Waste Liquors: Total Solids: Total	Total Solids: Suspended	Loss on Ignition: Total	Loss on Ignition: Suspended	Ammonia: Free	Ammonia: Total Albuminoid	Ammonia: Suspended Albuminoid	Number of Employees	Disposal of Domestic Sewage
Leicester	1	Woolen cloth	Cloth scour	1,700	Kettle Brook	691.30	200.6	607.6	222.6	.3600	6.8400	4.9000	180	Brook
			Rinse after scour	102,000	Kettle Brook	2,412.80	300.2	362.0	351.4	.0330	1.8100	1.1140		
	2	Woolen cloth	Cloth scour	1,800	Kettle Brook	8,634.00	1,720.0	3,332.0	1,332.0	2.2000	88.2000	16.9000	77	Brook
			Rinse after scour	106,000	Kettle Brook	22.20	16.0	21.0	13.6	.0030	.3220	.2500		
	4	Flannel	Wool scouring liquor	600	Kettle Brook	14,834.00	6,700.0	6,312.0	1,860.0	3.7200	18.8400	3.0400	160	Brook
			Wool scouring liquor		Kettle Brook	3,118.00	290.8	3,297.0	310.6	14.3000	11.8800	3.1100		
			Rinse after wool scour	36,900	Kettle Brook	246.60	39.6	106.2	71.4	.8000	1.1300	.6300		
			Rinse after cloth scour	67,000	Kettle Brook	196.00	49.2	118.4	43.2	.3200	1.0800	.4600		
			Last part cloth rinse	-	Kettle Brook	16.80	1.0	6.0	0.8	.0160	.1060	.0160		
			Rinse on cloth	800	Kettle Brook	3,629.00	720.0	1,246.0	712.0	.7200	11.2800	7.5200		
			Rinse after bleach	1,500	Kettle Brook	201.00	-	30.0	-	.6000	.6400	.0600		
	3	Woolen goods	None	-	-	-	-	-	-	-	-	-	20	Brook
	5	Woolen cloth	Cloth scour	2,800	Kettle Brook	1,805.00	830.0	1,087.0	860.0	.7600	13.8000	8.2000	150	Brook
			First part rinse	-	Kettle Brook	181.20	61.2	100.8	64.6	.0130	1.6000	1.1240		
			Second part rinse	-	Kettle Brook	18.20	2.0	4.6	3.4	.0030	.4240	.3465		
			Average rinse after scour	173,000	Kettle Brook	34.20	16.0	22.3	14.2	.0080	.4000	.3105		
			Oxford dye	700	Kettle Brook	103.20	5.0	31.2	3.8	.3480	.6500	.3310		
			Sumac on blue	700	Kettle Brook	391.80	10.2	-	-	.3720	.7300	.7040		
			Royal blue	850	Kettle Brook	31.30	3.8	17.0	3.2	.0800	.7000	.1400		
			Navy blue	1,400	Kettle Brook	3,040.60	11.2	222.0	9.2	.6600	4.1200	.3100		
			Light brown	350	Kettle Brook	1,036.80	8.0	31.6	3.2	.0700	.6600	.5200		
			Rinse on khaki	1,740	Kettle Brook	133.60	-	8.6	-	.1900	.6320	.5220		
Worcester	6	Woolen cloth	Dye liquor	29,000	Kettle Brook	344.20	-	40.0	-	1.6300	1.2900	.0500	160	Sewer and river
			Cloth scour and rinse	30,000	Kettle Brook	84.00	-	20.0	-	.0210	.6500	.6100		
	7	Woolen cloth	Cloth rinse	14,000	Kettle Brook	-	-	-	-	-	.8720	.6230	130	Compost
	8	Woolen cloth	Dye liquor	1,000	Kettle Brook	695.00	-	20.4	-	.1800	1.7000	.3400	61	Compost
			Cloth scour	15,000	Kettle Brook	240.80	160.0	102.0	74.6	.1000	1.1300	.8420		
			Rinse after dye	2,000	Kettle Brook	35.60	10.8	20.6	0.2	10.1000	.9700	.6220		
	9	Elevators	Condenser water	Large amount	Kettle Brook	-	-	-	-	-	-	-	110	Compost
	10	Rendered by products	Wash water	Large amount	Kettle Brook	-	-	-	-	-	-	-	150	Compost
Auburn	11	Carpets	Yarn scour	1,000	Kettle Brook	714.00	290.6	830.0	346.2	2.1000	6.2000	4.5400	160	Brook
			Rinse after yarn scour	13,000	Kettle Brook	29.50	-	13.0	-	.3000	.3500	.0800		
			Ecru dye	3,000	Kettle Brook	1,007.00	-	65.6	-	3.1000	4.3000	.7000		
			Tan dye	1,000	Kettle Brook	1,395.00	-	128.8	-	3.0000	6.1000	.4100		
	12	Closed	-	-	-	-	-	-	-	-	-	-		
	13	Woolen cloth	Cloth scour	1,000	Ramshorn Brook	345.40	118.8	180.6	108.6	.1000	3.1300	1.0800	100	Brook
			Rinse after scour	71,000	Ramshorn Brook	131.20	29.4	90.4	30.0	.1000	1.1100	.7100		
			Blue dye	15,000	Ramshorn Brook	1,867.00	-	562.4	-	.7600	2.9000	.6400		
Millbury	14	Scoured wool	Wool scouring liquor	500	Ramshorn Brook	6,500.00	5,810.0	4,270.0	2,968.0	56.0000	60.0000	10.0000	10	Brook
			Rinse after scour	219,000	Ramshorn Brook	104.00	63.0	61.0	35.0	.1000	.9000	.5500		
	15	Chisel handles	None	-	-	-	-	-	-	-	-	-	5	Brook
	16	Scoured wool	Overflow first bowl	750	Ramshorn Brook	4,302.00	706.8	1,164.0	800.8	0.5000	31.2000	18.4800	12	Brook
			Overflow second bowl	750	Ramshorn Brook	3,372.00	291.0	280.0	136.0	2.4800	21.4000	30.7000		
			Rinse after scour	1,800	Ramshorn Brook	176.44	73.2	79.8	42.6	3.0000	3.1000	3.2800		
Worcester	17	Tools	Slight amount of oil	-	Blackstone River	-	-	-	-	-	-	-	200	Sewer
	18	Machine knives	Slight amount of oil		Blackstone River	-	-	-	-	-	-	-	60	Sewer
	19	Electric power	Considerable oil	-	Blackstone River	-	-	-	-	-	-	-	25	Sewer
	20	Wire	Considerable oil		Blackstone River	-	-	-	-	-	-	-		
	21	Cartridge belts	-	-	-	-	-	-	-	-	-	-	140	Sewer
	22	Machines	Small amount of oil		Blackstone River	-	-	-	-	-	-	-	850	Sewer
	23	Bleached and dyed yarns	Kier discharge	1,000	Blackstone River	1,144.40	8.4	-	-	.4600	12.5000	1.5000	125	Sewer
			First wash	7,000	Blackstone River	461.60	-	-	-	.1340	8.6000	.4000		
			Second wash	6,000	Blackstone River	113.16	3.6	-	-	.0090	1.4570	.1300		
			First wash after chemic	600	Blackstone River	168.50	-	17.8	-	-	-	-		
			Second wash after chemic	600	Blackstone River	73.60	-	11.4	-	.0150	.0240	-		
			Acid bath	1,000	Blackstone River	-	-	-	-	.0604	.0300	-		
			First rinse after acid bath	800	Blackstone River	416.60	-	431.6	-	.0807	.0436	-		
			Second rinse after acid bath	800	Blackstone River	80.20	-	60.1	-	.1040	.0192	-		
			Soap solution	330	Blackstone River	314.00	17.0	53.8	14.8	.0400	.1300	.0548		
			Bluing	6,000	Blackstone River	20.60	4.2	6.0	3.4	.0060	.0948	.0500		
	24	Electric power	Considerable oil	-	Blackstone River	-	-	-	-	-	-	-	50	Sewer
	25	Woolen cloth	Dye liquor, etc.	-	Sewer	-	-	-	-	-	-	-	175	Sewer
	26	Carpets	Dye liquor, etc.	-	Sewer	-	-	-	-	-	-	-	700	Sewer
	27	Dyed yarn	Dye liquor, etc.	-	Sewer	-	-	-	-	-	-	-	100	Sewer
	28	Spool cotton	-	-	-	-	-	-	-	-	-	-	135	Sewer
	29	Wire	Large amount of oil	-	Blackstone River	-	-	-	-	-	-	-	200	Sewer
	30	Wire	Considerable oil	-	Blackstone River	-	-	-	-	-	-	-	2,400	Sewer
	31	Wire	Considerable oil	-	Blackstone River	-	-	-	-	-	-	-	2,500	Sewer
Millbury	32	Felt	Felt scour	106,800	Blackstone River	113.20	14.6	27.0	13.4	.4600	7.4800	.6300	150	River
			Trend-wool wash	600	Blackstone River	983.50	80.8	90.0	30.0	.2800	3.1000	2.2100		
			Trend-wool wash rinse	4,800	Blackstone River	52.70	-	6.1	-	.0110	.1100	.0770		
			Union dye	4,000	Blackstone River	772.40	-	17.6	-	.0480	.2301	.1001		
			Acid dye	12,000	Blackstone River	251.20	-	-	-	.0440	.1210	.0980		
	33	Machine tools	Oil	Slight amount	Blackstone River	-	-	-	-	-	-	-	10	River
	34	Heddle frames	Oil	Slight amount	Blackstone River	-	-	-	-	-	-	-	25	River
	34	Shuttles	Oil	Slight amount	Blackstone River	-	-	-	-	-	-	-	25	River
	37	Woolen cloth	Mordant	4,000	Singletary Brook	128.60	-	-	-	4.4040	.0920	.0840	225	River
			First rinse after direct dye	6,500	Singletary Brook	11.70	-	-	-	.0480	.0770	.0360		River
			Second rinse after direct dye	7,500	Singletary Brook	6.60	-	-	-	.0112	.0408	.0090		
			Cloth scour and rinse	180,000	Singletary Brook	29.40	7.8	14.0	6.1	.0270	.2780	.1818		
			Second bath of alizarine dye	4,000	Singletary Brook	341.00	38.4	73.8	38.6	.0330	.0292	.0124		
			Direct cotton dye	300	Singletary Brook	1,394.80	48.2	101.0	22.0	.2800	1.6600	.6000		
			Black sulphur color	4,000	Singletary Brook	278.40	1.2	90.4	0.6	2.2800	1.5900	.0000		
			Direct black dye	300	Singletary Brook	478.00	88.0	93.6	47.3	-	.6312	.8138		
	35	Woolen cloth	All dyeing and washing done at No. 37	-	Singletary Brook	-	-	-	-	-	-	-		
	38	Woolen cloth	All dyeing and washing done at No. 37	-	Singletary Brook	-	-	-	-	-	-	-		
	40	Woolen cloth	All dyeing and washing done at No. 37	-	Singletary Brook	-	-	-	-	-	-	-		
	36	Linen thread	Bleach liquor	1,600	Singletary Brook	834.00	-	41.0	-	.0038	-	-	170	Compost to brook
			Spent dye	350	Singletary Brook	2,037.60	60.6	60.8	10.0	.0300	.9891	.4500		
			Kier rinse	41,400	Singletary Brook	61.50	-	14.2	-	.6100	.5300	.1900		
			Wash after scour	165,000	Singletary Brook	-	-	-	-	-	.0311	.0015		
	[illegible]	Scoured wool	Scour liquor	500	Singletary Brook	10,998.0	2,812.0	55.0	2,132.0	760.0000	94.0000	30.0000	25	Brook
			Rinse after scour	270,000	Singletary Brook	104.0	48.0	45.4	26.0	1.1200	.9100	.5900		
	41	Cotton damask	None	None	-	-	-	-	-	-	-	-	30	Vault
	42	Woolen cloth	None	None	-	-	-	-	-	-	-	-	35	River
	43	Toweling	Soap bath	850	Blackstone River	51.6	13.8	42.8	13.8	.0280	.3840	.1450	112	River
			Kier boil	700	Blackstone River	14.4	7.0	10.8	6.3	.0980	.1540	.1301		
			Wash after kier boil	10,700	Blackstone River	1,022.0	47.6	871.8	60.0	2.4300	10.4000	1.2600		
	44	Castings	None	None	-	-	-	-	-	-	-	-	60	River
	45	Electric power	None	None	-	-	-	-	-	-	-	-		
	46	Cotton ticking	Wash after indigo bath	2,900	Blackstone River	180.6	33.0	17.6	7.2	.0240	.6000	.7280	110	River
	47	Edge tools	Oil and vitriol	Slight amount	Dorothy Brook	-	-	-	-	-	-	-	50	Brook
	48	Closed	-	-	-	-	-	-	-	-	-	-		
	49	Cotton duck	None	None	-	-	-	-	-	-	-	-	220	Compost
	50	Cotton goods	None	None	-	-	-	-	-	-	-	-	175	River
	51	Cotton goods	Slight amount of oil	-	Blackstone River	-	-	-	-	-	-	-	400	River
	52	Shoes	Slight amount of oil	-	Quinsigamond River	-	-	-	-	-	-	-	250	Privy
	53	Shoe laces	Dye and wash water	100	Quinsigamond River	-	-	-	-	-	-	-	25	Compost
	54	Emery	Wash water	50,000	Quinsigamond River	-	-	-	-	-	-	-	15	River
	55	Linen thread	Kier boil	3,000	Quinsigamond River	673.6	24.6	441.0	13.0	.5400	5.1900	.1803	240	Compost to river
			Wash after bleach	100,000	Quinsigamond River	7.4	-	2.4	-	.0060	.0310	.0015		
	56	Worsteds	First rinse	1,400	Blackstone River	710.6	-	22.4	-	1.7600	.9370	.0401	350	River
			Second rinse after union dye	2,600	Blackstone River	797.6	0.6	-	-	.4000	.0305	.0040		
			Rinse after acid dye	3,100	Blackstone River	244.6	3.6	40.6	3.2	.8400	.2300	.1290		
			Rinse after soap	22,000	Blackstone River	90.6	23.6	40.8	19.0	1.1200	.5000	.3320		
[illegible]	57	Cotton goods	Slight amount of oil	-	Blackstone River	-	-	-	-	-	-	-	350	Privies
	58	Coated paper	Flushing of floors	11,300	Blackstone River	-	-	-	-	-	-	-	75	Compost
Sutton	59	Cotton sheeting	Slight amount of oil	-	Mumford River	-	-	-	-	-	-	-	350	Vaults
Douglas	60	Woolen cloth	Soap and rinse	87,000	Mumford River	168.6	54.6	107.2	50.0	.8040	2.0000	1.5700	200	River
			First bath of stripping liquor	500	Mumford River	417.0	37.2	-	-	3.7000	11.2000	3.9000		
			Second bath of stripping liquor	800	Mumford River	371.8	12.0	-	-	3.2400	9.7000	.0000		
			Rinse after second bath of stripping liquor	600	Mumford River	50.4	2.7	-	-	.2740	.4100	.1900		
			Alizarine dye	3,800	Mumford River	122.8	7.2	21.6	6.9	.4400	.4720	.3240		
			None	None	-	10.0	-	0.2	-	.1900	.1160	.1830		
	61	Sweaters	Cloth scour	1,000	Mumford River	3,340.0	2,388.0	2,276.0	1,816.0	2.7100	67.1000	33.0000	50	River
	62	Woolen cloth	First rinse after cloth scour	71,000	Mumford River	224.0	77.4	170.0	65.0	.6600	5.7300	4.9300	210	River
			Second rinse after cloth scour	-	Mumford River	118.8	88.6	36.4	31.6	.0300	1.5900	1.6000		
			Final rinse after cloth scour	-	Mumford River	10.6	3.8	12.0	1.2	.0500	.5900	.4900		
			Spent union dye	3,400	Mumford River	1,070.4	83.0	227.4	17.6	.6400	7.4400	.3000		
			Rinse after union dye	2,800	Mumford River	145.8	0.4	10.8	0.8	.6000	.6400	.1700		
			Union dye on shoddy	3,400	Mumford River	2,024.4	104.0	881.4	83.8	1.6400	4.6400	1.9600		
			Rinse after union dye on shoddy	3,600	Mumford River	190.6	10.6	12.6	0.0	.5200	1.1000	.9000		
			Acid dye	1,300	Mumford River	334.2	13.6	36.8	2.2	1.3500	1.9900	.7600		
			Rinse after acid dye	1,300	Mumford River	34.8	-	6.6	-	.2100	.2500	.2100		
			First bath alizarine dye	3,500	Mumford River	198.0	2.2	28.2	1.6	1.5200	1.1200	.9400		
			Rinse after first bath alizarine dye	3,000	Mumford River	6.2	-	3.2	-	.0540	.1070	.0860		
			Second bath alizarine dye	3,500	Mumford River	29.6	-	7.2	-	.3320	.7940	.1260		
			Rinse after second bath alizarine dye	3,600	Mumford River	0.1	0.8	3.0	0.7	.0600	.1080	.0495		
Northbridge	63	Spinning rings	Vitriol and water	50	Mumford River	-	-	-	-	-	-	-	45	River
	64	Machinery	Vitriol and water	3,100	Mumford River	-	-	-	-	-	-	-	3,500	Sewer
	65	Sheetings	None	None	-	-	-	-	-	-	-	-	150	Vaults
	66	Cotton cloth	None	None	-	-	-	-	-	-	-	-	275	Vaults
Uxbridge	67	General laundry	Soapy water	3,300	Mumford River	-	-	-	-	-	1.1000	.8600	10	River
			Rinse	7,600	Mumford River	-	-	-	-	-	.1340	.0540		
	68	Cotton goods	Slight amount of oil	-	Mumford River	-	-	-	-	-	-	-	175	Vaults
	69	Worsted yarns	None	None	-	-	-	-	-	-	-	-	50	Vaults
	70	Woolen cloth	Cloth scour and rinse	14,700	Mumford River	20.0	3.8	6.0	1.6	.2100	.3800	.2840	73	River
			Union dyes	6,000	Mumford River	236.6	13.0	40.5	5.2	7.1200	3.4000	.7000		
	71	Woolen goods	Wash on narrow goods	150,000	Mumford River	80.4	23.0	42.4	10.4	.4000	.7400	.6300	300	River
			Wash on shoddy	22,800	Mumford River	48.5	14.5	34.8	14.2	.9300	.7600	.6300		
			First wash on white worsteds	4,500	Mumford River	143.4	27.0	76.2	33.0	3.8400	1.3300	.9800		
			Second wash on white worsteds	4,500	Mumford River	65.6	6.4	27.6	7.2	1.4600	.4000	.2600		
			Union dye		Mumford River	2,027.6	123.4	111.1	22.4	.4000	.3401	.1800		
			Salt bath	91,000	Mumford River	490.5	33.6	42.0	14.4	.1040	.1100	.0230		
			Rinse		Mumford River	730.4	4.0	6.0	9.6	.2000	.1300	.0420		
			Acid dye	105,000	Mumford River	-	-	-	-	-	1.9000	.7600		
	72	Woolen goods	First cloth rinse	600	Blackstone River	3,260.4	730.8	1,334.8	434.0	6.7000	10.6000	11.6000	135	River
			Second cloth rinse	600	Blackstone River	812.4	153.2	276.0	135.6	.6900	3.4400	3.7200		
			Third cloth rinse	10,900	Blackstone River	33.6	4.6	11.3	4.0	.3941	.2700	.2100		
			Wash after chrome	5,000	Blackstone River	20.6	0.8	3.0	0.1	.7290	.0460	.0113		
			Chrome	3,500	Blackstone River	48.2	0.0	-	-	1.4400	.1600	.0700		
			Black dye	2,500	Blackstone River	363.0	4.0	226.4	4.4	3.4000	1.9000	.6500		
			Alizarine dye	5,000	Blackstone River	164.4	8.6	52.4	2.2	23.0000	1.1400	.1600		
			Rinse after alizarine dye	5,000	Blackstone River	27.0	2.1	4.1	0.8	1.4800	.1420	.0700		
	73	Woolen goods	First cloth rinse	15,000	Blackstone River	130.0	23.0	38.6	22.8	.5640	1.0200	.7600	200	River
			Second cloth rinse	15,000	Blackstone River	31.2	2.8	5.1	2.3	.2840	.2500	.2200		
			Black dye	1,200	Blackstone River	2,616.4	800.0	1,220.2	798.4	3.5600	4.9000	1.1600		
			Rinse after black dye	1,200	Blackstone River	701.8	11.2	53.6	6.0	1.7600	1.0800	.4800		
			First bath of alizarine dye	1,200	Blackstone River	2,063.4	-	716.0	-	3.1600	4.0600	1.0400		
			First rinse of first bath	1,200	Blackstone River	680.6	10.2	30.4	2.6	3.2000	2.6400	.0540		
			Second rinse of first bath	1,200	Blackstone River	35.4	2.0	4.8	1.6	.4200	.1030	.0520		
			Second bath of alizarine dye	1,200	Blackstone River	116.4	5.7	18.6	7.0	-	.5800	.3100		
			First rinse of second bath	1,200	Blackstone River	77.2	4.6	10.0	1.2	-	.1400	.6500		
			Second rinse of second bath	1,200	Blackstone River	23.4	3.7	7.2	3.0	.2800	.1780	.1900		
	74	Woolen goods	Cloth rinse	7,600	West River	21.6	1.8	10.0	1.6	2.2000	.3000	.1400	150	River
			Rinse after union dye	8,900	West River	226.7	3.6	16.4	2.0	.6050	.4700	.5600		
			Rinse after acid colors	14,300	West River	64.1	1.1	7.6	1.1	1.8800	.1700	.0740		
Blackstone	75	Woolen goods	Cloth rinse	116,700	Blackstone River	171.2	63.2	104.0	49.2	.4600	1.8260	1.2700	60	Brook
	76	Felting	Rinse on felt	4,000	Blackstone River	-	-	-	-	-	2.3000	1.4000	100	River
			Dyes	3,000	Blackstone River	-	-	-	-	-	.5000	.3400		
	77	Rubber goods	Rubber boil	3,300	Blackstone River	-	-	-	-	-	6.0000	1.2000	425	River
			Rubber wash	15,000	Blackstone River	-	-	-	-	-	.4600	.1800		
			Total	2,060,790 +	-	-	-	-	-	-	-	-	10,840	

* In all four mills.

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Lawrence Experiment Station.

The Lawrence Experiment Station has now been in operation for more than twenty-five years, and has always been of great value in supplying information for the use of the Board in its replies to requests for advice from cities, towns, corporations, individuals, etc., on matters pertaining to water purification, sewage disposal and purification, trade wastes disposal and other sanitary subjects.

The station has also an educational value, as typical examples of well-known methods of treating or purifying sewage and water are kept in operation there and are frequently examined by officials concerned with proposed treatments of water and sewage. The station is also frequently visited by students from the engineering schools in the State and the instructors in these schools. Further than this investigations are constantly being made at the station in regard to new or proposed methods of water purification, sewage disposal, etc., and practically all the bacteriological examinations of the public water supplies of the State are made in the station laboratories.

Besides studies upon water purification during the year, studies upon the disinfection of water, corrosion of pipes, removal of carbonic acid, iron and manganese from water, methods of maintaining a fair degree of cleanliness of the water used in swimming pools, and of the effect of the various constituents of water in storage upon fecal and other bacteria, have been made.

In the studies of sewage treatment or sewage purification 11 intermittent sand filters, 9 trickling filters, 11 contact filters and 9 special filters have been kept in operation. Methods for the preliminary clarification of sewage and for the disposal of sewage sludge have been further investigated. It has long been recognized that the amount of sewage which can be absorbed by a given volume of water without producing a nuisance is limited by the oxygen content of that water and by the rapidity with which oxygen is taken up by the sewage, and studies upon the oxygen requirement of different sewages before and after treatment by different sewage-disposal methods have been in progress for a number of years. In this connection, during the past year a new and promising process for the treatment of sewage by aeration, in specially designed tanks, has been devised. By this method not only is a greater percentage of the suspended and colloidal matters removed than by ordinary sedimentation or chemical precipitation, but the oxygen requirement of the sewage is so greatly reduced that filters can be successfully operated at very high rates with sewage treated in this way. Sewage undergoing this treatment can be clarified to as great a degree as, or perhaps greater than, by chemical precipitation, and at a much less cost. An extensive investigation in regard to the fertilizing value of sewage and sewage sludge has also been made during the year.

Bacterial examinations of 1,800 samples and chemical examinations of 750 samples, forwarded by the engineering department to the station during 1913, have been made, and the usual large amount of chemical and bacteriological work, made necessary by the investigations at the station, has been carried on.

Proprietary Medicines.

During the year one proprietary preparation containing alcohol, and with no statement as to the percentage of alcohol, was advertised as unsalable at retail, under the provisions of chapter 386 of the Acts of 1906, namely: —

Bracer: Artificial Wild Cherry, Flavored and Colored, Straight or Mixed.

Distribution of Pamphlets.

That portion of the Board's work concerned with the distribution of pamphlets on various public health topics has grown remarkably within the last few years, so that at the present time the following literature is available for distribution: —

The Occurrence of Infantile Paralysis in Massachusetts in 1908.
Infantile Paralysis in Massachusetts in 1909.
Infantile Paralysis in Massachusetts during 1910.
The Control of Tuberculosis.
Directions for Living and Sleeping in the Open Air. (The National Association for the Study and Prevention of Tuberculosis.)
The Control of Typhoid Fever.
Antityphoid Inoculation: Typhoid Prophylactic.
Hygiene of Occupations: Permanent Exhibit of the Massachusetts State Board of Health.
Hygiene of the Boot and Shoe Industry in Massachusetts.
The State Board of Health of Massachusetts: A Brief History of its Organization and its Work.
Cholera: Its Nature, Detection and Prevention. (United States Public Health Reports.)
Epidemic Cerebrospinal Meningitis. (United States Public Health Reports.)
For Mothers with Little Babies: How to take Care of Baby's Health.
Death in School Drinking Cups.
Recommendations for the Control of the Stable Fly (*Stomoxys calcitrans*).

Preventive and Remedial Work against Mosquitoes. (United States Bureau of Entomology, Bulletin, No. 88, 1910.)
Anti-malarial Measures for Farmhouses and Plantations. (United States Public Health Reports, No. 105, 1913.)
The Mosquito Plague of the Connecticut Coast Region and How to Control it. (Connecticut Agricultural Experiment Station Bulletin.)
The Abatement of Nuisances.
The Sanitary Privy. (United States Department of Agriculture, Farmers' Bulletin, 463.)
The State Board of Health and its Relation to the Milk Problem in Massachusetts.
Dont's for Dairymen.
Address to the State Inspectors of Health of Massachusetts: Typhoid Fever.
Address to the State Inspectors of Health of Massachusetts: The Suppression of Tuberculosis.
Monthly Bulletin of the Massachusetts State Board of Health.

State Board of Examiners of Plumbers.

At a meeting of the State Board of Health, held on Aug. 7, 1913, Mr. Charles R. Felton of Brockton was reappointed to the State Board of Examiners of Plumbers.

A brief report of the work carried on by this Board in 1913 appears in the Supplement.

Food and Drug Inspection.

The number of samples of foods and drugs collected and examined during the year ended Nov. 30, 1913, was 9,727, and the total number since the work was begun in 1882 has now reached 223,052.

During the year 161 prosecutions were made in the various courts of the Commonwealth, bringing the total number to 4,272. The details are presented in the Supplement.

Inspection of Liquors.

The work of the Board in connection with the duties of the office of inspector and assayer of liquors, transferred to the Board in 1902, is reported upon in the Supplement.

Inspection of Dairies.

During the year ended Nov. 30, 1913, 4,493 dairies were examined by the Board's veterinarian, and the attention of 1,543 proprietors and of boards of health of cities and towns, wherein the dairies were situated or the product thereof sold, was called to a total of 5,071 objectionable conditions.

Of the total number of dairies examined, 4,492 were situated in Massachusetts and 1 in a neighboring State. The details will be found in the Supplement.

Slaughtering Inspection.

During the year ended Nov. 30, 1913, there were appointed 460 inspectors of slaughtering in the cities and towns throughout the State, this being an increase of 100 over the appointments of 1912; two State inspectors of slaughtering were also appointed.

A more detailed report will be found in the Supplement.

Cold Storage of Food Products.

Three State inspectors of cold storage of food products were appointed by the Board during the year ended Nov. 30, 1913, to look over the cold-storage plants throughout the State. Licenses were issued to 47 cold-storage warehouses, — an increase of 10 over the number issued in 1912 (three months, September to November, inclusive).

Each cold-storage plant renders a quarterly report on all goods placed in storage and of the amount of articles of food held by it at the end of each quarter.

For confiscations on account of articles unfit for food found in cold storage, as per physical and chemical analyses, see the detailed report in the Supplement.

Sale of Eggs taken from Cold Storage.

Under this law 72 cases were prosecuted and convicted during the year ended Nov. 30, 1913.

For detailed information see Supplement.

Vital Statistics, Distribution of Antitoxin and Vaccine, etc.

Reports upon Fatality of Certain Diseases, Official Returns of Deaths in Cities and Large Towns, the Vital Statistics of the State, the Production, Distribution and Use of Diphtheria Antitoxin and Vaccine, and upon Bacteriological Diagnosis are presented in the Supplement.

Routine Work of the Board.

Statistical Table for the Year ended Nov. 30, 1913.

Whole number of samples of food and drugs examined,	9,727
Samples of milk examined (included in the foregoing),	6,702
Number of prosecutions against offenders during the year,	161
Number of convictions during the year,	116
Amount of fines imposed,	$2,807.75
Number of dairies examined,	4,493

Number of packages of antitoxin of 1,500 units each issued to cities and towns,	96,891
Number of tubes of vaccine issued to cities and towns,	112,039
Number of ampoules of typhoid vaccine,	21,014
Number of bacterial cultures made for diagnosis and release of diphtheria in cities and towns,	5,332
Number of examinations made for diagnosis of tuberculosis,	2,525
Number of examinations of blood made for diagnosis of malarial infection,	55
Number of examinations of blood made for diagnosis of typhoid fever, Widal test,	1,502
Number of cultural tests of typhoid fever,	337
Number of nitrate of silver solution outfits for use in cases of ophthalmia neonatorum, issued to cities and towns,	2,639
Number of notices of cases of infectious diseases received and recorded under the provisions of chapter 75, section 52, Revised Laws,	66,249

Force employed in the General Work of the Board.

Secretary,	1
Assistant to the secretary,	1
Clerks,	5
Messengers,	2
Supervising inspector of dairy, slaughtering and cold storage,	1
Inspectors of slaughtering,	2
Inspectors of cold storage of food products,	3
Health District Act: —	
State Inspectors of Health,	12
Assistants to the State Inspectors of Health,	3
Clerks,	3
Total,	34

Force employed for food and drug inspection: —	
Chemists and assistants,	4
Inspectors,	4
Clerk,	1
Total,	9

Force employed at laboratory (Bussey Institution): —	
Pathologist,	1
Expert assistants,	2
Laboratory assistants,	5
Stable helpers,	2
Total,	10

Under the Provisions of Sections 112 to 118 of Chapter 75, Revised Laws.

Applications for advice from cities, towns and others: —

Relating to water supply,		139
Relating to ice supply,		19
Relating to sewerage and drainage,		34
Relating to pollution of streams,		4
Miscellaneous,		15
Total,		211

Number of samples examined at the State House laboratory: —

Chemical examinations of water and sewage,	8,601	
Microscopical examinations of water,	2,630	
Special examinations for lead,	147	
Special examinations (field work) for carbonic acid, dissolved oxygen and alkalinity,	282	
Other miscellaneous examinations,	10	
		11,670

Number of samples examined at the Lawrence Experiment Station: —

Chemical examinations of water, sewage, ice and manufactural wastes,	3,180	
Chemical examinations of sand,	101	
Mechanical examinations of sand,	28	
Bacterial examinations of water, sewage, ice and manufactural wastes,	5,048	
Bacterial examinations of sand,	22	
Bacterial examinations of shellfish,	42	
		8,421
Total,		20,091

Force employed at Central office: —

Chief engineer,	1	
Assistant engineers,	11	
Stenographers and clerks,	5	
Messenger,	1	
		18

Force employed at laboratory, Room 502, State House: —

Chief chemist,	1	
Assistant chemists,	8	
Biologist,	1	
Stenographer and clerks,	2	
		12

Force employed at Lawrence Experiment Station: —

Assistant chemists,	2	
Bacteriologists,	2	
Other assistants and laborers,	4	
		8
Total ordinary force,		38

The number of applications for advice under the provisions of the acts relating to water supply and sewerage, received since July, 1886, when these acts first went into operation, is as follows: —

1886,	8	1901,	105
1887,	22	1902,	93
1888,	28	1903,	129
1889,	38	1904,	125
1890,	23	1905,	105
1891,	53	1906,	130
1892,	56	1907,	125
1893,	51	1908,	134
1894,	53	1909,	128
1895,	52	1910,	139
1896,	65	1911,	176
1897,	59	1912,	149
1898,	75	1913,	211
1899,	79		
1900,	104	Total,	2,515

Appropriations.

The appropriations for the year ended Nov. 30, 1913, as recommended by the Board in the annual estimates made under the provisions of chapter 6, section 26 of the Revised Laws, were as follows: —

For the general expenses of the Board,		$26,500 00
For the investigation of anterior poliomyelitis,	$10,000 00	
Balance from 1912,	1,514 08	
		11,514 08
For the inspection of food and drugs,		17,500 00
For the production and distribution of antitoxin and vaccine,		21,000 00
For the purity of inland waters,		36,000 00
For the examination of sewer outlets and Neponset River,		16,000 00
For the supervision of water companies,		1,000 00
For the sanitary condition of the Merrimack River,		1,000 00
For the Aberjona River,		1,000 00

For printing the annual report,	$5,000 00
State Inspectors of Health,	38,800 00
For the prevention of ophthalmia neonatorum,	500 00
For slaughtering and meat inspection,	5,000 00
For cold storage of food,	7,000 00
For extermination of mosquitoes, balance from 1912,	855 40
Total,	$188,669 48

Expenditures.

The expenditures under the different appropriations for the year ended Nov. 30, 1913, were as follows: —

General Expenditures.

Appropriation (including appropriation for typhoid fever) for the year ended Nov. 30, 1913,	$26,500 00
Credit by paid to State treasury from sales of serum and other sources,	106 61
	$26,606 61

Salaries,	$11,120 92
Traveling expenses,	3,282 97
Express charges,	94 55
Stationery, maps and blue prints,	1,012 18
Printing,	3,963 95
Books, subscriptions and binding,	1,066 52
Advertising,	45 92
Extra services,	1,176 19
Messenger,	246 72
Postage and postal orders,	2,772 66
Telephone and telegraph messages,	369 21
Typewriting supplies, repairs and rental,	398 06
Sundry office supplies,	491 13
Laboratory supplies,	384 53
Labor and materials,	16 45
Miscellaneous,	164 65
Total,	$26,606 61

For carrying out the Provisions of the Resolve relative to the Investigation of the Disease known as Anterior Poliomyelitis or Infantile Paralysis (Chapter 49, Resolves of 1911 and Chapter 22, Resolves of 1913).

Appropriation for the year ended Nov. 30, 1913,	$10,000 00
Balance from 1912,	1,514 08
Credit by paid to the State Treasurer on account of sales of animals,	40 00
	$11,554 08

Salaries,	$650 00
Traveling expenses,	120 68
Printing,	52 47
Postage,	18 52
Telephone and telegraph messages,	19 08
Laboratory supplies,	548 76
Purchase of animals.	127 40
Food for animals,	453 54
Express,	19 33
Extra services,	1,257 25
Labor,	194 43
Miscellaneous,	62 15
Total,	$3,523 61

Expenditures under the Provisions of the Food and Drug Acts for the Year ended Nov. 30, 1913.

Appropriation,	$17.500 00
Credit by cash returned to treasury on account of money advanced to inspectors,	13 79
	$17,513 79

Salaries of analysts,	$6,900 00
Salaries of inspectors,	6,180 01
Salary of laboratory assistant,	214 00
Traveling expenses and purchase of samples,	3,383 18
Apparatus and chemicals,	390 24
Printing,	161 88
Services, cleaning laboratory,	50 75
Express,	4 04
Telephone messages and postage,	27 85
Sundry laboratory supplies,	55 51

Books, binding and stationery,	$53 89
Extra services,	47 62
Advertising,	1 80
Miscellaneous,	19 40
Total,	$17,490 17

Expenditures for the Production and Distribution of Antitoxin and Vaccine for the Year ended Nov. 30, 1913.

Appropriation,	$21,000 00
Salaries,	$8,602 21
Traveling expenses,	6 92
Express charges,	37 86
Apparatus, chemicals and laboratory supplies,	3,605 53
Books and stationery,	54 70
Printing,	251 43
Purchase of animals,	872 89
Services of veterinarian,	2 00
Food for animals,	3,523 15
Rental of telephone, messages and postage,	48 06
Extra services,	218 81
Water, gas, electric lighting and heating,	441 65
Labor and materials,	338 27
Ice,	150 32
Rent,	2,008 32
Miscellaneous,	215 27
Total,	$20,377 39

For carrying out the Provisions of the Act to protect the Purity of Inland Waters, and to require Consultation with the State Board of Health regarding the Establishment of Systems of Water Supply, Drainage and Sewerage.

Appropriation for the year ended Nov. 30, 1913,	$36,000 00
Credit by amount returned to the State Treasurer,	4 65
	$36,004 65
Salaries, including wages of laborers at Lawrence Experiment Station,	$29,311 40
Apparatus and materials,	1,438 49
Traveling expenses,	2,079 19
Express charges,	1,377 71
Books and binding,	376 13
Maps and blue prints,	198 27

Stationery, drawing materials and typewriter supplies,	$703 61
Telephone, telegraph messages and postage,	30 52
Labor,	3 00
Extra services,	81 55
Services, collecting samples and reading gauges,	226 56
Miscellaneous,	168 42
Total,	$35,994 85

For the Examination of Sewer Outlets, under the Provisions of Section 4, Chapter 75 of the Revised Laws.

Appropriation for the year ended Nov. 30, 1913,	$16,000 00
Salaries, including wages of laborers at Lawrence Experiment Station,	$10,569 06
Apparatus and materials,	1,314 72
Rent of Lawrence Experiment Station,	150 00
Labor,	17 38
Traveling expenses,	2,775 30
Express charges,	377 91
Telephone and telegraph messages and postage,	77 31
Extra services,	22 59
Services, collecting samples and reading gauges,	12 00
Books, maps, blue prints and binding,	210 82
Stationery, drawing materials and typewriting supplies,	341 41
Miscellaneous,	131 04
Total,	$15,999 54

For carrying out the Provisions of the Act relative to the Supervision of Water Companies (Chapter 319, Acts of 1909).

Appropriation for the year ended Nov. 30, 1913,	$1,000 00
Salaries,	$861 67
Extra services.	123 75
	$985 42

For carrying out the Provisions of the Act relative to the Sanitary Condition of the Merrimack River (Chapter 505, Acts of 1909).

Appropriation for the year ended Nov. 30, 1913,	$1,000 00
Salaries,	$776 66
Traveling expenses,	222 50
Total,	$999 16

For carrying out the Provisions of the Act relative to the Aberjona River (Chapter 291, Acts of 1911).

Appropriation for the year ended Nov. 30, 1913, ...	$1,000 00
Salaries, ...	$975 00
Traveling, ...	24 00
Total, ...	$999 00

Expenses under the Provisions of the Act to provide for the Establishment of Health Districts and the Appointment of State Inspectors of Health (Chapter 537, Acts of 1907; Chapters 405 and 543, Acts of 1910; Chapters 603 and 709, Acts of 1911) for the Year ended Nov. 30, 1913.

Appropriation, ...	$38,800 00
Salaries of State Inspectors of Health, ...	$23,553 77
Assistants to the State Inspectors of Health, . . .	1,277 87
Clerical assistants, office of State Board of Health, . .	2,916 14
Clerical expenses of State Inspectors of Health, including typewriting, ...	491 14
Extra services, office employees, ...	120 46
Extra services, public stenographers, ...	106 60
Traveling expenses, State Inspectors of Health, ...	5,060 76
Traveling expenses, assistants to the State Inspectors of Health,	221 34
Typewriting supplies, State Inspectors of Health, . . .	10 10
Typewriting supplies and rental, office State Board of Health, .	132 35
Printing, administrative purposes, ...	571 72
Printing, public information, ...	95 53
Books, ...	12 00
Office supplies, inspectors of health, ...	33 20
Office supplies, office, State Board of Health, ...	303 93
Laboratory and experimental work, ...	9 96
Postage, ...	571 91
Express, ...	51 32
Telephone and telegraph, ...	331 07
Miscellaneous, ...	9 30
Total, ...	$35,880 47

For carrying out the Provisions of the Act relative to the Prevention of Ophthalmia Neonatorum (Chapter 458, Acts of 1910).

Appropriation for the year ended Nov. 30, 1913, ...	$500 00
Ophthalmia outfits, ...	$300 80
Total, ...	$300 80

For carrying out the Provisions of the Act relative to Slaughtering and Meat Inspection (Chapter 297, Acts of 1911).

Appropriation for the year ended Nov. 30, 1913,	$5,000 00
Credit by paid to State treasury for the sale of branding outfits,	243 80
	$5,243 80
Salaries,	$3,622 42
Traveling expenses,	732 73
Telephone and telegraph,	6 35
Printing,	91 24
Branding outfits,	300 30
Office supplies and stationery,	288 25
Purchase of typewriter and supplies,	64 75
Extra services,	124 50
Miscellaneous,	11 00
Total,	$5,241 54

For carrying out the Provisions of the Act relative to the Cold Storage of Food Products (Chapter 652, Acts of 1912).

Appropriation for the year ended Nov. 30, 1913,	$7,000 00
Salaries,	$5,975 77
Traveling expenses,	661 48
Printing,	53 41
Telephone, telegraph and postage,	6 13
Extra services,	204 20
Office and typewriting supplies,	82 75
Miscellaneous,	15 08
Total,	$6,998 82

HENRY P. WALCOTT.
M. J. ROSENAU.
HIRAM F. MILLS.
ROBERT W. LOVETT.
C. E. McGILLICUDDY.
CLEMENT F. COOGAN.
JOSEPH A. PLOUFF.

SUPPLEMENT.

Water Supply and Sewerage.

Advice to Cities, Towns and Persons.

ADVICE TO CITIES, TOWNS AND PERSONS.

Under the provisions of the Revised Laws (chapter 75, section 117), the State Board of Health is required to

consult with and advise the authorities of cities and towns and persons having, or about to have, systems of water supply, drainage or sewerage, as to the most appropriate source of water supply, and the best method of assuring its purity or as to the best method of disposing of their drainage or sewage with reference to the existing and future needs of other cities, towns or persons which may be affected thereby. It shall also consult with and advise persons engaged or intending to engage in any manufacturing or other business whose drainage or sewage may tend to pollute any inland water as to the best method of preventing such pollution, and it may conduct experiments to determine the best methods of the purification or disposal of drainage or sewage. No person shall be required to bear the expense of such consultation, advice or experiments. Cities, towns and persons shall submit to said board for its advice their proposed system of water supply or of the disposal of drainage or sewage, and all petitions to the general court for authority to introduce a system of water supply, drainage or sewerage shall be accompanied by a copy of the recommendation and advice of said board thereon.

During the year 1913 the Board has given its advice to the following cities, towns and persons who have applied for such advice under the provisions of this act or under special acts relating to water supply and sewerage.

Official communications were made during the year under the provisions of acts relating to water supply and to sources of ice supply, as follows: —

WATER SUPPLY.

Amherst.
Andover (well at school).
Barnstable (Massachusetts Volunteer Militia) (two).
Belchertown (two).
Blackstone (Woonsocket Rubber Company).
Boston (Boston Belting Company).
Braintree (two).
Bridgewater (well) (two).
Brookfield.
Brookfield (Foster-Moulton Shoe Company).
Cambridge (Y. M. C. A.).

Canton (Plymouth Rubber Company).
Canton (Massachusetts Hospital School).
Chelmsford.
Chelmsford (Silesia Worsted Mills).
Chelmsford (wells) (two).
Clinton.
Dedham (wells).
Douglas (camp ground).
Dracut (American Woolen Company).
Dracut (spring).
Duxbury (wells).
Everett (Belmont Hill Spring).
Fall River (two).
Fall River (Enterprise Brewing Company).
Fitchburg (two).
Fitchburg (spring).
Framingham (Society of St. Vincent de Paul).
Gardner (spring).
Great Barrington (Housatonic).
Great Barrington (well in Housatonic).
Greenfield (Fire District No. 1).
Hamilton (Asbury Grove).
Hamilton (South Hamilton).
Hanson (well).
Haverhill.
Haverhill (spring).
Holbrook (spring) (two).
Holden (spring).
Holyoke (Deane Steam Pump Company).
Lanesborough.
Lawrence (Arlington Mills).
Lawrence (Hartig & Miller).
Lawrence (well at Bay State building).
Lawrence (spring).
Lawrence (wells) (two).
Lenox.
Leominster.
Lexington (well).
Lincoln.
Lynn (well).
Lynnfield (well at school).
Marion.
Marshfield (well in Sea View).
Medford (well).
Medway (well).
Methuen (spring).
Middleborough.
Middleton (Haswell Park).
Milton (well).
Nantucket (Sachem Spring).
New Bedford (well).
Norfolk (Norfolk State Hospital).
North Adams.
Northampton (Hampshire County Sanatorium).
North Attleborough (Riley & French).
Northbridge (wells) (two).
North Reading (water supply of proposed school).
Norwood.
Norwood (F. W. Bird & Son).
Norwood (well).
Palmer (Central Vermont Railroad).
Palmer (Forest Lake Park).
Palmer (spring).
Peabody (four).
Pelham (wells).
Plainville (Whiting & Davis Company).
Plymouth (spring at Manomet Bluffs).
Princeton (wells).
Provincetown.
Randolph & Holbrook.
Reading (Massasoit Spring).
Rockport.
Salem.
Salisbury (Salisbury Beach).
Sandwich (Massachusetts Volunteer Militia).
Saugus (Baker's Hill).
Saugus (town pump).
Scituate.
Sharon.
Shelburne Falls (well).

Shirley (wells).
Shrewsbury (three).
Shutesbury (springs).
Somerset (two).
Spencer (Isaac Prouty & Co.).
Sterling.
Sterling (wells) (two).
Stoughton (two).
Sturbridge (wells).
Swansea (wells).
Townsend (wells).
Walpole (F. W. Bird & Son).
Watertown (Ætna Mills).
West Brookfield.
Westfield (Pequot Park).
Weston (well on Sibley Road).
Weston (Hastings Organ Factory).
Westport (wells) (two).
West Stockbridge.
Westwood (well at Colburn School).
Westwood (well of H. F. Mylod).
Williamsburg (two).
Winchester (well).
Woburn (well).
Worcester.

ICE SUPPLY.

Amherst.
Auburn.
Canton.
Chicopee.
Fall River.
Georgetown.
Greenfield.
Hyde Park.
Lawrence.
Lynn.
Marshfield.
Milton.
Northampton.
Palmer.
Pittsfield.
Rockland.
Southwick.
Westford.
Westport.
Winchendon.
Worcester.

Official communications were made during the year under general and special acts relating to sewerage and sewage disposal, as follows: —

Amherst.
Andover.
Barnstable.
Chelmsford (Middlesex County Training School).
Chicopee (Fairview).
Chicopee (Chicopee Falls).
Dartmouth.
Duxbury.
Easthampton.
Foxborough.
Franklin.
Hull.
Malden (Boston Rubber Shoe Company).
Manchester.
Norwood (Dr. Lewis H. Plimpton).
Rockland (New System Laundry).
Rockland (E. T. Wright Company).
Russell.
South Hadley (two).
Springfield (House of the Good Shepherd).
Walpole (Lewis Manufacturing Company).
Waltham (Pond End School).
Ware.
Westfield.
Weymouth (Laundry in South Weymouth).
Wilmington (C. S. Harriman & Co.).
Winchendon.

MISCELLANEOUS.

Agawam (two).
Cohasset.
Everett (N. E. Gas and Coke Company).
Hampshire County (County Commissioners) (two).
Haverhill.
Hyde Park (New York, New Haven & Hartford Railroad).
Lexington.
Lowell (two).
Millbury.
Northbridge.
Pittsfield.
Tisbury.
Uxbridge.
Weston (two).
Westport.

WATER SUPPLY.

The following is the substance of the action of the Board during the year in reply to applications for advice relative to water supply: —

AMHERST.

OCT. 30, 1913.

To the Amherst Water Company, Amherst, Mass., MR. L. DWIGHT HILLS, *President.*

GENTLEMEN: — In response to your request of Sept. 27, 1913, relative to using Amethyst or Orient Brook as a temporary water supply if necessary, the State Board of Health has caused the locality to be examined by one of its engineers and a sample of the water to be analyzed.

Since filing your application, the quantity of rainfall has been such that it is probable that a further supply of water than that furnished by your regular sources will not be required. Nevertheless, it is advisable to make provision for an additional supply of water in case the flow of streams and the supply in your reservoirs should again become deficient.

The examination of Amethyst Brook indicates that it is not at present desirable to take water for the supply of the town from that stream at the point at which water was diverted last year. In case an additional supply becomes necessary, it will be best to take the water from Buffum Brook, a tributary of Amethyst Brook, at a point about 1¼ miles upstream from the former intake and about 200 feet above the North Road from Amherst to Pelham.

It appears to be practicable to divert the water of this stream by a short pipe line into a tributary of your lower reservoir by gravity, and in that case a considerable additional supply can be obtained at a comparatively small cost. It is essential, in the opinion of the Board, if the water company is to supply water enough for the requirements of the town in future, that it shall either increase the capacity of its reservoirs or secure an additional supply from a suitable source, or reduce very materially the consumption of water in the town. It is evident that there is a great, and probably unnecessary, loss of water from your mains by waste or leakage, or both, and the cause of the excessive use of water in the town should be ascertained as soon as practicable, and unnecessary use and waste prevented.

It is understood that the meter designed for the measurement of all of the water delivered into the pipes of the town will shortly be put into operation, and as soon as the meter is available for use an investigation should be made, with the assistance of an engineer of experience in such matters, to ascertain what leakage, if any, takes place along the pipe lines and in what districts in the town excessive consumption of water occurs. It is also important to install service meters as rapidly as possible until all water is delivered to consumers through meters.

If it is found, as a result of this investigation, that it is impracticable to reduce materially the consumption of water by the town, the Board recommends that measures be taken at the earliest practicable time to introduce an additional supply of water sufficient with the present sources to furnish all of the water required by the town at all times.

Barnstable (Massachusetts Volunteer Militia).

June 12, 1913.

To Maj. Frank P. Williams, *Medical Corps, M. V. M., Boston, Mass.*

Dear Sir: — In response to your request for an examination of the water of the North and Middle Cotuit ponds, and advice as to the use of these waters for drinking, the State Board of Health has caused the locality to be examined by one of its engineers and has considered the results of analyses of samples of water from these ponds.

The investigations show that the conditions affecting these ponds are much the same as at the time of a previous examination in 1908, when the Board advised your department that the water was naturally of good quality and probably safe for drinking, but that with a camp of soldiers near its shores it would be essential to guard the purity of the water carefully.

It is understood that the camp now proposed will be near the northeasterly shore of the North Cotuit Pond, and under these conditions it would be best not to take water from that pond for drinking during the encampment. If taken from either of the other ponds it would be necessary under the circumstances to guard carefully the purity of the water.

An examination has also been made of a spring not far from the house on the northeasterly shore of the North Cotuit Pond, and the results show that the water at the time this examination was made was probably safe for drinking. If the spring is carefully covered and provision made for drawing the water with a pump in such a way as to prevent its pollution, this water could probably be used with safety for drinking.

The safest plan of supplying water to this camp will be by sinking tubular wells near the pond at points unaffected by danger of local pollution, and there is no doubt that an adequate supply of good water can be obtained in this way at no great expense.

June 12, 1913.

To Maj. John H. Sherburne, *1st Battalion Field Artillery, M. V. M., Boston, Mass.*

Dear Sir: — In response to your request for an examination of the water of the well at the Benjamin E. Blossom farm in West Barnstable, and advice as to its quality for drinking, the State Board of Health has caused the well and its surroundings to be examined and a sample of the water to be analyzed.

The results of the examination indicate that the water contains an excessive quantity of iron, which imparts considerable color and turbidity to the water and may at times give it a noticeable taste. There are no sources of pollution in the immediate neighborhood of the well, however, and, except for the objectionable appearance and taste, the water in the condition in which it was found at this time was probably safe for drinking.

It is not a desirable drinking water, however, and a better supply should be provided for future requirements if the use of this locality is to be continued. It is important that the well be covered securely, and it will be advisable to draw the water wholly by means of a pump.

Belchertown.

June 16, 1913.

To the Belchertown Water Company, Belchertown, Mass.

Gentlemen: — In response to your request of June 5, 1913, for an examination of certain tubular wells in the vicinity of Jabish Brook, and advice as to their use as sources of water supply for the village of Belchertown, the State Board of Health has caused the wells and their surroundings to be examined by its engineer and has also considered the results of a pumping test made recently to determine the probable quantity and quality of the water obtainable from the ground in this region.

The results of a number of analyses of the water collected while pumping from the wells between May 6 and May 16 of the present year indicate that the water is of good quality for the purposes of a domestic water supply. The quantity of water pumped during the greater part of the pumping test was much greater than would be required for the water supply of Belchertown for domestic purposes, but observations of the height of the ground water in the test wells during and after the test show that its level decreased rapidly while pumping and recovered very slowly after the test was completed. Considerable rain fell during the test, and under the circumstances it is doubtful in the opinion of the Board whether these wells would furnish enough water for the requirements of the village. It is not unlikely, moreover, that considerable water will eventually be used by the railroads and in dry seasons for the watering of gardens and irrigation of crops, and under the circumstances it is not probable that these wells would furnish an adequate quantity of water for all the requirements of the village after the water has come into general use.

The conditions appear to be more favorable for obtaining an adequate quantity of water on the southwesterly side of Jabish Brook farther downstream at a point where a test well was put in last year, and it is possible also that an ample supply of water could be obtained from wells a short distance farther upstream from the wells used during the recent test.

In view of the circumstances, the Board recommends that further tests be made and a location secured if practicable where the porous soil is of such a depth and covers such an extent of territory that it is likely that an adequate quantity of water can be secured. The Board will assist you in further investigations, if you so request, by making the necessary analyses of water and will give you further advice as soon as the results of further tests are available. There would be no objection to the use of the water of the wells recently tested in connection with water from other wells in the neighborhood in case an additional quantity of water can be obtained from some other location in the immediate neighborhood.

OCT. 22, 1913.

To the Belchertown Water Company, Belchertown, Mass., Mr. M. C. BAGGS, *Treasurer.*

GENTLEMEN: — In response to your request of Sept. 2, 1913, for approval by the State Board of Health, under the provisions of chapter 350 of the Acts of the year 1912, of the taking of a water supply for Belchertown from the ground near Jabish Brook by means of tubular wells, the Board has considered the results of a pumping test made by pumping from several wells from August 21 to 27 and again from September 29 to October 2.

During these tests water was pumped from the wells at rates ranging from 144,000 to 158,000 gallons per day during the first period, and at a rate of somewhat over 200,000 gallons per day during the second period, and after these tests the ground water level recovered very rapidly.

An examination of the locality by one of the engineers of the Board shows that, excepting the cultivated lands which it is proposed to acquire, there are no sources of pollution in the immediate neighborhood of the wells, and the quality of the water as shown by the analyses of a number of samples sent in by you at various times during the tests is satisfactory for domestic purposes.

It is probable, in the opinion of the Board, that an adequate quantity of good water for the requirements of Belchertown, so far as can now be foreseen, can be obtained from wells in the location in which this test was made, and the Board approves the taking of water from wells in this location for the supply of the town under the provisions of chapter 350 of the Acts of the year 1912.

Braintree.

March 25, 1913.

To the Board of Water Commissioners, Braintree, Mass.

Gentlemen: — In response to your request for an examination of the waters of Great Pond, from which the water supply of Braintree is now being taken, and advice as to its quality, especially with reference to complaints of an objectionable color, taste and odor of the water, the State Board of Health has caused the pond and its watershed to be examined and samples of the water from the pond and its tributaries and from the water pipes in the town to be analyzed.

The results of these and previous examinations show that the water of Great Pond is affected at times by a high color and a disagreeable taste and odor, and these objectionable conditions were quite marked at the time of the recent examination.

The disagreeable taste and odor which affect the water at the present time are probably due largely to the presence in the water of considerable numbers of the microscopic organism Synura, which imparts to water a disagreeable taste and odor even when present in small numbers. The presence of these organisms in water used for drinking is not known to be injurious to health, though they render the water very disagreeable for drinking and other domestic uses.

The watershed of Great Pond is quite thickly populated, and analyses of its waters show that the tributaries of the pond receive considerable pollution. The population within the watershed already probably amounts to 1,500, or 430 persons per square mile, and besides the dwelling houses and a small institution there are numerous barns and other outbuildings within this watershed, as well as large areas of cultivated land, some of which are heavily fertilized.

The water is also unfavorably affected by standing in contact with the organic matter in the swamps on its watershed, especially a large swamp at the upper end of the pond nearly equal in area to the pond itself, which is flooded at high water to a slight depth. The pond is also quite shallow, with a muddy bottom over parts of its area, upon which weeds and water plants grow in considerable abundance.

Under these conditions it is unlikely that any material improvement in the quality of the water will take place in the future, and with the further increase of population on the watershed its quality is likely to deteriorate. Without doubt considerable improvement could be effected in the quality of the water of this pond by lowering its level so as to prevent the flooding of the swamp at the upper end, and by drainage and other improvements in its watershed, including the construction of sewers in the more densely populated parts of the area; but lowering the pond would diminish its yield, and it is unlikely that any improvements that it is practicable to make in this way — unless at great expense — will prevent a recurrence from time to time of the objectionable conditions of which complaint is now made.

The best practicable plan of effecting a satisfactory improvement in the condition of this water is by filtering it through sand, and in that way not only would a further safeguard be provided against danger of injury to the public health from the pollution of the water, but the objectionable color would be satisfactorily reduced and the disagreeable taste and odor removed.

The improvement of the quality of the water of Great Pond could probably be effected at less expense by joint action on the part of all of the towns using this pond as a source of water supply, and if it is decided to filter the water a joint filtration works would be much less expensive than separate works at each of the pumping stations.

It is very important, in the opinion of the Board, that early action be taken by the towns interested to improve the conditions affecting the water supply taken from this pond, and the Board recommends that these towns consider without delay the question of improving the quality of the water by filtration and of making more adequate provision for preventing the pollution of the pond and its tributaries. It is of especial importance at the present time that the rules and regulations for the sanitary protection of this pond shall be strictly enforced.

The Board will, upon request, give you such advice or assistance as it can in further investigations as to the improvement and protection of this water supply.

Oct. 22, 1913.

To the Board of Water Commissioners, Braintree, Mass.

Gentlemen: — The State Board of Health has considered your request for the establishment of rules and regulations for the sanitary protection of Little Pond in Braintree similar to those now in force at Great Pond, and has caused the locality to be examined by one of its engineers.

The results of this examination show that the area of watershed of Little Pond is about half a square mile, and that it contains at the present time approximately 150 dwelling houses and a probable population of 650 persons, or about 1,300 persons per square mile of watershed. There are also many barns and other buildings in the immediate vicinity of the shores of the lake, and at many of the places examined there are privies, cesspools, sink drains and other sources of pollution within 100 feet of the water. In the course of the examination numerous deposits of fecal matter and other foul matters were found along the shores of the pond, in many cases within a few feet of the water.

There are no sewers within the watershed of Little Pond, and under the existing conditions it is impracticable, in the opinion of the Board, to protect the purity of this water efficiently by the enforcement of sanitary regulations unless a system of sewers for the removal of sewage and other foul matter from the watershed is provided, or unless the water is efficiently filtered.

In past years water has been taken from the filter gallery near the shores of this pond; but the ground water upon the side of the pond on which the filter gallery is situated is very badly polluted by the sewage from the numerous dwelling houses in this neighborhood, all of which is deposited upon or in the ground in this region, and the analyses of the water of the filter gallery show that it is badly polluted, evidently by sewage from these dwellings.

Under the circumstances it is not advisable, in the opinion of the Board, to use either the water of Little Pond or that of the filter gallery for the supply of the town under present conditions, and if it should become essential to introduce either of these waters temporarily into the water supply pipes of the town, it should either be treated with a disinfectant or the water takers should be notified to boil the water thoroughly before using it for drinking.

The Board recommends that the question of the further use of Little Pond or the filter gallery for the water supply of Braintree be given immediate consideration, and, if it is decided to use water from either of these sources in future, the town should either construct a system of sewerage within this watershed and connect therewith all dwelling houses and other buildings from which polluting matters may find their way into the pond or filter gallery, or provide an efficient system of filtration by which all of the water will be filtered before being supplied to the town. If it is decided to carry out either of these plans and then continue the use of this watershed, the Board will adopt such regulations as may be required for the adequate protection of the quality of the water.

It is not improbable, in the opinion of the Board, that, under the existing conditions, the cost of improving efficiently the quality of the waters of Little Pond or the filter gallery so that these waters may be used with safety for domestic purposes might be greater, all things considered, than the cost of a supply of good water from some other source.

Brookfield.

Dec. 5, 1913.

To the Board of Water Commissioners, Brookfield, Mass.

Gentlemen: — In response to your request for an examination of certain available sources of additional water supply for the town of Brookfield, and advice as to the practicability of their use for that purpose, the State Board of Health has caused the sources indicated to be examined and samples from the present and proposed sources to be analyzed.

One of the sources is a well 12 feet square and 9 feet deep, located about a quarter of a mile southeast of the Brookfield railroad station and 50 feet from the Quaboag River. It appears that the well was sunk through coarse sand or gravel to clay or hardpan, and that when used for the supply of the town in the summer of 1912 it yielded water quite freely, but for a limited time.

The analyses of the water indicate that under present conditions it is probably safe for domestic use. There is a considerable population at no great distance from the well, but at the present time the drainage from this population does not appear to be affecting the ground water in the neighborhood of the well. It is impossible to determine without further investigations whether the quality of the ground water in this region would remain satisfactory or would change materially in case a considerable quantity, such as would be required for the supply of the town, should be drawn from wells or other works in this region.

In order to determine whether an adequate supply of good water for the requirements of the town could be obtained from the ground in this region, it would be necessary to sink a number of wells and test them by pumping for a period of several days. It would not apparently add very materially to the cost of works if, instead of locating a well at the point where the present well is situated, it should be constructed from half a mile to a mile farther east, and, considering the circumstances, it appears to be desirable that further tests should be made in this region to determine the possibility of obtaining there an adequate supply of good water for the requirements of the town at all times.

The other source mentioned in your application is the ground in the valley of the brook northwest of the village, but it does not appear that any tests have been made in this locality which would furnish any definite information as to the possibility of obtaining an adequate supply of good water in this region.

The Board recommends, as the first step in securing an additional supply of good water for the requirements of the town, that you cause tests to be made, both in the valley of the brook northwest of the town and in the region east of the present well near the Quaboag River, to determine the character of the soil and the probable quantity and quality of water obtainable from the ground in these regions. These tests should be made under the direction of an engineer of experience in matters relating to ground-water supplies, and if favorable conditions are found a pumping test should be made by pumping from a group of wells at that place for several days.

The Board will assist you in further investigations, if you so request, by making the necessary analyses of water, and will give you further advice in the matter when the results of further investigations are available.

Cambridge (Y. M. C. A.).

May 27, 1913.

To the Young Men's Christian Association, Cambridge, Mass.

Gentlemen: — In response to your request for an examination of the waters of the Belmont Crystal and Robbins springs, located respectively in Belmont and Arlington, the State Board of Health has caused the springs and their surroundings to be examined and samples of their waters to be analyzed.

The water of the Belmont Crystal Spring contained at the time of the last examination a slightly greater quantity of organic matter than in former times, but in other respects it has shown little or no change in quality for many years. The amounts of chlorine and nitrates present in this water are larger than the normal for the region, but the number of bacteria is low. The watershed of the spring is uninhabited, and the presence of the abnormally high chlorine and nitrates is undoubtedly due to the fertilizer applied to the cultivated lands about the spring. In the opinion of the Board the water of this spring is at present safe for drinking, and if the fertilizing of the land about the spring should be discontinued, the quality of the water would no doubt be greatly improved and the spring could continue to be used with safety so long as the water-shed about it remains uninhabited as at present.

An examination of the water of Robbins Spring in Arlington shows that the use of some of the springs from which water was formerly taken has been discontinued, and only one of the springs was in use at the time of this examination. The quality of this source has varied considerably for several years, showing on the whole a slight deterioration. The results of the analysis indicate that this water at the time of the recent examination was safe for drinking; but dwelling houses have been constructed recently upon lands about the spring, and, unless these houses shall be connected with the sewer, there is danger that the wastes discharged from them may affect unfavorably the quality of the water. The Board recommends that the water of this source be examined from time to time in the future, in order that its use may be discontinued if deterioration occurs.

Canton (Massachusetts Hospital School).

May 21, 1913.

To the Board of Trustees, Massachusetts Hospital School, Canton, Mass.

Gentlemen: — In reply to your request for advice as to a water supply for the Massachusetts Hospital School, to be obtained from drilled wells on the grounds of the hospital, the State Board of Health has caused the locality to be examined by its engineer and has considered the information presented as to tests already made with a view to obtaining a well-water supply for the institution.

It appears that the pressure under which water is supplied from the works of the town of Canton is insufficient for adequate fire protection and that the expense of obtaining an adequate supply of water from the Canton works would be large. The tests made in various parts of the grounds of the hospital with a view to obtaining a ground-water supply have not been favorable, all of the test wells having been driven to rock without obtaining any considerable quantity of water.

Under these circumstances there is considerable doubt as to whether an adequate supply of water for the institution could be obtained by drilling a deep well or wells in the rock, and there is also uncertainty as to the quality of the water that might be obtained in that way. An examination of the region about the hospital indicates that on adjacent lands east of the hospital grounds in the neighborhood of Reservoir Pond the soil is coarse and porous, and the conditions appear to be favorable for obtaining an adequate supply of water by means of tubular wells.

The Board recommends that as the next step in your investigations for obtaining a water supply for the institution you cause test wells to be driven in the lower grounds not far from Reservoir Pond east of the institution to determine whether a porous stratum exists in this region from which an adequate supply of water can be secured. The Board will assist you in further investigations, if you so request, by making analyses of samples of water, and will give you further advice in the matter when additional information is available.

Chelmsford.

Sept. 2, 1913.

To the Board of Water Commissioners of the Chelmsford Water District, Chelmsford, Mass.

Gentlemen: — In response to your request for the approval of the taking of water from the ground in the valley of River Meadow Brook, about half a mile southeast of Chelmsford Center, as a source of water supply for the Chelmsford Water District, the State Board of Health has caused the locality to be examined and has considered the results of a test made by pumping from a group of wells in this location for a period of about six days between August 8 and August 14. During this test water was pumped from eight wells at a rate of about 300,000 gallons per day, and measurements of the height of the ground water in observation wells at several points in the neighborhood before, during and after the test, considered in connection with the quantity of water pumped, indicate that an adequate supply of water for all the present requirements of the Chelmsford Water District can be obtained from the ground in this locality.

The results of analyses of samples of water taken daily throughout the test show that it is soft, free from iron, and in all respects of good quality for the purposes of a public water supply.

The Board, acting under the provisions of chapter 641 of the Acts of the year 1913, hereby approves the taking of a water supply for the Chelmsford Water District from wells in the location in which this test was made.

At the present time the region about the wells is uninhabited, and the source does not appear to be exposed to danger of pollution. It is desirable, however, in the opinion of the Board, that the district should eventually acquire a considerable area of land about the wells to protect the purity of the water.

Clinton.

Sept. 18, 1913.

To the Board of Water Commissioners, Clinton, Mass.

Gentlemen: — In response to your request for advice as to the complete removal of the organic matter found in a large depression in the bottom of Heywood Pond, so called, which you are now enlarging and improving for use as a storage reservoir, the State Board of Health has caused the locality to be examined by its engineer and has caused samples of the soil from the area in question to be analyzed.

The results of the analyses show that the deposit in question consists almost wholly of diatomaceous earth containing a considerable percentage of nitrogen. Experiments with it show, furthermore, that water standing upon it takes up color, and there is little doubt that if this deposit were left in the reservoir it would affect very unfavorably the quality of the water.

The Board recommends that the deposit be removed if practicable, and if it is not found practicable to remove it the best plan would be to cover it to a depth of at least 12 inches with hardpan or similar material from the higher parts of the reservoir bottom or the adjacent hillsides. It appears that a large quantity of this material has been deposited along the sides of the reservoir above the high-water line, where it is exposed to the action of rains and is likely to be washed into the water. It is impracticable to remove this material, and the best plan would be to seed it with grass so as to grow a sod as soon as possible.

Dracut (American Woolen Company).

Aug. 18, 1913.

To the Board of Health, Dracut, Mass.

Gentlemen: — In response to your request for an examination of the water supplied by the American Woolen Company in Collinsville, and advice as to its quality, the State Board of Health has caused the wells to be examined and samples of the water to be analyzed.

The results of the examination show that the water of these wells is quite hard and contains an excessive quantity of iron, a part of which precipitates from the water on standing. While there are no indications that the water in its present condition is injurious to health, the presence of the excess of iron makes it very objectionable for many domestic purposes.

At the time of the introduction of water from these wells, the Board advised concerning them in part as follows: —

. . . Analyses of samples of water from test wells . . . show that it is soft, nearly colorless, and free from odor, and is otherwise of good quality for the purposes of a public water supply. Whether the water will remain satisfactory when the quantity required for the supply of Collinsville is drawn continuously from wells at this place cannot be predicted with certainty. The meadow in which the wells are located contains a considerable depth of peaty soil and is subject to flooding at times of high water in the brook, and water drawn from wells in similar locations has in some cases deteriorated after a longer or shorter period of use and become objectionable on account of an excess of iron. The chances of deterioration in this case can apparently be materially lessened by draining the meadow so that water will not stand upon it for a very considerable time, and it appears to be feasible to provide drainage at no great expense. . . .

At the time of the recent examination it was evident that the ground about the wells is kept flooded more or less continuously during the greater part of the year. This condition has undoubtedly led to the deterioration in the quality of the water, and it is very doubtful whether, even if the flooding of the meadows should now be discontinued, the quality of the water of these wells would improve sufficiently to make it satisfactory for domestic use.

Considering the circumstances, it is advisable that the use of these wells be discontinued and a supply introduced as soon as practicable from some source which will furnish water of good quality.

Aug. 18, 1913.

To the American Woolen Company, Collinsville, Mass.

Gentlemen: — In response to a request from the board of health of Dracut, the State Board of Health has caused an examination to be made of the water supplied by you in the village of Collinsville, and finds that the water has greatly deteriorated on account of the presence of an excess of iron and become very objectionable for many domestic purposes.

The Board recommends that a supply of water of good quality be introduced in this village at the earliest practicable time.

A copy of the advice of the Board to the board of health of the town of Dracut is enclosed herewith.

Duxbury (Wells).

Dec. 4, 1913.

To the Board of Health, Duxbury, Mass., Mr. Charles W. Eaton, *Secretary.*

Gentlemen: — In response to your request for an examination of certain wells in South Duxbury and advice as to the use of their waters for domestic purposes, the State Board of Health has caused the wells indicated to be examined and samples of their waters to be analyzed.

The waters of the wells at the Point school and at the grammar school on Washington Street appear to be very badly polluted and unsafe for drinking. The well at the South Duxbury school shows less evidence of pollution than the others, but the water at the time of this examination was slightly turbid and contained greater numbers of bacteria than are found in good well waters. Under the circumstances it cannot be regarded as a safe source from which to take water for drinking. It is probable that a well could be located west of the school, at a greater distance from danger of pollution, from which water might be obtained that would be safe for drinking.

The water of the well at Partridge Academy is similar in many respects to that of the South Duxbury school, and it is advisable that water from a source of known safety should be provided as soon as practicable and the use of this well discontinued.

Samples of water have also been examined from four private wells, viz., the house of E. S. Grover on Stetson Street and the houses of Dr. Spaulding, H. E. Hunt and H. E. Merry on Washington Street. One of these wells apparently contains a considerable amount of sea water, and all of them were found to be polluted, some of them containing more chlorine and nitrates than are found in ordinary sewage effluents. In the opinion of the Board all of these wells are unsafe sources from which to take water for drinking or other domestic purposes.

The results of the examination of these wells show, on the whole, much the same conditions as were found in the course of the investigations of last July. The continued discharge of sewage into vaults and cesspools in the thickly settled areas in this town pollutes the ground water drawn for drinking from adjacent wells, and the objectionable conditions will inevitably grow worse until a public water supply is provided and the use of these wells discontinued.

The Board again recommends that the question of introducing a public water supply be taken up and a satisfactory general supply introduced at the earliest practicable time.

Everett (Belmont Hill Spring).

May 24, 1913.

To Mr. A. J. Day, *Purchasing Agent, Barrett Manufacturing Company, 297 Franklin Street, Boston, Mass.*

Dear Sir: — In response to your request of March 31, 1913, for information as to the condition of the water of the Belmont Hill Spring, so called, in Everett, the State Board of Health has caused the spring and its surroundings to be examined and a sample of the water to be analyzed.

The results of the analysis show that the water has at some time been very badly polluted and not subsequently thoroughly purified in its passage through the ground before entering the spring. There is also evidence that the quality of the water has deteriorated in recent years. The spring is located in a populous district where the ground water is evidently subject to pollution, and, considering the circumstances, in the opinion of the Board this spring is not a safe source from which to take water for drinking.

Fall River.

April 28, 1913.

To Hon. James H. Kay, *Mayor, and Chairman of Reservoir Commission, Fall River, Mass.*

Dear Sir: — The State Board of Health received from you on March 8, 1913, the following communication requesting its approval of the modification of the general plan for protecting the purity of the water of North Watuppa Pond approved by this Board on March 2, 1911: —

The Reservoir Commission, on Dec. 16, 1912, voted to carry out at once and began work upon a modification of its general plan for protecting the purity of North Watuppa Pond, approved by you March 2, 1911, the modification being to divert Cress Brook from its present channel, at a point about 135 feet easterly of Freelove Street and discharge it into Highland Brook, about 1,000 feet westerly of Meridian Street through a 30-inch conduit, instead of directly into the proposed intercepting conduit; but has been stopped and prevented from carrying this to completion on account of certain claims and injunctions by parties claiming rights in the land and water to be occupied.

The reasons for this modification of the general plan were: —

The necessity for diverting Cress Brook away from the water works pumping station, in advance of the completion of the proposed intercepting conduit, the start of which has already been delayed nearly two years since the approval of the general plan by your Board.

The successful negotiation with Samuel Hyde, who owns all the abutting land between New Boston Road and Freelove Street, upstream from the Watuppa Reservation, through which Cress Brook runs, for the easement across his land at a reasonable price and reasons for anticipating serious objection from him to the original plan for taking in this brook.

The additional storage for the waters of Cress Brook to be furnished by the Highland Brook basin.

The approval of this modification of the general plan is requested from your Board, in order that the City may acquire by condemnation, land for this Cress Brook diversion, under section 1 of chapter 437 of the Acts of 1909, if the work is further delayed by these claims and injunctions.

The work of constructing the conduit to divert Cress Brook was begun on Dec. 17, 1912, at the southerly edge of the site of the proposed Highland storage basin shown on the plan approved by your Board March 2, 1911, and also shown by red "A" on R. C. blue print No. 323–R which accompanies this application. The work was pushed as rapidly as the weather permitted until Dec. 31st, when it was stopped by a restraining order from the Court issued upon application for injunction on part of an abutter claiming rights in the proposed street, from New Boston Road north in which the pipe was being laid. This was followed by legal notices from another abutter and from parties owning land through which Highland Brook flows, claiming damages for the diversion and there seems no prospect of settlements being effected at reasonable terms, if at all. At the time of stopping the work, 269 feet of pipe had been laid and a total of 425 feet of trench opened. Nothing has been done since the stopping of work and the City is at a weekly expense of nearly fifty dollars for watchmen, etc. The red line on the accompanying blue print shows the pipe laid.

The Board has caused the locality to be examined by one of its engineers and has considered your application and the plan presented therewith.

Judging from the information available as to the flow of these streams at different seasons of the year and the conditions affecting the movement of water in the lake, it is probable that, if the waters of Cress Brook were diverted into Highland Brook, they would require several weeks longer to reach the water works intake than at the present time. Under the circumstances and considering the extra storage available on the watershed of Highland Brook for the regulation of flow into the conduit, the Board approves the plan of constructing a conduit from Cress Brook to Highland Brook, as shown in the plans submitted on March 8 and April 3, 1913. The Board wishes it understood that, while the proposed change of outlet of Cress Brook to Highland Brook has advantages, especially during the construction of the proposed intercepting conduit and to some extent thereafter, it is not to be taken as in any sense replacing the conduit, which should be pushed to completion as early as practicable. It will be essential, of course, to enlarge somewhat the size of the main intercepting conduit between Cress Brook and Highland Brook to allow for the change in the point of admission of the water of Cress Brook.

The plans approved bear the following titles: "Reservoir Commission. Fall River, Mass. Plan Showing Proposed Diversion of Cress Brook. Scale: 1 inch = 200 feet. Revised Feb. 24, 1913. R. C. No. 323–R" and "City of Fall River, Mass. Reservoir Commission. Plan Showing

Cress Brook and Proposed Diversion to Highland Brook and Proposed Intercepting Drain. Courses are referred to true meridian. Scale: 1 inch = 50 feet. March 24, 1913. R. C. No. 367."

DEC. 23, 1913.

To the Reservoir Commission, Fall River, Mass.

GENTLEMEN: — In response to your request for advice as to authorizing the cutting of ice upon North Watuppa Pond, the source of water supply of the city of Fall River, and the leasing of city lands abutting the pond for the storage of ice thereon, the Board has caused the locality to be examined and has considered the information presented at the hearing given at this office at your request on Dec. 16, 1913.

The city of Fall River began many years ago to acquire the lands within the watershed of North Watuppa Pond for the protection of the purity of the water, and at the present time some two-thirds of the land within the watershed has passed within the control of the city. It was found impracticable to purchase at a reasonable cost enough of the lands in the westerly part of the watershed, chiefly in the watersheds of Cress and Highland brooks, to protect adequately the purity of the waters tributary to the pond in this region, and after a thorough study you have devised a plan for diverting the flow of water from populated areas in this region into the South Watuppa Pond.

With the construction of this conduit, which should be completed at the earliest possible time, little further expenditure will be required to enable the city to secure and adequately protect for the future use of its inhabitants as a source of domestic water supply this great reservoir, so well suited for that purpose both in its location and the character of its waters.

In the course of the work of securing the lands about the pond and protecting this water supply, it appears that it has been the plan of the city to acquire the ice house properties in order to prevent danger of contamination of the waters of the pond from its continued use for the cutting, storage and handling of ice. This danger, in the opinion of the Board, cannot be ignored. In order to harvest and remove any considerable quantities of ice, it is necessary to introduce within the watershed and upon the surface of the pond considerable numbers of men and horses. Observations of the conditions under which ice is cut, stored and handled, even on lakes where these operations are subject to an inspection which is intended to be adequate, show that these processes may result in the serious contamination of the water, — in a recent case being the probable cause of a most serious epidemic.

Furthermore, from the information presented at the hearing, it does not appear to be necessary to use North Pond as a source of ice supply in order to secure an adequate quantity of good ice for the inhabitants of Fall River at reasonable cost. Ice which may be safely used for domestic purposes can undoubtedly be obtained from large portions of the South Pond, and other ponds were indicated at the hearing from which ice of good quality can be secured at distances from the city involving little greater haulage than would be the case if ice were taken from the North Pond.

In view of the circumstances and the information presented, it seems to the Board unnecessary to use North Watuppa Pond as a source of ice supply and, considering the danger to the purity of the drinking water of the city that would inevitably result from such use, the Board recommends that the further use of North Watuppa Pond as a source of ice supply be discontinued at the earliest practicable time.

Fitchburg.

April 17, 1913.

To the Board of Water Commissioners, Fitchburg, Mass.

Gentlemen: — The State Board of Health has considered your request, received through your engineers, Messrs. Metcalf & Eddy of Boston, for advice as to the quality of the water of Wyman Reservoir in relation to its use as a source of water supply for the city of Fitchburg, and has caused the reservoir and its surroundings to be examined by one of its engineers and samples of the water to be analyzed.

This examination was made at a time of the year when the condition of the water of ponds and reservoirs is usually at its best, and the results of the chemical analysis showed that the color of the water at this time was slight and the quantity of organic matter not excessive. The microscopical examination showed the presence of organisms of kinds which have been known to impart very disagreeable tastes and odors to the waters of ponds and reservoirs when present in considerable numbers. It is probable that organisms grow in this water in greater abundance at other seasons of the year than at the time when the recent examination was made.

Wyman Reservoir was not constructed with a view to its use as a source of domestic water supply, and, while a reservoir formerly existed on this site for many years, its size was much enlarged when the new dam was built a few years ago, and a considerable area of the portion flowed is said to be covered deeply with mud. There is also a considerable population within the watershed, which is largely increased in summer when the cottages near the reservoir are occupied, and the reservoir and its tributaries already receive considerable pollution.

Under the circumstances it is not unlikely that the quality of the water is quite different in the summer and autumn from its condition as found at the time of the recent examination.

The Board is unable to advise you definitely at the present time as to the probable quality of the water of Wyman Reservoir at other seasons of the year, but, judging from such information as is available concerning it and experience with other reservoirs, it is likely that in order to obtain satisfactory water from this source either the condition of the reservoir and its watershed must be improved or the water must be efficiently filtered. It is probable that the improvement of the water can be effected more economically by sand filtration than by any other plan, and if this plan were adopted the water could probably still be supplied to the city by gravity.

The question whether Wyman Reservoir is the most appropriate source of water supply of the city of Fitchburg has not been considered by the Board, it being understood that you are investigating also sources to the north of the city, which were examined by the engineer of the Board last year and for the development of which it is understood that plans are now being prepared. As soon as your investigations are completed the Board will, upon request and the receipt of plans and estimates of the cost of works, consider such other sources as may be available and advise you as to the most appropriate plan for securing an additional water supply for the city.

Aug. 18, 1913.

To the Board of Water Commissioners of the City of Fitchburg, Mass.

Gentlemen: — The State Board of Health has considered your application for advice relative to increasing the water supply of the city of Fitchburg, in which your proposed plans are outlined as follows: —

> This city having outgrown its present water supply we have had engineers look up a larger supply and from their report we have decided to recommend, subject to your approval, the following scheme: —
>
> To build a dam at Shattucks on the Falulah Brook at an elevation that would supply water to Overlook Reservoir, said dam would hold about 291,000 gallons, and also to secure the rights in Ashby Reservoir and divert the flow of that watershed into the brook supplying Shattucks Reservoir.
>
> Ashby Reservoir is of shallow flowage and muddy bottom but by drawing it down the brook and storing it in this reservoir the quality would we think become satisfactory.
>
> Later when an increased supply is needed to raise the level of Ashby Reservoir 10 feet by dams at each end and build a permanent dam at Wachusett Lake, and raise the level there about 10 feet. The expense of the whole scheme has been estimated at about $300,000.

We wish your opinion of this plan and would refer you to report in the possession of your engineer for details of not only this scheme but the whole subject of an increased supply that we have considered.

Accompanying the application is a report of your engineers, Messrs. Metcalf and Eddy of Boston, containing the results of the investigation of the available methods of enlarging the water supply of the city of Fitchburg, together with estimates of the quantity of water to be obtained from the various sources used in connection with your present supplies and the probable cost of the necessary works for the development of these sources for the use of the city.

From these investigations it appears that the practicable methods of increasing the supply of water for the city are (1) the construction of additional storage reservoirs on Falulah Brook above the present Falulah Reservoir; (2) raising the level of Wachusett Lake; and (3) the taking of water from Ashby Reservoir north of the Falulah Brook watershed. It also appears that investigations show that additional watersheds can be developed, if necessary, northwest of Ashby Reservoir and the water obtained therefrom brought to the city by gravity through Ashby Reservoir and Falulah Brook.

The Board has caused the locality to be examined and has considered the conditions affecting the development of an additional water supply for the city of Fitchburg and the results of the investigation presented. The city of Fitchburg is growing rapidly, and the quantity of water used for manufacturing purposes is large, probably amounting to an equivalent of 34 gallons per day for each inhabitant of the city. The quantity of water supplied to the city is unfortunately not all measured, so that it is impracticable to determine accurately the amount used at the present time. It is evident, however, that the yield of the present sources is no more than equal to the present requirements in a dry season. Much of the water is supplied through meters, and there has been a great reduction in unnecessary use and waste of water since the introduction of meters was begun, and it is no doubt possible to effect a considerable further saving when meters have been provided for all services. While by the introduction of meters a considerable further reduction in the consumption of water could doubtless be made, it is necessary, in the opinion of the Board, on account of the growth of the city, to provide an additional water supply at the earliest practicable time.

An examination of your present sources of supply shows that, while most of these sources are quite fully developed, large quantities of water go to waste from Falulah Brook in the wetter portion of the year, owing to lack of storage. The studies of your engineers show that it is practicable to construct reservoirs upon this stream at several points, the most favorable being just above the present Falulah Reservoir at the lower end of the watershed and in the neighborhood of Shattucks, so called, about a mile farther upstream. Your engineers recommend that reservoirs be constructed at these points, the lower one of which is designated as the Lovell Reservoir and the upper one as the Shattuck Reservoir. Calculations of the probable yield of your sources of supply indicate that by the construction of these two reservoirs, and by using them in connection with the present sources, the probable yield of your entire works would be increased from about 3,700,000 gallons per day to about 5,900,000 gallons per day, — a quantity sufficient to meet the requirements of the city probably for the next ten years, assuming that the growth of the city continues about as in the past. When the capacity of these sources has been reached it will be possible to increase the supply further by the acquisition of Ashby Reservoir and the subsequent raising of its water level. The watershed of Ashby Reservoir is adjacent to that of Falulah Brook on the north, and its waters can be drawn by gravity into Falulah Brook. It is also possible to increase materially the storage capacity in Wachusett Lake by increasing the height of the dam at its outlet. The increase in the yield resulting from the enlargement of Wachusett Lake, however, would be small compared with the increase obtainable from the use of Ashby Reservoir. The increase obtainable by raising Wachusett Reservoir in the beginning would be comparatively small, and if this course were adopted a further additional supply would very soon become necessary.

Considering all of the circumstances, it appears to the Board that the most appropriate method of increasing the water supply of the city of Fitchburg at the present time is to provide additional storage on Falulah Brook. The water of this brook, while slightly colored, is in other respects of good quality for domestic purposes and the watershed is sparsely populated; but on account of the very small storage now provided, the water of this watershed during much of the year is delivered to consumers quite directly without the sanitary advantages of storage for a considerable time.

The investigations of your engineers show that it is practicable to construct two reservoirs of considerable size on Falulah Brook. The proposed Lovell Reservoir, located near the lower end of the watershed, would be more expensive, but it would hold a considerably larger quantity of water than the proposed Shattuck Reservoir. The Shattuck Reservoir would be at a higher level than the Lovell Reservoir, and it would be practicable to divert the water of the former into the high-service system of the city. It is probable, however, that the present sources of supply are sufficient for the high-service districts for a considerable time in the future.

It appears to the Board that there are decided advantages, especially from a sanitary point of view, in the construction of the Lovell Reservoir, near the lower end of the Falulah watershed, in the beginning, and thus secure for this watershed the sanitary protection due to storage which is available for all of the other watersheds. Moreover, a greater increase in the yield of your sources of supply can be secured by the construction of the Lovell Reservoir than would be the case if the Shattuck Reservoir were constructed in the beginning, the difference being about 500,000 gallons per day.

From a careful study of all of the conditions, the Board is of the opinion that it is advisable to construct the Lovell Reservoir in the beginning, to be followed by the construction of the Shattuck Reservoir whenever the need of a further supply becomes apparent. When the watersheds from which your supply is now drawn have been developed by the construction of these reservoirs, the additional supply obtainable by increasing the storage capacity of Wachusett Lake would be comparatively small and it would be necessary within a very short time to secure a supply from other watersheds. Investigations show that it is practicable to divert water from Ashby Reservoir into the Falulah Brook watershed by gravity, and, in the opinion of the Board, this method of increasing your water supply after the proposed development of Falulah Brook is completed will probably be the most appropriate and satisfactory that it is practicable to adopt. By the development of this watershed, with the proposed additional storage reservoirs on Falulah Brook, the supply of water available for the city can be increased to double the quantity available at the present time. The plans further show that it will probably be practicable to obtain a very large additional supply from the upper waters of the Souhegan River, when a further quantity is required, and divert it into the Ashby watershed by gravity.

The Board recommends the construction in the beginning of the Lovell Reservoir, so called, on Falulah Brook, to be followed by the construction of the Shattuck Reservoir as soon as a further supply becomes necessary. The Board further recommends that you secure the right to take water from Ashby Reservoir and the watersheds northwest thereof, from which the Ashby Reservoir can be supplemented by gravity. The Board also recommends that Venturi meters, or other suitable measuring devices, be installed on all the sources of water supply of the city and an accurate record of the daily consumption maintained at all times. It is also advisable that all water supplied to consumers, including city departments, public fountains, etc., shall be metered.

Greenfield (Fire District No. 1).

June 13, 1913.

To the Board of Water Commissioners of Fire District No. 1, Greenfield, Mass.

Gentlemen: — The State Board of Health received from you on June 4, 1913, an application for its advice relative to, and approval of, a proposed plan for obtaining an additional supply of water for Fire District No. 1 of Greenfield from the ground on the easterly side of Green River about half a mile north of the present pumping station on that stream and south of the highway bridge near the boundary between Greenfield and Leyden.

The application is accompanied by a plan showing the contour of the ground in the region in which it is proposed to locate the collecting well and the location of test wells which have been driven in this region to determine the depth of porous soil and the character of the ground water. This plan also shows two possible locations for a dam on Green River for diverting the water of that stream onto the ground in the vicinity of the proposed collecting well and the lands which it is proposed to acquire for the development and protection of the proposed supply.

The Board has caused the locality to be examined by one of its engineers and has considered the plan presented and the results of the tests made in 1911 with a view to securing an additional supply of water from the ground in this locality. The results of the analyses of samples of water collected at that time showed the ground water of this locality to be of very good quality for domestic purposes. The tests also showed that the wells penetrated a porous soil several feet in depth extending below the level of the river, and these conditions — taken in connection with the character of the soil in the region about the proposed well, which appears to be favorable for the absorption of a considerable portion of the water falling upon the ground — are favorable for obtaining a large quantity of water from wells or other collecting works in this region.

The plan provides, however, in case the quantity of water obtainable from the proposed well or other additional works in this locality should not prove sufficient for the requirements of the district at all times in connection with the present sources, for diverting water from Green River above the highway bridge into trenches or areas in the neighborhood of the proposed well for the purpose of supplementing the yield of ground water.

In the opinion of the Board the plan is an appropriate one for increasing the water supply of the fire district, and, used in connection with the present sources, is likely to provide an additional quantity of water for all requirements — if reasonably used — until the population becomes much greater than at the present time. It is important, in case the water of Green River shall be diverted to the proposed trenches or filter beds upon the ground near the wells, that the trenches or filters should not be located nearer than 100 feet from the well, and it is also important that these trenches or filters be located at places where the soil to a depth of as much as 4 feet is composed of sand suitable for filtration. The area of land which it is proposed to acquire in the beginning is a reasonable one for the purpose under the conditions existing at the present time.

The Board, acting under the provisions of chapter 497 of the Acts of the year 1913, approves the taking of an additional water supply from the ground on the easterly side of the Green River and the lands indicated upon the plans submitted with your application and the location of the well shown thereon.

Hamilton (Asbury Grove).

Sept. 4, 1913.

To the Board of Health, Hamilton, Mass.

Gentlemen: — In the course of an investigation of the sanitary conditions at Asbury Grove in Hamilton, the State Board of Health has caused an examination to be made of a number of wells located in this densely populated area and samples of their waters to be analyzed.

The results of the analyses show that the waters of these wells are practically all polluted to a greater or less extent, evidently by the sewage deposited upon the ground in a large number of receptacles located in the neighborhood of the dwelling houses about the grounds. Some of these wells show evidence of more serious pollution than others, the most seriously polluted being the well near the car office, the well on the westerly side of Mudge Avenue, just south of Mt. Zion Avenue, the well at the corner of Kingsley and Mudge avenues, the well in the passageway between Olin and Essex avenues, and the well in a stable on Asbury Avenue, opposite Maple Avenue; but all of the other wells show evidences of pollution, and experience with such wells indicates that with the existing conditions the quality of the water of these wells is likely to deteriorate further in the near future.

Under the circumstances it is very important, in the opinion of the Board, that an adequate supply of good water for domestic purposes shall be provided for use in this thickly settled community. The Board recommends that every effort be made to secure the introduction of a supply of good water for this densely populated area before the coming of another summer season, and the further use of the wells located in the immediate neighborhood of dwelling houses, or other possible sources of pollution, prevented.

Hamilton (South Hamilton).

Dec. 4, 1913.

To the Board of Health, Hamilton, Mass., Mr. George W. Fitz, *Secretary.*

Gentlemen: — In response to your request for an examination of private wells in South Hamilton and advice as to the conditions affecting the wells in that village, the State Board of Health has caused a number of wells in various parts of the village to be examined and samples of their waters to be analyzed.

This examination included nine driven wells, some of which were located in the more densely populated parts of the village and others on the outskirts. These wells consisted of an iron pipe from 1½ to 2½ inches in diameter, driven usually to a depth of from 18 to 57 feet, though in some cases wells were sunk to depths of from 72 to 90 feet. Where tubular wells are used, no cases were found of pollution of the well by surface drainage, but in all cases there were numerous privies and cesspools at no great distance from the wells, and pollutions of the ground water have a very decided effect upon the condition of the water taken from the wells. The waters of all of these wells were found to be polluted, many of them to such an extent as to be unsafe for domestic use.

Among these the worst were the wells of G. Adams, A. W. Chandler, Mrs. McGlauflin, the well at the South School and the well of J. W. Roberts on Pleasant Street. The further use of these wells should be prevented.

The quality of well waters in such locations as these is subject to considerable change from time to time, owing to variations in the circumstances affecting their pollution, and their condition may be worse at other seasons of the year than at the time of this examination.

An examination has also been made of two additional wells at Asbury Grove, one being a dug well near the house of J. W. Mann, and the other a new tubular well near the Tabernacle in Asbury Grove. The water of these wells at the present time is probably safe for drinking, but both wells show some evidence of pollution and both are located in populous districts. In each case there are sources of pollution at no great distance from the wells and the quality of their water is likely to deteriorate with continued use.

The conditions are such at the present time in the village of South Hamilton that it is evidently impracticable for the householders in the greater part of the village to secure a supply of water which is safe for drinking upon their own premises, and it appears to the Board that the introduction of a general water supply from some suitable source is essential for the adequate protection of the public health in this village. Your attention has already been called in a previous communication to the condition of wells in Asbury Grove, where much the same conditions were found, and the circumstances are such that it would probably be practicable to supply both Asbury Grove and South Hamilton from the same source at less expense than would be necessary for the supply of these villages from separate sources.

The Board recommends that the matter of a public water supply in the thickly settled portions of Hamilton be taken up without delay and the preliminary investigations made at the earliest practicable time. When the necessary information has been obtained to determine the most appropriate source of water supply and the probable cost of works, the town will have been supplied with the requisite information to enable it to give due consideration to this important question.

Haverhill.

Aug. 8, 1913.

To the Board of Health, Haverhill, Mass., Mr. Chester Bryant, *Agent.*

Gentlemen: — In accordance with your request of July 25, 1913, an examination of Crystal Lake and its surroundings shows that there are about forty-three summer cottages or camps on the shores of the lake, all of which are provided with privy vaults located generally in the rear of the buildings and 50 feet or more from high-water mark in the lake. While no cases of direct pollution of the lake were found at this time, it was found that in some cases the privies are so located that there appears to be danger that at times of heavy rain some of the contents may be washed over the ground and enter the lake. It is uncertain, also, whether sufficient care is exercised in the disposal of other refuse matter from the cottages near this water supply to prevent pollution of the lake therefrom.

The Board has recommended to the Haverhill Water Board the strict enforcement of the rules and regulations adopted by this Board for the sanitary protection of this lake and of other sources of water supply of the city on Feb. 1, 1912. While these rules are designed for enforcement by the water department, the sanitary conditions about the lake are, nevertheless, within the jurisdiction of your board, and your board can take action to prevent nuisances, sources of filth and causes of sickness in the territory about the lake notwithstanding these rules. The powers of a local board of health over water supplies within its jurisdiction are quite fully set forth in the decision of the Supreme Court in the case of Stone *v.* Heath, 179 Mass. 385, and the following extracts from that decision are important in this connection: —

The jurisdiction over nuisances given to town boards of health by Pub. Sts. c. 80, §§ 20–27, is summary in its nature, and the orders made thereunder are not subject to judicial examination and revision at the instance of parties affected by them before they are carried out. After they are carried out, however, the questions whether there was a nuisance, and, if so, whether it was caused or maintained by the parties charged therewith, may be litigated.

St. 1897, c. 510, does not give the State Board of Health exclusive jurisdiction of nuisances affecting the purity of the sources of water supply. There is nothing in that statute which takes away or limits the power of local boards of health to deal with nuisances in their respective jurisdictions.

Under Pub. Sts. c. 80, section 20, giving town boards of health the power to examine into, destroy, remove or prevent "all nuisances, sources of filth, and causes of sickness" within the town, those boards have jurisdiction over nuisances affecting the purity of the water supply as well as other causes of sickness.

Under the circumstances it is probable that your board can aid greatly to prevent nuisances about this lake in case of need, especially by co-operation with the water department.

AUG. 8, 1913.

To the Board of Water Commissioners, Haverhill, Mass.

GENTLEMEN: — In response to a request from the local board of health, the State Board of Health has caused an examination to be made of the conditions about Crystal Lake with reference to the possible pollution of the lake from population living about it, and, while no place was found at which the lake is being directly polluted at the present time, the conditions are such that there is danger that pollution from some of the privies and other places of deposit of sewage or refuse may at times of heavy rain be washed or carried over the ground to the lake.

The Board recommends that the conditions about the lake be carefully inspected and that the rules and regulations for the sanitary protection of the lake adopted by this Board Feb. 1, 1912, be strictly enforced. It is also advisable that the other sources of supply, especially Johnson's Pond, be carefully examined and that the strict enforcement of sanitary regulations be established about those sources.

LANESBOROUGH.

OCT. 22, 1913.

To the Water Committee, Lanesborough, Mass., F. C. DOWNING, M.D., *Secretary.*

GENTLEMEN: — In response to your request the State Board of Health has caused a further examination to be made of Rice Brook and Newton Brook, which are now being considered as sources of water supply for Lanesborough, and further samples of water from these streams to be analyzed.

The results of the examination show no material change in the conditions as shown by the previous investigation. The watershed of Newton Brook above the point at which it is proposed to take water is uninhabited, and the water, though somewhat harder than desirable, is of good quality for domestic purposes. The flow of the stream appears to be well maintained in dry weather, and it is likely that, with a suitable reservoir, an adequate quantity of water for the requirements of the town can be obtained from this source at all times.

Rice Brook is a less desirable source, having at least two groups of farm buildings on its watershed, while the flow of the stream appears to be less in the drier part of the year in proportion to the area of watershed.

Judging from the results of the investigations, the Board is of the opinion that a suitable water supply for Lanesborough can be obtained from Newton Brook at less cost than from any of the other sources suggested.

LENOX.

DEC. 15, 1913.

To the Lenox Water Company, Lenox, Mass.

GENTLEMEN: — In response to a request received on Oct. 22, 1913, from the selectmen of Lenox for an examination of your reservoir, which at that time was nearly dry, the State Board of Health has caused the reservoir and its surroundings to be examined and samples of the water to be analyzed.

The work of scraping the bottom of the reservoir was being carried on at that time, and analysis of the water showed the effect of this work. Further analyses have been made since this work was completed and the reservoir filled, and the most recent one indicates that the water has now returned to a condition in which it may safely be used for drinking.

The experience of the past summer shows very conclusively that the quantity of water that your present sources are capable of supplying is inadequate for the requirements of the town of Lenox in the summer season. It is possible that the yield of your present watershed can be increased materially by providing additional storage either above or below the present reservoir. There also appear to be other sources from which an additional supply might be obtained.

Before it will be practicable to advise definitely as to the most appropriate method of increasing the water supply, it is essential that a careful engineering study be made and the necessary information collected to determine the probable quantity and quality of water that can be obtained from available sources and the probable cost of the works. The Board recommends that the investigation be made under the direction of an engineer of experience in matters relating to water supply and that the information be collected at the earliest practicable time. As soon as the results of the investigations are available the Board will, upon request, advise you as to enlarging and improving the water supply of the town.

There are indications that a considerable quantity of water is lost from the mains and service pipes of the company by waste and leakage. The Board further recommends that a Venturi meter, or other measuring device, be installed upon the main leading from the reservoir to the town and that careful records of the consumption of the water be kept in the future. If the results of these observations disclose an excessive amount of leakage, it is not improbable that this will have a considerable bearing upon plans for an additional supply.

Leominster.

Oct. 22, 1913.

To the Board of Water Commissioners, Leominster, Mass., Mr. W. H. Chase, *Chairman.*

Gentlemen: — The State Board of Health has considered your communication of Sept. 8, 1913, requesting its advice as to the wisdom of allowing the cutting of ice on the reservoirs of the town of Leominster, especially Fall Brook Reservoir, and has caused the locality to be examined by one of its engineers.

Fall Brook Reservoir is an artificial basin constructed and owned by the town. It has an area of about 82.5 acres, a drainage area of about 1.26 square miles and a storage capacity of about 386 million gallons. The water in this reservoir is supplied to the town by gravity, the reservoir being connected directly with the distribution system. The use of the reservoir for storage produces considerable fluctuations in its surface level, the water usually overflowing in the spring in the period of high flow of streams, while in the summer and late fall in dry years it is drawn to levels considerably below full pond. As the town grows and the use of water increases, the fluctuations in the level of the water in this source are likely to increase, and in very dry years the amount of water in storage when ice-cutting would begin might be much less than the full capacity of the reservoir.

If this reservoir is to be used as a source of ice supply it will be essential, in harvesting the ice by the methods commonly employed at the present time where considerable quantities of ice are harvested, to introduce numbers of men and horses not only within the watershed but upon the surface of the ice of the reservoir itself. The experience of the Board in the matter of the use of water-supply ponds and reservoirs as sources of ice supply has shown that the pollution of the water is practically inevitable, and very serious pollutions caused by the use of reservoirs as sources of ice supply have been found recently in cases where thorough sanitary rules have been established for the protection of the water supply.

In the opinion of the Board the use of Fall Brook Reservoir as a source of ice supply would inevitably involve pollution of the water, and the health of the inhabitants of the town would be exposed to danger of very serious injury. In the consideration of this question the Board has assumed that the ice houses would be located at some point outside the watershed; if located within the watershed the danger of pollution of the water would be even greater.

The objections to the cutting of ice on the Haynes or Morse reservoirs are even more serious, notwithstanding the fact that the waters of these reservoirs flow through the distributing reservoir before entering the city. The cutting of ice on either of the storage reservoirs would require the introduction of numbers of men and horses into the watershed of the distributing reservoir at a time when the condition of the ground is such that danger of the pollution of the water of the reservoirs is especially great. The storage capacity of the distributing reservoir is small, and at times of high flow, especially in the late winter and early spring, the water in this reservoir changes frequently, so that the value of the storage obtained there is slight, and pollution entering this reservoir would quickly enter the supply pipes of the town.

After careful consideration of this question the Board recommends that the town of Leominster prevent the use of its reservoirs as sources of ice supply and avoid the great danger to the health of the inhabitants of the town involved in such use.

Lincoln.

April 12, 1913.

To the Board of Water Commissioners of the Town of Lincoln, Mass.

Gentlemen: — Complaint having been made of an objectionable turbidity and color which affect the water drawn from faucets in Lincoln, the State Board of Health has caused the water supply of the town to be examined and samples of the water from various parts of the water-distributing system to be analyzed.

The results of the analyses show that the water drawn from faucets near the ends of the pipes at various points about the boundaries of the town is generally turbid and highly colored and contains such a quantity of iron as to make it objectionable for many domestic uses; but these conditions are not confined to the dead ends of the mains, being found in some cases at other points in the town. Practically no complaints have been made by consumers living along those streets in which the water is supplied through cement-lined mains, and at one of the dead ends where a suitable blow-off has been provided and used there appears to be no trouble for a time after the use of the blow-off.

Some of the most serious complaints are from a locality in which a new pipe has been laid within a few months, indicating that the trouble in this case is probably due to conditions affecting the water before it reaches this section of the pipe.

It appears to be the custom to flush the pipes by opening hydrants in the neighborhood of places where complaint is made, and so far as the Board is informed only one regular blow-off valve has been installed in any part of the system.

The water of Sandy Pond is naturally very soft and of excellent quality for domestic purposes, and such waters act somewhat more readily upon the material of pipes and upon the substances with which they come in contact than do the waters of less purity which contain larger amounts of mineral matter.

The system has been in use for many years, and the results of the examination indicate that considerable iron rust has accumulated in the pipes, which, on account of the inadequate facilities for flushing, is now being carried out of the mains into the service pipes of the water takers. It is probable, also, that a part of the trouble is due to service pipes, which are largely galvanized iron and which after a few years' use are seriously attacked by the water.

In the opinion of the Board the condition of this water can be very greatly improved and thereafter maintained in a much better condition than at the present time by a thorough and regular flushing of the mains throughout the town, and especially in those portions thereof where the circulation of water is small.

It is impracticable to flush the pipes satisfactorily by opening the hydrants, the best plan being to provide regular blow-off valves of suitable size leading from the mains at the dead ends and at other convenient points on the pipe lines in thinly settled districts, especially in the low places where suspended matter in the water has apparently a tendency to collect in greater quantities than elsewhere. These blow-offs should be installed at the earliest practicable time, and the system should then be given a thorough flushing for the purpose of removing the accumulated suspended matter from the pipes. After this has been accomplished the pipes should be flushed regularly and with sufficient frequency to prevent the occurrence of further accumulations.

The water discharged from the blow-offs can be allowed to run ultimately into any convenient body of water, since it contains nothing which is injurious to health.

In future extensions to these works it is advisable to use cement-lined pipes for mains and also cement-lined or tin-lined pipes for services.

Marion.

Oct. 22, 1913.

To the Board of Water Commissioners, Marion, Mass.

Gentlemen: — In response to your request of Oct. 1, 1913, for advice as to an additional water supply for the town of Marion, the State Board of Health has caused the locality to be examined by its engineer and has considered the results of tests made by sinking tubular wells in the valley of the brook flowing from Bear Swamp just above its junction with Benson's Brook, in the valley of which the present wells are located.

These tests consisted of sinking four tubular wells from 37 to 40 feet in depth and pumping from them for a sufficient time to obtain suitable samples of water for analysis. It was found that water could be pumped quite freely from these wells, but analyses of samples of the water sent in by you show that it is of much less satisfactory quality than that of your present sources of supply, the water showing evidence of previous pollution, probably caused by the discharge of sewage or sewage effluent from the sewage filter beds of the town into the adjacent brook.

In view of these conditions and the danger of more serious pollution at times of high flow when the ground about the wells is probably flooded, it appears to the Board inadvisable for the town to take water from this locality. The Board recommends that further investigations be made with a view to securing water from the ground in the valley of one of the streams in this region not affected by the discharge from the filter beds.

The valley of Doggett's Brook east of that stream between the Marion-Rochester line and the highway from Marion to Rochester is free from danger of sewage contamination, and if suitable soil is found here it is probable that ground water of good quality could be obtained. The conditions also appear to be favorable for obtaining water of good quality on the northerly side of the Sippican River above the mouth of the brook flowing from the filter beds. It is advisable in making these further tests that they be carried out under the direction of an engineer of experience in such work. The preliminary test wells should be distributed so as to obtain general information as to the territory explored and the subsequent tests made in the locality in which the most favorable conditions are found.

The Board will assist you in further investigations by making the necessary analyses of water and will, upon request, give you further advice in this matter when the results of further tests are available.

Middleborough.

May 24, 1913.

To the Board of Water Commissioners, Middleborough, Mass.

Gentlemen: — The State Board of Health has received the following application from you through your engineer for advice as to certain proposed plans for the treatment of the water supply of Middleborough for the removal of the iron, which makes the water objectionable for many domestic purposes: —

On behalf of the Middleborough Water Works, I am sending you by messenger a set of plans and specifications for the new deferization plant at Middleborough. As you know, the water supplied the town contains about 1.5 parts of iron and 1.0 parts of manganese per million; and after a series of experiments and studies in which I have been greatly assisted by the results furnished from your laboratory, the plans and specifications now sent you have been worked out.

As I understand the matter, the consent of the Board is not required in a case of this kind where improvements for æsthetic reasons only are contemplated, but I would respectfully ask your advice in the premises.

The plans submitted with the application provide for the construction of an aërator, a preliminary sprinkling filter of coke, a subsiding basin and two covered sand filters having an aggregate area of about one-tenth of an acre, equipped with the usual appurtenances of such filters. From the filters the water will flow to a regulator house and thence to the filtered-water reservoir, having a capacity of about 45,000 gallons, whence the water will be pumped for distribution to the town.

The Board, having examined the plans and the specifications relative to the size and quality of the coke and sand to be used in the filters, is of the opinion that the proposed works, if constructed in accordance with the plans and properly operated, will provide for the satisfactory purification of the present water supply of the town of Middleborough.

Middleton (Haswell Park).

Sept. 4, 1913.

To the Board of Health, Middleton, Mass.

Gentlemen: — In connection with an investigation of the sanitary conditions at Haswell Park at Middleton, the State Board of Health has caused two public wells at the park to be examined and samples of their waters to be analyzed.

The results of the analysis indicate that the waters of these wells at the time of this examination, though showing some evidence of previous pollution, were probably safe for drinking. There appears to be some difficulty in obtaining water from these wells at times when the ground water is low, and, in consequence, objectionable water is said to be used at times to prime the pumps.

It is important that an effective method of supplying water in this park shall be installed at the earliest practicable time and that the present method of drawing the water be discontinued. There are sources of pollution at no great distance from the present wells, and it is not unlikely that the quality of their waters will deteriorate with continued use. It is important that, if these wells are to continue to be used as sources of water supply in this place, the water shall be analyzed from time to time in order that its use may be discontinued if deterioration occurs.

Norfolk (Norfolk State Hospital).

Sept. 29, 1913.

To Irwin H. Neff, M.D., *Superintendent, Foxborough State Hospital, Foxborough, Mass.*

Dear Sir: — In response to your request for an examination of the water of a tubular well located on the game preserve at the Norfolk State Hospital and advice as to its suitability for drinking, the State Board of Health has caused the well and its surroundings to be examined and a sample of the water to be analyzed.

The well had not been pumped clear at the time of this examination, but so far as can be judged from this test, the indications are that the water would be of good quality for drinking. There appear to be no sources of pollution in the neighborhood of the well at the present time, and as long as these conditions continue it is probable that this well can safely be used as a source of drinking water supply for this part of the hospital grounds.

North Adams.

Dec. 4, 1913.

To the Committee on Water Supply of the City Council, North Adams, Mass., Mr. S. MacVeigh, *Chairman.*

Gentlemen: — The State Board of Health received from you, through Mr. F. B. Locke, Commissioner of Public Works, the following application for advice as to a proposed additional water supply for North Adams, accompanied by outlines of the plans of the proposed works: —

The City Council of North Adams has (subject to approval by the Board) accepted the report of the Special Committee on Water Supply. This report recommends the adoption of the plans for a storage reservoir on the stream commonly known as the Lillie brook in the vicinity of the Beaman and Paul places in North Adams. The plans now in the hands of the Board show in a general way the principal features of the proposed changes. Briefly stated they provide for a storage basin of about 200,000,000 gallons' capacity. Provision is to be made for conducting the surplus waters from the Notch brook into the new basin by means of a cement, concrete or iron conduit starting from the westerly end of the Notch dam and running north-westerly about one-half mile to the head waters of the Lillie brook, whence the water will find its way to the new basin by way of the natural water course. It is also intended to bring a portion of the surplus waters from Broad brook by means of the present 24-inch supply main and a new connection between this 24-inch main and the new basin. This connection will probably consist of two 18-inch pipes so arranged that they can both be used to deliver water into the new reservoir when the flow is large in Broad brook; or, when the flow is small one 18-inch pipe will take water into the basin and the other will furnish water to the city. The proper valves and pressure regulators will be installed to accomplish the results indicated.

The members of the Council Committee ask that the Board, after considering the plans, will inform them as to their conclusion regarding the proposed extensions as early as convenient.

Subsequently, the following further request was received for advice as to additional water supply: —

Regarding the subject of additional water supply for the City of North Adams: The Council Committee on water supply have requested me to say that when the Board renders its findings on the proposition now under consideration, the Committee would be glad to also know your views on the following propositions: —

I. As to the feasibility of obtaining a sufficient supply for the needs of the city by sinking wells on the Notch brook watershed above the present storage reservoir.

II. As to whether the Board would advise attempting to get a sufficient supply by enlarging the present storage basin in the Notch by excavation above the present dam or by enlarging the dam by strengthening and raising it.

III. As to whether the city should undertake, considering all our local conditions, to find an underground supply before going ahead with the proposition of obtaining the necessary storage to carry the city through a very dry season.

IV. As to the amount of storage that should be provided for in case it should be decided to depend upon storage rather than underground supplies.

V. As to whether, considering the conditions, the Board would feel inclined to favor an attempt to get the necessary storage on the Broad brook watershed or would favor an attempt to enlarge the supply from the Broad brook by driving wells.

These various methods of securing water have been advanced and are urged more or less strenuously by their several advocates. They have all been considered by the Committee, and the views of the Board upon any or all of them would be highly appreciated.

On November 25 a report by Prof. W. O. Crosby, geologist, relative to the various schemes, was also submitted, and further information has been supplied by the commissioner of public works at the request of the Board.

The Board has caused the locality to be examined by its engineer and has considered the proposed plans and the information submitted relative thereto. The plans and reports of your engineers indicate that it is practicable to construct on Lillie Brook a storage reservoir having a capacity of 200,000,000 gallons and a drainage area of about 1.35 square miles. The plans provide further for diverting into the Lillie Brook watershed the surplus flow of Notch Brook, and it is also found to be practicable, by a change in the intake at Broad Brook and the construction of a pipe line of no great length, to divert water from the Broad Brook supply into the proposed Lillie Brook Reservoir.

Notch Brook and Broad Brook together, as at present developed, are capable of yielding about 1,700,000 gallons per day, and by the construction of the proposed reservoir on Lillie Brook the capacity of the works will probably be increased to somewhat more than 2,800,000 gallons per day, a quantity adequate for the present requirements of the city, even at the present high rate of water consumption.

The Board has also considered carefully the other plans suggested in your application. The first of these plans proposes the sinking of wells in the Notch Brook watershed above the present storage reservoir. The conditions in this watershed are such that there is no probability of the existence of any large storage of water in the ground above the reservoir that does not now find its way into the present basin, and there is no likelihood that an additional supply could be obtained in this valley which would increase materially the yield of your present sources. The plan does not appear to be worthy of further consideration.

As to the second plan, the increase of storage in the Notch Brook valley: The information presented by your engineers shows, as a result of their investigations, that the fall of this brook is very rapid and that, in order to construct storage reservoirs of considerable size, a very high dam or dams would be required. From the information presented it would be impracticable, in the opinion of the Board, to increase the storage on this watershed unless at a very great expense.

In regard to the third question, as to whether it is advisable for the city, considering the circumstances, to make investigations relative to obtaining a ground-water supply before constructing a storage reservoir: The Board has considered the results of a superficial examination of the territory in North Adams where the conditions appear to be most favorable for obtaining a ground-water supply. From these investigations it appears probable that enough water for the supply of North Adams might be obtained in the valley of the south branch of the Hoosick River above the city, and it is possible that an adequate additional supply could be obtained from the ground in the valley of the north branch of the Hoosick River in Clarksburg near the Vermont line. The results of the analyses of such samples of water as have been collected from the ground in the valley of the south branch of the Hoosick River above North Adams show these waters to be excessively hard, even where not affected by drainage from populated territories, and it is very doubtful, in the opinion of the Board, whether water that will be satisfactory in quality could be obtained from the ground at any point in this valley within reasonable distance of North Adams. In the valley of the north branch of the Hoosick River the waters are said to be softer, but the most favorable territory in which to sink wells in this region contains large areas of cultivated lands and a considerable population, and it is probable that the ground water would be affected unfavorably by these conditions. It is impracticable to determine without a thorough test whether a sufficient quantity of water of suitable quality for domestic purposes could be obtained in this region. The district appears to be the most favorable one, however, all things considered, in which to make tests for a ground-water supply for North Adams in case it should be found necessary or desirable to attempt to secure a supply in that way.

As to the fourth question, as to the amount of storage that should be provided for in case it is decided to depend upon storage rather than an underground water for an additional supply to the city: It may be said that the proposed additional storage of 200,000,000 gallons will bring the yield of all the watersheds of the city up to an amount a little in excess of the quantity now used. It is obvious under the circumstances that a storage of 200,000,000 gallons, including the additional watershed made available by the proposed reservoir, will be but little more than sufficient for the present needs of the city. With a smaller storage than that proposed it would probably be necessary to cut down the use of water in order to avoid a shortage in dry seasons.

In regard to the fifth question, as to whether, considering the conditions, it is advisable to attempt to obtain the necessary storage on the Broad Brook watershed above your present intake either by the construction of a reservoir or by drawing ground water from tubular wells: The information submitted by your engineers indicates that the slope of this brook is so great that it is impracticable to construct reservoirs of any considerable size except by the construction of very high dams, which would be very expensive. The geological conditions also appear to be such that the practicability of constructing a suitable reservoir on this stream is somewhat doubtful, and under the circumstances the expense might be very large.

As to the practicability of obtaining a ground-water supply in this valley, a definite recommendation cannot be made, since no tests of the character of the soil have been undertaken in that region. From the information presented, however, and a general examination of the locality, there appears to be no probability that a large quantity of ground water could be obtained in this valley by means of wells or other works.

After a consideration of the various plans and the information presented relating thereto, the Board is of the opinion that the most appropriate method of increasing the water supply of North Adams will be by the construction of the proposed reservoir on Lillie Brook with a capacity of at least 200,000,000 gallons. If, in the further studies preliminary to the construction of this reservoir, it is found to be possible to increase its size, it is very desirable that its capacity be enlarged to the greatest extent found practicable. The reservoir is at such an elevation that water can be supplied to the city by gravity, and yet it is low enough to make it possible to increase its yield by diverting into it the surplus water of Notch Brook, making it certain that it can be filled in the spring of each year, even should its capacity be increased considerably beyond that now proposed. It appears to be possible, also, by slight changes at the intake of Broad Brook Reservoir, to divert the water from Broad Brook into the proposed Lillie Brook Reservoir when there is an excess flowing in that stream. It is not likely that for several years, at least, the additional quantity of water which Broad Brook is capable of supplying to this reservoir will be necessary to maintain an adequate storage for the requirements of the city, but the water of Broad Brook is considerably softer than that of Notch Brook and some improvement in the quality of the water in this respect would be effected by diverting some of this water into the Lillie Brook Reservoir. Such a pipe line would also save a part of the water which now wastes from Broad Brook in times of summer rains.

While the connection of Broad Brook with the proposed Lillie Brook Reservoir does not appear to be necessary at the present time, it is desirable to make a provision for such a connection in future. In the construction of the proposed Lillie Brook Reservoir it is advisable to remove the surface soil and other organic matter from the area to be flooded, but it is also important to examine carefully the character of the soil that will be exposed to the water, and if clay is encountered which is likely to cause serious turbidity provision should be made for covering it in such a way as to prevent its affecting the quality of the water.

It is evident from the investigations already made that the consumption of water in the city is excessively great and could be materially reduced by the introduction of meters. It is advisable, as the first step in the prevention of unnecessary waste, to introduce Venturi meters or some other system of measuring accurately all of the water delivered into the pipes for the supply of the city, and the Board recommends that such systems of measurement be instituted at the earliest practicable time and a careful record kept of the daily quantity of water used by the city. If it is then found impracticable to keep the consumption within reasonable limits by careful inspection, it will be advisable to begin without delay the application of meters to all service pipes.

NORTHAMPTON (HAMPSHIRE COUNTY TUBERCULOSIS SANATORIUM).

OCT. 22, 1913.

To the County Commissioners of Hampshire County, Mass.

GENTLEMEN: — In response to your request for an examination of Day Brook and advice as to its use as a source of water supply for the proposed tuberculosis sanatorium in the northerly part of Northampton, the State Board of Health has caused the locality to be examined by one of its engineers and has considered the information presented.

It is impracticable to estimate the quantity of water that would be used in this institution and upon its grounds, but there is probably little doubt that the quantity required will equal 50,000 gallons per day during the summer season, at least, and may eventually amount to a much larger quantity.

Day Brook drains an apparently uninhabited area of about .52 of a square mile. The watershed is steep and, according to information submitted by you, the flow of the brook sometimes falls to 10,000 gallons per day in a dry summer.

In order to secure an adequate quantity of water for the uses of the sanatorium from this stream it would be necessary to construct a storage reservoir of considerable size at some point within its watershed. Such a reservoir might be built at a point southwest of the hospital, but this site is not a very desirable one. The cost of such a reservoir would be large, and the quality of the water would be likely to be less satisfactory than that obtainable from the Northampton water works. Such a reservoir would also inevitably be exposed to considerable danger of pollution and, under the circumstances, the Board does not recommend the adoption of this plan for supplying water to the proposed institution.

If it is found desirable to obtain an independent water supply for the institution it would probably be best to secure it if possible from tubular wells, either in the valley of Day Brook or in the valley of Mill River east of the proposed institution. If it is decided to obtain a ground-water supply for the institution, the Board will assist you by making the necessary analyses of water and will give you further advice in this matter when the results of tests are available.

From the information at present available it appears to the Board probable that the most appropriate method of securing a water supply for this institution will be by pumping water from the works of the city of Northampton.

You have also requested advice as to the location of a sewage-disposal system and as to the material to be used for filter beds.

The locality indicated for the construction of filter beds is about 500 feet west of the highway along Mill River and 200 feet north of the southern property line of the institution. The soil at the location indicated is not apparently of a suitable character for the purification of sewage by intermittent filtration, and it is proposed to obtain sand or gravel from a gravel pit located about half a mile southeast of the village of Leeds. An examination of this gravel pit indicates that soil suitable for the filtration of sewage can probably be obtained from it and that an ample quantity can probably be secured here for the purpose.

In considering the location of filter beds for the institution it is very important that they shall be sufficiently remote from the roadway leading to the buildings to avoid offence to visitors, and they should, of course, be at a sufficient distance from the sanatorium to avoid danger that objectionable odors will be noticeable in the vicinity of the buildings. The location selected appears to be at a sufficient distance from the proposed buildings, and if the roadway leading to the buildings shall be located 400 feet or more from these filter beds it is likely that the danger of objectionable odors being noticeable along the roadway will be avoided. It will be advisable, however, to plant trees thickly about the area to assist in preventing the escape of objectionable odors.

It is important, in the opinion of the Board, before locating the filters, to make a careful examination of the soil in this region by means of test pits, since it is possible that material suitable for filtration can be found at some point in this neighborhood, and in that case the cost of the necessary works might be materially reduced.

When plans of the proposed filters have been prepared the Board will give you advice concerning them, if you so request.

NORWOOD

JULY 15, 1913.

To the Board of Water Commissioners, Norwood, Mass.

GENTLEMEN: — The State Board of Health received from you on July 2, 1913, the following application for advice as to a proposed plan for filtering the water supplied to the town from Buckmaster Pond: —

The Water Commissioners of the Town of Norwood desire your advice and submit for your approval, plans of a slow sand filter, which it is proposed to construct at Buckmaster Pond.

It is proposed to filter the water from Buckmaster Pond and use it in connection with the new Purgatory Brook well-water supply (which supply is at times inadequate for the needs of the town). Buckmaster Pond will furnish about 500,000 gallons of water per day throughout the year. The quality is at times unsatisfactory, particularly during the summer months when the water becomes affected by tastes and odors, caused by possible vegetable growths. It is proposed to use the filter during the summer and fall only. During the winter and spring months the supply will be pumped from the Purgatory Brook source.

The filter will have an area of 13,000 sq. ft. or a little less than one-third of an acre. A clear-water well having a capacity, when full, of 375,000 gallons, will be constructed in connection with the filter.

The plan provides for aërating the water both before going onto the filters and after passing through the filter.

In operating the filter it is not proposed to exceed a rate of over four million gallons per acre per day.

. . . .

The present maximum daily consumption of water during the dry months is approximately 900,000 gallons. The Buckmaster Pond water in its present state is unsatisfactory for domestic use and the Commissioners desire the approval of the plans submitted in order that they may proceed with the construction the present summer.

The application was accompanied by general plans of the proposed filter prepared by your engineer and by information relating to the operation of a small experimental filter during a period of several weeks before the plans were submitted.

The Board has caused the locality to be examined by its engineer and has considered the plans presented and the results of analyses of samples of water sent in by you from the experimental filter from time to time during the past two months.

The plans in general provide for filtering the water after aëration through an uncovered sand filter containing 3½ feet of filtering material at a rate of not more than four million gallons per acre per day. Provision is made for the aëration of the water after leaving the filter and for a storage well of suitable capacity to receive the water after filtration.

The filter is designed chiefly for the removal of the objectionable taste and odor by which this water is at times affected on account of the presence of microscopic organisms in considerable numbers. When such organisms are present in very large numbers, as was the case in the year 1892, it would probably be impracticable to remove the objectionable taste and odor efficiently by single filtration such as now proposed; but it is many years since the pond has been affected by the presence of very large numbers of organisms during the months from April to November, inclusive, and if the proposed works are properly constructed and operated they will probably remove the objectionable taste and odor from the water during the greater part of the year. Under the circumstances it does not appear to be advisable to provide a more thorough filtration of the water of this pond than is proposed in the plans now presented.

In the opinion of the Board filtration of the water of Buckmaster Pond, as shown by the proposed plans, is the best practicable method of improving its quality at the present time. It is important that the storage in Buckmaster Pond shall be drawn upon as fully as practicable during the summer months so as to relieve the draft on the tubular wells, which under the scheme proposed are to be depended upon for the entire supply during the winter season. While the supply of water from the two sources is adequate for the present requirements of the town, it is important that a continued effort be made to prevent the waste of water, since otherwise, if the town continues to grow rapidly, the supply from both sources may at no distant time become inadequate for all requirements.

Palmer (Central Vermont Railroad Station).

Dec. 5, 1913.

To Mr. G. L. Gibbs, *Agent Central Vermont Railroad Company, Palmer, Mass.*

Dear Sir: — In response to your request for advice as to the water of the Palmer Water Company, used for the supply of the railroad station in the town, the State Board of Health has caused the source of supply and its surroundings to be examined and has considered the results of analyses of samples of water.

The supply of the Palmer Water Company, as taken from the reservoirs now in use, is of good quality for domestic purposes. It is necessary for the protection of this supply that the watershed be subjected to careful inspection in order that danger of pollution may be promptly detected and its effects prevented. No objectionable conditions were found, however, at the time of the recent inspection.

The supply of water which these reservoirs are capable of yielding is inadequate for the village of Palmer in dry seasons, and it has been necessary in past times to draw water from temporary sources. The Board has frequently recommended that an additional supply be provided by the water company which will be adequate at all times for the requirements of the village, but these recommendations have not yet been carried out. The water of the reservoirs is affected at times by a noticeable taste and odor due to growths of microscopic organisms, but the presence of these organisms in water is not known to be injurious to health, and in the opinion of the Board the water of the reservoirs as supplied to the village at the present time is safe for domestic purposes.

Whenever the yield of the reservoirs becomes inadequate, however, the quality of the water supplied to the town is dependent upon the character of the source from which a temporary supply is taken.

Peabody.

Jan. 17, 1913.

To the Commission of Public Works, Peabody, Mass., Mr. Charles A. Leary, *Engineer.*

Gentlemen: — In response to your request for advice as to the advisability of taking water from Humphrey's Brook without filtration for the purpose of increasing the water supply of the town of Peabody, the State Board of Health has caused the brook and its watershed to be examined and samples of the water to be analyzed.

The water of this brook is naturally of good quality for water supply purposes, the color ordinarily being low and the quantity of organic matter present not excessive. The watershed contains two small lakes, near one of which are several summer camps. The total number of dwelling houses, exclusive of summer camps, is about forty, some of which are unoccupied, and the population within the watershed at present is probably less than fifty persons per square mile.

The soil throughout the greater part of the watershed is evidently coarse and porous, and it is probable that much of the waste discharged from dwelling houses and buildings on the watershed is well purified before entering the brook or its tributaries; but there are several groups of farm buildings and a number of piggeries from which polluting matters probably find their way at times into the streams. An examination shows that in many of these cases it is practicable, by providing proper means of disposal for household wastes and by relocating or discontinuing some of the other sources of pollution, to prevent objectionable drainage from entering the streams directly.

If in connection with these improvements suitable sanitary regulations are established and enforced, it is probable that water taken from the brook without filtration can be used with safety for domestic purposes if pumped, as proposed, into Suntaug Lake at some point near the present outlet and delivered thence into Spring Pond before being supplied to the town.

It may be that larger numbers of pigs or other animals are kept on this watershed at other seasons of the year than was found to be the case at the time of the recent examination, and if so the purchase of lands and buildings may in some cases be necessary. The Board is of the opinion, however, that, with the conditions under which it is proposed to supply this water, it can be adequately protected from pollution in the manner herein suggested at much less expense than would be required in case it were necessary to filter all of the water taken from the streams.

Oct. 11, 1913.

To the Board of Public Works, Peabody, Mass.

Gentlemen: — In response to the prompt notice of the Board of Health of an extensive epidemic of diarrhœal disease in Peabody on Oct. 3 and 4, 1913, the State Board of Health began, on the latter date, an investigation in co-operation with the local board to determine the extent and nature of the epidemic and its probable cause.

Up to the present time nearly 500 cases have been located, information concerning them collected, and the location of the cases plotted upon a map of the town. The great majority of cases occurred on Friday night and Saturday, and they were so distributed as to indicate very strongly that the water supply was the cause of the trouble.

Samples of water were collected for chemical and bacterial examination from all parts of the system on Saturday, October 4, and on Monday, October 6, and a thorough examination has been made of the conditions about the various reservoirs and of other circumstances affecting the public water supply.

In the course of this investigation many deposits of fecal matter have been found in the neighborhood of the ice houses along Spring Pond, some of which was deposited in the bottom of the pond exposed by the drawing down of the water; also along the shores of the pond on the opposite side near its outlet; on the shores of the outer basin near the pumping station within a few inches of the point where water flows from the outer basin to the inner basin adjacent to the pumping station; in the old crib located in the outer basin but not now used; and a small amount at the edge of the distributing reservoir. The deposits are no doubt due in part to visitors to the locality, a number of whom were seen fishing along the basin and Spring Pond at different times during the investigation, and in part to those engaged in the handling of ice in and about the ice houses and in making improvements and repairs about these buildings.

The conditions are such that the water supply may have been polluted from any or all of these deposits. Bacterial examinations, moreover, show the presence of fermenting bacteria in Spring Pond, the basins and reservoir, and in various parts of the distributing system, together with bacteria characteristic of sewage.

While the specific cause of the epidemic of October 3 and 4 cannot be definitely stated at the present time, the conditions about the sources of water supply of the town, especially about Spring Pond, the basins and reservoir, are extremely unsanitary and a great menace to the health of the users of the water. The Board recommends that the use of the water of Spring Pond and the basins be completely discontinued for the present and that the supply be drawn from Suntaug Lake and the tubular wells, if they are available for use at the present time. At the same time the water should be drawn out of the distributing reservoir and the mains thoroughly flushed, and the water therein should be replaced with water from the lake.

It is further recommended that after the removal of the deposits of excrement about Spring Pond, the basins and the reservoir, to which attention has already been called, fishing in the ponds and basin be prevented, and that the rules and regulations already established by this Board for the sanitary protection of the waters used for the water supply of Peabody be strictly enforced.

If the town is to continue to use Spring Pond as a source of water supply the Board again recommends that the shores of the pond be acquired at the earliest practicable time and the further use of the pond for the cutting of ice and its storage along the shores prevented. It is also important to secure control of other portions of the watershed from which polluting matters are likely to enter the pond. There is considerable leakage from Brown's Pond through the pipe line leading to the basin, and it is important that this leakage be prevented until such time as the plan to be followed by the town relative to Brown's Pond has been carried out.

In the course of this investigation the Board has found a number of places in the town where the private water supplies of factories, used for fire protection or other purposes, are connected with the public water mains, being separated only by check valves, and — judging from information available to the Board — there is much danger that the water from the fire supplies may enter the mains at times of fire or when the fire pumps are tested. It is important, in the opinion of the Board, that this practice shall be discontinued. Until this can be done the most reliable check valves available should be substituted.

The Board repeats its recommendation that all drinking water be thoroughly boiled before being used and that this practice be continued until all of the water at present in the pipe system has been completely removed.

DEC. 22, 1913.

To the Board of Public Works, Peabody, Mass.

GENTLEMEN: — Following the epidemic of October last, the State Board of Health has caused samples of water to be collected at frequent intervals from the various sources of water supply available for the town of Peabody in order to advise you as to the further use of water from these sources for the supply of the town.

The results of the analyses of the waters of Spring Pond continued to show the presence of objectionable bacteria for several weeks after the epidemic, but recent samples from the pond collected on Dec. 2 and 9, 1913, indicate that the objectionable bacteria have disappeared from the pond and the basin, and judging from the results of these analyses there is nothing to indicate that the water is now objectionable for drinking.

It is very important that the pond and basin and their surroundings be continued under careful inspection in order that danger of pollution of these waters may be prevented or their use again discontinued if necessary.

If ice cutting is allowed on Spring Pond during the coming winter, the Board recommends that the use of the water of the pond for the supply of the town be discontinued while ice cutting is in progress and that the water be not again used until the results of analyses show that it may be supplied to the town with safety.

Copies of the most recent analyses are enclosed herewith.

DEC. 22, 1913.

To the Board of Public Works, Peabody, Mass.

GENTLEMEN: — In response to your request for an examination of the watershed of Cedar Pond and advice as to its use as a source of water supply, the State Board of Health has caused the pond and its surroundings to be examined and a sample of the water to be analyzed.

The results of the examination show that the watershed of the pond contains a number of dwelling houses, most of which, however, are located quite remote from the pond, and the source does not appear to be exposed to serious danger of pollution from these dwellings at the present time.

It was found in the course of this examination that no sanitary facilities are provided at the pumping station connected with the wells located a short distance below the pond, and if water is to be taken from the outlet of the pond in the neighborhood of this pumping station it is exposed to danger of pollution from the employees at this place. In any case it is advisable that proper sanitary conveniences be provided at this place as soon as possible.

It is understood that the request for the advice of the Board relative to Cedar Pond is with a view to its use as a temporary water supply until the question of the future supply of Peabody can be acted upon by the town, and in the opinion of the Board the pond may reasonably be used for that purpose under the provisions of chapter 25 of the Revised Laws, section 35.

Provincetown.

March 25, 1913.

To the Board of Water Commissioners, Provincetown, Mass.

Gentlemen: — In response to your request for an examination of the water of the tubular wells used for the water supply of Provincetown and advice as to the cause of the increase in chlorine and its probable effect on the quality of the water, the Board has caused the wells to be examined and samples of their waters to be analyzed.

An examination of the records of analyses of this water since the new works at North Truro were established in 1908 shows that the chlorine increased slowly from about 2.0 parts in 100,000 early in 1908 to about 2.5 parts in 100,000 in the early part of 1910, and subsequently increased more rapidly until the amount reached 3.6 parts in 100,000 in the latter part of 1912.

Examinations of the water of the individual wells from which the supply is drawn show that the amount of chlorine is smallest in the wells farthest from the sea, but in wells Nos. 14, 16 and 18 the quantity of chlorine found in these examinations was much greater, especially toward the end of the period of the day's pumping, than in any of the other wells. The cause of this excess in chlorine has not yet been ascertained. It will very likely be found to be due to some variation in the character of the formation in which the wells are sunk rather than to any matter deposited or discharged upon the ground in the region about the wells.

It is probable, in the opinion of the Board, that if the three wells mentioned were shut off and new wells put in east of wells Nos. 1 and 2, the quantity of chlorine in the water as a whole would be decreased, though very likely there would be some increase in the amount of chlorine in the wells adjacent to Nos. 14, 16 and 18.

Under the circumstances it seems best to add a few wells at the easterly end of the present lines and to discontinue the use of the wells giving the larger amounts of chlorine, and the Board recommends that this change be made. If you decide to make this change the Board will, upon request, examine the water of the new wells as they are put in and will advise you concerning its quality. If, after the new wells have been connected with the pumps, a further test of the entire supply should seem advisable to determine the effect of the changes upon the quality of the water, the Board will make a further examination if you so request.

The quantity of chlorine found in the water at the present time is not sufficient to affect its quality for domestic purposes, and the water in general continues to be of as excellent quality as when the works were first put in.

Randolph and Holbrook.

March 25, 1913.

To the Joint Board of Water Commissioners of the Towns of Randolph and Holbrook, Mass., Mr. William F. Barrett, *Chairman.*

Gentlemen: — In response to a request from the Board of Water Commissioners of the town of Braintree for an examination of the water of Great Pond and advice as to its quality, the State Board of Health has made an examination of the pond and its watershed and has reported the results, together with its recommendations, to the Board of Water Commissioners of the town of Braintree.

Inasmuch as this pond is used as a source of water supply by the towns of Randolph and Holbrook, a copy of these recommendations is sent you herewith for your consideration.

Rockport.

March 25, 1913.

To the Board of Water Commissioners, Rockport, Mass.

Gentlemen: — In response to your request for advice in regard to the condition of the watershed surrounding the pond from which you take your water supply, and also as to the best plan of increasing the supply, the Board has caused Cape Pond and its surroundings to be examined by one of its engineers and has considered such information as is available relative to the sources from which an additional supply might be obtained.

The examination of the watershed of Cape Pond discloses a number of sources from which the water is exposed to pollution at the present time.

A considerable quantity of very foul waste from a glue works on High Street now finds its way into the swamp which borders the northerly end of the pond and probably affects unfavorably the quality of the water.

At the time of the recent examination ice cutting was in progress upon the pond and several horses and a large number of men were at work there. No sanitary conveniences appeared to be provided for the men, and the conditions in the woods at places near the eastern shore of the pond were very filthy. Pollution from this locality in case of heavy rain would be washed into the pond.

There are several cottages near the shores of the pond about some of which the conditions were very objectionable and likely to cause serious pollution of the water. There are indications, also, that the pond is used to a considerable extent for boating and fishing in summer.

The Board recommends that the waste from the glue factory be diverted from the watershed, that the foul deposits found in the neighborhood of the ice houses and elsewhere be removed, and that in the future the rules and regulations adopted by this Board for the sanitary protection of Cape Pond be strictly enforced. If it is not then found practicable to prevent danger of pollution of the pond, it would be best for the town to acquire control of the lands about the shores of the pond.

The pollution of Cape Pond is no doubt one of the causes of the poor quality of the water, which often contains large quantities of organic matter and is affected at times by disagreeable tastes and odors, due to the presence of large numbers of microscopic organisms.

An examination of the pond indicates that the bottom is covered largely with mud, and there is an extensive area of swamp on the watershed, the level of which is but little above the level of the water in the pond. The water is not very highly colored, however, and its quality could no doubt be greatly improved by ordinary filtration through sand.

It is evident from the examination of the records of the fluctuations in level of the water in Cape Pond for several years past that the quantity of water drawn from this source already equals its capacity in a series of very dry years and that provision must be made without delay for future requirements of the town. It is inadvisable, in the opinion of the Board, to raise the level of Cape Pond in connection with any plans for securing a large supply of water, since thereby the objectionable swamp at its upper end would be flooded and the quality of the water injured.

The consumption of water per inhabitant in Rockport is larger than in most towns of similar size, due undoubtedly, in part at least, to the temporary large increase of population in the summer season, and no doubt in part, also, to waste or leakage. It is probable that the consumption of water could be reduced somewhat by the general introduction of meters, but it is unlikely that a sufficient reduction in the use of water could be made in this way to make certain that the yield of Cape Pond would be adequate for the requirements of the town for any considerable time in the future. Nevertheless, if the consumption of water per inhabitant should show a tendency to increase, it would be advisable to apply meters generally to the service pipes in the town, as is now being done in many of the other towns in the State.

The sources from which it appears probable that the water supply of Rockport can be most easily supplemented are Alewife Brook and its tributaries, especially a tributary which enters the brook from the northwest a little over half a mile below the pond. The latter stream drains an uninhabited watershed about twice as large as the drainage area of Cape Pond, and it appears to be practicable to divert water from this source into Cape Pond by gravity. Judging from a general examination of the locality, it is probable that, if it is found practicable to divert the water from this stream into Cape Pond by gravity, the water supply of Rockport can be supplemented from this source at less cost than from any other in this region.

The Board recommends that you cause the necessary surveys and investigations to be made to determine the practicability and probable cost of supplementing Cape Pond with water from the stream indicated, and that at the same time investigations be made to determine the practicability of supplementing the supply from any other portions of the Alewife Brook drainage area or adjacent watersheds which appear to be available for the purpose. The Board will assist you in these investigations by making the necessary analyses of water and will give you further advice in this matter when you have the results of investigations to present.

Salem.

Feb. 6, 1913.

To Mr. P. J. Kelley, *Director of Public Works, Salem, Mass.*

Dear Sir: — In response to your request of Jan. 21, 1913, for an examination of the water of Miles River above the point where it crosses the pipe line leading from Longham Reservoir to Wenham Lake, with a view to the temporary use of this water as an emergency supply for the cities of Salem and Beverly, under the provisions of section 25 of chapter 35 of the Revised Laws, the State Board of Health has caused the proposed source of supply to be examined by one of its engineers and samples of the water to be analyzed.

The examination of the watershed shows that there has been only one dwelling house constructed within it since the previous examination in 1911 and that it will be practicable, by the enforcement of sanitary rules and regulations, to secure adequate protection of this water for the limited period within which its use is practicable.

The results of the examination of the water of Miles River show that at the present time this water is of somewhat better quality than at the time of the previous examination and that it does not differ materially from the water of Wenham Lake and Longham Reservoir.

The Board, acting under the provisions of the law above mentioned, hereby approves Miles River at the point where it crosses the pipe line leading from Longham Reservoir to Wenham Lake as a proper source of water supply for temporary use, the water drawn from this source to be discharged into Wenham Lake. The Board recommends that before the water is used the possible sources of pollution at the various buildings on the watershed be carefully inspected and sanitary rules and regulations established.

Salisbury (Salisbury Beach).

Jan. 2, 1913.

To the Hon. George F. Haley, *Director, Artesian Water Company, Salisbury, Mass.*

Dear Sir: — The State Board of Health has considered your request for the examination of the water of the wells used by the Artesian Water Company for the supply of Salisbury Beach and has caused the wells and their surroundings to be examined and samples of the water to be analyzed.

The results of the examinations show that the wells are located in low, sandy upland in Salisbury adjacent to the salt marshes, which are flooded at high tides, and there are no dwelling houses or other sources of contamination in the immediate neighborhood.

The water supplied to Salisbury Beach from these wells is very hard and it is affected by the presence of an excessive quantity of iron, which renders it very objectionable for many domestic uses. The water of some of the wells contains, also, a very large quantity of chlorine, though the average quantity found in the water supplied to the beach has not been sufficient to affect its taste.

The information submitted to the Board indicates that the supply from these wells has been inadequate for the requirements of the beach, and considering its poor quality the Board is of the opinion that the source is not a suitable one from which to take water for domestic purposes.

It is understood that you propose to make tests, with a view to obtaining a better water supply, by sinking wells at points farther back from the sea, but these tests have not yet been begun.

The plan of taking water from the ground appears to be the most practicable method of securing an adequate independent supply for Salisbury Beach, and the Board recommends that careful tests be made by sinking wells at the localities in which the conditions appear to be favorable for obtaining a suitable supply for this district. The Board will assist you in further investigations, if you so request, by making the necessary analyses of water, and will give you further advice as to a water supply for Salisbury Beach when you have the results of further tests to present.

Sandwich (Massachusetts Volunteer Militia).

July 31, 1913.

To Frank P. Williams, M.D., *Surgeon General, M. V. M., Boston, Mass.*

Dear Sir: — In response to your request for an examination of Tispaquin Pond in Middleborough and Peters Pond in Sandwich, the State Board of Health has caused these ponds to be examined and samples of their waters to be analyzed.

The water of Tispaquin Pond is highly colored and contains much organic matter, derived doubtless from vegetation in swamps within the watershed of the pond. There are very few dwelling houses on the watershed of the pond, however, and there was very little danger of its serious pollution at the time of this examination. With a camp of militiamen located in its neighborhood, the chief possible source of pollution to the pond would be from the men themselves. If properly protected from pollution by campers or others near its shores or near either of the brooks tributary to the pond, this pond could probably be used temporarily as a source of water supply without injury to health.

The condition of Peters Pond was found to be much the same as at the time of the previous examination in 1909. The water is colorless, nearly clear and naturally of good quality for domestic purposes. There is very little population near the pond, and with the conditions that exist there its waters can be used with safety, providing it is protected from local pollution, especially in case a camp should be established on or near its shores.

The water supplied on the State Farm in Bridgewater is filtered water of the Taunton River, which has long been the source of supply of this institution for drinking. There is no reason to suspect that its quality is objectionable for that purpose.

Saugus (Baker's Hill).

Aug. 7, 1913.

To the Board of Water Commissioners, Saugus, Mass.

Gentlemen: — In response to a petition from certain residents on Baker's Hill, in the town of Saugus, the State Board of Health has caused the locality to be examined and finds that there is no available water supply for a considerable number of houses on this hill at the present time. The population of this region appears to be growing, and it appears to the Board that the lack of a public water supply in this section constitutes a serious danger to the public health which should be relieved at the earliest possible time. It is practicable for the town to provide a water supply in this section, without special difficulty, by means of a suitable pumping station and pipe system, and the Board recommends that an adequate system be provided there at the earliest practicable time.

Scituate.

Aug. 7, 1913.

To the Board of Health, Scituate, Mass., Dr. H. F. Cleverly, *Chairman.*

Gentlemen: — In response to your request of July 31, 1913, the State Board of Health has examined the results of a recent inspection of the sources of water supply of the town of Scituate and of analyses of samples of water from these sources of supply and from faucets in various parts of the town.

It appears that at the time of this examination water was being supplied to the town from three sources, two of which — the tubular wells and the Beaver Dam Spring — have long been used as sources of water supply for the town. The results of the recent examination show no material change in the quality of the water of either of these sources for several years. The water of the wells is quite hard and shows evidences of the presence of population at no great distance from the wells, but the water is thoroughly purified in its passage through the ground and the quantity of organic matter present is very low. The water of the Beaver Dam Spring is in all respects of very good quality for domestic use.

A third source of supply has recently been developed in order to provide for the great increase that has taken place in the consumption of water in the town. This supply is drawn from a pond on First Herring Brook near Greenbush and is delivered to the town after filtration through a sand filter recently completed.

The population on the watershed of this brook is small and there are no houses in the immediate neighborhood of the stream. The water is naturally highly colored at this time of the year and contains a large quantity of organic matter, due to contact of the water with vegetable matter in the swamps and small ponds within the watershed. While the high color of this water gives it a somewhat objectionable appearance as compared with the water of the driven wells and Beaver Dam Spring, and it cannot be used with safety for domestic purposes before filtration, it is probable that the quality of the water will improve after the filter has been longer in use and the pumping system is completed.

A partial supply of water for the northern part of Scituate has been obtained at times in the past from the works of the Cohasset Water Company, but it does not appear that any water is being drawn from that source at the present time.

From the results of the examination there does not appear to the Board to be any reason to doubt that the quality of the water now being supplied to the town is such that it may safely be used for domestic purposes.

Sharon.

June 5, 1913.

To the Board of Water Commissioners of the Town of Sharon, Mass.

Gentlemen: — The State Board of Health received from you on May 27, 1913, through Edmund H. Talbot, Town Counsel, an application under the provisions of section 1 of chapter 128 of the Acts of the year 1913 for the approval by the Board of the taking of certain lands and underground sources of water supply necessary for the purpose of extending and increasing the water supply of the town of Sharon by means of driven wells and for preserving the purity of the water. The application is accompanied by a plan showing the location of the wells and the area of land which it is proposed to acquire in connection therewith.

The Board has caused the locality to be examined by its engineer and has considered the plan presented and the records of tests made in this locality for the purpose of obtaining an additional water supply for the town of Sharon. The results of these tests having been favorable for obtaining an adequate supply of water of good quality for the requirements of the town from the ground in this locality, the Board hereby approves the taking of the area of land shown upon the plan presented, and the taking of water from the ground by means of wells in this land, subject to the recommendations contained in its letter of advice to the Board of Water Commissioners of Sharon under date of Feb. 11, 1907.

The land, the taking of which is herein approved, is bounded, measured and described as follows: —

A certain parcel of land situated in Sharon in the County of Norfolk and Commonwealth of Massachusetts bounded and described as follows: Beginning at a stone bound on the westerly side line of the proposed relocation of the New York, New Haven & Hartford Railroad Company at land of heirs of Patrick J. Carroll, thence running north 46° 16′ west by said land of said heirs of Patrick J. Carroll and by land formerly of Burkhardt 488.80 feet by ditch to middle of brook; thence north 35° 30′ west by land of owners unknown and by land of heirs of Elianor Choate 654.07 feet to a stone bound; thence north 50° 38′ east by land of heirs of Elianor Choate and by land of heirs of John A. Bowman 711.60 feet to a stone bound; thence south 64° 30′ east 360.85 feet to a stone bound; thence north 8° east 150.15 feet to a stone bound; thence north 47° 15′ east 383.92 feet by Bowman heirs and by George W. Field to Crossmoor Road; thence easterly 59.53 feet by Crossmoor Road by an arc to the left of which arc the radius is 979.92 feet; thence south 47° 15′ west 413.70 feet; thence south 8° west 148.50 feet, all by land of George W. Field and land of heirs of John A. Bowman; thence south 64° 30′ east by land of heirs of John A. Bowman 27.20 feet to a stone bound; thence on the same course by land of George W. Field 205 feet to the middle of Beaver Hole Meadow Brook; thence up stream by the thread of the stream of said brook bounded easterly by land of the New York, New Haven & Hartford Railroad Company about 540 feet; thence south 62° 33′ east by said land of the New York, New Haven & Hartford Railroad Company 113.50 feet to a stake in the westerly side line of relocation of the New York, New Haven & Hartford Railroad Company; thence southwesterly by said side line 623.50 feet to a stone bound by an arc to the left of which arc the radius is 5819.65 feet; thence south 19° 29′ west by said side line 117.91 feet to a stone bound at the point of beginning and containing 17.31 acres.

Shirley (Wells).

Dec. 5, 1913.

To the Board of Health, Shirley, Mass.

Gentlemen: — In response to a request from the State Inspector of Health, the State Board of Health has caused a number of private wells in the village of Shirley Center to be examined and samples of their waters to be analyzed.

One of the most important of the wells is the town well, so called, and the analysis of the water of this well shows that it is badly polluted and, in the opinion of the Board, unsafe for drinking or other domestic purposes. The water of a driven well in a barn on the Sweetser place near by appears to have been used at times to prime the pump at the town well. An examination of the Sweetser well shows that it is located in the cellar of a barn containing much manure and other organic matter and that there is another barn, also containing polluting matter, at no great distance from the well. The analysis of the water of the well shows that it is considerably polluted and, in the opinion of the Board, it is unsafe for domestic use. The water from this well should not be used for priming the town pump.

The second well examined is located in the yard of the unoccupied house of John Faerrar. An analysis of this water shows that it is very badly polluted and unfit for domestic use. The same is true of the water of a well located beneath the kitchen at the house of Mrs. Felton; there are sources of pollution very close to this well, and the condition of the water as shown upon analysis is very objectionable.

An examination has also been made of a spring, located in a woodland about a mile west of the village, from which water is taken at times for drinking. There are no sources of pollution in the neighborhood of this spring, and the water is naturally of good quality for domestic purposes. It is exposed to danger of surface pollution and could readily be protected by walling and covering the spring, and if this were done the spring would undoubtedly yield water of very good quality.

The conditions in this village are such that a suitable public water supply is greatly needed, and the Board recommends that such a supply be provided at the earliest possible time and the further use of the polluted wells be discontinued.

Shrewsbury.

July 11, 1913.

To Mr. W. S. Knight, *Worcester, Mass.*

Dear Sir: — In response to your request for an examination of Harlow's or Newton Pond, a tributary of Lake Quinsigamond, in the northwestern part of the town of Shrewsbury, the State Board of Health has caused the pond and its watershed to be examined and a sample of the water to be analyzed.

The results show that at the time of this examination the water had considerable color and contained a larger quantity of organic matter than is found in good pond waters. There was a considerable growth of water plants in the pond, the bottom of much of which is evidently muddy, and it is probable that this water if used for domestic purposes would be affected at times by noticeable tastes and odors which would make it unpleasant for drinking. The watershed of the pond contains many farmhouses, and the enforcement of sanitary regulations would be essential in order to protect the water from pollution.

There are several localities on the banks of the pond and elsewhere in the town in which it appears to be practicable to obtain an adequate supply of good ground water which would be by far more satisfactory for domestic use than the water of Harlow's Pond, and such a source would be far more appropriate and desirable for the supply of the lake district in Shrewsbury, or for the village itself, than water from Harlow's Pond. Moreover, a supply of ground water would be likely to be less expensive than from the pond in question, and under the circumstances, in the opinion of the Board, it is not advisable to consider the use of the water of Harlow's Pond for the supply of any part of Shrewsbury until the possibility of securing a supply of ground water has been thoroughly tested.

SEPT. 18, 1913.

To the Committee on Water Supply, Shrewsbury, Mass., Mr. R. E. ALLEN, *Chairman.*

GENTLEMEN: — The State Board of Health has considered your request of Sept. 13, 1913, for advice as to the advisability of making certain tests with a view to obtaining a water supply for the town of Shrewsbury from the valley of Hop Brook, near Temple Hill in South Shrewsbury, and has considered the results of the analyses of samples of water from test wells in this location.

According to the information submitted to the Board these test wells penetrated a porous soil to a depth of about 18 feet, and at that level water could be drawn freely from these wells with a hand pump. Below that level fine material was encountered in each of the wells from which no water could be obtained.

The results of analyses of samples of water from the test wells indicate that the ground water in this locality is probably of good quality for domestic purposes.

Regarding the quantity of water obtainable from the ground in this locality, it is impracticable to give you a definite estimate without a further test. The depth of porous material is not favorable to obtaining a large supply of water from the ground in this region, but, in view of the comparatively small quantity of water required for the supply of the town, it is not unlikely that an adequate quantity could be obtained from the ground in this location by means of suitable works.

Considering the circumstances, it appears to the Board advisable to make a pumping test in this location by pumping continuously from a number of wells for a period of as much as a week or ten days at a rate as great as would be required for the supply of the village. When the results of such a test are available it will be practicable to determine definitely whether it is likely that enough water could be obtained from the ground at this place for the requirements of the town in the matter of a public water supply. The Board will assist in this test by making the necessary analyses of water, and when the results are available will give you further advice as to the practicability of obtaining a water supply for the town at this place.

DEC. 5, 1913.

To the Committee on Public Water Supply, Shrewsbury, Mass., MR. R. E. ALLEN, *Chairman.*

GENTLEMEN: — The State Board of Health has considered your application for advice relative to a water supply for the town of Shrewsbury, to be taken from the ground in the valley of Hop Brook about a mile southeast of the village, and has examined the results of a pumping test recently made by pumping from a group of five wells in this region for a period of about eight days, from Nov. 3 to 11, 1913.

It appears that the porous material in this region extends only to a depth of about 18 feet below the surface of the ground and, while it yields water freely, it was not practicable to pump at a higher rate than 170,000 gallons per day for the greater part of the test. This rate of pumping, however, was maintained without difficulty, and the water in the wells quickly recovered its former height after pumping was discontinued. Considering the high rainfall immediately preceding and at the time of this test, the results would have been more conclusive if a higher rate of pumping could have been maintained.

Judging, however, from the results of this test and other information as to the conditions affecting a ground-water supply from this region, it appears to the Board probable that, with a system of tubular wells of considerable extent in this valley, enough water can be obtained there for the present requirements of the town after water has come into general use. Since it appears that it is not intended to supply water from this source to the growing population in the neighborhood of Lake Quinsigamond, it is probable that, unless an extraordinary demand for water, not now foreseen, should arise, enough water can be obtained in the locality in which this test was made to supply the town for a considerable period of years in the future.

Analyses of the water collected from time to time during the pumping test show that it is soft and in other respects of good quality for domestic purposes.

Considering the results of this investigation, the Board is of the opinion that the source is an appropriate one for the water supply of the present village of Shrewsbury.

SOMERSET.

JULY 15, 1913.

To the Water Supply Committee, Somerset, Mass., MR. OWEN J. EAGAN, *Chairman.*

GENTLEMEN: — In response to your application of July 8, 1913, for advice as to the practicability of obtaining a water supply from the ground in the valley of the Labor in Vain Creek in the neighborhood of the Pierce and Donovan farms, where tests have recently been made, the State Board of Health has caused the locality to be examined and samples of the water from two of the test wells to be analyzed.

The results of these analyses indicate that the ground water at the Pierce farm is affected somewhat at present by the cultivation of the soil in the immediate neighborhood, but in other respects — except for the hardness — the waters of these wells are apparently of good quality for domestic purposes, and the hardness is not materially greater than the hardness of the waters used for domestic purposes in many of the towns in the State. If the cultivation of the soil were discontinued it is not unlikely that the hardness would diminish.

Regarding the probable quantity of water obtainable from the ground in this region, it is impracticable to advise you definitely with the information at present available. Several of the test wells penetrated a porous stratum from which water could be pumped very freely, and while there are indications that the porous soil may extend over a considerable area, its depth as shown by the test wells thus far driven was not great, and the area which may drain toward them is somewhat limited. It does not appear, however, from the investigations thus far made that the conditions in other parts of the town are more favorable for obtaining a supply of ground water sufficient for all requirements than in the locality where these tests have been made.

On account of its location the source will be a favorable one from which to supply the town economically in case an adequate supply can be secured there, and considering all of the circumstances the Board is of the opinion that it is advisable to make further tests in this locality before making investigations elsewhere.

The Board recommends that you put in additional wells in the region in which the recent tests were made and test them by pumping continuously at a rate of at least 200,000 gallons per day, and preferably a somewhat higher rate, for a period of as much as two weeks. The water pumped during this test should be discharged directly into the brook at a point at least 100 feet below the wells, and if practicable at a greater distance. In addition to the wells connected with the pump, three or four observation wells should be put in — one in the immediate neighborhood of the test wells and the others at a distance of 300 or 400 feet from these wells — and observations made once each day of the height of the ground water, beginning before the pumps are started and continuing for a period of at least ten days after the test is completed. The Board will assist you in these investigations by making the necessary analyses of water and advises that a sample of water be collected daily while the test is in progress. In case the conditions for obtaining water are unfavorable, it may not be necessary to continue the test for as long a period as two weeks. Upon notice that the test is about to begin, the Board will make the necessary further examinations and arrange for the collection of samples.

DEC. 16, 1913.

To the Committee on Water Supply of the Town of Somerset, Mass., Mr. OWEN J. EAGAN, *Chairman.*

GENTLEMEN: — The State Board of Health has considered your application for advice as to a plan for obtaining a water supply for Somerset from the ground in the vicinity of the reservoir north of Swansea village and has caused the locality to be examined by its engineer and samples of water from test wells in this region to be analyzed. The Board has also considered carefully the results of the thorough investigation made by the town of Somerset with a view to securing an adequate water supply for its inhabitants within its corporate limits. These investigations consisted of an examination of all of the valleys within the limits of the town and the sinking of wells in all places where the conditions appeared to indicate that it might be possible to obtain a considerable quantity of water.

The results of these tests were in all cases very unfavorable except in the valley of Labor in Vain Creek near its head waters in the northerly part of the town. As a result of tests in various parts of this valley it was found that the only apparently favorable location in which ground water of good quality could be obtained was near Wilson's Lane on the Pierce farm in the valley of this stream. In this location it was found practicable to sink test wells to a depth of from 20 to 30 feet which would yield water very freely when pumping with a hand pump. The water upon examination was found to be of good quality, and in view of the circumstances it was deemed essential to test more completely the probable quantity and quality of water that could be obtained from the ground in this locality.

A pumping test was accordingly made by pumping from eight wells, averaging about 22 feet in depth, for a period of about nine days, beginning on September 10. At the beginning of this test water was pumped on the first day at an average rate of a little over 300,000 gallons per day, but the level of the ground water lowered and the rate of pumping steadily decreased in subsequent days until it fell to a rate of about 95,000 gallons per day. Upon stopping the pump and observing the rise of the ground water, it was found to be many days before it returned to the level at which it stood when pumping began, notwithstanding the occurrence of a very considerable rainfall during this period.

While the water furnished by these wells was found to be of good quality for domestic purposes, the test showed very conclusively that it would be impracticable to obtain an adequate quantity of water for the supply of Somerset from the ground in this region, and the tests as a whole fail to show any other location within the limits of Somerset from which it would be practicable to obtain an adequate supply of good water for all the requirements of the town.

Subsequent to these tests further investigations were made with a view to obtaining a water supply at the nearest practicable point to the boundaries of the town. The results of a general examination of the territory in the region bordering the boundaries of the town of Somerset indicate that the most favorable place, judging from surface indications, in which it might be practicable to obtain an adequate quantity of good ground water was in the lower part of the valley of Lewin Brook, a short distance northwest of the village of Swansea, and test wells have been sunk by your committee both on the easterly and westerly sides of this brook near the reservoir in the lower part of its watershed. These tests show that the ground on both sides of this reservoir is composed of very coarse and porous material to a considerable depth, and the test wells yielded water very freely while pumping with a hand pump. Analyses of these waters indicate that the quality would probably be satisfactory for domestic purposes.

While it has been impracticable for your committee with the funds available to make a more thorough test at the present time as to the probable quantity and quality of ground water obtainable in this location, the tests thus far made are sufficiently favorable to warrant the belief that an adequate quantity of water for the requirements not only of Somerset but also of the town of Swansea can be obtained from the ground in that region. Moreover, this location is a favorable one from which to supply water to all parts of Somerset, and water could also be supplied very economically from works in this region to the thickly settled portions of the town of Swansea.

In the opinion of the Board the investigations thus far made are favorable for obtaining an adequate supply of water from the ground in the valley of Lewin Brook, and this location appears to be the most appropriate and available source from which to obtain a water supply for the town of Somerset. It is likely that an ample quantity of water can be obtained in this location for the town of Swansea also, in case that town should desire to introduce a public water supply.

If the further tests that are desirable before the construction of works is entered upon shall confirm the results of the tests thus far made, there is no doubt that it would be more economical for Somerset and Swansea to obtain their water supplies from joint works in this valley than by the construction of separate systems.

Spencer (Isaac Prouty & Co.).

Jan. 13, 1913.

To the Board of Health, Spencer, Mass., Dr. J. C. Austin, *Chairman.*

Gentlemen: — In response to your request the State Board of Health has caused the water supplies used in the factory of Isaac Prouty & Co. to be examined and samples of these waters to be analyzed, and the Board has also caused an investigation to be made of the typhoid cases which have occurred recently in the town with a view to determining the probable source of the disease.

The results of the investigation show that two cases of typhoid appeared in a house near the banks of Cider Mill Pond in October and November, and the Board is informed that an investigation of the premises shows that the sewage from this house is discharged directly into the pond. Since that time eleven persons have been attacked by the disease, all of whom are employees in the factory of Isaac Prouty & Co.

An examination of the sources of water supply in this factory shows that the buildings are piped with water from the public supply to be used for drinking; that water is also supplied from a tubular well for washing; and that, furthermore, there is a connection by which water can be pumped from Cider Mill Pond to be used in the boilers. Faucets connected with the drinking water supply and with the tubular well supply are located at the sinks, and notices are posted to show which is the drinking water; but notices were not found at all of the faucets, and there is opportunity for operatives to drink from either faucet in some cases without notification as to the difference in the water. When water is pumped from Cider Mill Pond it enters the system of pipes through which wash water is supplied to the sinks.

The recent analyses show that the driven well water supplied to this factory contains more bacteria than are found in good well waters, and the chemical analysis also shows evidence that the water has been polluted and subsequently not thoroughly purified before entering the well. The bacterial analysis of Shaw Pond water supplied to the factory shows that bacteria are practically absent from this water.

Considering the fact that Cider Mill Pond has evidently been polluted by the discharges from typhoid patients, and that this water has been supplied frequently to the wash-water pipes and thus can be and probably is used for drinking by operatives in the factory, the indications point very strongly to this water as the source of the disease. The Board recommends that you require that all pipes supplying water from Cider Mill Pond or from the tubular well at any point on the premises of this factory where it may be used for drinking be immediately cut off, and that in the future no connections from which water may be taken for drinking be allowed with any pipes except those which supply town water.

The Board also recommends that a sewer be extended so as to intercept the sewage from houses in the region along Cider Mill Pond, including the ones in which the first cases of typhoid fever occurred.

Sterling.

Dec. 23, 1913.

To the Sterling Advancement Association, Committee on Water Supply, Sterling, Mass.

Gentlemen: — In response to your request for advice as to a proposed source of water supply for the village of Sterling, to be taken from the ground in the valley of a brook a little over half a mile northeast of the village, the State Board of Health has caused the locality to be examined by one of its engineers and a sample of the water of a spring in this locality to be analyzed.

The results of the analysis show that the water of the spring has at some time been considerably polluted but subsequently quite well purified in its passage through the ground, indicating that the ground water in this region may be affected somewhat by the pollution in the valley above, though it may possibly be due to local pollution.

The watershed available for a water supply in this locality is quite limited, but, if a deep layer of porous soil of considerable extent exists in this region, it is possible that an adequate quantity of water for the present requirements of the village can be obtained from the ground in this neighborhood. While the conditions appear to be more favorable for obtaining ground water at either of the localities suggested by the Board at the time of the previous examination in 1908, one being the valley below Smith's Spring a half mile north of the village, and the other being the valley of Lydes Brook west of the village, it is, nevertheless, possible that enough water for the requirements of the town may be obtained in the neighborhood of the location now proposed, or farther down the valley of this stream.

The Board is unable to give you more definite advice until tests have been made which will show the character of the soil and the probable quantity of water that can be obtained from wells in this region. The Board recommends that further tests be made by means of tubular wells, both at this place and in the other localities in which the conditions appear to be favorable for obtaining an adequate water supply for the town. The Board will assist you in these investigations by making the necessary analyses of water, and when the results of tests are available will give you further advice as to the sources of water supply for the village.

STOUGHTON.

JAN. 3, 1913.

To the Board of Health and the Water Board, Stoughton, Mass.

GENTLEMEN: — In connection with an investigation as to the causes of the occurrence of cases of typhoid fever recently in the town of Stoughton, an examination has been made of the condition of the water supply of the town in accordance with your request.

It appears that the supply is taken from Muddy Pond Brook above Leonard's Brook, and an examination of the watershed indicates that it contains several dwelling houses and small areas of cultivated lands. The water is drawn directly from the brook, and under the circumstances the source cannot be regarded as a safe one from which to take water for drinking.

The pipe line leading from the brook to the pumping station passes beneath Steep Hill Brook, which receives large quantities of sewage and manufacturing waste from Stoughton and the waters of which are highly polluted. Investigations of former years have indicated that this pipe line is not tight, but in the course of the recent tests there was no evidence of leakage from Steep Hill Brook directly into the pipe.

From the tests thus far made the Board finds no direct evidence that the sickness is due to the water supply, but there is no doubt that the source of supply now used is exposed to danger of pollution, as the town has already been advised. The Board again recommends that measures be taken by the town to secure a water supply which will be safe from pollution. The indications are very favorable for obtaining an adequate supply of excellent water at a reasonable cost from the ground in the valley of Muddy Pond Brook, as the Board has advised at previous times, and the Board again recommends that steps be taken to secure such a supply as soon as possible. In the meantime the watershed should be placed at once under thorough inspection to learn if any fecal matter is entering the brook.

JAN. 8, 1913.

To the Board of Health, Stoughton, Mass.

GENTLEMEN: — Your letter of Jan. 6, 1913, is received, with a request for information in answer to the following questions: —

In connection with investigations as to the causes of the occurrence of cases of typhoid in other parts of the State, has the State Board found "direct evidence" that the sickness was due to the water supply, *i.e.*, in large water supplies, not wells? If such "direct evidence" has been found, please cite a few particular instances. Briefly, what constitutes "direct evidence" that a water supply is a cause of cases of typhoid fever?

On undertaking such an examination as was recently made of the Stoughton water supply, did the State Board anticipate that "direct evidence" of the water supply being the cause of typhoid would be found even if the cause of the sickness was in the water supply?

Did the State Board make an examination to determine whether or not the specific germ which causes typhoid was actually present in the water supply?

Will the State Board submit a report of their chemical and bacteriological findings in the recent examination?

In answer to your first question, it may be said that for many years there has been no occurrence in Massachusetts of typhoid fever attributable to the larger water supplies, that is, none since the use of water from running streams was discontinued many years ago. In places outside the State epidemics directly traceable to large water supplies have occurred, such as the epidemic at Butler, Pa., described in books and reports relating to this subject.

In answer to your second question — ". . . did the State Board anticipate that direct evidence of the water supply being the cause of typhoid would be found even if the cause of the sickness was in the water supply?" — it may be said that it is often very difficult to obtain satisfactory evidence as to the actual manner of infection of a water supply by typhoid fever, even when the circumstances indicate clearly that the water supply is the cause of the disease.

The difficulty of determining the source or manner of infection of the water supply by typhoid fever will be more readily understood if the circumstances under which the investigation must necessarily be made are kept clearly in mind. In the present case, assuming that the infection is due to the water supply, it appears from the records submitted by your board that the first case was reported on December 21; other cases were reported subsequently on December 23, 26, 31, and on January 1 and 3. The investigations of your board as to the onset of the disease indicated that the onset in two cases occurred on December 4 and 5, and in the others, so far as known, between December 10 and 14, except one case, which occurred on December 21. The cases of December 4 and 5 presumably received their infection about November 20, while in the bulk of the cases infection presumably occurred between November 25 and the first few days of December, so that there elapsed a period of three weeks between the time when infection occurred and the first case was reported. When such cases continued to come in, information was collected as to the movements of patients before sickness, the sources of food, milk and water supply, and the other data necessary to form a judgment as to the probable source of the disease, the results in this case showing that the only source of possible infection common to all or most of the cases was the public water supply. The work of investigation was as prompt and efficient as practicable, yet by the time suspicion pointed to the water supply as a possible source of infection as many as four weeks had elapsed after the infection must have taken place. Assuming that the disease was caused by the water supply, the fact that the bulk of the cases developed between December 10 and 14 would indicate that whatever pollution may have occurred to cause this infection must have affected the water supply only for a very limited period. Since the occurrence of cases had practically ceased by the time the question of the agency of the water supply in producing the disease had arisen, it was obvious that examinations of the water supply would not show its condition at the time the infection occurred.

In answer to your third question, as to whether an examination was made to determine whether or not the specific germ which causes typhoid fever was actually present in the water supply, of course no such test was made, nor is it practicable — except possibly in very rare instances — to determine whether typhoid fever bacteria are present in water under such circumstances as occurred in this case. The common bacterial test to determine the presence of pollution in a water supply is the determination of the Colon bacillus, and this was found to be present in 90 per cent. of the samples of your water supply examined in the recent test. Moreover, the numbers of bacteria present were high, and in other respects the results of the bacterial examination were unfavorable.

While no direct evidence has been found of the infection of the water of your water supply by discharges from typhoid fever patients, there is ample evidence from the investigations of the Board that it has been and is greatly exposed to pollution by visitors within the watershed, traces of whose presence were found along the streams above your intake.

Most of the water of Leonard's Brook under ordinary conditions is diverted away from the intake, but there is leakage through the diversion dam, and at times of higher flows in the brook the water overflows the diversion dam and enters Muddy Brook from which your supply is directly drawn. The watershed of Leonard's Brook contains a large ice house at which there are no sanitary conveniences, and there are evidences that not long ago work was carried on in the brook in repairing a dam. It also appears that some time last fall, manure, into which privy waste had been mixed, was spread upon the ground in the neighborhood of Leonard's Brook, and there is evidence that a similar method of disposal of privy waste has taken place in the watershed of Drake's Brook. Hunters, woodchoppers and others were found to be present within the watershed, for whom, of course, no sanitary conveniences exist.

Under such conditions the water supply could easily be infected and yet no trace of the manner of infection be found several weeks later when the disease has made its appearance.

Cases of typhoid fever occur in which the patient, although capable of spreading infection, is not confined to the house or prevented from going about his usual occupations, and there are, besides, the cases of the bacillus carriers, so called, who may be apparently in perfect health, yet be capable of spreading the disease.

Under the conditions found in your watershed the danger of infection of your water supply, taken as it is directly from a running stream, is very serious.

The Board recommends that the town begin at once the work of securing a good water supply adequately protected from danger of pollution. Such a supply can probably be obtained from your present watershed at a very reasonable expense. Until such a supply is secured, the watershed should be rigidly inspected daily and all practicable measures taken to prevent pollution. It will also be best that all water used for drinking be boiled or that the supply be treated temporarily with hypochlorite of lime under proper supervision until a safe supply has been introduced.

Copies of the recent chemical and bacterial analyses of your water supply are appended.

Townsend (Wells).

Dec. 5, 1913.

To the Board of Health, Townsend, Mass.

Gentlemen: — In response to the request of Dr. H. B. Boynton, agent of your board, and Mr. H. C. Knight, Superintendent of Schools, the State Board of Health has caused certain wells in Townsend to be examined and samples of their waters to be analyzed.

The well at the Center School, at the junction of Pleasant and School streets, is located near the center of the densely populated part of the village but was not being used regularly at the time of this examination. A sample was obtained, however, and the results of the analysis show that the water has at some time been considerably polluted and not subsequently well purified in its passage through the ground before entering the well. Considering this result in connection with previous analyses of this water, it appears that its quality is very variable, showing at times when it has been in use a greater amount of pollution than at the present time. In the opinion of the Board the well is an unsafe source from which to take water for drinking.

The well of W. A. Russell, School Street, is located in the cellar of the house, which is in a thickly populated part of the village. The results of the analysis show that the water entering this well has at some time been seriously polluted and not subsequently completely purified in its passage through the ground before entering the well. Under the circumstances, the source cannot be regarded as a safe one from which to take water for drinking.

An examination of the well of W. G. Domina, Smith Street, shows that it is well protected from pollution at the surface, but the results of the analysis show that the water has at some time been very badly polluted and not subsequently completely purified in its passage through the ground before entering the well. In the opinion of the Board the well is an unsafe source from which to take water for drinking.

The well at the school on Main Street in West Townsend is not provided with a pump, the water being drawn by lowering a pail. There are sources of pollution in the immediate neighborhood of the well, as in the case of the other wells examined, and the results of an analysis of water show that it receives considerable pollution. In the opinion of the Board the source is not a safe one from which to take water for drinking.

A public water supply is greatly needed in the thickly settled portions of Townsend, and a supply of good water adequate for the requirements of the town can be obtained at a comparatively small cost. In view of the great danger to the public health from the continued use of the polluted wells in the thickly settled parts of the town, the Board recommends the introduction of a public water supply at the earliest practicable time.

West Brookfield.

Jan. 2, 1913.

To the Board of Water Commissioners, West Brookfield, Mass.

Gentlemen: — The State Board of Health has considered your application for the approval, under the provisions of chapter 373 of the Acts of the year 1911, of the taking of water for the supply of the town of West Brookfield from a system of tubular wells to be located on the southwesterly shore of Wickaboag Pond, and has caused the locality to be examined by its engineer and considered the results of a pumping test made by pumping from a group of wells in this locality from November 29 to December 7, inclusive.

The results of analyses of samples of water collected at frequent intervals during the test show that it is soft and in all other respects of good quality for the purposes of a public water supply.

The quantity of water pumped during the test was considerably in excess of the quantity likely to be required for the supply of West Brookfield at the present time, and the results of observations of the height of the ground water in the neighborhood during the test, together with other information affecting the wells, indicate that the yield is likely to be adequate for the requirements of the village at all times, unless the quantity of water used shall become much greater than is required at the present time.

The Board approves the taking of water for the supply of West Brookfield from the ground at the location at which the test was made and approves the general location of the wells used in this test. There are small areas near the wells which are flooded at times of high water in the pond, which it is understood you propose to improve by removing the organic matter and filling to the level of high water. These improvements are very desirable in order to preserve the quality of the well water.

An adequate area of land should be acquired to prevent the location of buildings or other structures at any point in the neighborhood of the wells from which polluting matter might enter them by passing over or through the ground.

If you desire more definite advice concerning the acquirement of lands for the protection of the water supply the Board will, upon the submission of a plan showing the area which you propose to acquire, advise you concerning it.

West Stockbridge.

Oct. 2, 1913.

To the Committee on Water Supply, West Stockbridge, Mass., Mr. W. W. Bartlett, *Chairman.*

Gentlemen: — In response to your request for an examination of the Cheever Ore Pit, so called, located about two miles north of the village of West Stockbridge, and advice as to the use of water from this locality for the supply of the village, the State Board of Health has caused the source indicated to be examined by one of its engineers and a sample of the water to be analyzed.

The results of the examination show that the Cheever Ore Pit is an abandoned iron mine which has become filled with ground water. No tests have been made to determine the quantity of water that can be obtained from this source, but the area of the watershed appears to be extremely limited and it is improbable that it will supply by gravity enough water for the requirements of the village at all times.

Considering the conditions, the source does not appear to the Board to be a desirable one from which to attempt to obtain a water supply for West Stockbridge.

An examination has also been made of Pauls Brook in the neighborhood of Stevens Glen, where this stream has a drainage area of about one square mile. The brook would probably supply an adequate quantity of water for the requirements of the village, but the brook is exposed to considerable danger of pollution, especially from visitors to Stevens Glen, and — considering the circumstances — the source is not a desirable one in the opinion of the Board from which to take water for domestic use.

The Board recommends that you have a careful investigation made, with the assistance of an engineer of experience in water supply investigations, to determine the most available source or sources for the supply of the town. The Board will, upon request, assist you in these investigations by making the necessary analyses of water and will advise you as to the most appropriate source of supply for the town when the results of further investigations are available.

Williamsburg.

Sept. 4, 1913.

To the Board of Water Commissioners, Williamsburg, Mass.

Gentlemen: — In response to your request for advice as to taking an additional water supply for the town of Williamsburg temporarily from Mill River at a point about half a mile north of the village, the State Board of Health has caused the Mill River and its watershed to be examined and a sample of water to be analyzed.

At the time of this examination the water was turbid and had an unpleasant odor, caused possibly by a recent rain.

The watershed of this stream is extensive and contains numerous dwelling houses, some of which are near the stream or its tributaries. While it does not appear that the stream was being directly polluted at the time this examination was made, the water is exposed to such danger of pollution that, in the opinion of the Board, it is not advisable to use it for domestic purposes unless it is boiled or, if practicable, effectually treated with disinfectant; and if it is necessary to introduce this water immediately into the supply pipes of the town, all of the water takers should be warned to boil the water before using it for drinking.

The supply main of the city of Northampton, leading from Mountain Street Reservoir, passes through the valley of Beaver Brook apparently at no great distance from the supply mains in Haydenville, and if practicable it would be best to secure an auxiliary supply from that source so as to avoid the use of Mill River in the future.

The Board recommends that investigations be made without delay for the purpose of securing a permanent additional supply for the town of Williamsburg, so that the necessity of taking water from temporary sources may be avoided.

Dec. 15, 1913.

To the Board of Water Commissioners, Williamsburg, Mass.

Gentlemen: — In response to your request of Nov. 25, 1913, for the establishment of sanitary rules and regulations for the protection of the purity of the water of Unquomonk Brook, the source of water supply of Williamsburg, the State Board of Health has caused an examination of the watershed to be made by one of its engineers and has considered the information presented as to the conditions now existing there.

From this examination it appears that a hospital for tuberculosis patients is now being constructed within this watershed, and it is evident that the sewage therefrom must be disposed of at some point within the watershed, while the drainage of all the grounds around the buildings will flow to the reservoir. It appears to the Board that the operation of a tuberculosis hospital within this watershed, under the conditions existing there, would be a serious menace to the purity of the water, and considering its location it appears to the Board impracticable to protect adequately the purity of your source of water supply by any rules and regulations which might now be made.

The Board recommends that the town acquire at once the hospital property, which if necessary can be taken under existing laws, and that the use of these buildings for hospital purposes in the future be prevented. When this property has been acquired and the location of a hospital there prevented, it will be practicable, in the opinion of the Board, by the adoption of sanitary rules and regulations, to protect adequately the purity of your water supply.

Worcester.

Under the authority of section 113 of chapter 75 of the Revised Laws, rules and regulations were made by the Board on May 1, 1913, for preventing the pollution and securing the sanitary protection of the waters of Asnebumskit Brook and its tributaries, used by the city of Worcester as a source of water supply.

In addition to the foregoing, the Board has advised the following cities, towns and persons relative to spring waters, waters used for the supply of factories, public wells or wells used by a number of families; but as these matters are for the most part of minor public importance, the communications of the Board in these cases have not been printed. Copies of them are on file in the office of the Board: —

Andover, well at North School.
Blackstone, wells of Woonsocket Rubber Company, Millville.
Boston, well of Boston Belting Company.
Bridgewater, wells (two).
Brookfield, well of Foster-Moulton Shoe Company.
Canton, well of Plymouth Rubber Company.
Chelmsford, wells (two).
Chelmsford, well of Silesia Worsted Mills.
Dedham, wells.
Douglas, spring at Douglas Camp Ground.
Dracut, spring.
Fall River, wells of Enterprise Brewing Company.
Fitchburg, spring in Boston & Maine Railroad yard.

Framingham, water supply of Society of St. Vincent de Paul.
Gardner, spring.
Great Barrington, well in Housatonic.
Hanson, well.
Haverhill, spring.
Holbrook, springs (two).
Holden, spring.
Holyoke, wells of Deane Steam Pump Company.
Lawrence, wells (two).
Lawrence, spring.
Lawrence, well of Arlington Mills.
Lawrence, well of Hartig & Miller.
Lawrence, well at Bay State Building.
Lexington, well.
Lynn, well.
Lynnfield, well at school.
Marshfield, well at Sea View.
Medford, well on Boulevard Heights.
Medway, well.
Methuen, spring.
Milton, well.
Nantucket, Sachem Spring.
New Bedford, well.
North Attleborough, well of Riley & French.
Northbridge, wells (two).
North Reading, water supply of school.
Norwood, well of F. W. Bird & Son.
Norwood, well.
Palmer, water supply at Forest Lake Park.
Palmer, spring.
Pelham, wells.
Plainville, wells of Whiting & Davis Company.
Plymouth, spring at Manomet Bluffs.
Princeton, wells.
Reading, Massasoit Spring.
Saugus, town pump.
Shelburne Falls, well.
Shutesbury, springs.
Sterling, wells (two).
Sturbridge, wells at schoolhouses.
Swansea, wells.
Walpole, spring of F. W. Bird & Son.
Watertown, wells of Ætna Mills.
Westfield, well in Pequot Park.
Weston, well on Sibley Road.

Weston, well at Hastings Organ Factory.
Westport, wells (two).
Westwood, well at Colburn School.
Westwood, well of H. F. Mylod.
Winchester, well.
Woburn, well.

Ice Supplies.

The following is the substance of the action of the Board during the year in reply to applications for advice relative to ice supplies: —

Amherst.

Feb. 24, 1913.

To the Board of Health, Amherst, Mass.

Gentlemen: — In response to your request for an examination of an ice pond on Amethyst Brook in the easterly part of Amherst, from which ice is harvested for general purposes, the State Board of Health has caused the pond and its surroundings to be examined and samples of the water and ice to be analyzed.

The results of the examination show that the pond is an artificial one of no great depth and that the brook which flows into the pond is polluted by the discharge of sewage from a factory and dwelling house about half a mile above the pond. The analyses of samples of ice from this pond show that it contains a larger quantity of organic matter than is found in good ice, but the number of bacteria in the samples examined was very small.

Under the existing circumstances the only way in which ice taken from this pond can be used with safety is by removing from the ice, after cutting, all snow ice, including the first inch of clear ice that formed upon the pond, and rejecting all ice containing particles of foreign matter. If this plan is strictly followed it is probable that the clear ice cut from this pond may safely be used for domestic purposes. The discharge of sewage into the brook above the pond should be prevented if the use of the pond as a source of ice supply is to be continued.

Auburn.

Feb. 6, 1913.

To the Board of Health, Auburn, Mass., Mr. John J. Allen, *Secretary.*

Gentlemen: — In response to your request for an examination of Pondville mill pond and advice as to its use as a source of ice supply, the State Board of Health has caused the pond and its surroundings to be examined and a sample of the water to be analyzed.

From the information presented to the Board it appears that it is proposed to cut ice from the lower part of the pond at a point about 0.3 of a mile above the dam at Pondville. The pond is apparently a little over a mile in length and has a maximum depth of about 20 feet. The location from which the ice is to be cut is in the deeper and wider section of the pond. An examination of the watershed shows that the water receives little direct pollution, but sewage is apparently discharged into one of the tributaries of the pond from a factory in West Millbury, where from 30 to 40 persons are employed. This pollution should be discontinued immediately and the sewage disposed of in some suitable place where it will not pollute the pond.

In the opinion of the Board ice may safely be taken for domestic purposes from the mill pond at Pondville, providing that all snow ice, including the first inch of clear ice that forms upon the pond, is removed before the ice is used, and that all ice containing particles of foreign matter is rejected.

Canton.

Dec. 4, 1913.

To the Board of Health, Canton, Mass., Mr. W. A. Bense, *Secretary.*

Gentlemen: — In response to your request for a further examination of Dean's Pond and advice as to its use as a source of ice supply, the State Board of Health has caused the pond and its surroundings to be examined and samples of the water to be analyzed.

The results of the examination show that the brook which enters the pond drains a territory containing a considerable population and that it receives considerable pollution, but it does not appear to be directly polluted from the houses mentioned in your communication. It also receives considerable soot and ashes from the railroads.

The results of the examination do not show that the conditions differ materially from those found at the time of the examination in 1912, when the results of the analysis of a sample of the ice indicated that it could be used with safety for domestic purposes.

The circumstances affecting this pond are such, however, that it is of the greatest importance that the ice shall be carefully inspected when harvested to insure the carrying out of the requirements recommended last year; these were that the first inch of ice that forms upon the pond, including all snow ice or ice which may have formed above it, shall be removed, and that all ice which contains particles of foreign matter shall be rejected.

When ice of sufficient thickness again forms upon this pond the Board will, if you so request, make an examination of it and advise you further as to the continued use of this source.

Chicopee.

Dec. 22, 1913.

To the Board of Health, Chicopee, Mass., Mr. Charles J. O'Brien, *Secretary.*

Gentlemen: — In response to your request of Dec. 4, 1913, for an examination of the water of a pond from which it is proposed to harvest ice to sell for domestic purposes in Chicopee, the State Board of Health has caused the pond and its surroundings to be examined and a sample of the water to be analyzed.

The results of the examination show that the watershed of the pond is uninhabited, that the pond itself is fed mainly by springs, and that its waters are not exposed to pollution.

In the opinion of the Board the source is a safe one from which to take ice for domestic purposes.

Fall River (Arctic Ice Company).

Dec. 5, 1913.

To the Board of Health, Fall River, Mass., Mr. Samuel B. Morriss, *Agent.*

Gentlemen: — In response to your request for an examination of the ice stored in the houses of the Arctic Ice Company on South Watuppa Pond and advice as to its quality, the State Board of Health has caused the locality to be examined and samples of the ice to be analyzed.

The results of the examination show that the ice found in these houses consists in part of snow ice and in part of clear ice, and the analyses show that the clear ice beneath the snow ice may safely be used for domestic purposes, but the Board recommends that all snow ice, including the first inch of clear ice, be removed before using.

There appears to be no doubt that ice of good quality for domestic purposes can be obtained from South Watuppa Pond, but it is advisable that this recommendation be carried out with all ice used from that source.

Georgetown.

June 5, 1913.

To Mr. George O. Putnam, *Danvers, Mass.*

Dear Sir: — In response to your request for an examination of Rock Pond in Georgetown and advice as to its use as a source of ice supply, the State Board of Health has caused the pond and its surroundings to be examined and samples of the water and ice to be analyzed.

The results of the examination show that the ice found in the ice house on the shore of the pond is of good quality for domestic purposes.

Greenfield.

April 28, 1913.

To the Greenfield Ice and Trucking Company, Greenfield, Mass.

Gentlemen: — In response to your request for an examination of three ponds from which you are proposing to supply ice for domestic purposes in Greenfield, the State Board of Health has caused the ponds and their surroundings to be examined and samples of the water and ice to be analyzed.

The results of the examination show that the ponds are not exposed to danger of serious pollution, and the ice from each of these ponds appears to be of good quality. The Board recommends that all snow ice, including the first inch of clear ice that forms upon the ponds, be removed before using, and all ice containing particles of foreign matter be rejected. With these precautions ice from these three ponds can continue to be used with safety while the conditions affecting them remain as at present.

Hyde Park.

Dec. 5, 1913.

To Mr. Ernest W. Flagg, *Hyde Park, Mass.*

Dear Sir: — In reply to your request for an examination of Sprague Pond in Hyde Park and advice as to its use as a source of ice supply, the State Board of Health has caused an examination of the pond to be made and a sample of ice from an ice house on the shore to be analyzed.

The results of the examination show that the pond receives considerable pollution from surface drainage of a rather densely populated area near the pond and is exposed to wash from the railroad tracks near its southerly shore. Much floating matter was observed on the water at the time of the examination, due, no doubt, largely to cinders and ashes from the railroad.

The analysis of the ice from one of the ice houses on the shore of the pond shows that it contains a larger quantity of organic matter than is found in good ice, but the number of bacteria in this sample was low and this ice was probably safe for domestic use.

In order to obtain ice from this pond that would be safe for domestic purposes it would be essential to remove from the ice, before using, all snow ice, including the first inch of clear ice that forms upon the pond, and to reject all ice containing particles of foreign matter. With careful inspection, to see that these requirements are carried out, it is probable that the clear ice obtained from this source would be safe for domestic purposes while the conditions affecting the pollution of the pond are no more objectionable than at the present time.

Lawrence.

May 1, 1913.

To the Lawrence Ice Company, Lawrence, Mass.

Gentlemen: — In response to your request for advice as to the use of ice from Great Pond, or Lake Cochickewick, in North Andover, and Mystic Pond in Methuen, the State Board of Health has examined the sources and finds that both are satisfactory as sources of domestic ice supply. Analyses of samples of the ice show that it is of good quality.

Lynn.

June 11, 1913.

To Mr. Walter Creamer *and Others, Lynn, Mass.*

Gentlemen: — The State Board of Health received from you on May 6, 1913, the following petition relative to the sale of certain ice cut from Flax Pond in the city of Lynn: —

We, the undersigned citizens of Lynn, Mass., being consumers of ice cut from Flax Pond which is located in said Lynn hereby make complaint to the State Board of Health and allege that said ice is impure and injurious to the health of those who use said ice.

This complaint is made under section 59 of chapter 75 of the Revised Laws of Massachusetts, and such other chapters and sections as are applicable thereto. . . .

In accordance with the requirements of chapter 75 of the Revised Laws, section 59, the State Board of Health has held a hearing after notice to the parties interested, and after repeated examinations of specimens of the ice obtained from this pond, and investigations of the surroundings of the pond, has issued the following order: —

An Order relative to the Sale of Ice taken from Flax Pond in the City of Lynn.

At a meeting of the State Board of Health held on the fifth day of June, 1913, upon the complaint in writing of not less than twenty-five consumers of ice cut from Flax Pond in the city of Lynn and sold or held for sale, alleging that said ice is impure and injurious to health, after notice to the parties interested of the time appointed for the hearing and after hearing said parties it is the judgment of said Board that the public health requires that the State Board of Health, acting under Revised Laws, chapter 75, section 59, make the following order, which is hereby made: —

Ice cut from Flax Pond in the city of Lynn during the winter of 1912–1913 shall not be sold or held for sale for domestic purposes. It may, however, be used for cooling where it will not come in contact with food or drinking water.

The Board will consider the results of any investigations which may be made by the ice companies relative to the use of ice cut in future from this pond.

Marshfield.

Dec. 5, 1913.

To the Board of Health, Marshfield, Mass.

Gentlemen: — In response to a request for an examination of a pond near Highland Street, Marshfield Hills, and advice as to its use as a source of ice supply, the State Board of Health has caused the pond and its surroundings to be examined and a sample of the water of the pond and of the ice from an ice house near the shore of the pond to be analyzed.

The results of this examination show that the pond is not at the present time exposed to any notable danger of pollution from the buildings on its shore or within its watershed which would affect materially its use as a source of ice supply. A considerable amount of salt water, resulting from the freezing of ice cream at a shop near the shore of the pond, flows into the pond, but it was not especially harmful at the time this examination was made. This waste water could easily be diverted to advantage into the stream below the pond.

An analysis of the water of the pond shows that it contains a considerable quantity of vegetable matter, and the ice contains more organic matter than is ordinarily found in good ice. The number of bacteria in the ice was low, however, and in the opinion of the Board it may safely be used for domestic purposes. It is advisable, in the use of ice from this pond, to reject the ice containing particles of foreign matter and to remove, before using, all snow ice, including the first inch of clear ice that forms upon the pond.

Milton.

March 25, 1913.

To the Board of Health, Milton, Mass., Mr. A. W. Draper, *Secretary.*

Gentlemen: — In response to your request of February 6 for an examination of the water and ice of the ponds of Pope and Turner, situated near Blue Hill Parkway and Central Avenue, respectively, and the water of Pine Tree Brook, the Board has caused the sources of supply to be examined and samples of water and ice from the brook and ice ponds to be analyzed.

The results of the examination show that the brook receives considerable pollution, especially from the portion of its watershed between Pope's Pond and Turner's Pond. There has been very little change in the quality of the water as compared with former years.

The results of the analyses of samples of ice from these ponds differ but little from those of former years. They show that ice from these ponds contains a rather larger quantity of organic matter than is found in good ice, but the clear ice from both ponds at the time of the recent examination was practically free from bacteria. In the opinion of the Board, ice harvested from these ponds may safely be used for domestic purposes, provided the snow ice and the first inch of clear ice which forms upon the pond are removed before using and all ice containing particles of foreign matter is rejected.

NORTHAMPTON.

MAY 21, 1913.

To MR. GEORGE R. TURNER, *Agent Board of Health, Northampton, Mass.*

DEAR SIR: — In response to your application of April 22 for an examination of the ice from certain ponds in Northampton and advice as to its quality, the State Board of Health has caused the ponds to be examined and samples of the water and ice to be analyzed.

The ponds in question are known as Norwood Pond, located near the highway between Northampton and Easthampton, Rocky Hill Pond, located about half a mile northwest of Norwood Pond, and Rice Pond, located about a mile south of the village of Leeds.

The watershed of Rice Pond is uninhabited, and the watershed of Rocky Hill Pond is very sparsely populated and that pond does not appear to be exposed to serious danger of pollution. Norwood Pond also appears to be adequately protected from danger of pollution at the present time.

Samples of ice harvested during the past year from all of these sources have been found upon analysis to be of good quality, and in the opinion of the Board these ponds can continue to be used with safety as sources of ice supply. The Board renews its recommendations as to the treatment of ice from these sources as contained in its communication to your board dated Oct. 4, 1906, a copy of which is appended.

Palmer.

Sept. 18, 1913.

To the Board of Health, Palmer, Mass.

Gentlemen: — In response to a request the State Board of Health has caused an examination to be made of the ice found in an ice house near a small meadow on Park Street, about half a mile southeast of the village. The Board is informed that this ice was obtained from an area of meadow which is flowed in the winter season to a depth of about four feet.

The results of an analysis of a sample of ice from this ice house does not show that this ice is objectionable for domestic purposes. The pond is located very close to the village, however, and there appear to be dwelling houses on the watershed of the pond, polluting matters from which may be carried into the pond at times of heavy rain.

Under the circumstances, in the opinion of the Board, it is important, if ice is to continue to be used in future from this pond for domestic purposes, to remove from the ice, before using, all snow ice, including the first inch of ice that forms upon the pond, and to reject all ice containing particles of foreign matter. It is important that these recommendations be carefully followed in case ice from this source is to be used for domestic purposes.

Pittsfield.

March 25, 1913.

To Mr. W. H. Eaton, *Secretary, Pittsfield Country Club, Pittsfield, Mass.*

Dear Sir: — In response to your request for a further examination of Morewood Lake and advice as to its use as a source of ice supply, the Board has caused the lake and its surroundings to be examined and a sample of the ice to be analyzed.

The results of the examination show that the conditions are much the same as at the time of the previous examination in 1901.

It is probable that a small quantity of water from Wanpenum Brook, which is exposed somewhat to pollution, finds its way into the lake at times, but the results of the recent examination of a sample of the ice show that it is of good quality and suitable for domestic purposes. It is advisable that provision be made for preventing the water of Wanpenum Brook from entering the lake at any time so long as the lake is used as a source of ice supply.

The Board further recommends that all snow ice, including the first inch of ice that forms upon the lake, be removed before using and all ice containing particles of foreign matter be rejected.

Rockland.

March 6, 1913.

To the Board of Health, Rockland, Mass., Dr. Joseph Frame, *Secretary.*

Gentlemen: — In response to your request of Feb. 17, 1913, for an examination of the ice recently harvested from Cushing's Pond in Rockland and advice as to its quality, the Board has caused the pond and its surroundings to be examined and a sample of the water and ice to be analyzed.

The results of the examination show that the conditions affecting the quality of the water of this pond are much the same as were found at the time of the previous examination in 1909. The pond is very badly polluted by sewage from many sources, especially by the overflow from large cesspools located near the stream a short distance above the pond.

A sample of the ice, consisting of about 6 inches of clear ice and 2 inches of snow ice, taken from an ice house near the shore of the pond has been analyzed, and the results show that the snow ice contained an excessive quantity of organic matter and a very large number of bacteria and would be unsafe for domestic use. The clear ice contained more organic matter than is found in good ice, but the number of bacteria was low.

In the opinion of the Board this ice is unsafe for domestic purposes.

Southwick.

Jan. 6, 1913.

To the Board of Health of the Town of Southwick.

Gentlemen: — The State Board of Health has considered your request for advice as to the use of the Congamond Ponds in Southwick as a source of ice supply and as to preventing the pollution of these waters, and has caused the ponds and their surroundings to be examined by one of its engineers and samples of the water to be analyzed.

The ponds were examined in 1905 relative to their use as a source of ice supply, at the request of the authorities of the city of Holyoke, and the Board recommended at that time that the clear ice harvested from these sources might safely be used for domestic purposes. The recent examination shows that, while a few additional summer cottages have been built in the neighborhood of the ponds, very little change has taken place in their surroundings since the time of the previous examination. Most of the dwellings about the ponds are summer cottages, rarely occupied later than the middle of November, and, considering the location of the houses about the ponds and the porous character of the soil, there is little probability that the ponds are seriously polluted from these buildings.

The only source from which pollution appears to be finding its way into the ponds at the present time is a cesspool at the Lake House, and it is probable that by the construction of suitable cesspools in the rear of this hotel, so arranged that one will overflow into another, this nuisance can be prevented if the cesspools are cleaned when necessary. It is also advisable that sanitary conveniences be provided for the laborers about the ice houses, and the enforcement of these provisions comes within the powers of your board under existing laws.

It has not been practicable to obtain from these ponds a suitable sample of ice during the present season, but in the opinion of the Board ice of good quality can be obtained from these ponds, provided that all snow ice and the first inch of clear ice which forms upon the pond be removed before using and that all ice containing particles of foreign matter be rejected.

The Board has also examined, in accordance with your request, the water supply of the railroad station and dwelling houses in its neighborhood, which the Board is informed is taken from Great Brook.

An examination of this brook shows that it is exposed to such danger of pollution from the inhabitants on the watershed that it cannot be regarded as a safe source from which to take water for drinking, and the Board recommends that its use for that purpose be discontinued and a water of good quality provided from an unpolluted source.

Westford.

July 3, 1913.

To Miss M. A. Gage, *Lowell, Mass.*

Dear Madam: — In response to your request for an examination of ice cut from Forge Pond and advice as to its quality, the State Board of Health has caused the pond to be examined and a sample of ice from an ice house at Forge Village near the outlet of the pond to be analyzed.

The results show that this ice, while containing a rather greater amount of organic matter than is found in good ice, contains a low number of bacteria and is, in the opinion of the Board, safe for domestic purposes.

Westport.

Sept. 4, 1913.

To the Board of Health, Fall River, Mass.

Gentlemen: — In response to your request of Aug. 12, 1913, for an examination of the ice in an ice house near the cranberry bog of David Ouellette, lying between the Fall River & New Bedford Railroad and the New Bedford highway a short distance from Davis Road in the town of Westport, the State Board of Health has caused the cranberry bog from which ice is cut to be examined and a sample of the ice in the ice house to be analyzed.

The results of the analysis show that the snow ice in the sample examined was of very poor quality and should not be used in contact with food or drinking water, but that the clear ice beneath the snow ice, while containing a somewhat larger quantity of organic matter than is usually found in good ice, is probably safe for domestic purposes.

It appears that it is the custom to flow the cranberry bog to a depth of about 3½ feet in the winter with water from the brook draining through the cranberry bog from the northwest, and an examination of the surroundings of the cranberry bog and the watershed of the brook does not show that they are exposed at the present time to very serious danger of pollution, and while the conditions affecting the cranberry bog remain as at the present time it is probable that ice may be harvested from it with safety, provided it is subject to careful inspection to insure the removal of all snow ice, including the first inch of clear ice that forms upon the pond, and to secure the exclusion of all ice containing particles of foreign matter. If these restrictions are carried out in future, ice from this source can probably continue to be used with safety for domestic purposes while the conditions remain as at the present time.

Winchendon.

May 1, 1913.

To the Board of Health, Winchendon, Mass.

Gentlemen: — In response to your request for an examination of the ice taken from Bullardville Pond, Pequoig Pond and Whitney's Pond, in Winchendon, and advice as to its quality, the State Board of Health has caused the sources indicated to be examined and samples of the water and ice to be analyzed.

Neither Bullardville Pond nor Pequoig Pond is exposed to serious danger of pollution, and both ponds are suitable sources of ice supply. The ice harvested from these sources during the past winter apparently consisted largely of clear ice with very little snow ice on top, and the results of the analyses show that the ice contains a somewhat greater quantity of organic matter than is found in good ice. It would be best to remove from the ice, before using, all snow ice, including the first inch of clear ice that forms upon the ponds, and it is advisable, also, to reject all ice containing particles of foreign matter.

The conditions affecting Whitney's Pond do not appear to have changed materially since 1909, when the last examination was made. At that time the Board made the following recommendations: —

> The conditions affecting this source of supply do not appear to have changed very materially since the time of the previous examination in 1906, when the Board advised you as follows concerning the use of ice from this pond: —
>
> . . . The mill pond is large and quite deep, but it receives considerable pollution from mills on the stream which enters it. In order to obtain ice from this pond which may safely be used for domestic purposes it will be necessary to remove from the ice, when harvesting, the first inch that formed upon the pond, including all snow ice and ice formed by flooding, and retain for use only the clear ice forming beneath the first inch. It is also important that all ice containing particles of foreign matter be rejected.
>
> It appears that these recommendations have been carefully followed in harvesting the ice cut from this pond during the past winter. The results of the analysis of a sample of ice taken recently from one of the ice houses on the shore of this pond show that it is of good quality, and, in the opinion of the Board, this ice may safely be used for domestic purposes. The recommendations contained in the previous communication of the Board should still be followed while ice is taken from this source for domestic purposes.

If the recommendations made by the Board continue to be carried out, it is probable that ice harvested from this source can be used for domestic purposes with safety.

May 1, 1913.

To the Board of Health, Winchendon, Mass.

Gentlemen: — In the course of the examination of Whitney's Pond, used as a source of ice supply, it has been found that considerable waste, including sewage, is discharged into the streams which feed the pond, especially at two mills located above the pond.

It is not difficult to dispose of the sewage and wastes from these mills satisfactorily in such a way that they will not pollute the streams feeding Whitney's Pond, and the Board recommends that the further pollution of the pond by sewage from these mills be prevented.

Worcester.

March 27, 1913.

To the Board of Trustees of the Worcester State Hospital, Worcester, Mass.

Gentlemen: — In accordance with a request for an examination of the ice taken from Lake Quinsigamond for use in the hospital and advice as to its quality, the State Board of Health has caused the locality from which the ice is taken to be examined and a sample of the ice harvested during the present year to be analyzed.

The sample of ice analyzed in the course of the recent examination was 7 inches in thickness and consisted only of clear ice. The results of this analysis show that this sample contained rather more organic matter than is found in good ice, but the number of bacteria was low, and the ice in the opinion of the Board is probably safe for domestic purposes.

Lake Quinsigamond receives considerable pollution from many sources, though the pollution is probably less in the winter season when ice is harvested than at other times. It is probable that the use of ice from this source can be continued with safety, provided that all snow ice, including the first inch of clear ice that forms upon the lake, be removed before using and all ice containing particles of foreign matter be rejected.

Sewerage and Sewage Disposal.

The following is the substance of the action of the Board during the year in reply to applications for advice relative to sewerage and sewage disposal: —

Amherst.

Oct. 22, 1913.

To the Board of Sewer Commissioners, Amherst, Mass.

Gentlemen: — In response to the request of your engineer, the State Board of Health has caused an examination to be made of the East Street sewage disposal area of the town of Amherst and has considered the results of the operation of the filters and the measurements of the flow of sewage discharged upon them.

The aggregate area of filters now available for use amounts to about 2 acres, and the average flow of sewage as measured at various times during the past three years has been found to range from 140,000 gallons per day to more than 600,000 gallons. The present area of filters is probably capable of purifying satisfactorily the entire flow of sewage when the quantity does not exceed the smaller figure mentioned above, but for the disposal of the sewage when the flow amounts to as much as indicated by the higher figure, the area of filters required would be between 8 and 10 acres.

It is obvious that these wide variations in the flow of sewage are due to leakage into the sewerage system, and it will probably be less expensive for the town to reconstruct such portions of the sewers as may be necessary to prevent excessive leakage than to attempt to build and maintain a filtration area of adequate capacity to purify the sewage at all times.

The Board recommends that a careful study of the sewerage system be made without further delay to determine its condition and the practicability of preventing excessive leakage into the sewers. When the results of this investigation are available, it will be practicable for the Board to give you more definite advice as to the disposal of the sewage of the portion of the town served by this system. It is very important, in the opinion of the Board, that the investigations necessary for the determination of this question be made without delay in order that the work of improving the sewage disposal system of the town may be entered upon as soon as practicable.

Andover.

Feb. 6, 1913.

To the Board of Public Works, Andover, Mass.

Gentlemen: — The results of the examinations of the Andover sewage disposal works made by the State Board of Health show that the efficiency of the purification of the sewage of the town by the filter beds has been diminishing for several years and has now become quite unsatisfactory. Moreover, the examination of the works shows that a considerable quantity of sewage is discharged untreated directly into the Shawsheen River.

It is probable that, unless the condition of your filtration works is greatly improved, the character of the effluent will grow rapidly worse and result in a continued and increasing pollution of the Shawsheen River.

The filters at the present time are seriously clogged, and large parts of the area remain covered with sewage for long periods, a condition which is unfavorable for the proper operation of the filters. An examination of the filter beds shows that the underdrains in some of them at least are not in a proper condition to drain the filters satisfactorily, and lack of efficient underdrainage is one of the chief causes of the unsatisfactory operation of these filters. The filters in which the underdrains have been recently relaid by your department are operating more satisfactorily than the others.

The quantity of sewage discharged upon these filters is such that the average rate of operation amounts to about 70,000 gallons per acre per day. This quantity is greater than filters containing material of the character found in this area are capable of purifying satisfactorily. As already stated the filters, moreover, do not treat all of the sewage, a considerable quantity of which is discharged untreated into the Shawsheen River, and it is understood that you propose to extend the sewerage system in the near future, thus increasing the quantity of sewage to be cared for. It is essential under the circumstances that the condition of the filter beds shall not only be improved, but that the area shall be enlarged.

The Board recommends that the underdrains in all of the filters which have become seriously clogged be relaid under proper inspection and that the filters be subsequently carefully leveled and adequate provision made for distributing the sewage evenly to all parts of the area of each filter. It is further recommended that the gates upon the distributing pipes from which sewage is discharged upon the filters be repaired or renewed so as to prevent leakage and the constant discharge of small quantities of sewage upon the filters, as is the case at the present time.

The Board further recommends that the filtration area be enlarged and that all of the sewage of the town be conveyed to the area and purified. The discharge of crude sewage directly into the Shawsheen River should be discontinued as soon as the improvements at the filtration area are completed.

Barnstable.

May 27, 1913.

To Alfred Crocker, Jr., *Barnstable, Mass.*

Dear Sir: — The State Board of Health has considered your request of May 10, 1913, for advice as to the probable need of sewerage in the village of Barnstable in case a water supply should be introduced there and has caused the conditions existing in the village to be examined by one of its engineers.

The questions which you have submitted are the following: —

. . . .

1. On the above facts if water is installed, in the opinion of the State Board of Health, will it be necessary to have a sewerage system for the village?

2. In the opinion of the State Board of Health would not a sewerage system with a cesspool for each house which has a water supply be sufficient?

3. Are there any records which show what proportion of the towns that have water supply do not have sewerage systems? If so what is the proportion of towns? Are you willing to state what are some of the towns somewhat similar in conditions to what I have described that have water supply and do not have sewerage system?

An examination of the conditions existing in the portions of Barnstable in which it is proposed to introduce a water supply indicates that there are about 220 houses scattered along about 7½ miles of streets in which the water pipes may eventually be laid. The houses for the most part are on large lots in which wells are located from which the domestic water supply is now obtained, and the surplus water is disposed of by cesspools located on each lot. Throughout the thickly settled portions of the town the soil appears to be porous and well adapted for the disposal of sewage by the methods now in use.

The conditions are favorable for the continued disposal of the sewage after a public water supply has been introduced, in accordance with the practice at the present time, and, unless great quantities of water are allowed to run to waste, there is little doubt but that the present methods of sewage disposal can be continued in the future until the village becomes more densely populated than at the present time. Moreover, if a sewerage system should be put in there is no necessity for discharging the sewage into any of the waters about the town in such a way as to cause their pollution. A large number of the inland cities and towns at the present time purify their sewage upon land, and the conditions for such disposal in Barnstable are much more favorable than ordinarily found elsewhere for the purification and satisfactory disposal of sewage.

Regarding the information asked for in your question No. 3, as to what proportion of towns that have water supplies are also provided with sewerage systems, the Board finds that there were in 1912 approximately 195 of the cities and towns in the State provided with public water supplies and that of these, 104, or 53 per cent., have sewerage systems. A list of the towns having and not having sewerage systems will be found in the annual report of the Board for 1911 (pages 384–394), and a list of the towns having and not having public water supplies will be found in the annual report for 1910 (pages 209–219). Extracts from the reports mentioned giving these pages are sent you herewith. You will find from these tables that there are 26 towns in the State having a population in excess of that of Barnstable, by the census of 1910, which are not provided with sewerage systems, though most of them have had public water supplies for many years.

Chelmsford (Middlesex County Training School).

Dec. 22, 1913.

To the Middlesex County Commissioners, East Cambridge, Mass., Mr. Levi S. Gould, *Chairman.*

Gentlemen: — The State Board of Health has considered your application for advice as to the disposal of the sewage from the Middlesex County Training School at North Chelmsford, and the report of your engineers submitted therewith, and has caused the locality to be examined by one of its engineers.

In the report of your engineers two plans are considered, one providing for the disposal of the sewage by discharging it into one of the sewers of the city of Lowell, and the other for discharging it into tanks or cesspools at each building and disposing of it by subsurface filtration. Estimates of the cost of the two plans of disposal indicate that the discharge of the sewage into the sewerage system of the city of Lowell would cost somewhat more in the beginning than its disposal upon the grounds of the school. If the plan of disposal upon the grounds of the school should be adopted, it would be necessary to clean the receiving tanks for the sewage at frequent intervals, and this offensive sludge would doubtless have to be disposed of within the school grounds. Moreover, experience with subsurface filtration shows that it is necessary to dig up, clean and relay the distribution pipes from time to time in order to keep the filters in successful operation.

Under the circumstances, while the first cost of connecting with the Lowell sewers would be greater than the cost of disposal of the sewage of each building separately, there is very little doubt that in the end disposal into the Lowell sewers would be the less expensive plan to adopt.

An examination has also been made of the practicability of collecting the sewage from all of the buildings and disposing of it at some point within the grounds of the institution, but the soil of the areas which might be used for that purpose is not suitable for such use and such a method of disposing of the sewage does not appear to be practicable in this case.

Considering all of the circumstances, the best plan of disposing of the sewage of this school, in the opinion of the Board, is to discharge it into the sewers of the city of Lowell, provided that a satisfactory arrangement for that method of disposal can be made.

Chicopee (Fairview).

June 16, 1913.

To Hon. Frank A. Rivers, *Mayor of Chicopee, Mass.*

Dear Sir: — Complaint has been made to this Board of the unsanitary conditions existing in parts of the village of Fairview in the extreme northwesterly part of the city of Chicopee, and in response to this complaint the State Board of Health has caused the locality to be examined by one of its engineers.

It appears from this examination that, while the surface soil in the village is largely composed of sand, the subsoil is composed of very fine material and the ground-water level in many places is quite close to the surface. In consequence, it is extremely difficult to construct suitable cesspools which will dispose of household waste without overflowing, especially in the spring when the ground water is highest. The conditions in parts of the village are very objectionable, and in the wetter parts of the year it is necessary to clean out the cesspools frequently.

As no night-soil carts are available, it appears that the contents of the cesspools are pumped upon the surface of the ground, thus increasing the objectionable odors caused by the present method of disposing of the sewage.

In view of these conditions it is necessary, in the opinion of the Board, for the protection of the public health in this village, to provide as soon as practicable adequate means for the proper disposal of the sewage. It appears to be practicable to convey sewage by gravity to an outlet into the Connecticut River, and it may be possible to make an arrangement with the town of South Hadley for the disposal of the sewage into one of the sewers in that town which has an outlet into the Connecticut River near the Chicopee boundary at a point where the conditions do not appear to be objectionable.

The conditions in Fairview can be improved materially by providing night-soil carts for the cleaning out of cesspools, and the material removed from the cesspools can be disposed of in this way at some point sufficiently remote from the village where it will not create a nuisance.

The Board recommends that the city of Chicopee cause an investigation to be made as soon as practicable to determine the best available plan of collecting and disposing of the sewage of the village of Fairview, and that in connection with this plan the question of providing drainage for lowering the ground water in the village be also considered. In the meantime it is advisable to provide suitable night-soil carts for cleaning out and removing the contents of the cesspools in the village at such intervals as may be necessary to prevent overflow.

When you have prepared plans for the sewerage and drainage of the village of Fairview, the Board will, upon request, give you further advice as to the improvement of the sanitary conditions in the village.

Chicopee (Chicopee Falls).

July 28, 1913.

To the Board of Health, Chicopee, Mass.

Gentlemen: — The State Board of Health has considered your request of July 16, 1913, for advice as to a plan for removing the objectionable conditions along the bank of the Chicopee River in the rear of the works of the Fisk Rubber Company at Chicopee Falls, due to the discharge of crude sewage directly into the river at points above, and has caused the locality to be examined by one of its engineers.

The results of the examination show that the discharge of sewage at the principal sewer outlets in that section of the city pollutes badly the banks of the river for a considerable distance below the outlets, and with the growth of the district and the occupation of the banks of the river below the sewer outlet for manufacturing purposes, the effect of the pollution has become seriously objectionable.

The scheme for improvement suggested is to construct an intercepting sewer along the southeasterly bank of the river to remove the dry-weather flow of sewage from the present sewer outlets, together with the sewage from other small sewers discharging into the river farther down-stream, and to discharge this sewage into the river at a point about a third of a mile below the present main sewer outlets. The point chosen for the new outlet is about opposite an area which it will be practicable to utilize in the future for the treatment of the sewage in case it shall be decided to subject it to some form of treatment before discharging it into the stream in this neighborhood.

It appears to the Board necessary, for the protection of the public health, that the discharge of sewage at the present sewer outlets in Chicopee Falls, except such as may overflow at times of storm, should be discontinued, and it is also desirable that this sewage should either be purified or conveyed to some suitable outlet into the Connecticut River. In either case it will be necessary to convey the sewage farther down-stream, and the plan of discharging it temporarily at the point suggested, about a third of a mile below the present outlets, appears to be a reasonable one to adopt at the present time. While this outlet should be regarded as a temporary one, to be discontinued as soon as it is practicable for the city to provide a more satisfactory means of disposal of the sewage, the Board recommends that the outlet be carried out into the river at least 50 feet from the shore to a point where it will be covered with water at all times.

The Board recommends that at the time of making this extension an investigation be made by the city to determine the best practicable plan for the ultimate disposal of this sewage, in order that the works now constructed may conform as nearly as may be to plans for the final disposal of the sewage.

As soon as plans have been prepared for the proposed extension the Board will, if you so request, advise you concerning them.

Dartmouth.

June 5, 1913.

To the Board of Selectmen, Dartmouth, Mass.

Gentlemen: — The State Board of Health has considered your application for advice as to the construction of a sewer or main drain to be laid in Rogers Street from the Russell Mills Road to an outlet into Clark's Cove, as shown upon a plan submitted with the application. Subsequent to submitting this application you verbally informed the engineer of the Board that, in view of the objection to the discharge of sewage into Clark's Cove at the point proposed, you desire the advice of the Board simply as to the construction of the proposed main drain for the purposes of the removal of surface water and ground drainage only, leaving the question of the disposal of sewage for this region to be considered at a future time.

The Board has caused the locality to be examined by one of its engineers and has considered the plan presented. In the opinion of the Board the proposed plan is an appropriate method of providing for the collection and disposal of the surface water and ground drainage of the district which it is designed to serve, provided sewage, sink drainage and other objectionable matters be excluded from the drain.

The outlet of the drain may under the circumstances, if desired, be located nearer the high-water line than shown on the plan presented.

Duxbury.

Aug. 13, 1913.

To the Board of Health, Duxbury, Mass.

Gentlemen: — In response to your request for an examination of a sewer outlet in Duxbury and advice as to a plan for disposing of the sewage of the Powder Point School, the State Board of Health has caused the locality to be examined by one of its engineers and has considered the information presented.

It does not appear that the recommendations of this Board made several years ago relative to the disposal of sewage in this locality have been carried out, and an examination shows that the sewage from the buildings formerly used for the school, together with that from adjacent buildings, is discharged into a sewer running toward the bay, and that sewage leaks quite freely upon the flats from openings in the sewer. It further appears that your board has required the discontinuance of this nuisance and the proper disposal of the sewage.

The soil in the neighborhood of the Powder Point School is not well adapted to the disposal of sewage in cesspools, and considering the probable number of persons that will occupy the buildings and the adjacent houses used in connection there it is not practicable, in the opinion of the Board, to dispose of the sewage satisfactorily by that method.

The best plan to adopt in the existing circumstances would probably be to construct a subsurface filter bed, which could be located in a small area of low land about 400 feet south of the old school building and east of the houses connected with the school. It will be necessary to remove the soil at this location and replace it with sand of suitable quality for sewage purification which can be obtained at no great distance. The filter should have an area of at least 3,000 square feet for a population of 75 to 100 persons, assuming that the quantity of sewage will be kept as small as possible by preventing the unnecessary use and waste of water at fixtures discharging into the sewer.

The sewage, after first passing through a settling tank, should be discharged into the filter through pipes laid with open joints, with their bottoms at least one foot below the surface of the sand, and the filter should be thoroughly underdrained by tile pipes which may be connected with the present sewer pipe. Distributing systems and subsurface filters such as this become clogged after a longer or shorter period of use, and the distributing pipes must be cleaned and relaid under such conditions as here proposed at least as often as once in two years. The settling tank will require cleaning from time to time, and the contents would probably require removal in a suitable cart. They should be disposed of at some place where they will not be objectionable. The design of the settling tank and filter and the construction of the works should be carried out under the direction of an engineer of experience in matters relating to sewage disposal.

In the opinion of the Board it will be increasingly difficult to prevent the pollution of the flats along this coast by sewage, unless a system of sewers is constructed for the densely populated portions of the town and a suitable system of disposal provided. The disposal of sewage in these thickly settled areas by the ordinary methods of vaults and cesspools is already causing the serious pollution of the wells in these areas, and for the purpose of ascertaining the condition of these wells the Board has caused a number of them to be examined and samples of their waters to be analyzed. The results show that several of the wells examined are polluted, some of them seriously. There are certain of these wells that should not longer be used for domestic purposes; these are the following: —

Well of E. H. Ellison, well at the Powder Point School, well of E. E. Chandler, well of Miss E. Ellison — all in the neighborhood of Powder

Point — well of Harry Cushing, South Duxbury, well at E. Sweetser's store, well of Dr. N. K. Noyes, Duxbury.

The results of the examination as a whole show that this town is greatly in need of a good public water supply. It is probable that an adequate supply of good water for the requirements of the thickly settled portion of the town could be secured at a cost which would not be a serious financial burden upon the inhabitants.

The Board recommends that the question of introducing a public water supply be taken up and considered by the town at the earliest possible time and that the necessary investigations be made and plans prepared to determine the most appropriate source of supply and the probable cost of the works. It is practicable at a small expense to determine definitely the feasibility of securing an adequate supply of good water within a reasonable distance of the thickly settled portion of the town and to estimate very definitely the cost of the works.

Should the town decide to make investigations for a water supply, the Board will assist in making the necessary analyses of water and will advise as to any plan that the town may present for consideration.

Easthampton.

Oct. 31, 1913.

To the Board of Public Works, Easthampton, Mass., W. C. Tannatt, Jr., *Town Engineer.*

Gentlemen: — The State Board of Health has considered your application for advice as to the discharge of sewage from a proposed sewer near the Mt. Tom Junction Station of the Boston & Maine Railroad into the Connecticut River opposite the said station and has caused the locality to be examined by one of its engineers.

The plans presented provide for the disposal of the sewage of a small but somewhat thickly settled area in the neighborhood of Mt. Tom Junction, containing at the present time approximately 125 inhabitants. In constructing the outlet, however, it is proposed to use larger pipe than is necessary for the disposal of the sewage of the Mt. Tom district alone, with the idea eventually, it is understood, of conveying the sewage from the main sewer system of the town of Easthampton to an outlet into the Connecticut River in this neighborhood.

The proposed sewer outlet in the Connecticut River as shown upon the plans is about 40 feet out from the bank of the river at the summer water level and is to be located at such an elevation that it will ordinarily be completely submerged, though possibly exposed at times of extreme low water.

After a careful consideration of all of the circumstances the Board concludes that the best practicable plan of disposing of the sewage from the proposed sewers in the vicinity of Mt. Tom Junction is to discharge it into the Connecticut River. The discharge of sewage from this district into the river can probably be allowed to continue for several years, but the adoption of this outlet is subject to the condition that it shall be extended such further distance into the river as may be necessary in case objectionable conditions arise and that the sewage shall be removed from the river and purified whenever such treatment shall become necessary.

For the disposal of the entire sewage of the town of Easthampton the outlet proposed would, in the opinion of the Board, be very objectionable under the existing circumstances. It is possible, however, that an outlet might be selected at some point in this part of the river at which the sewage of Easthampton might be discharged without objection for a period of several years, provided it were subjected to efficient sedimentation and screening before final disposal. The necessary sedimentation and screening could very likely be carried on at the present disposal area, using the present works so far as they are suitable. It is probable, however, that further treatment would become necessary in case the sewage of the town is discharged into the Connecticut River, and the likelihood of such necessity arising in the future should be taken into account in considering any change in the present plan of disposing of the sewage.

Before deciding upon the disposal of the sewage of the town by discharge into the Connecticut River, the Board recommends that the whole question be carefully investigated and comparative plans prepared showing the cost of the disposal of the sewage into the Connecticut River by some satisfactory plan as compared with the cost of purification of the sewage and the discharge of the effluent into the Manhan River, as at present. The present disposal area is inadequate for the treatment of the sewage of the town, and it is important that further means for the treatment of the sewage shall be provided at the earliest practicable time. As soon as the results of the suggested investigations are presented, the Board will advise you as to the best available plan for the disposal of the sewage of the town.

Foxborough.

May 1, 1913.

To the Board of Selectmen of the Town of Foxborough.

Gentlemen: — The State Board of Health received from you on April 21, 1913, a petition for the approval by the Board, under the provisions of chapter 49, section 1, of the Revised Laws, of the purchase or taking of certain lands in the town of Foxborough for the purification and disposal of sewage, accompanied by a plan and a description of the lands which it is proposed to acquire, which are situated in the town of Foxborough about three-quarters of a mile south of the Foxborough railroad station on the easterly side of the New York, New Haven & Hartford Railroad and south of Leonard Street.

In response to this petition the Board, after having caused an examination of the lands to be made by one of its engineers, gave a public hearing, as required by law, at its office, Room 143, State House, on Thursday, May 1, 1913, at 11.30 A.M., due notice of said hearing having been given by publication in the Foxborough "Reporter." After the hearing, at which no one appeared to oppose the taking of the lands in question by said town, the Board upon consideration voted to approve the purchase or taking of the lands indicated upon the plan submitted for the purification and disposal of sewage, said lands, which are in four parcels having an aggregate area of about 49 acres, being bounded, measured and described as follows: —

The 1st parcel which belongs to the W. T. Cook Heirs is situated on the southerly side of Leonard Street and is bounded and described as follows: —

Beginning at the intersection of the easterly location line of the N. Y. N. H. & H. R.R. with the southerly line of Leonard street thence N 64° — 01′ E on the line last mentioned one hundred and twenty two (122) feet to a point at land of U. W. Boyden; thence S 26° — 09′ E on the westerly line of land of said Boyden four hundred forty seven and five tenths (447.5) feet to a point in the wall at land of Timothy F. Lynch; thence S 49° — 41′ W on the northerly line of land of said Lynch one hundred and seventy five (175) feet to a point on the easterly location line of the N. Y. N. H. & H. R.R.; thence N 20° — 04′ W on said location line four hundred ninety one and forty eight one hundredths (491.48) feet to the point of beginning. This parcel contains one and fifty four one hundredths (1.54) acres.

The 2nd parcel which belongs to Timothy F. Lynch is situated on the southerly side of the parcel above described and is bounded and described as follows: —

Beginning at the intersection of the easterly location line of the N. Y. N. H. & H. R.R. with the southerly line of the parcel above described, thence N 49° — 41′ E on the said southerly line one hundred and seventy five (175) feet to a point in the wall at land of U. W. Boyden; thence S 26° — 09′ E on land of said Lynch two hundred sixty and five tenths (260.5) feet to a point in the wall at land of W. T. Cook Heirs; thence S 29° — 29′ W on the northerly line of land of said Cook Heirs thirty four (34) feet to a point; thence S 36° — 56′ W one hundred ninety five and five tenths (195.5) feet to a point on the easterly location line of the N. Y. N. H. & H. R.R.; thence N 20° — 04′ W on said location line three hundred thirty two and six tenths (332.6) feet to the point of beginning. This parcel contains one and two hundred and sixty three one thousands (1.263) acres.

The 3rd parcel which belongs to the W. T. Cook Heirs is situated on the northerly side of Elm Street and is bounded and described as follows: —

Beginning at the intersection of the northerly line of Elm street with the easterly location line of the N. Y. N. H. & H. R.R. thence N 20° — 04′ W on the said location line thirteen hundred thirteen and nineteen one hundredths (1313.19) feet to a point in the wall on land of Timothy F. Lynch; thence N 36° — 56′ E on the southerly line of land of said Lynch one hundred ninety five and five tenths (195.5) feet to a point; thence N 29° — 39′ E thirty four (34) feet to a point; thence N 25° — 30′ E one hundred seventy two and three tenths (172.3) feet to a point; thence N 50° — 38′ E three hundred seventy and seventy five one hundredths (370.75) feet to stub at land of the Town of Foxborough; thence S 28° — 13′ E on said Town land one hundred six and eight tenths (106.8) feet to a stake and stones; thence S 27° — 06′ E three hundred fifty seven and six tenths (357.6) feet to a point at the end of a wall at land of R. S. Carpenter; thence S 25° — 05′ W on the westerly line of land of said Carpenter four hundred twenty two and eight tenths (422.8) feet to the end of a stone wall; thence S 25° — 21′ E on said wall one hundred and twenty six (126) feet to a point; thence S 23° — 59′ E on said wall one hundred ninety five and seven tenths (195.7) feet; thence S 24° — 07′ E on said wall two hundred eighty and six tenths (280.6) feet to a point in the wall on the northerly line of Elm Street; thence S 55° — 36′ W on said northerly line eight hundred nineteen and forty two one hundredths (819.42) feet to the point of beginning. This parcel contains twenty four and fifty five one hundredths (24.55) acres.

The 4th parcel which belongs to the W. T. Cook Heirs is situated on the southerly line of Elm Street and is bounded and described as follows: —

Beginning at the intersection of the easterly location line of the N. Y. N. H. & H. R.R. with the southerly line of Elm Street thence N 55° — 30′ E on the line last mentioned eight hundred and thirty (830) feet to the intersection of walls at land of Charles G. Wilbur; thence S 80° — 20′ E on the southerly line of land of said Wilbur seventy seven (77) feet to a point in the wall; thence S 29° — 45′ E on said wall one hundred and ninety eight (198) feet to a point; thence S 31° — 00′ E on said wall one hundred and five (105) feet to a point; thence S 29° — 45′ E on said wall sixty two (62) feet to a point; thence S 7° — 30′ E on said wall thirty one (31) feet to a point; thence S 29° — 15′ E on said wall eighty one (81) feet to a point; thence S 21° — 45′ E on said wall fifty six (56) feet to a point at the intersection of two walls at land of E. V. Rosenbusch; thence S 61° — 15′ W on the northerly line of land of said Rosenbusch three hundred and ninety (390) feet to a point at the intersection of two walls; thence S 22° — 39′ E on the westerly line of land of said Rosenbusch three hundred sixty three and sixty five one hundredths (363.65) feet to a point; thence S 0° — 44′ E eighty one and two tenths (81.2) feet to a point; thence S 5° — 34′ E one hundred twenty nine and seven tenths (129.7) feet to a point; thence S 15° — 07′ W thirty six and five tenths (36.5) feet to a point; thence S 12° — 43′ W fifty nine and three tenths (59.3) feet to a point; thence S 9° — 02′ W sixty two and five tenths (62.5) feet to a point; thence S 17° — 18′ W sixty nine and six tenths (69.6) feet to a point; thence S 9° — 19′ W ninety two and eight tenths (92.8) feet to a point; thence S 1° — 47′ W one hundred fifty four and nine tenths (154.9) feet to a point; thence S 7° — 24′ E fifty nine and six tenths (59.6) feet to a point in a wall at land of S. S. Wilbur Heirs; thence S 73° — 16′ W on the northerly line of land of said Wilbur Heirs thirty five (35) feet to a point; thence S 85° — 56′ W fifty three and five tenths (53.5) feet to a point; thence N 89° — 46′ W one hundred ninety five and five tenths (195.5) feet to a point on the easterly location line of the N. Y. N. H. & H. R.R. thence N 20° — 04′ W on said location line thirteen hundred sixty seven and forty nine one hundredths (1367.49) feet to the point of beginning. This parcel contains twenty one and seventy two one hundredths (21.72) acres.

Your petition also requests the advice of the Board relative to the construction of certain sewage disposal works upon the lands described above, but in accordance with your suggestion the Board postponed action upon this part of your application until further details of your plan have been presented.

Franklin.

April 12, 1913.

To the Board of Water and Sewer Commissioners of the Town of Franklin, Mass.

Gentlemen: — The State Board of Health received from you on March 25, 1913, an application under the provisions of chapter 613 of the Acts of the year 1912, for the approval by the Board of plans of a proposed system of sewerage and sewage disposal for the town of Franklin, which in general provide for the collection of the sewage from the westerly or larger portion of the main village and the objectionable portions of the manufacturing wastes, which are now discharged into and seriously pollute Mine Brook, and conveying them to disposal works to be located on the easterly bank of Mine Brook, about one and three-quarters miles northwest of the center of the village, where it is to be purified by intermittent filtration and the effluent discharged into the brook.

In accordance with the provisions of said chapter 613 of the Acts of the year 1912, the State Board of Health gave a hearing on the proposed plans at its office, Room 143, State House, Boston, on April 3, 1913, after notice of the hearing had been given by the Board by publication in the Franklin "Sentinel." At the hearing no person appeared to object to the approval of the plans presented.

After the hearing the Board voted to approve the proposed system of sewerage and sewage disposal as shown upon the five plans submitted with the application and bearing the following titles: —

1. Franklin Sewerage. Plan Showing Location of Sewers. Franklin, Mass. January, 1913. J. J. VanValkenburgh, C.E. Scale — 1 inch = 200 Feet.

2. Franklin Sewerage. Plan Showing Location of Trunk Sewer and Filtration Field. Franklin, Mass. January, 1913. J. J. VanValkenburgh, C.E. Scale — 1 inch = 200 Feet.

3. Franklin Sewerage. Topographical Plan of Filtration Field Showing Location of Proposed Filters and Trunk Sewer. Franklin, Mass. January, 1913. J. J. VanValkenburgh, C.E. Scale — 1 inch = 60 Feet.

4. Franklin Sewerage. Plan of Filtration Areas Showing Systems of Distribution and Underdrainage. Franklin, Mass. January, 1913. J. J. VanValkenburgh, C.E. Scale — 1 inch = 40 Feet.

5. Franklin Sewerage. Plan Showing Details of Reservoir. Franklin, Mass. January, 1913. J. J. VanValkenburgh, C.E. Scale — 1 inch = 4 Feet.

It is proposed to construct the sewers upon the separate plan excluding storm water and ground drainage so far as practicable. It is very important, in the opinion of the Board, that this plan be strictly adhered to in order that the full capacity of the sewers may be available for the removal of sewage and manufacturing wastes, and also to limit the area necessary for the purification of the sewage and wastes, and consequently the cost of constructing and maintaining the works.

The area of filters which it is proposed to construct is likely to be sufficient for the requirements of the town in the beginning, and it appears to be possible to provide additional filtering area north of the filter beds now proposed, either by the construction of trickling filters or additional filter beds. With settling tanks of the capacity proposed it would be advisable in the beginning, and until the sewers have come into general use, to use only half of the tanks at a time and clean them frequently to avoid putrefaction of the sewage and objectionable results therefrom.

The Board has already advised you relative to the disposal of the manufacturing wastes into the proposed sewers in a communication under date of Nov. 22, 1912, and it is important that the suggestions made in that communication be closely followed in the admission of these wastes to the public sewers.

Hull.

Oct. 22, 1913.

To the Board of Selectmen, Hull, Mass., Mr. James Jeffrey, *Clerk.*

Gentlemen: — The State Board of Health has considered your request for advice as to a suitable place of disposal for the sewage of Sagamore and Hampton hills, Hull, and has caused the locality to be examined by one of its engineers.

The district in which it is proposed to construct sewers has an area of approximately 50 acres and is stated to contain at the present time upwards of 230 houses. The population is already quite dense, and, as the soil of the hills is fine and will absorb but little water, the cesspools overflow upon the ground and create very objectionable conditions. It has evidently become impracticable to dispose of the sewage of the higher parts of this district satisfactorily by means of cesspools, and a sewerage system should be provided at the earliest possible time.

Considerable sections of the town are already provided with sewers discharging through as many as six outlets, three of which are in the northerly part of the town and three toward the southerly end. The northerly outlets, one at Windmill Point, another about a third of a mile northeast of Telegraph Hill, and the third about one-quarter of a mile west of Point Allerton, appear to be unobjectionable with the quantity of sewage now discharging there. No serious complaint appears to have arisen from two outlets in the extreme southeasterly part of the town, which discharge directly into the sea, but the sewage of Nantasket, which is discharged into the head of the channel near the steamboat landing, is the probable cause of objectionable odors noted in this locality at times, and it is unlikely that the discharge of sewage can be long continued at this point without creating objectionable conditions.

The outlet suggested for the sewage of Sagamore and Hampton hills is located in the Weir River at a point about 1,900 feet west of the shore at the lowland lying between the hills. At this point the depth of water at low tide — according to the coast survey charts — is about 8 feet, and in the neighborhood of this outlet extensive flats are exposed at times of low tide. An alternative outlet is suggested off Sunset Point, where the water at low tide is about 17 feet in depth, and in the neighborhood of this location, also, there are large areas of flats which are exposed at low tide.

The quantity of sewage to be discharged at the proposed outlet in the beginning will probably not exceed 100,000 gallons per day, but the region is growing rapidly and the quantity of sewage will doubtless increase in the near future. The shores of Sunset Point and World's End are used already for bathing, and are likely to be used to an increasing extent for this purpose in the not distant future, and the waters about the suggested outlets are used considerably for boating. Under the circumstances, it is not desirable, in the opinion of the Board, to discharge the sewage from Sagamore and Hampton hills at either of the outlets suggested.

It appears to the Board very important that before an outlet is selected for the sewage of the areas in question, the whole question of the collection and disposal of the sewage of these portions of Hull and of other sections which seem likely to require sewerage in the near future, including the section from which sewage is now discharged near the steamboat wharf, be thoroughly investigated and a place of disposal selected which is likely to be unobjectionable. So far as now appears, such an outlet can probably be found north of Point Allerton where, if the sewage is discharged into deep water, the danger of creating objectionable conditions will probably be avoided.

When a definite plan for the sewerage of the districts in the town likely to require sewerage at no distant time in the future has been selected, it may be practicable to build portions of the system from time to time and to utilize temporary outlets at some point or points into Hingham Bay, or some of its arms, without creating objectionable conditions.

The Board recommends that the investigations suggested be made at the earliest practicable time, and when the results are available the Board will, upon request, advise you as to the plans in general and as to the disposal of the sewage of Sagamore and Hampton hills or other areas at temporary outlets, if such outlets are found necessary or desirable.

Malden (Boston Rubber Shoe Company).

Aug. 8, 1913.

To the Boston Rubber Shoe Company, Malden, Mass.

Gentlemen: — In response to your request of July 16, 1913, for an examination of the industrial wastes of your factory to determine whether these wastes are of such a quality that they may be discharged into the Malden River or should be disposed of into the sewers, the State Board of Health has caused the locality to be examined and samples of the wastes to be analyzed.

The results of the examination show that the waste water from the boiling, washing and grinding of rubber contains a large quantity of organic matter which should be disposed of into the sewers, as should also the wastes from the carbonizing of old rubber. These wastes, however, contain large quantities of matter in suspension which can easily be removed by sedimentation, and the wastes should not be discharged into the sewer until after they are passed through properly designed settling tanks for the removal of such heavy matters as will settle out on standing. The period of sedimentation required, judging from the recent examination, should be at least two hours. The tanks should be designed by an engineer of experience in the construction of such works, and will require cleaning at sufficiently frequent intervals to maintain them in proper operation. The tanks should be so designed that the settled sludge can be discharged upon strainers of sand, cinders or coke, with proper drains leading to the sewer. After draining, the solid matter should be removed to some unobjectionable place of disposal.

The dye wastes also contain large quantities of organic matter, part of which is in suspension. These wastes if discharged into the Malden River would cause serious discoloration of the water, besides polluting it considerably, and in the opinion of the Board it is advisable that they be disposed of by discharging them into the sewers. These wastes are ordinarily discharged at a high temperature and would be objectionable if admitted to the sewers in that condition, and they should also be passed through tanks for cooling, including the removal of such suspended matters as can be removed by sedimentation.

The wastes from the rinsing after dyeing contain very little organic matter and may be discharged into drains leading direct to the Malden River. These wastes and other waters used for cooling or any other purpose where they are not contaminated should be kept out of the sewers and discharged into the river.

Manchester.

April 3, 1913.

To the Committee on Sewerage of the Town of Manchester, Mass.

Gentlemen: — The State Board of Health received from you on Feb. 26, 1913, an application for advice as to a proposed system of sewerage for the town of Manchester as described in the report and shown upon the plans of your engineer presented therewith.

These plans provide for the collection of the sewage of the more thickly settled portions of the town into a receiving basin, to be located on the northerly side of the Gloucester Branch of the Boston & Maine Railroad, between Church and Beach streets, whence it is proposed to pump the sewage through a cast-iron force main 14 inches in diameter and about 9,500 feet in length to a settling tank of the Imhoff type on House Island, from which the sewage will be discharged into the sea off the southerly end of the island at a point where the depth of water, according to the coast survey charts, is about 42 feet at low water.

You have also asked advice as to the discharge of the sewage directly into the sea in the same general locality without settling tanks on House Island.

The Board has caused the locality to be examined by one of its engineers and has considered the report and plans presented. The quantity of sewage to be disposed of will depend very largely upon the care used in the construction of the sewers and the connections therewith, and it will probably be several years before the amount will reach 300,000 gallons per day. It appears that the question of disposing of the sewage upon land within the limits of the town by any of the methods available for that purpose has been carefully considered, but that no suitable location for this purpose has been found. The plan of disposing of the sewage by discharging it into the sea has also been considered and recommended by your engineer, and in the opinion of the Board this method of disposal is the best that it is practicable to adopt.

The location of the proposed settling tanks on House Island would add considerably to the cost of the work, and there would be likely to be a noticeable odor about such works. It would be best, in the opinion of the Board, in the beginning at least, to omit the construction of these tanks and discharge the sewage directly into the sea as pumped from the reservoir. If the quantity of sewage should increase, or floating matters should ever be noticeable in the neighborhood of the outlet, settling tanks could be provided if necessary, though it is probable that a satisfactory removal of suspended matters could be effected by screening at the pumping station without danger of causing objectionable conditions at any point. In the design of the works at the reservoir and pumping station provision should be made, so far as practicable, for the future screening of the sewage in case further treatment should ever be found desirable. The plans of the works provide for a reservoir having a capacity of not less than 100,000 gallons. It is desirable that the size of the reservoir be as small as practicable in order to avoid decomposition of the sewage therein, and a capacity of less than 100,000 gallons should be adequate for the purpose for several years.

The location of the outlet now proposed in the deep water outside of House Island appears to be a satisfactory one, but it is possible that by eliminating the tanks on House Island the location might be changed somewhat and a saving thereby effected in the cost of the force main. Before locating the outlet definitely, the Board recommends that suitable surveys and soundings be made, together with observations of the movements of the currents, in order that the force main and the point of discharge may be as favorably located as practicable for the economical and satisfactory disposal of the sewage.

Norwood (Dr. Lewis H. Plimpton).

Dec. 4, 1913.

To Dr. Lewis H. Plimpton, *Norwood, Mass.*

Dear Sir: — The State Board of Health has considered your proposed plan for disposing of the sewage of certain houses in Norwood and has caused the locality to be examined by one of its engineers.

It appears that the proposed sewerage system is intended to provide for the disposal of the sewage of about twenty dwelling houses on the westerly side of Washington Street and on either side of Rock Hill Street in the extreme southwesterly portion of Norwood near the Walpole boundary. The ground upon which these dwellings stand is apparently composed largely of ledge, so that it is impracticable to dispose of the sewage satisfactorily by means of cesspools, and a general system of sewerage is evidently essential to the maintenance of proper sanitary conditions in this locality.

The plan presented provides for collecting the sewage in a 4-inch pipe sewer and conveying it to a subsurface filter bed having an area of about .13 of an acre, to be located about 150 feet east of Washington Street and north of Water Street, and about 100 feet from the Neponset River.

Examinations of the soil from test pits in this locality show that much of it is rather fine for the disposal of sewage by subsoil filters, but the underlying surface soil near the westerly extremity of the proposed filter appears to be of better quality for the purpose than any other place. The two cesspools used for the disposal of sewage at the present time are to be continued in use, and it is probable that the quantity of sewage to be disposed of by the proposed filter, in the beginning at least, will not exceed 3,500 gallons per day. Under these conditions it is probable that the proposed filter, which will have an area of .13 of an acre, will be adequate, with proper care in its construction and maintenance, for the purification of the sewage. It is advisable, however, that the filter be quite thoroughly underdrained with drains laid at least three feet below the level of the distribution pipes.

Filters of similar design to that proposed have been operated satisfactorily in many places for the disposal of domestic sewage, but experience shows that the distribution pipes through which the sewage is applied to the filter usually become clogged after a longer or shorter period of use and must then be taken up, cleaned and relaid, in order to secure continued satisfactory operation of the filters.

Rockland (New System Laundry).

July 11, 1913.

To the Rockland New System Laundry, Rockland, Mass.

Gentlemen: — The State Board of Health received from you through your engineers, Messrs. E. B. and C. L. Hayward of Brockton, on June 12, 1913, the following application for advice as to the disposal of wastes from the Rockland New System Laundry: —

We are sending herewith a pencil tracing of the laundry and outlying lands of the Rockland New System Laundry.

They have asked us to prepare plans for the disposal of the waste from their laundry and we would like to have your Engineer examine the premises and make such recommendations to us in the matter as you deem advisable.

We have not given the matter much study as yet and are sending you the information we have in hand in order that no time may be lost as they desire to get their plant in working order at as early a date as possible.

Their present capacity is 312 washings per week using 135 gallons per wash. On Mondays they do 156 washings. They wish to arrange for a capacity of 200 washings for three days or 27,000 gallons per day for three days.

The laundry is located on Bigelow Avenue in the town of Rockland very near Union Street.

The application is accompanied by a sketch of the laundry and existing tank and cesspool, and subsequently a plan was submitted showing the proposed new works for the disposal of these wastes.

It appears that the wastes from the laundry amount to from 18,000 to 20,000 gallons per day for three days in each week, and the plans provide for disposing of the wastes upon a subsurface filter with an area of about .3 of an acre and a depth of about 4.14 feet. The plans provide for the distribution of the waste upon this area from thirty-one lines of 4-inch distribution pipe, with an aggregate length of about 2,950 feet, and for ten lines of 4-inch underdrain laid 12 feet apart, discharging into a small stream probably tributary to Weymouth Back River.

The distribution system, according to the plans, is divided into four sections, and the pipes are to be laid about 6 inches below the surface of the filter. The distance between the invert of the distribution pipes and that of the underdrains averages about 3.3 feet. It is proposed in the operation of the works to discharge the wastes first into a tank of field stone 6 feet by 8 feet in plan and 4 feet in depth, from which they will overflow into a cesspool 12 feet in diameter and 8.5 feet in depth, whence the overflow will be discharged upon the filter beds. It is proposed to remove the sludge intercepted by the settling tank and cesspool in night soil carts.

The Board has caused the locality to be examined by one of its engineers and has considered the plans presented. The land in the rear of the laundry is comparatively flat, and apparently not more than 2½ feet above high-water level in an adjacent pool. The soil as shown by test pits appears to be composed of loam and muck at the surface, underlaid with fine sand containing a small amount of gravel, and very fine sand or clay is found in the easterly portion of the lot. The soil is of poor quality for sewage disposal purposes, but it is understood that it is proposed to construct the filters of coarse material from a gravel pit located not far from the laundry.

By constructing the filter bed of suitable coarse sand or gravel, with an effective depth of 3.5 feet, it will be practicable in the opinion of the Board to dispose of the wastes from this laundry satisfactorily, provided an adequate area is prepared for the purpose and the filter receives the necessary care. In such filters the subsurface distribution pipes gradually become clogged, and it is necessary after a longer or shorter period of use to dig up, clean and relay these pipes. It is best to lay them at a depth of at least one foot below the surface, covering and surrounding the pipes with coarse gravel graded to small sizes in order to keep the sand from entering the pipes. In order to provide for a depth of filter of 3.5 feet and for laying the distribution pipes at a depth of at least one foot, it will probably be necessary to raise the laundry machinery, to pump the wastes or to lower the water in the pool receiving the effluent of the proposed filter. The area which it is proposed to construct is somewhat limited for the purpose, and it is quite likely that the distribution pipes will become clogged and require relaying at more frequent intervals than if a much larger area were provided. It is desirable, in the opinion of the Board, to provide an area of as much as 0.5 of an acre in the beginning, since better results are likely to be secured if the filtration area is of ample size. In case the quantity of waste discharged from the laundry is increased at any future time, the area of the filter beds should be proportionately increased to care properly for the wastes.

It is important to pass the wastes through a settling tank or fine screen before discharging into the distribution pipes, in order to reduce the clogging as much as practicable, and it may be necessary, in order to provide adequate preliminary treatment for the wastes, to pump them to suitable tanks or screen chambers prepared for the purpose.

If the filter beds are properly constructed of suitable material with an effective depth of 3.5 feet it is probable, in the opinion of the Board, that the proposed plans, with the modifications herein suggested, would provide satisfactorily for the disposal of these wastes so long as the filters are maintained in efficient working condition.

Rockland (E. T. Wright Company).

Sept. 4, 1913.

To the E. T. Wright Company, Rockland, Mass.

Gentlemen: — The attention of the State Board of Health having been called to the proposed construction of a filter bed on the northerly side of Webster Street and east of Liberty Street for the purification of sewage from your factory, the Board has caused the locality to be examined with reference to the possibility that the proposed new works might create objectionable conditions in the neighborhood.

Subsequently, through your engineer, Mr. E. Worthington, the advice of the Board was requested as to a proposed plan for disposing of this sewage, the construction of works having already been begun.

It appears that the quantity of sewage discharged from the factory — judging from the water consumption — is slightly less than 5,000 gallons per day and that this sewage at present discharges into three cesspools in the neighborhood of the factory south of Webster Street, through which an overflow pipe leads to a large cesspool on the easterly side of a brook north of Webster Street. The soil in which this cesspool is located appears to be rather fine, and the sewage rises to the surface in an open pool west of the cesspool, which has been the cause of complaint.

According to the plan presented, it is proposed to construct two filter beds near this cesspool having an aggregate area of about .15 of an acre. The filter beds are apparently to be constructed with one foot of stone on the bottom covered with a stratum of sand and gravel 2 feet in thickness, the sand and gravel to be obtained from a sand bank in the region. It does not appear that it is proposed to provide underdrainage for these filters other than the coarse stone forming the substratum.

Considering the elevation of the surface of the filters as compared with the level of the brook, there is likely to be difficulty in operating these filters satisfactorily unless their surfaces can be raised or the level of the brook lowered. In any case, in the opinion of the Board, in order to purify this sewage adequately it is advisable to construct filters having a depth of at least 4 feet of sand thoroughly underdrained and having an area equal to that indicated in your plans. Open filter beds in this region will be likely, unless they receive much more than usual care, to give off objectionable odors at times, which may be noticeable at a considerable distance from the filters. It would be best, in the opinion of the Board, to apply the sewage to the filters in pipes laid about one foot beneath the surface of the filter and so constructed that the sewage can pass into the sand from properly protected open joints in these pipes. Subsurface filters of this sort have been used successfully for the disposal of sewage in similar quantities at several places, but with such filters the distribution pipes become clogged after a longer or shorter period of use, depending upon the rate of operation of the filters, and must be taken up, cleaned and relaid in order to maintain the filters in proper operation.

The Board recommends the construction of a filter of this kind for the disposal of the sewage of the factory until such time as the town shall provide an adequate sewerage system capable of preventing further contamination of local waters and other objectionable conditions.

SEPT. 4, 1913.

To the Board of Health, Rockland, Mass.

GENTLEMEN: — Enclosed herewith is a copy of the advice of the State Board of Health to the E. T. Wright Company relative to the disposal of sewage from their factory in Rockland.

The Board again calls attention to the great need of a system of sewers for the maintenance of proper sanitary conditions in the thickly settled portions of the town of Rockland.

RUSSELL.

JUNE 9, 1913.

To Mr. E. D. PARKS, *Chairman, Board of Selectmen, Russell, Mass.*

DEAR SIR: — The State Board of Health has considered your application for its advice as to the discharge of the sewage of the village into Bradley Brook and has caused the locality to be examined by one of its engineers.

The results of the examination show that it is proposed to discharge the sewage from the main portion of the village into the northerly channel of Bradley Brook, at a point where it will be crossed by a proposed new highway about 1,200 feet from the mouth of the brook.

Assuming that the flow of Bradley Brook is well maintained in the summer season, the total quantity flowing in both channels would hardly be sufficient for the proper dilution of the sewage of Russell in the drier part of the year, and if the sewage from the streets indicated were to be discharged into the northerly channel of the brook there is little doubt that a serious nuisance would soon be created. There would probably also be serious objection to discharging the sewage into the main brook, unless at some point below the suspension bridge.

The best point for disposing of the sewage would be to discharge it into Westfield River at the mouth of the brook. It may be possible, also, to extend the sewer through Main Street and discharge the sewage directly into the river beneath or near the highway bridge. At either location it is probable that the sewage could be disposed of satisfactorily for several years without objection.

It is probable that at some future time it will be necessary to purify the sewage of the village before discharging it into the river, and it is advisable that the storm water be kept out of the sewers or, if admitted, that the connections be so made that the storm water can readily be diverted if necessary.

South Hadley.

March 6, 1913.

To the Board of Sewer Commissioners, South Hadley, Mass.

Gentlemen: — The State Board of Health received from you, through your engineers, on Jan. 28, 1913, an application for advice as to a proposed system of sewers for South Hadley Center and Woodlawn, accompanied by plans of the proposed sewers and outlet and a report describing the proposed works.

The plans provide for collecting the sewage from these villages and the sewage from Mount Holyoke College, which now pollutes Stony Brook, into a system of pipe sewers connected with branch mains in College Street running toward the valley of Stony Brook, where they connect with the main sewer which it is proposed to lay in the valley of Stony Brook to convey the sewage to an outlet into the Connecticut River opposite the mouth of the brook. The plans also provide for sewers in the valleys of two small tributaries of Stony Brook which will connect with the main sewer at the outlets of these tributaries below College Street. The sewers are to be constructed upon the separate plan and all storm water excluded. It is understood that no definite plans have yet been made for underdrainage of the sewers but that underdrains will be laid when the works are constructed if found necessary.

The Board has caused the locality to be examined by one of its engineers and has considered the plans and information presented. The plans in general appear to provide adequately for the collection of all of the sewage from the present thickly settled portions of South Hadley Center and Woodlawn and for conveying it to the Connecticut River by gravity. The main sewer is of sufficient capacity to serve a considerably larger population than is now found in the district which this sewer is capable of serving by gravity, provided all storm water and ground drainage, so far as practicable, are excluded from the sewers.

The plan of the proposed outlet provides for conveying the sewage through a 16-inch cast-iron pipe to an outlet in the river about 200 feet from the northerly side of the bridge across Stony Brook at its mouth and about 100 feet from the general shore line of the river at a point where the water is several feet in depth at the ordinary low-water stage of the river.

Owing to the topographical conditions in the valley of Stony Brook, through which the proposed main sewer is to be laid, numerous changes in the direction of the sewer appear to be necessary, and these changes in direction have been made at manholes to provide for inspection and cleaning. The line appears to be a practicable one, although it is possible that in the final construction it can be straightened and improved. Numerous manholes along this line will be submerged at times of high water in the Connecticut River, and there will doubtless be times under these conditions when sewage will escape from the manholes. It is unlikely, however, that any sewage will flow out of the manholes at points in the neighborhood of the village, and such overflows along the main sewer are not likely to be objectionable. It is possible that at some future time it will be advisable to avoid danger of the escape of sewage from the manholes, and in that case it would be necessary to raise these manholes above the level of the hydraulic gradient. Such extension does not appear to be necessary at the present time.

The disposal of the sewage by discharging it directly into the Connecticut River appears to be the best that it is practicable to adopt under the existing conditions. The discharge of sewage into the river can probably be allowed to continue for many years, but the adoption of this outlet is subject to the condition that the sewage shall be removed from the river and purified whenever purification shall become necessary.

In the opinion of the Board the plan in general is a suitable one for the sewerage of South Hadley Center and Woodlawn and the method of disposal the best that it is practicable to adopt at the present time.

July 11, 1913.

To the Board of Sewer Commissioners, South Hadley, Mass.

Gentlemen: — The State Board of Health received from you on June 18, 1913, the following application for advice as to the discharge of sewage from the Woodlawn District in South Hadley into Stony Brook: —

Our board of sewer commissioners of the town of South Hadley wish to make of you a formal application for permission to discharge the sewerage for that section of the town known as the Woodlawn District into Stony Brook. This is shown on the map which you have on file at your office.

In making this application we wish it distinctly understood that it is done for the sake of affording temporary relief for the district mentioned.

It is the present intention of the board as outlined to your Mr. Whittet to continue this trunk sewer as fast as the financial condition of the town will warrant to its outlet at the Connecticut River. We have no intention whatever of letting this remain as a permanent discharge in the brook but the financial condition of our town is such that we believe this a wise course to be followed out at the present time.

The Woodlawn District is situated mostly on high, flat land adjacent to College Street and contains apparently at the present time about twenty dwelling houses and an estimated population of a little less than 100 persons. The proposed outlet for the sewage from this district into Stony Brook is to be located below College Street bridge, about two miles above the point where the brook enters the Connecticut River.

The Board has caused the locality to be examined by one of its engineers and has considered the plan presented. There is no doubt that a system of sewerage is greatly needed in the village of Woodlawn, where the soil is not adapted to the satisfactory disposal of domestic sewage by means of cesspools, and it is very important to provide an adequate method of sewage disposal in this locality at the earliest practicable time.

The quantity of sewage that would be discharged into Stony Brook from this village is small, even compared with the flow of Stony Brook, but Stony Brook evidently receives considerable pollution from other sources in the village, and the discharge of any considerable amount of crude sewage directly into the stream would be likely, in the opinion of the Board, to be objectionable.

While the difficulty and expense of providing a proper means of disposal for the sewage of the village are considerable, on account of the topographical conditions and the length of sewer required to reach the Connecticut River, there appears to the Board no better or less expensive plan of disposing of the sewage of the thickly settled areas in the valley of Stony Brook and preventing the objectionable pollution of the stream than by conveying it to an outlet into the Connecticut River.

Under the circumstances the Board is unable to advise the discharge of sewage into Stony Brook, as proposed, except that the small amount of sewage that would be contributed by the twenty houses or thereabouts in Woodlawn may be discharged temporarily into the brook below the junction with the second tributary about 3,000 feet below College Street. It is important, in the opinion of the Board, that the discharge of sewage into the brook be discontinued, and all the sewage of the village should be conveyed to the Connecticut River at the earliest practicable time.

Springfield (House of the Good Shepherd).

Sept. 4, 1913.

To the Mother Superior, House of the Good Shepherd, Springfield, Mass.

Dear Madam: — In response to your request, made through the State Inspector of Health, the State Board of Health has caused an examination to be made of the House of the Good Shepherd in Springfield with a view to suggesting a plan of sewage disposal for this institution which will obviate the objections to the present method.

The results of the examination indicate that the quantity of sewage may be about 18,500 gallons per day, and it also appears that there is no sewer of the city of Springfield in the neighborhood of the institution into which the sewage can be discharged by gravity.

Under the circumstances, there appear to be two practicable plans for a satisfactory improvement in the method of sewage disposal at this institution; one, by the construction of a sewer between 1,100 and 1,200 feet in length in a northwest direction to the city sewer in Benton Avenue and pumping the sewage to that sewer. Pumping could probably be done automatically, if electric power is used, with a comparatively little outlay for the care and operation of the works, but in the construction of the sewer it would probably be essential to obtain a right of way over private land, and the practicability of employing this method of disposal would depend upon the ability to secure the right to cross intervening land not belonging to the institution. The other method of effecting a satisfactory disposal of the sewage would be to construct filtration works south, east or northeast of the institution and to purify the sewage by filtration until such time as a city sewer is available for its disposal.

There appear to be adequate areas for the treatment of sewage upon lands of the institution in such a way as will produce a satisfactory effluent which can be turned into the neighboring stream without objection and at the same time not create a nuisance in the neighborhood.

As to which of these plans would be the more economical it is impracticable for the Board to advise you with its present information. The Board recommends that you have the matter investigated by an engineer of experience in such matters and estimates of the cost of disposing of the sewage by each plan prepared. When the results of these investigations are available the Board will, if you so request, give you further advice as to the disposal of the sewage from this institution.

WALPOLE (LEWIS MANUFACTURING COMPANY).

MAY 24, 1913.

To the Lewis Manufacturing Company, Walpole, Mass.

GENTLEMEN: — The State Board of Health has considered your application of April 21, 1913, and the plan submitted therewith, for advice as to the disposal of wastes from your factory in Walpole, assuming that the capacity of the works will be increased 25 per cent. and eventually to about double its present capacity, and has caused the locality to be examined by one of its engineers.

Measurements of the wastes discharged from your works at the present time indicate that the total quantity amounts to about 100,000 gallons per day, and analyses show that the wastes from the first boil or keir discharge, from the first wash after boiling and from the absorbent boil, so called, — amounting to about 16,000 gallons per day, — contain large quantities of organic matter which require purification before being discharged into the river. The wastes from the other processes did not contain at the time of this examination so great a quantity of organic matter as to require treatment before being discharged into the river.

Under present conditions the wastes requiring treatment and those requiring no treatment are both discharged into the river through the same pipe, and there are indications that at times some of the wastes other than those requiring purification are discharged into the settling tanks and thence upon the filter beds, while at other times some of the wastes requiring purification are discharged untreated into the river.

The settling tanks used at the present time have a capacity of about 7,500 gallons. They are divided into two compartments and are probably large enough, if properly operated, to provide adequate sedimentation for a quantity of waste not exceeding 16,000 gallons per day. So far as the Board is informed, these tanks are not operated in such a way as to secure satisfactory sedimentation of the wastes; in fact, it appears that the tanks are cleaned out at very rare intervals, and necessarily, under the circumstances, except for a few days after cleaning, they are of little value in their effect upon the purification of the wastes. Moreover, considerable floating matter which might be arrested in the tanks evidently goes over to the filter beds through lack of proper scum boards.

It is probable that a large part of the suspended matter in these wastes could be removed by properly operated settling tanks. The tanks should be cleaned out at as frequent intervals as is necessary to secure the best results from sedimentation, and it is probable that they should be emptied at least as often as once in ten days. By providing proper scum boards a large part of the suspended matter which floats to the surface can be prevented from escaping from the tanks. It is possible also that, by the use of chemicals, precipitation of a considerable additional portion of the organic matter could be effected in these settling tanks and the rate at which the filter beds could be operated would be increased.

The filter beds now in use have an area of about 8,800 square feet, which is less than was recommended by the Board in its communication of Dec. 3, 1908, for the treatment of these wastes. It is probable that with proper care of the settling tanks an area of 12,000 square feet of filters would provide adequately for the purification of the wastes at present discharged from the factory. In order to provide for double this quantity of waste, which it would be necessary to treat in case the factory were enlarged to the maximum extent indicated in your application, it would be necessary to provide an area of at least 24,000 square feet of filters, assuming that the process will not be materially changed from the process in use at the present time.

The present filters have not been cleaned as often as desirable, and in addition to being somewhat unsightly in consequence of lack of sufficient care it is probable that they have caused some odor in the neighborhood. There is little doubt, however, that with proper care of the filters danger of objectionable odors in the neighborhood would be very largely avoided.

Of the lands suggested for the purification of these wastes, the lots near the corner of West and Station streets and those along the easterly side of Station Street are nearer the village than it is desirable to use for this purpose. The land southwest of Elm Street north of the river and the areas north of the New York, New Haven & Hartford Railroad would be satisfactory for the purpose, provided suitable material were obtained and the filters properly constructed thereon.

In the opinion of the Board, if you can secure a sufficient area of land within a reasonable distance of your factory of such extent that it would be practicable for you to construct thereon filters having an aggregate area of at least 24,000 square feet, it will be practicable for you — if the capacity of the works is not more in the future than described — to purify the foul portions of your manufacturing wastes sufficiently so as to prevent causing objectionable conditions in the river. Such filter beds are somewhat unsightly and, though they need not be seriously objectionable on account of odor if properly cared for, it is nevertheless advisable that they be located at some point as far as practicable from the densely populated part of the village. If located near a highway or not far from other buildings it is best to screen them from view by planting trees and shrubs about them. In constructing additional filter beds it is advisable to so locate the outlets of underdrains that samples of the effluent can be obtained from time to time so as to determine its quality and the efficiency of the purification effected by the filters.

It is also important that settling tanks of suitable design and capacity be provided to secure the best results from sedimentation, and finally it is very important that the settling tanks, both those now in use and any hereafter constructed, shall be emptied at frequent intervals and that the surfaces of the filter beds shall be cleaned as often as is necessary to keep them in most efficient working order.

The sludge from the settling tanks can probably be dried upon sludge beds before final disposal, provided the sludge beds are so located that they will not be objectionable. Otherwise, the sludge should be removed to some suitable place of disposal in proper carts.

Waltham (Pond End School).

Sept. 24, 1913.

To the Board of Health, Waltham, Mass., Mr. A. L. Moody, *Agent.*

Gentlemen: — The State Board of Health has considered your request for advice as to the disposal of sewage from the Pond End School, so called, and the plans submitted subsequently by the city engineer.

It appears that the school is intended to accommodate 40 pupils in the primary grades, and it is estimated that the total quantity of water that would be used for the school and the probable quantity of sewage would be about 500 gallons per day. The plans provide for collecting the sewage in a settling tank and discharging it upon an artificial filter bed composed of suitable sand and gravel having an area of 750 square feet and a total depth of about 5½ feet. It is proposed to apply the sewage to the filter through subsurface drains of open-jointed pipe laid about 18 inches below the surface of the filter. The purified effluent will flow into an adjacent water course.

The Board has caused the locality to be examined by one of its engineers and has considered the plans and information presented and concludes that the best method of disposing of the sewage of this school will be to discharge it ultimately into the sewerage system of the city of Waltham since, according to the information available to the Board, the length of sewer required would be about 3,500 feet and the cost probably not more than $5,000, exclusive of land damages.

Until a sewer has been provided to remove the sewage of the school to an outlet into the Waltham system, the plan presented appears to be the best that it is practicable to adopt. With a system of subsurface filtration such as is here proposed the distributing pipes through which the sewage is delivered to the filter usually become clogged after a longer or shorter period of use, and it is necessary to dig up, clean and relay these pipes from time to time in order to maintain the filters in successful operation. It is very important, if the filters shall be constructed for the temporary disposal of the sewage from this school, that the area prepared shall be at least as large as proposed and that the work shall be carefully carried out under the supervision of your engineer.

Ware.

Jan. 6, 1913.

To the Board of Health of the Town of Ware.

Gentlemen: — The State Board of Health received from you on Dec. 28, 1912, a report upon the Cheever Swamp nuisance in Ware, prepared by your engineer, Mr. James L. Tighe, together with a plan for relieving the nuisance.

The plan provides for a sewer to be extended from the present town sewer in West Street northerly toward West Main Street and then toward the west in the rear of the houses on that street, into which all of the sewage from the various houses in the neighborhood of the swamp can be discharged by gravity. The plan also provides for lowering the present 12-inch drain pipe and extending it to a point near the southerly end of the swamp, and it is suggested that more thorough drainage can be provided by extending this drain to a point near the northerly end of the swamp and laying lateral drains to provide thorough drainage for all parts of the area.

The Board has examined the plan presented and is of the opinion that this plan, if properly carried out, will provide adequately for relieving the nuisance now caused by the inefficient drainage of this swamp, provided the further recommendation for the removal of objectionable organic matter now deposited there and the prevention of further accumulations of foul matter is strictly enforced. The sewer and drain, if properly laid, are adequate for the purposes for which they are designed, and it is advisable that the further suggestion of the engineer be carried out as to extending the drain and providing laterals for the more thorough drainage of the area. It will probably be found desirable, in addition, to raise the level of the area by filling; and, if so, this improvement can be made later if deemed necessary.

Westfield.

June 9, 1913.

To Mr. John L. Hyde, *Town Engineer, Westfield, Mass.*

Dear Sir: — The State Board of Health received from you on May 3, 1913, the following application for advice relative to a proposed sewer in Curtis and Atwater streets in the town of Westfield: —

> . . . At a recent town meeting it was voted to build a sewer for house drainage on Curtis street, which is on the north side of the river and runs west from Atwater street a distance of three hundred feet.
>
> The contour of the ground is such that it cannot be drained into Parker Ave., and the elevation of the present sewer on Pochassic will not allow it to drain that way.
>
> It is therefore proposed to connect it with the storm-water sewer on Atwater street. There are at present six houses on Curtis St. . . .

The proposed sewer is located north of the Westfield River near the westerly limits of the thickly settled portion of the town. The plan submitted with the application provides for constructing a sewer in Curtis Street to Atwater Street, and thence through Atwater Street to an outlet in the Westfield River opposite the foot of that street. The sewer is to be built on the combined plan to receive both sewage and storm water and will have a diameter of 8 inches in Curtis Street and 10 inches in Atwater Street.

The Board has caused the locality to be examined by one of its engineers and has considered the plan presented. While there are very few houses in this portion of the town as yet, sewers appear to be necessary to remove the sewage from the neighborhood of the dwelling houses, and drainage is also desirable for the relief of this district.

It is of the greatest importance in the opinion of the Board that the sewage and the storm water should be kept wholly separate in the town of Westfield, because with continued growth it will be necessary for the town at no distant time to provide for the purification of its sewage before it is discharged into the Westfield River or its tributaries. In the case of the proposed sewer on Curtis and Atwater streets it will be difficult and expensive to provide for discharging the sewage at the present time into any of the existing sewers of the town, and under the circumstances it is permissible, in the opinion of the Board, to dispose of the sewage from Curtis Street by discharging it temporarily into the river at the foot of Atwater Street. Provision should be made in the beginning for the separation, so far as practicable, of the sewage from the storm water in this district, and roof waters should be kept wholly separate from the sewage and discharged into the sewer or drain through separate pipes.

It is also important that the sewer be extended into the river to a point at least 40 feet beyond high-water mark and at such an elevation that the outlet will be entirely submerged at times of low water in the stream.

Subject to these conditions, the Board is of the opinion that the proposed plans may reasonably be adopted for the sewerage of the district in question to meet the present emergency.

WEYMOUTH (LAUNDRY IN SOUTH WEYMOUTH).

To Mr. W. H. DYER, *South Weymouth, Mass.* SEPT. 4, 1913.

DEAR SIR: — In response to a complaint of an objectionable odor in the vicinity of your laundry at South Weymouth, the State Board of Health has caused the locality to be examined by one of its engineers and finds that the works constructed for the disposal of the wastes therefrom do not appear to be operated satisfactorily at the present time.

An examination of the filters upon which the wastes are disposed indicates that the underdrainage is not satisfactory and also that the character of the material is not as favorable for the disposal of the wastes as was indicated from the limited number of test pits which were dug to show the character of the material at the time the works were proposed. There are also indications that the quantity of wastes from this laundry is greater than at the time the plans of the works were prepared.

The Board recommends that the filters be thoroughly underdrained with drains laid with their bottoms at a depth of as much as 5 feet below the surface of the filters and that these underdrains be given a free outlet into the brook. If it is found impracticable to lay drains at this level, the elevation of the filters should be raised even if it should be necessary to pump the wastes. The soil of the filter beds should also be examined and the portions found to be unsatisfactory for purification purposes should be removed and suitable sand or gravel substituted therefor. The Board further recommends that the work of improvement of these works should be done under the supervision of an engineer of experience in matters relating to the disposal of sewage.

Sewerage facilities appear to be greatly needed in this portion of Weymouth, in common with other thickly settled areas in the town, and the most satisfactory plan of disposing of these wastes will be in connection with a general system of sewerage in the village. Until such a system is available, however, there appears to be no more practicable plan than filtration for disposing of these wastes without creating objectionable conditions in the neighborhood or polluting the adjacent stream.

Sept. 4, 1913.

To the Board of Health, Weymouth, Mass.

Gentlemen: — In response to a complaint of objectionable odors in the neighborhood of a laundry in South Weymouth, and a request for advice as to the disposal of the wastes therefrom, the State Board of Health has advised as to a plan for treating these wastes, and a copy of this advice is enclosed herewith for your information.

It will be very difficult, in the opinion of the Board, to maintain satisfactory sanitary conditions in this thickly settled district unless a system of sewerage is provided for the removal of sewage and objectionable wastes. The Board recommends that the question of sewerage for the thickly settled portions of Weymouth be taken up by the town at its earliest opportunity and plans for the necessary works prepared. It will then be practicable to construct portions of the system from time to time as they become necessary. The Board is prepared to advise as to any plan of sewerage and sewage disposal that the town may desire to present.

Wilmington (C. S. Harriman & Co.).

Sept. 4, 1913.

To Messrs. C. S. Harriman & Co., *North Wilmington, Mass.*

Gentlemen: — The State Board of Health received from you on Aug. 21, 1913, through your engineers, Messrs. Metcalf & Eddy of Boston, plans for the purification of the wastes from your tannery in Wilmington, accompanied by a report describing the proposed works.

Estimates of the quantity of the wastes discharged from the tannery indicate that they amount to from 75,000 to 100,000 gallons per day at the present time, and an analysis indicates that they may contain somewhat less organic matter than wastes discharged from similar works elsewhere.

The plans submitted provide for collecting these wastes into two sedimentation tanks, each having a capacity of about 15,000 gallons, from which they will flow to a dosing tank having a capacity of 20,000 gallons, whence they will be pumped to sand filters having an area of about two acres, to be located on the westerly side of the Boston & Maine Railroad, southeast of the tannery. Sludge drying beds having an approximate area of .18 of an acre are shown upon the plans.

Examinations of the location of the proposed filter beds indicate that much sand can probably be found there which will be suitable for purifying the wastes, and it is proposed to provide additional filtering material from a gravel bank in the neighborhood.

The Board has caused the locality to be examined by one of its engineers and has considered the plans presented and is of the opinion that, if carried out as proposed, they will provide adequately for the purification of the wastes from this tannery while the quantity is no greater than it is estimated to be at the present time.

The wastes from this tannery appear to contain somewhat less organic matter than those from similar tanneries elsewhere, but the samples examined did not include the waste liquor from the lime vats. It appears that these tanks are emptied at infrequent intervals, and it is probable that a special sludge drying bed might be used to advantage for the disposal of this waste at such times, thus keeping it separate from the other wastes.

The elevation of the filter beds above the brook into which the effluent will be discharged is not shown upon the plans. It is desirable that the filters be elevated sufficiently above the level of this brook to make it practicable to provide for the further treatment of the wastes in case such treatment should be found desirable in the future.

The Board further recommends that when completed the works be placed under the care of a competent person trained in the operation of such works, under the supervision of your engineers.

Winchendon.

May 21, 1913.

To the Sewer Commissioners, Winchendon, Mass.

Gentlemen: — The State Board of Health has considered your petition for the approval of a system of sewerage in the town of Winchendon, with a temporary outlet into Millers River, the scheme being outlined in your petition as follows: —

> We, the undersigned, Sewer Commissioners of the Town of Winchendon, hereby respectfully petition for your approval for so much of the system of sewerage as is shown in red, on a plan submitted herewith, the outlet to be into Millers River at the point indicated for a temporary outlet; with the approval of the Board of additions of streets connecting with the streets marked in red, where sewers seem to be most needed, should the Commissioners find that the amount of the appropriation which will be in their hands, viz., $100,000.00, will allow of such extensions.

The application is accompanied by a plan showing the streets in which it is proposed to construct sewers in the beginning, also the line of the main sewer, the location of the filtration area, and the location of a proposed temporary outlet for the sewage into Millers River about 700 feet below the lowest dam in town.

The plan is similar in most respects to the plan presented for the consideration of the Board in 1906 and provides for the ultimate disposal of the sewage upon land on the east side of Millers River, about two miles west of the main portion of the town, in a sparsely settled region where the conditions are favorable for the satisfactory purification of the sewage. The plans provide for constructing the main sewer down the valley of Millers River from the center of the town to a point within a quarter of a mile of the proposed filtration area, whence the sewage will be diverted into Millers River through a temporary pipe line about 1,200 feet in length.

The Board has caused the locality to be examined by its engineer and has considered your application and the plan presented therewith. Millers River at the point at which it is proposed to discharge the sewage drains an area of about 56 square miles, and the flow of the river, judging from the information available to the Board, falls to a very small quantity in the summer season in dry years. The river already receives considerable pollution from the factories and mills along its course above the proposed temporary sewer outlet, and the discharge of a quantity of sewage such as would be collected by the proposed sewer system would be likely to create a nuisance in the river.

At a point opposite the proposed filtration area the river is joined by a large stream from the north, and its drainage area at the highway crossing just below this area is 50 per cent. greater than at the temporary outlet proposed on the plan submitted. It is probable that a limited amount of sewage could be discharged temporarily into the river below the highway bridge without causing seriously objectionable conditions, provided the sewage were first treated in settling tanks for the removal of suspended matters which would create objectionable conditions in the stream.

The proposed filtration area contains soil well suited to the purification of sewage by intermittent filtration. The land is quite level and filter beds can be constructed upon it at a reasonable cost. An ample area appears to be available for the purification of all of the sewage of the town until the population becomes considerably greater than at the present time, and there are other areas on the opposite side of the river which can be used in case of need.

The general system of collecting the sewage of the town in a system of pipe sewers, from which storm water and ground drainage are excluded so far as practicable, and disposing of it by intermittent filtration upon filter beds to be located on the area indicated in the northwestern part of the town appears to the Board the best practicable method of providing for the collection and disposal of the sewage of the town.

The Board does not approve the proposed temporary outlet shown upon the plan submitted, but recommends that the main sewer be extended to the proposed filtration area in the beginning and that the necessary settling tanks, screens and sludge beds for the removal, so far as practicable, of the suspended matter in the sewage be constructed in the beginning. In the opinion of the Board it will be permissible during the construction of the works to discharge the sewage into Millers River through a temporary outlet to be located not more than 600 feet above the bridge on the Royalston Road, this outlet to be used for the disposal of the sewage only during the construction of the proposed works, the discharge of the sewage into the river to be discontinued in any case on July 1, 1918, unless earlier required by the Board, after which the sewage is to be purified upon the area shown upon the plan submitted with your application.

The Board recommends that the detailed plans for the settling tanks, filter beds and temporary outlet for the sewage be submitted for its consideration before the construction of the works is begun.

Miscellaneous.

The following is the substance of the action of the Board during the year in reply to applications for advice relative to the pollution of streams and miscellaneous matters: —

Agawam.

Oct. 1, 1913.

To the Board of Health, Agawam, Mass.

Gentlemen: — Complaint has recently been made of the pollution of the water of Three Mile Brook near Riverside Park in Agawam, and an examination shows that the stream still receives pollution by wastes from the works of the Agawam Company, though the cause of the recent complaint relates to conditions near the mouth of the brook below the point where the stream receives the discharge from a distillery. The wastes from this works are of a character to cause very serious pollution of a stream no larger than Three Mile Brook at times in the summer season when the water is low, and in order to prevent the nuisance it will be necessary either to purify these wastes or divert them from the stream. It would be very difficult and expensive to treat these wastes in such a way that they might be discharged into the brook without causing objectionable conditions, and unless the entire quantity can be otherwise disposed of the best practicable plan will probably be to discharge them through a sewer having an outlet into the Connecticut River.

The condition of the upper portions of Three Mile Brook below the works of the Agawam Company appears also to be objectionable, and no work appears to have been done in carrying out the recommendations of this Board of Oct. 3, 1912.

The Board recommends that the proprietors of these establishments be required to take such steps for the treatment of their wastes before their discharge into the brook as will prevent a nuisance resulting therefrom, or that provision be made for the removal of these wastes to a suitable outlet or outlets in the Connecticut River.

Dec. 5, 1913.

To the Board of Health, Agawam, Mass.

Gentlemen: — In response to your request, received through Dr. J. V. W. Boyd, State Inspector of Health of that district, the State Board of Health has caused an examination to be made of the sanitary conditions in the thickly settled district in the extreme northerly part of Agawam near the Westfield River and has caused samples of water from a spring and well in this district, from which water is taken for drinking, to be analyzed.

It appears that no system of public water supply has yet been provided in this densely populated area, and the examination shows that the conditions now existing in this district are unfavorable to health. The most important source of water supply for drinking is apparently Lynch's Spring, so called, located a little over 100 feet north of Church Street upon ground sloping toward the river. There are a number of dwelling houses on the slopes above the spring, and an analysis of the water shows that it is considerably polluted, though at the time of this examination it was probably not unsafe for drinking.

Another source of supply which was examined is the well of John Dalio, located in the basement of his dwelling house. An analysis of the water of this well shows that it is badly polluted and unsafe for drinking.

While the condition of this village is extremely unsanitary, there is no doubt that a very great improvement could be effected at once in the protection of the public health by the introduction of a public water supply, and the Board recommends that the water pipes of the town be extended to the district at the earliest possible time and the further use of objectionable wells and springs prevented. When a public water supply has been provided, such further improvements can be made as shall then be found necessary or desirable.

Everett (New England Gas and Coke Company).

April 12, 1913.

To Mr. Dudley P. Bailey, *Everett, Mass.*

Dear Sir: — In accordance with your request of Feb. 7, 1913, the State Board of Health has investigated the escape of odors from the works of the New England Gas and Coke Company and has sent a communication to the company relative to this matter, a copy of which is enclosed herewith.

In case relief from the objectionable conditions complained of is not experienced within a reasonable time, the Board should be notified of the fact.

April 12, 1913.

To the New England Gas and Coke Works, 111 Devonshire Street, Boston, Mass.

Gentlemen: — Complaints having been made to this office that during the past winter residents of portions of the city of Everett have been annoyed by objectionable odors from the New England Gas and Coke Works, the State Board of Health has caused observations to be made by its agents to determine the cause of complaint.

The results of this examination show that on numerous occasions in February and March odors, which were undoubtedly derived from your works, were observed within distances extending from half a mile to a mile and a half from the works. The investigations further show that there has been a practical absence of odors from the works for several years until the middle of the past winter, indicating that some change in the method of operation or the materials used at the works, or lack of the usual care in carrying out the various processes, causes the escape of odors therefrom.

The experience of the past few years shows that the works can be so operated as to prevent annoyance to the inhabitants of Everett by odors from these works, and the Board recommends that you make an investigation as to the cause of the escape of objectionable odors in the past two months and take such steps as may be necessary to restore the former efficiency of the works in respect to the prevention of odors.

Hampshire County (County Commissioners).

June 5, 1913.

To the County Commissioners of Hampshire County.

Gentlemen: — In response to your request, received through Dr. John S. Hitchcock, State Inspector of Health, for advice as to certain sites suggested for the location of the proposed tuberculosis hospital for

Hampshire County, the State Board of Health has caused the sites indicated to be examined by its engineer and has considered the information presented concerning them. Of the eight sites proposed, three are within the limits of the city of Northampton and five are in the town of Williamsburg.

The first site examined is on what is locally known as Baker's Hill, situated about midway between the villages of Bay State and Florence. According to the State map this hill has an elevation of 320 feet above sea level and about 120 feet above the level of Mill River, which passes near the foot of the hill. A hospital on this site could easily be supplied with water from the water works of the city of Northampton, and the sewage could be disposed of without difficulty into the Northampton city sewers, but a serious objection to the use of this location is the nearness of numerous dwelling houses on the easterly and southerly slopes of the hill, and under the circumstances the Board does not recommend its adoption.

Site No. 2, known as the Seth Warner place, is located on the slope of a hill 420 feet high, situated about midway between the villages of Florence and Leeds. The summit of this hill and its westerly slope are for the most part covered with trees, while the southeasterly slope would form an excellent site for a hospital at an elevation of between 300 and 350 feet above sea level. An institution at this place could easily be supplied with water from the water works of the city of Northampton, and the sewage could be disposed of into the Northampton city sewers. The location, while close to both electric and steam transportation facilities, is nevertheless well removed from any dwelling houses and is, in the opinion of the Board, an appropriate location for the proposed hospital.

Site No. 3 is located on the southwesterly slope of Main's Hill, about three-quarters of a mile northeast of the village of Leeds. A supply of water for an institution at this location could be secured without difficulty from the Mountain Street main of the Northampton water works, which passes at the foot of the slope. The sewage would have to be disposed of by means of purification works constructed on the property, and the construction of such works would be expensive inasmuch as there does not appear to be any material of suitable quality for sewage purification upon the lands in question. The site is somewhat removed from transportation facilities and its exposure is not a very desirable one for such an institution.

Site No. 4, on the northwesterly side of Walpole's Hill, so called, appears to be the most undesirable of the sites indicated for the location of the proposed tuberculosis hospital.

The fifth location indicated is on White's Hill, somewhat less than a mile north of the village of Haydenville. This site is at such an elevation that any buildings constructed upon it could not be supplied with water by gravity either from Williamsburg or from any of the reservoirs of the city of Northampton, and the water supply of the institution, whether secured from the works of either of those municipalities or from independent sources, would have to be pumped. The sewage would also have to be disposed of on the grounds of the institution, but it is probable that satisfactory sewage disposal works could be located at some point on the easterly or southerly slope of this hill. The site is somewhat inaccessible and would be expensive to develop, and for these reasons it is much less desirable than site No. 2.

The sixth location suggested is on the southerly slope of a hill locally known as Hosford's Hill in Williamsburg. Water from the public works of the town of Williamsburg could probably be supplied to buildings on the lower slopes of this hill without special difficulty, but if buildings should be constructed upon the higher slopes, where a more desirable location is found, it would be necessary to pump the water to some suitably elevated tank in order to furnish water to the institution under adequate pressure. The sewage would have to be purified by means of works especially constructed for the purpose, the cost of which in this location would be considerable. The site is in other respects a favorable one and appropriate for the purpose in view, though not as desirable as site No. 2, already described.

Site No. 7 is located on the easterly slope of a ridge extending in a northerly and southerly direction west of Wright Brook. An adequate water supply could probably be obtained under suitable pressure for buildings on this site without extra pumping, but the sewage would have to be disposed of by means of special works constructed in the valley of Wright Brook. The disposal of the sewage would not be especially difficult at this place, as an ample quantity of gravel appears to be available for the purpose. The situation is in a rather narrow valley at no great elevation above the bottom lands, and it is not as desirable a one as sites No. 2 or No. 6.

Site No. 8 is located on what is known as the Breckinridge Place on the southeasterly slope of a ridge extending in a northerly and southerly direction north of the main village of Williamsburg. There is little doubt that an adequate supply of water for buildings at this site could be furnished from the public works of the town of Williamsburg without extra pumping. The disposal of the sewage would require the construction of special works in the valley of a small stream flowing south into the Mill River. There might be difficulty in locating the sewage disposal works in an unobjectionable location at this site, but by placing the buildings at a sufficiently high elevation a suitable location could probably be found. The site is, on the whole, a less satisfactory one than sites Nos. 2 and 6, to which reference has already been made.

As a result of the examination, the Board is of the opinion that site No. 2 is the most desirable of all those mentioned and that site No. 6, with the buildings located on the southerly slope of the hill near the summit, would also be suitable for the purpose, though less satisfactory than site No. 2.

Aug. 7, 1913.

To the County Commissioners, Hampshire County, Mass.

Gentlemen: — In response to your request of July 30, 1913, for advice as to two additional sites suggested for the location of the proposed tuberculosis hospital for Hampshire County, the State Board of Health has caused these sites to be examined by one of its engineers and has considered the conditions affecting their use for the purpose proposed.

One of these sites is located about half a mile north of the village of Leeds on the westerly side of the Mill River, a short distance south of the boundary between Northampton and Williamsburg. The elevation of the land at the highest part of this location is about 500 feet above sea level, and the ground slopes from this elevation to the east, south and west. There are places on both the southeast and southwest slopes well adapted for the location of a hospital and within a very short distance of the electric railway. There are no dwelling houses in the immediate neighborhood of this location.

The best practicable plan of supplying water to an institution at this place would probably be to take water either from the water supply system of the town of Williamsburg, from which the institution could be supplied by gravity, or to pump water from the system of the city of Northampton, the pressure in which is not sufficient to supply a hospital at the location in question by gravity. In order to obtain a water supply from the Williamsburg system legislative action would probably be necessary, but the Williamsburg supply could probably be furnished at somewhat less cost than a supply from the Northampton system. A considerable expense would also be necessary to provide a proper system of sewage disposal, since special works would have to be constructed for this purpose, there being no available sewer into which the sewage could be discharged in the region about the hospital.

Notwithstanding the probable considerable cost for water supply and sewerage for an institution in this location, it appears to be a desirable one for the purpose.

The other site is located on the westerly side of Mill River about half a mile west of the village of Bay State. A part of the land at this site is elevated 100 feet or more above the Mill River valley, and most of it slopes in a northeasterly direction toward Mill River from a tableland situated in the southwesterly part of the area. There is considerable population at no great distance from this land, but buildings could be so located that there would be no dwelling houses in their immediate neighborhood. A water supply for a hospital at this location could be obtained from the Northampton supply, though there is some doubt as to whether the pressure would be sufficient without a pump. The sewage could be cared for by a connection with the Northampton system.

While the cost of a hospital in this location might be less than at the site near Leeds already considered, the location does not possess the natural advantages of the latter, and its exposure is not a very desirable one for the proposed hospital. In the opinion of the Board the proposed site near Leeds is an appropriate one for the location of the proposed hospital, and a much more desirable location than the one suggested near Bay State.

Haverhill.

Aug. 13, 1913.

To Mr. Louis C. Lawton, *City Engineer, Haverhilll, Mass.*

Dear Sir: — The State Board of Health has considered your application for advice as to a proposed plan for improving the condition of Little River, which you describe as follows: —

> I desire to obtain the advice of your Board relative to a proposed plan for improving Little River in this city from Washington Square to Winter Street.
>
> On account of the rough and irregular character of the present river bottom refuse material collects at various places, which during the dry summer season, when the water is low, and the bed is exposed, becomes objectionable.
>
> Our plan is to construct a smooth concrete pavement in the bed of the river, sloping to a central depression, on a true established grade. With this pavement properly constructed, the dry weather flow would be confined to the center, and the surface of the concrete could be easily kept clean. . . .

In response to this application the Board has caused Little River in the portion of its course in which it is proposed to improve the channel, this portion being included between Winter Street and Washington Square, to be examined by one of its engineers and has considered the plan presented.

The results of the examination of the river show that at the present time the channel of the stream throughout its length between Winter Street and Washington Square is bordered for the most part by rough stone walls which are in many places out of repair, while the bottom is very irregular, being covered largely with stones and especially with large quantities of detritus, including tin cans, wooden boxes and much other refuse.

The water of the river above Winter Street is used for manufacturing, a large part of the flow at the present season of the year being used in various processes in the mills along the stream, and at the time of the examination the entire flow of the stream below Winter Street was highly colored with manufacturing waste. By carrying out the plan suggested the bottom of the channel would be materially improved, and by reconstructing or repairing the side walls the channel could be brought into such condition that — if floating matters are kept out of it and the bottom is kept free from detritus — its sanitary condition would be satisfactory; but the experience with similar channels flowing through densely populated districts has been that they are used to a very great extent as places of deposit for such materials as are now found in the channel of Little River, including much foul organic matter, and it is very difficult, if not impracticable, even with careful inspection and frequent cleaning, to keep such channels in proper condition.

In the opinion of the Board the best practicable plan of preventing efficiently further nuisance from the channel of Little River will be to cover the channel completely with a suitable structure capable of carrying off the flow of the stream at times of extreme freshet. The cost of such a channel will of course be much greater than the cost of improving the bottom of the stream alone, and — since it is very desirable that a material improvement in this stream should be made at the earliest possible time — it is advisable to improve the bottom of the channel by covering it with concrete as proposed, and in carrying out this work to provide, so far as practicable, for the final covering of the channel throughout its length from Winter Street to Washington Square. Until the channel is covered the Board recommends that its use as a place of deposit for refuse of any kind be prevented, so far as possible, and that the channel be cleaned at the necessary intervals to maintain it in a satisfactory sanitary condition.

The Board further recommends that foul manufacturing waste and other polluting liquids be disposed of into the sewers and the pollution of the stream be prevented.

HYDE PARK (NEW YORK, NEW HAVEN & HARTFORD RAILROAD).

JUNE 5, 1913.

To Mr. F. K. IRWIN, *Superintendent of Bridges and Buildings, New York, New Haven & Hartford Railroad, New Haven, Conn.*

DEAR SIR: — In accordance with your request of April 26, relative to improving the character of the waste discharged from the New York, New Haven & Hartford Railroad yards into the Neponset River near Readville, the State Board of Health has caused the locality to be examined and finds that the wastes from your works consist at present of water from car washing and other cleaning operations incidental to repair work, steam exhaust and roof and area drainage from the works.

An examination of the waste shows that, while it contains a sufficient quantity of oil to have an objectionable effect upon the river, the amount is not great enough, compared with the total flow of the waste water from the works, to be separated by the use of the oil separator which you have suggested. So far as can be judged from an inspection of the works and information supplied as to the sources of the waste discharged into the drain, it appears that the waste from the boiler and engine rooms probably contributes by far the greater part of the oil which goes into the river, and it is probable, also, that if the oil contained in the wastes from these rooms should be eliminated the objection caused by the discharge of these wastes into the river, so far as it is caused by the oil they contain, would be removed. The wastes contain, however, a considerable quantity of organic matter, and it may be necessary after the removal of the oil to discharge the objectionable portions of these wastes into the sewer.

The Board recommends that you investigate first the practicability of separating the wastes from those parts of the works from which large quantities of oil are discharged, and that as soon as this separation has been effected investigations be made as to the treatment of these wastes for the extraction and recovery of the oil they contain. After the separation of the oily portion of the wastes has been effected, it will be practicable to determine what portion, if any, of these wastes will require to be discharged into the sewer or to receive further treatment before being discharged into the river.

Lexington.

Feb. 6, 1913.

To the Cemetery Committee of the Town of Lexington, Mr. Alonzo E. Locke, *Chairman.*

Gentlemen: — The State Board of Health has considered your petition of Aug. 24, 1912, requesting approval by the Board of the use for cemetery purposes of certain lands, forming a portion of the Monroe estate in the town of Lexington, and has caused the locality to be examined by one of its engineers.

The lands in question are situated within the watershed of the Arlington Reservoir, the former source of water supply for the town of Arlington, the control of which is retained by the town for the purpose of a reserve water supply, though not used for domestic consumption.

The Board gave a hearing to the authorities of the town of Arlington on Sept. 5, 1912, at which hearing it was stated on behalf of the town of Arlington that the said town "retains control of these lands for the purpose of a reserve water supply to be used not for human consumption but for sprinkling the lawn at the new town hall, sprinkling streets, and other similar uses."

The Board, acting under the provisions of chapter 379 of the Acts of the year 1909, hereby approves the use for cemetery purposes by the town of Lexington of the lands shown upon the plans submitted with the application.

The location and boundaries of the lands herein approved are shown upon a plan on file at this office, entitled: "Lexington. Plan showing the relation of the land held under lease by the Breck-Robinson Nursery Co., and other land which the Town of Lexington proposes to take for a Cemetery, and the works of the Old Arlington Supply. Scale 1 inch = 300 feet."

Lowell.

Aug. 25, 1913.

To Hon. James E. O'Donnell, *Mayor, Lowell, Mass.*

Dear Sir: — The State Board of Health has considered your request as to the advisability of using certain lands as a site for a contagious disease or tuberculosis hospital, or both, the lands in question being described as follows: —

The land in question comprises about 20 acres of a plot of 59 acres purchased by the city in 1900, for the purpose of enlarging and protecting its Boulevard well plant so called. In 1900 when the Boulevard well plant was enlarged by the installation of more wells it became necessary to cross the

Boulevard, and the Cushing farm, so called, 35½ acres, was purchased. "But to preserve the water from possible contamination it was deemed advisable to buy all the land west of the terminus of Pawtucket Boulevard as far as the Cushing land adjoining Tyngsborough Boulevard and extending back about 750 feet." (Water Board Report for 1900.)

The land suggested as a possible site for the hospital is the northerly portion of the above-described property and runs southerly from Varnum Avenue to Fowler road, and is remote from the well plant.

In response to this request the Board has caused the locality to be examined and finds that the land in question has a general slope toward the Boulevard wells, so called, from which the water supply of the city is now obtained. The city has acquired considerable areas of land in the vicinity of these wells in order to protect its sources of water supply from pollution, and the lands which are suggested as a location for a contagious disease or tuberculosis hospital form a part of these lands.

The examination of the territory shows that drainage from the area indicated must inevitably flow toward the wells, and the occupation of these lands for hospital purposes would affect unfavorably the quality of the water obtained therefrom.

Under the circumstances the Board does not recommend the use of the lands in question for a contagious disease or tuberculosis hospital.

Nov. 6, 1913.

To the Municipal Council of the City of Lowell, Mass.

GENTLEMEN: — In response to your vote of October 21, "that the State Board of Health be requested to send a representative to examine the various proposed contagious hospital sites and make a report as to what site or sites, in his judgment, is best adapted for the erection of a building for the care of tuberculosis," the location of the several proposed sites was obtained from the mayor and each was carefully examined by a committee of the Board.

Of the eight sites proposed, two are, in the opinion of the Board, very well adapted for the purpose. One on Chelmsford Street, designated as the Hope estate, is about 5,500 feet from City Hall. It includes about six acres and rises to a site for buildings about 80 feet above water. It overlooks all neighboring buildings with free air from distance in all directions. The high ground with a southerly slope is well situated for perambulation. There is vacant land a little higher to the northeast. Existing homes are much lower and 200 or 300 feet from the building site. Street cars are on adjoining street 50 feet below, and steam railroad is 1,700 feet distant.

The other site is on the northwest side of Seventh Avenue, Pawtucketville, between Mt. Hope Street and Mt. Grove Street prolonged. It contains about five acres, being about 700 feet on Seventh Avenue and about 314 feet wide. It is about 7,000 feet from City Hall, with street car lines 1,000 feet east and 1,000 feet west. There is a water pipe in front and sewers near each end. Much of the area has a growth of pine trees, is nearly level at about 65 feet above water in the river above the dam, with a gentle southerly slope and with a steep slope to the northeast at one end. The surface is well above the land in all directions, except to the northwest, where unoccupied land rises perhaps 15 feet higher.

With the addition of two acres of this higher land, the Board is of opinion that this site is the best adapted for a tuberculosis hospital among those proposed. Without this addition the Hope estate on Chelmsford Street is preferable.

Millbury (see Northbridge).

Northbridge.

June 5, 1913.

To the Boards of Selectmen of the Towns of Northbridge, Uxbridge and Millbury and the Board of Health of the Town of Millbury.

Gentlemen: — The State Board of Health received from you on March 19, 1913, the following application for its advice relative to the condition of the Blackstone River: —

> Under the authority of Chapter 433 of the Acts of the Year 1909, the Selectmen of the towns of Millbury, Uxbridge, Northbridge, Grafton and Blackstone respectfully request your advice and assistance upon the following questions: —
>
> *First:* As to whether or not the Blackstone River in the Town of Millbury is so polluted as to be a public nuisance.
>
> *Second:* As to the manner in which the Blackstone River is polluted, and the parties that are responsible for its condition.
>
> *Third:* As to whether or not the City of Worcester is removing from its sewage, before its discharge into the Blackstone River, the offensive and polluting properties and substances therein, so that after its discharge in said River, either directly or through its tributaries it shall not create a nuisance or endanger the public health.
>
> *Fourth:* As to the most available and appropriate means for the Town of Millbury to adopt to correct the present objectionable conditions.

In response to this application the Board has caused an examination to be made of the sources of pollution of the Blackstone River and has examined the information available as to the condition of the stream and the records of analyses at various points within the limits of the State.

The sanitary condition of the Blackstone River has been investigated by the Board, at the request of the town of Millbury, on three previous occasions during the past twenty-two years — in 1891, 1895 and 1906 — and a copy of the statement of the Board in the latter year is appended to this communication.

In the upper part of the watershed of the Blackstone River, Kettle Brook, one of its principal tributaries, is badly polluted and its condition made objectionable partly by sewage but chiefly by wastes from woolen mills in the village of Cherry Valley in Leicester and Worcester. Farther downstream the river and its tributaries receive considerable additional pollution chiefly from mills in Worcester and Auburn, but before entering the thickly populated part of the city of Worcester the river passes through a number of large ponds and its condition is greatly improved.

At Quinsigamond — below Worcester but above the outlets of the effluent from the Worcester sewage disposal works — the quantity of organic matter in the river water, as represented by the albuminoid ammonia, was slightly less in 1912 than in 1905, the time when the observations were made upon which the previous advice of the Board was based.

In the town of Millbury — below all of the outlets from the Worcester sewage disposal works — the quantity of organic matter in the river water in 1912 was greater than for several years.

Farther down the river at Uxbridge the quantity of free ammonia in the river water was nearly 25 per cent. greater in 1912 than in 1905, and the albuminoid ammonia was about 40 per cent. greater. At Millville, on the other hand, the quantity of organic matter in the river water, as represented by the albuminoid ammonia, was less in 1912 than in 1905.

The chief source of pollution of the river is the effluent discharged from the sewage disposal works of the city of Worcester, including sewage overflowing into the river at times of storm, but the river also receives, either directly or through its principal tributaries, much pollution from other sources, especially from factories and mills. These wastes consist for the most part of waters used in the washing and dyeing of cloth and of sewage chiefly from factories, the total quantity of the latter discharged into the river and its tributaries below the city of Worcester being equivalent, probably, to the constant flow of sewage from about 4,000 people.

In the period between the year 1905 — the time when the observations were made upon which the previous reply was based — and the year 1912 the population of the city of Worcester increased about 19.5 per cent. and the total mileage of sewers about 17.9 per cent., while the total quantity of sewage treated at the works has also shown a material increase. According to the records of the sewer department of the city of Worcester, the percentage of organic matter removed from the sewage by all methods of treatment, judging from the albuminoid ammonia, was 61.5 in 1905 and 57.7 in 1912, while upon the basis of the oxygen consumed the percentage removed was 58.2 in 1905 and 60.3 in 1912.

The total cost of the sewage disposal works of the city of Worcester increased between the years 1905 and 1912 nearly 30 per cent., exclusive of the cost of construction of a new outfall sewer, while the total amount expended for maintenance in 1912 was about 7 per cent. less, according to the reports, than in 1905.

It is impracticable at the present season of the year to make an examination of the river which would indicate at all satisfactorily its condition in the drier portion of the year, and it is necessary to base conclusions as to its comparative condition at the present time and its condition in previous years upon the information available for 1912. Judging from this information, the condition of the Blackstone River below the Worcester sewage disposal works in the town of Millbury has shown but little change for many years. The river is offensive for a long distance below the city of Worcester, and the effects of the pollutions which it receives are noticeable for many miles.

As to the manner in which the Blackstone River is polluted, and the parties that are responsible for its condition, the Board finds that the chief pollution is caused by the discharge of crude and partly purified sewage from the city of Worcester.

The total length of sewers in the city of Worcester is 159.37 miles, of which 93.32 miles, or 58.5 per cent., are constructed upon the separate plan, but there still remain 66.05 miles of so-called "combined" sewers from which mingled sewage and storm water overflow into the river at times of heavy rain. It also appears that in 1912, of the total quantity of sewage, about 26.8 per cent. was treated by sand filtration and about 88 per cent. of the organic matter removed therefrom, while about 72.4 per cent. of the sewage delivered at the disposal works was treated by chemical precipitation and from 38 to 43 per cent. of the organic matter removed therefrom previous to discharge into the river.

The river is also polluted by sewage and manufacturing waste from numerous factories and mills, part of which are situated in the valley of the Blackstone River and its tributaries above Worcester, chiefly in the towns of Leicester and Auburn, and part in the valleys below that city. These pollutions consist chiefly of wastes from the scouring and dyeing of yarns and the washing and dyeing of cloth, together with the sewage of operatives in numerous mills and of certain sewers in Millbury, the total quantity of sewage discharged into the river below Worcester being equivalent, probably, to the total flow of sewage from a population of about 4,000.

As to the third question in your application, viz., "as to whether or not the City of Worcester is removing from its sewage, before its discharge into the Blackstone River, the offensive and polluting properties and substances therein, so that after its discharge in said River, either directly or through its tributaries it shall not create a nuisance or endanger the public health," the Board finds that, while a part of the sewage of the city is receiving adequate purification, a large part of it is still discharged into the river after treatment which removes less than 40 per cent. of the total quantity of organic matter contained therein and that the nuisance in the river in the town of Millbury is due chiefly to pollution by the sewage of the city of Worcester.

"As to the most available and appropriate means for the Town of Millbury to adopt to correct the present objectionable conditions," it appears to the Board that a remedy is provided under the provisions of chapter 331 of the Acts of the year 1886. While this chapter 331 of the Acts of 1886 applies to the chief source of pollution of the river, viz., the sewage disposal for the city of Worcester, there are other considerable sources of pollution of the river from factory wastes and from sewage extending all the way along the river and on its tributaries from Cherry Valley to Blackstone. These alone would probably not produce a nuisance at Northbridge, Uxbridge and Millbury, but they add to the nuisance there existing.

If it were thought desirable by the inhabitants of the valley, an act like that now existing in regard to the Neponset River might be effectual in removing all of the sources of pollution.

Tisbury.

Aug. 2, 1913.

To the Tisbury Water Works, Vineyard Haven, Mass., J. E. Howland, *Treasurer.*

Gentlemen: — In response to your request for advice as to the location of a dwelling house for the engineer at the water works pumping station near Tashmoo Pond, the State Board of Health has caused the locality to be examined by one of its engineers and has considered the information presented.

The water of the spring from which your supply is obtained is of excellent quality, and it is important that the dwelling house be so located that the ground water will not be polluted by the discharge of sewage from the house.

An examination of the locality indicates that by constructing the house about 320 feet northeast of the spring the sewage can be disposed of at some point north of the vault now used for that purpose, and the conditions affecting the water drawn from your spring would probably not be noticeably changed. It is important that no receptacle for sewage be located any nearer the spring than the vault now used, and it is also advisable that the use of fertilizers on the lands about the spring and between the spring and the proposed dwelling house should be avoided.

Uxbridge (see Northbridge).

Weston.

Jan. 17, 1913.

To the Board of Trustees of the Riverside Recreation Grounds, Weston, Mass., Mr. H. S. Upham, *Manager.*

Gentlemen: — In response to your request for an investigation of the water supply, sewerage and general sanitary conditions about the Riverside Recreation Grounds in Weston, the State Board of Health has caused the locality to be examined by one of its engineers and samples of water from the well and from the swimming pool to be analyzed.

The results of the analyses show that the ground water in this locality is very badly polluted and unsafe for drinking, though the condition of the water of the swimming pool at this time was not such that it would be objectionable for the purposes for which it is used.

The present plan of disposing of the sewage is to discharge it into cesspools from which it finds its way, either through overflow drains or by seepage through the ground, to the river. This method of disposal of the sewage is undoubtedly the cause of the very serious pollution of the ground water in the locality, as shown by the analyses of the water of the well and the swimming pool.

The Board recommends that the further use of the well, which is situated directly between the principal cesspools and the river, be prevented. The sewage should be collected and disposed of at some point at a much greater distance from the swimming pool than at the present time, and this change should be made with as little delay as possible, for with the continued pollution of the ground water the water supplied to the swimming pool is likely to be increasingly polluted.

The extent of the grounds appears to be such that it may be possible to dispose of the sewage at such a distance from the buildings as to prevent pollution of the swimming pool and at the same time secure a water supply at a sufficient distance from the place of sewage disposal to avoid danger that its quality will be affected thereby. If the saving in expense which can be effected by securing a water supply on the grounds will make it worth while. a careful investigation should be made, under the direction of an engineer of experience in such matters, to determine a practicable plan of sewage disposal and water supply for the grounds. If you decide to make investigations for a water supply the Board will, if you so request, advise you as to any plan you may wish to present.

Westport.

Jan. 6, 1913.

To Mr. Joseph Le François, *Westport, Mass.*

Dear Sir: — The Board is informed that you are putting up a slaughterhouse, known as the Cornell slaughterhouse, for use for the purpose of slaughtering animals, and an examination of the locality shows that this slaughterhouse is located within the watershed of the North Watuppa Pond, used by the city of Fall River as a source of water supply and subject to rules and regulations for the sanitary protection of this supply made under the provisions of chapter 75 of the Revised Laws.

From an investigation of the locality by the State Inspector of Health, and information supplied by you, it appears that all of the drainage from the slaughterhouse is to be discharged into a water-tight sump or well, the contents of which are to be pumped into water-tight wagons and transported and disposed of on farm lands outside of the watershed of the North Watuppa Pond. If these plans are strictly carried out the purity of the water, in the opinion of the Board, will be protected, and the Board approves the plans as described for the collection and disposal of the wastes from this slaughterhouse.

Examination of Public Water Supplies.

EXAMINATION OF PUBLIC WATER SUPPLIES.

The usual chemical analyses of the principal sources of public water supply in the State have been made during the year and are presented in the two following tables, the first of which contains averages of analyses of the surface-water supplies and the second the averages of analyses of the ground-water supplies.

Averages of Chemical Analyses of Surface-water Sources for the Year 1913.

[Parts in 100,000.]

City or Town.	Source.	Color.	Residue on Evaporation.	Ammonia.			Chlorine.	Nitrogen as		Oxygen consumed.	Hardness.
				Free.	Albuminoid.			Nitrates.	Nitrites.		
					Total.	Sus-pended.					
Metropolitan Water District.	Wachusett Reservoir, upper end.	.25	3.55	.0020	.0148	.0027	.31	.0014	.0000	.38	1.0
	Wachusett Reservoir, lower end.	.10	3.17	.0021	.0132	.0016	.29	.0012	.0000	.25	1.0
	Sudbury Reservoir,	.13	3.79	.0025	.0160	.0028	.34	.0042	.0000	.26	1.4
	Framingham Reservoir, No. 3.	.14	3.70	.0028	.0166	.0034	.34	.0031	.0000	.27	1.4
	Hopkinton Reservoir,	.58	4.45	.0030	.0209	.0024	.41	.0022	.0000	.70	1.3
	Ashland Reservoir,	.67	4.24	.0033	.0266	.0041	.35	.0013	.0000	.76	1.3
	Framingham Reservoir, No. 2.	.85	5.55	.0047	.0303	.0034	.44	.0036	.0001	.94	1.6
	Lake Cochituate,	.20	6.93	.0025	.0328	.0141	.71	.0000	.0000	.39	2.6
	Chestnut Hill Reservoir,	.15	3.94	.0020	.0153	.0027	.35	.0041	.0000	.26	1.4
	Weston Reservoir,	.12	3.76	.0023	.0142	.0021	.35	.0057	.0000	23	1.5
	Spot Pond,	.08	3.61	.0016	0176	.0035	.37	.0006	.0000	.21	1.4
	Tap in State House,	.13	3.93	.0015	0145	.0025	.35	.0062	.0000	.24	1.5
	Tap in Revere,	.09	3.71	.0016	.0145	.0019	.38	.0009	.0000	.21	1.5
	Tap in Quincy,	.11	3.77	.0014	.0121	.0008	.35	.0079	0000	.24	1.6
Abington,	Big Sandy Pond,	.09	3.57	.0036	.0155	.0022	.69	.0006	0000	.15	0.5
	Little Sandy Pond,	.00	4.20	.0040	.0112	.0023	1.46	.0036	0000	.11	0.5
Adams,	Dry Brook,	.21	7.28	.0027	.0098	.0016	.12	.0080	.0000	.29	4.2
	Bassett Brook,	.03	4.38	.0032	.0056	.0009	.10	.0030	.0000	.10	1.8
Amherst,	Amethyst Brook large reservoir.	.48	4.05	.0043	.0143	.0016	.17	.0005	0000	.59	0.8
	Amethyst Brook small reservoir.	.19	3.48	.0033	.0124	.0028	.19	.0007	0000	.28	1.0
	Lower Reservoir,	.31	3.93	0032	.0161	.0043	.17	.0010	.0000	.48	0.8

Averages of Chemical Analyses of Surface-water Sources, etc. — Continued.

[Parts in 100,000.]

City or Town.	Source.	Color.	Residue on Evaporation.	Ammonia. Free.	Ammonia. Albuminoid. Total.	Ammonia. Albuminoid. Suspended.	Chlorine.	Nitrogen as Nitrates.	Nitrogen as Nitrites.	Oxygen consumed.	Hardness.
Andover,	Haggett's Pond,	.13	3 92	.0028	.0206	.0027	.38	.0000	0000	32	1.5
Ashfield,	Bear Swamp Brook,	.31	5.50	.0009	.0166	.0019	.13	.0003	.0000	.49	2.6
Athol,	Phillipston Reservoir,	.45	4.67	.0017	.0501	.0246	.21	.0013	.0001	.75	1.0
	Buckman Brook Reservoir.	.25	4.02	.0028	.0247	.0067	.18	.0013	.0000	.41	1 2
Barre,	Reservoir,	.15	3.98	.0028	0171	.0029	.22	.0022	.0000	26	1.4
Blandford,	Freeland Brook,	.06	3.48	.0010	0051	.0005	.18	.0182	.0000	.12	1.8
Brockton,	Silver Lake,	.10	3.58	.0032	0160	.0035	.62	.0004	.0000	.21	0 6
Cambridge,	Upper Hobbs Brook Reservoir.	.61	6 75	.0069	.0342	.0061	.50	.0073	.0001	.77	2 5
	Lower Hobbs Brook Reservoir.	.16	6.55	.0047	.0291	.0066	.52	0021	.0001	.37	2.6
	Stony Brook Reservoir,	.48	6.82	.0035	.0263	.0039	.62	.0111	.0001	.64	2.7
	Fresh Pond,	.26	7.02	.0089	.0304	.0097	.69	.0127	.0003	45	2 9
Cheshire,	Thunder Brook,	.01	6.45	.0028	.0067	.0016	.12	.0095	.0000	.08	4.4
	Kitchen Brook,	.01	5.60	.0015	.0044	.0010	.11	.0025	.0000	.08	4.1
Chester,	Austin Brook,	.14	3.34	.0050	.0094	.0022	.14	.0025	.0000	.25	1.5
Chicopee,	Morton Brook,	.10	4.06	.0017	.0079	.0017	.14	.0030	.0000	.11	1.1
	Cooley Brook,	.31	4.20	.0037	.0116	.0025	.15	.0017	.0000	.30	1.2
Colrain,	McClellan Reservoir,	.07	6.31	.0015	.0087	.0014	.14	.0039	.0000	.15	3.5
Concord,	Nagog Pond,	.05	3.03	.0015	.0131	.0015	.33	.0007	.0000	.17	0.7
Dalton,	Egypt Brook Reservoir,	.30	3.65	.0017	.0113	.0008	.10	.0030	.0000	.45	1.6
	Cady Brook,	.34	5.13	.0014	.0118	.0011	.11	.0040	0000	.49	2.8
Danvers,	Middleton Pond,	.55	5.01	.0033	.0192	.0018	.43	.0005	.0000	.72	1.8
Deerfield (South),	Roaring Brook,	.06	6.34	.0028	.0109	.0025	.17	.0027	.0001	.15	3 3
Fall River,	North Watuppa Lake,	.17	4.27	0027	.0232	.0050	.66	.0007	.0000	.32	1.0
Falmouth,	Long Pond,	.01	3.38	.0020	.0125	.0020	.99	.0000	.0000	.12	0.4
Fitchburg,	Meetinghouse Pond,	.10	3.21	.0041	.0197	.0028	.21	.0008	.0000	.24	0.8
	Scott Reservoir,	.12	2.77	.0043	.0222	.0055	.25	.0003	.0000	.30	0.6
	Wachusett Lake,	.10	2.97	.0041	.0155	.0024	.20	.0003	.0000	21	0.7
Gardner,	Crystal Lake,	.08	5.01	.0022	.0153	.0022	.31	.0027	.0000	19	2.1
Gloucester,	Dike's Brook Reservoir,	.26	4.35	.0045	0173	.0026	.86	.0012	.0000	.33	0 4
	Wallace Reservoir,	.45	4.78	.0028	0290	.0105	1.05	.0007	.0000	.52	0 4
	Haskell Brook Reservoir,	.34	4.40	.0039	.0159	.0035	.91	.0002	0000	.28	0.4
Great Barrington,	East Mountain Reservoir,	.10	5.24	.0057	.0121	.0049	.15	.0000	0000	.15	3.2
	Green River,	.00	10.12	0027	.0044	.0008	.15	.0213	.0000	.08	8 2

Averages of Chemical Analyses of Surface-water Sources, etc. — Continued.

[Parts in 100,000.]

City or Town.	Source.	Color.	Residue on Evaporation.	Ammonia. Free.	Ammonia. Albuminoid. Total.	Ammonia. Albuminoid. Suspended.	Chlorine.	Nitrogen as Nitrates.	Nitrogen as Nitrites.	Oxygen consumed.	Hardness.
Great Barrington (Housatonic).	Long Pond, . . .	.07	8.33	.0036	.0195	.0033	.15	.0006	.0000	.22	6.9
Greenfield, . .	Glen Brook Upper Reservoir.	.01	5.34	.0021	.0090	.0015	.17	.0050	.0000	.12	3.1
	Glen Brook Lower Reservoir.	.02	5.04	.0019	.0084	.0019	.17	.0055	.0000	.12	3.2
Hadley, . .	Hart's Brook Reservoir,	.10	4.17	.0014	.0085	.0022	.20	.0000	0000	.15	1.7
Hatfield, . .	Running Gutter Brook Reservoir.	.15	4 55	.0023	0104	.0015	.19	.0217	.0000	.20	2.0
Haverhill, . .	Johnson's Pond, . .	.17	5.30	.0042	.0218	.0029	.50	.0008	.0000	.33	2.1
	Crystal Lake, . .	.24	3.46	.0023	.0197	.0024	.36	.0004	.0001	.40	1.3
	Kenoza Lake, . .	.19	4.50	.0030	.0205	.0032	.42	.0007	.0000	.39	2 0
	Lake Saltonstall, . .	.07	6.42	.0028	.0195	.0024	.60	.0003	.0000	.21	2.5
	Lake Pentucket, . .	.12	4.99	.0033	.0243	.0059	.50	.0002	.0000	.28	2.1
	Millvale Reservoir, .	.74	6.17	.0038	.0287	.0050	.41	.0012	.0000	.86	2.1
Hingham, . .	Accord Pond, . .	.22	3.83	.0023	.0169	.0028	.66	.0002	0000	.37	0.6
Holden, . .	Muschopauge Lake, .	.06	3.12	.0013	.0119	.0013	.33	.0008	.0000	.13	1.2
Holyoke, . .	Whiting Street Reservoir,	.09	5.14	.0035	.0176	.0028	.24	.0004	.0000	.17	2 7
	Fomer Reservoir, . .	.36	3.56	.0022	.0143	.0016	.16	0014	.0000	.40	1.4
	Wright and Ashley Pond,	.14	4.84	.0050	.0202	.0050	.20	.0004	.0000	.27	2.7
	High Service Reservoir,	.11	4.09	0034	.0221	.0050	.19	.0002	.0000	.26	1.9
Hudson, . .	Gates Pond, . . .	.08	3.47	.0036	.0178	.0021	.27	.0007	.0000	22	1.2
	Fosgate Brook, . .	.56	13.48	.0072	.0301	.0069	.26	0924	.0000	.86	5.6
Huntington, .	Cold Brook Reservoir, .	.27	4.15	0013	.0109	.0019	.14	.0007	.0000	.38	1.2
Ipswich, . .	Dow's Brook Reservoir,	.28	6.03	0044	.0189	.0039	.77	.0056	.0001	41	2.1
Lawrence, . .	Merrimack River, filtered.	.23	6.17	0038	.0096	–	.47	.0361	.0001	39	1.5
Lee, . . .	Codding Brook Upper Reservoir.	.16	3 83	.0013	.0099	.0015	.12	0008	.0000	24	1.6
	Codding Brook Lower Reservoir.	.10	5 83	0014	.0083	.0012	.13	.0028	.0000	20	3.4
	Basin Pond Brook, .	.35	3.83	.0024	.0136	.0030	.12	0031	.0000	48	1.4
Lenox, . . .	Reservoir, . . .	.10	7.63	.0020	.0099	.0024	.11	0025	.0000	18	5.6
Leominster, . .	Morse Reservoir, . .	.20	2.77	.0057	.0253	.0066	.24	0009	.0000	33	0.5
	Haynes Reservoir, .	.26	3.04	0182	.0355	.0110	.21	0016	.0001	.35	0.4
	Fall Brook Reservoir, .	.09	2.47	.0021	.0146	.0029	.21	.0004	.0000	25	0.6
Lincoln, . .	Sandy Pond, . . .	.00	4.95	.0022	.0163	.0030	.35	0002	.0000	17	1.9
Longmeadow, .	Cooley Brook, . .	.15	5 10	.0038	.0123	.0031	.24	0042	.0002	18	2 2
Lynn, . . .	Birch Reservoir, . .	.43	5.99	.0078	.0278	.0055	.78	0031	.0001	59	2.3
	Walden Reservoir, . .	.56	6.44	.0087	.0255	.0030	.79	0036	.0001	69	2 6

Averages of Chemical Analyses of Surface-water Sources, etc. — Continued.

[Parts in 100,000.]

City or Town.	Source.	Color.	Residue on Evaporation.	Ammonia. Free.	Ammonia. Albuminoid. Total.	Ammonia. Albuminoid. Suspended.	Chlorine.	Nitrogen as Nitrates.	Nitrogen as Nitrites.	Oxygen consumed.	Hardness.
Lynn — *Con.*, .	Hawkes Reservoir, .	.93	8.74	.0084	.0409	.0059	1.00	.0072	0001	1.05	3.7
	Saugus River, . .	1.02	10.49	.0076	.0382	.0044	1.18	.0022	.0001	1.22	4.5
Manchester, . .	Round Pond, . .	1.05	5.97	.0064	.0309	.0040	.85	.0007	.0000	1.02	1.5
	Gravel Pond, . . .	.13	3.89	.0018	.0171	.0020	.88	.0005	.0001	.25	0.9
Marlborough, .	Lake Williams, . .	.10	5.03	.0029	.0206	.0037	.60	.0020	0001	.20	1.8
	Millham Brook Reservoir.	.43	5.22	.0054	.0261	.0054	.46	.0051	.0001	.55	2.0
Maynard, . .	White Pond, . . .	.15	3.14	.0013	.0120	.0021	.28	.0015	.0000	.24	0.6
Milford, . .	Charles River, filtered, .	.20	4.06	.0016	.0084	–	.37	.0105	.0000	.29	1.3
Montague, . .	Lake Pleasant, . .	.06	2.97	.0015	.0090	.0013	.18	.0015	.0000	.13	0.6
Nantucket, . .	Wannacomet Pond, .	.11	6.38	.0030	.0172	.0056	2.11	.0000	.0000	.13	1.3
New Bedford, .	Little Quittacas Pond, .	.26	3.88	.0018	.0192	.0031	.54	.0002	.0000	.40	0.9
	Great Quittacas Pond, .	.42	4.07	.0017	.0199	.0015	.55	0002	.0000	.59	0.9
North Adams, .	Notch Brook Reservoir,	.08	7.23	.0020	.0052	.0009	.09	.0003	.0000	.11	6.0
	Broad Brook, . . .	.19	3.89	.0026	.0135	.0058	.09	.0075	.0000	.34	2.2
Northampton, .	Middle Reservoir, . .	.27	4.64	.0024	.0164	.0033	.16	.0018	.0001	.36	1.8
	Mountain Street Reservoir.	.10	3.80	.0012	.0103	.0025	.13	.0002	.0001	.17	1.9
	West Brook, . . .	.18	4.45	.0013	.0098	.0021	.15	.0012	.0001	.25	2.0
North Andover, .	Great Pond, . . .	.15	4.79	.0034	.0204	.0034	.45	.0002	.0000	.26	1.7
Northborough, .	Lower Reservoir, . .	.55	4.27	.0033	.0246	.0065	.28	.0010	.0000	.64	1.3
Northbridge, .	Cook Allen Reservoir, .	.19	3.26	.0044	.0306	.0177	.24	.0006	.0000	.27	0.5
North Brookfield,	Doane Pond, . . .	.42	3.55	.0040	.0280	.0057	.18	.0000	.0000	.49	0.9
	North Pond, . . .	.48	3.45	.0039	.0279	.0064	.18	.0010	.0000	.57	0.9
Northfield, . .	Reservoir, . . .	.16	3.10	.0009	.0059	.0003	.14	.0030	.0000	.27	1.0
Norwood, . .	Buckmaster Pond, .	.13	5.20	.0175	.0257	.0034	.63	.0055	.0001	.26	1.7
Orange, . .	Reservoir, . . .	.13	3.25	.0013	.0060	.0015	.14	0010	.0000	.13	0.7
Palmer, . .	Lower Reservoir, . .	.21	3.57	.0040	.0164	.0039	.17	.0008	.0000	.24	0.8
Peabody, . .	Brown's Pond, . .	.19	4.83	0025	.0215	.0040	.93	0033	.0001	.33	1.2
	Spring Pond, . . .	.23	7.36	.0067	.0184	.0040	.76	.0023	.0001	.36	3.0
	Suntaug Lake, . .	.06	4.98	.0024	.0189	.0025	.96	.0013	.0000	.18	2.6
Pittsfield, . .	Ashley Lake, . . .	.35	3.49	.0013	.0231	.0079	.10	.0006	.0000	.48	1.4
	Ashley Brook, . .	.20	5.74	.0014	.0125	.0024	.12	.0052	.0000	.33	3.9
	Hathaway Brook, . .	.05	9.54	0007	0049	.0004	.13	.0138	0000	.12	8.4
	Mill Brook, . . .	.21	5.55	.0028	.0130	.0024	.11	0081	.0001	.33	2.9

Averages of Chemical Analyses of Surface-water Sources, etc. — Continued.

[Parts in 100,000.]

City or Town.	Source.	Color.	Residue on Evaporation.	Ammonia.			Chlorine.	Nitrogen as		Oxygen consumed.	Hardness.
				Free.	Albuminoid. Total.	Albuminoid. Suspended.		Nitrates.	Nitrites.		
Pittsfield — *Con.*, .	Sacket Brook, . .	.13	6.89	.0006	.0066	.0014	.11	.0056	.0000	.23	5 2
	Farnham Reservoir, .	.48	4.61	.0027	.0190	.0038	.11	.0061	.0001	.66	2 0
Plymouth, . .	Little South Pond, .	.02	2.57	.0020	.0164	.0026	.66	.0002	.0000	.12	0.3
	Great South Pond, .	.00	2.53	.0020	.0120	.0019	.66	.0000	.0000	.09	0.3
Randolph, . .	Great Pond, ...	.42	4.94	.0024	.0202	.0024	.65	.0027	.0000	.53	1.3
Rockport, . .	Cape Pond, ...	.21	12.63	.0033	.0250	.0078	4.63	.0003	.0000	.26	2.2
Russell, . .	Black Brook, ...	.19	4.16	.0012	.0094	.0015	.14	.0019	.0000	.28	1.1
Salem, . . .	Wenham Lake, . .	.27	7.53	.0105	.0254	.0076	.95	.0067	0002	41	2.8
	Longham Reservoir, .	.86	7.31	.0048	.0291	.0093	.89	.0184	.0001	.86	2.2
Shelburne, . .	Fox Brook, ...	.05	5.62	.0005	.0048	–	.12	.0009	.0000	–	3.1
Southbridge, .	Hatchet Brook Reservoir No. 3.	.26	3.19	.0037	.0189	.0019	.20	.0022	.0000	.35	0 8
	Hatchet Brook Reservoir No. 4.	.33	3.60	.0044	.0226	.0040	.20	.0032	.0000	.39	0.6
South Hadley, .	Leaping Well Reservoir,	.09	3.27	.0374	.0250	.0088	.21	.0023	.0005	.14	0.7
	Buttery Brook Reservoir.	.08	3.95	.0070	.0118	.0042	.27	.0214	.0001	.09	1.0
Spencer, . .	Shaw Pond, ...	.07	2.70	.0017	.0158	.0023	.20	.0021	.0000	.18	1.0
Springfield, . .	Westfield Little River, filtered.	.16	3.45	.0009	.0080	–	.15	.0039	.0000	–	1.1
Stockbridge, . .	Lake Averic, ...	.15	6.56	.0027	.0179	.0024	.12	.0017	.0000	.26	4.2
Stoughton, . .	Muddy Pond Brook, .	.20	3.82	.0007	.0073	.0012	.36	.0052	.0000	.19	1.1
Taunton, . .	Assawompsett Pond, .	.25	3.89	.0029	.0190	.0027	.55	.0003	.0000	.41	0.7
	Elder's Pond, . .	.08	3.36	.0022	.0175	.0019	.54	.0000	.0000	.27	0.6
Wakefield, . .	Crystal Lake, . .	.19	5.53	.0036	.0260	.0051	.84	.0035	.0001	.35	2.3
Wareham (Onset),	Jonathan Pond, . .	.02	2 57	.0014	.0085	.0012	.65	.0002	.0000	.11	0 2
Wayland, . .	Snake Brook Reservoir,	1 19	5.64	.0058	.0333	.0046	.36	.0022	.0000	1.14	1.6
Westfield, . .	Montgomery Reservoir,	.45	3.13	.0062	.0217	.0053	.15	.0008	.0000	.55	0.3
	Tekoa Reservoir, . .	.37	2.79	.0034	.0159	.0032	.15	.0008	.0000	.43	0 3
	Tillotson Brook Reservoir.	.14	3.09	.0025	.0081	.0013	.17	.0005	.0000	.22	0 5
West Springfield, .	Darby Brook Reservoir,	.19	5.82	.0119	.0204	.0095	.29	.0085	.0001	.25	3.0
	Bear Hole Brook, filtered,	.05	7.09	.0008	.0051	–	.23	.0053	.0000	–	4.3
Weymouth, . .	Great Pond, . . .	.53	4.25	.0032	.0218	.0039	.51	.0009	.0000	.62	0 7
Williamsburg, .	Reservoir, ...	.15	3.87	.0028	.0092	.0011	.15	.0007	.0000	.20	1 9
Winchester, . .	North Reservoir, . .	.09	4.16	.0024	.0192	.0040	.48	.0007	.0000	.21	1.7
	South Reservoir, . .	.07	3.65	.0051	0167	.0032	.45	.0012	.0000	.17	1 6
	Middle Reservoir, . .	.15	3.69	.0048	.0243	.0053	.46	.0014	.0000	.25	1.5

Averages of Chemical Analyses of Surface-water Sources, etc. — Concluded.

[Parts in 100,000.]

City or Town.	Source.	Color.	Residue on Evaporation.	Ammonia.			Chlorine.	Nitrogen as		Oxygen consumed.	Hardness.
				Free.	Albuminoid.			Nitrates.	Nitrites.		
					Total.	Suspended.					
Worcester,	Bottomly Reservoir,	.22	5.59	.0029	.0198	.0033	.27	.0238	.0000	.42	2.3
	Kent Reservoir,	.20	4.63	.0030	.0173	.0033	.33	.0082	.0000	.34	1.8
	Leicester Reservoir,	.18	4.01	.0044	.0155	.0025	.26	.0052	.0000	.33	1.5
	Mann Reservoir,	.13	4 66	.0026	.0171	.0030	.29	.0123	.0000	.30	1.7
	Upper Holden Reservoir,	.20	3.55	.0026	.0166	.0044	.25	.0071	.0000	.32	1.0
	Lower Holden Reservoir,	.13	3.54	.0053	.0135	.0029	.25	.0062	.0000	.25	1 0

Averages of Chemical Analyses of Ground-water Sources for the Year 1913.

[Parts in 100,000.]

City or Town.	Source.	Color.	Residue on Evaporation.	Ammonia.		Chlorine.	Nitrogen as		Hardness.	Iron.
				Free.	Albuminoid.		Nitrates.	Nitrites.		
Acton,	Tubular wells,	.00	8.49	.0012	.0021	.50	.1029	.0000	3.3	.006
Adams,	Tubular wells,	.00	13.50	.0000	.0010	.11	.0420	.0000	10.0	.005
Amesbury,	Tubular wells,	.12	17.00	0009	.0022	.56	0000	.0000	8.6	.050
Ashland,	Tubular wells,	.00	5 23	.0005	.0021	.36	.0007	.0000	1.1	.009
Attleborough,	Large well,	.02	3.93	.0006	.0049	.44	.0050	.0000	2.1	.004
Avon,	Wells,	.00	6 27	.0008	.0028	.55	.1173	.0000	2.1	.005
Ayer,	Large well,	.00	7 20	.0006	.0028	.92	.0690	.0000	2.8	006
	Tubular wells,	.00	6.75	.0005	.0016	.22	.0075	0000	2.8	.009
Barnstable,	Tubular wells,	.00	3.72	.0003	.0016	1.13	.0012	.0000	0 4	.005
Bedford,	Large well,	.01	4.22	.0010	0028	.37	.0014	.0000	1.2	.012
Billerica,	Tubular wells,	.19	7.12	.0027	.0067	.41	.0017	.0000	2.5	.049
Braintree,	Filter-gallery,	.14	10.12	.0015	.0107	1.25	.1950	.0000	3.5	.014
Bridgewater,	Wells,	.17	11.16	.0006	.0033	.65	.0192	.0000	4 5	077
Brookfield (East),	Tubular wells,	.00	2.71	.0004	.0019	.22	.0029	.0000	0 4	003
Brookline,	Tubular wells and filter-gallery.	.23	9.50	.0056	.0081	.78	.0161	.0001	4 4	046
Canton,	Springdale well,	.02	4.42	.0005	0018	.43	.0087	.0000	1.4	010
	Well near Henry's Spring,	.04	5.30	.0009	0036	.51	.0328	0000	1.9	004

Averages of Chemical Analyses of Ground-water Sources, etc. — Continued.

[Parts in 100,000.]

City or Town.	Source.	Color.	Residue on Evaporation.	Ammonia. Free.	Ammonia. Albuminoid.	Chlorine.	Nitrogen as Nitrates.	Nitrogen as Nitrites.	Hardness.	Iron.
Chelmsford (North),	Tubular wells, . . .	.14	4.62	.0044	.0079	.48	.0358	.0007	1.8	.036
Chicopee (Fairview),	Tubular wells, . . .	.05	4.30	.0009	.0018	.15	.0038	.0002	1.3	.031
Cohasset, . .	Tubular wells No. 2, .	.05	14.33	.0007	.0061	1.89	.1483	.0001	6.2	.006
	Filter-gallery, . . .	.53	13.60	.3629	.0171	1.21	.0032	.0025	6.0	.123
	Large well, . . .	.69	6.97	.0077	.0165	1.04	.0009	.0000	1.9	.143
Dedham, . .	Large well and tubular wells.	.03	10.10	.0015	.0044	1.03	.1317	.0000	4.0	.004
Douglas, . . .	Tubular wells, . . .	.04	4.96	.0012	.0019	.38	.0381	.0000	1.7	.032
Dracut (Water Supply District).	Tubular wells, . . .	.01	8.86	.0005	.0020	.54	.0736	.0000	4.2	.009
Dracut (Collinsville).	Tubular wells, . . .	.13	9.30	.0015	.0066	.42	.0270	.0000	4.0	.028
Dudley, . . .	Tubular wells, . . .	.00	3.54	.0003	.0024	.26	.0039	.0000	1.2	.003
Easthampton, .	Tubular wells, . . .	.00	6.80	.0005	.0014	.15	.0221	.0000	3.8	.003
Easton, . . .	Well, ...	.00	4.85	.0007	.0028	.55	.0610	.0000	1.6	.004
Edgartown, . .	Large well, . . .	.00	3.00	.0007	.0019	.87	.0008	.0000	0.4	.004
Fairhaven, . .	Tubular wells, . . .	.45	6.98	.0011	.0101	1.01	.0340	.0000	2.5	.008
Foxborough, . .	Tubular wells, . . .	.00	3.70	.0009	.0013	.44	.0370	.0000	1.2	.004
Framingham, . .	Filter-gallery, . . .	.02	10.47	.0074	.0069	1.12	.0195	.0000	4.6	.009
Franklin, . .	Tubular wells, . . .	.00	5.24	.0008	.0019	.53	.0336	.0000	1.8	.018
Grafton, . .	Filter-gallery, . . .	.04	12.90	.0011	.0039	1.68	.2900	.0000	4.9	.004
Granville, . .	Well, ...	.00	4.30	.0004	.0021	.13	.0080	.0000	2.4	.007
Groton, . . .	Large well, . . .	.00	6.00	.0004	.0022	.22	.0022	.0000	2.8	.008
Groton (West Groton Water Supply District).	Tubular wells, . . .	.00	4.69	.0004	.0018	.20	.0142	.0000	2.8	.003
Hingham, . .	Wells, ...	.04	5.67	.0017	.0045	.75	.0220	.0000	1.8	.005
Holliston, . .	Large well, . . .	.55	5.06	.0036	.0160	.41	.0012	.0001	1.5	.076
Hopkinton, . .	Tubular wells, . . .	.00	14.50	.0002	.0021	1.20	.3550	.0000	5.2	.005
Kingston, . .	Tubular wells, . . .	.00	4.70	.0007	.0017	.74	.0065	.0000	1.0	.004
Leicester, . .	Wells, ...	.12	7.80	.0006	.0047	.44	.1113	.0000	3.1	.010
Leicester (Cherry Valley and Rochdale Water Supply District).	Wells, ...	.06	5.55	.0053	.0063	.31	.0089	.0000	2.5	.004
Littleton, . .	Tubular wells, . . .	.00	4.52	.0005	.0019	.26	.0462	.0000	1.9	.003
Lowell, . . .	Boulevard wells (tubular),	.30	6.22	.0377	.0064	.38	.0162	.0001	2.9	.115
Manchester, . .	Wells, ...	.00	11.95	.0007	.0023	1.97	.1617	.0000	3.9	.013
Mansfield, . .	Large well, . . .	.00	5.05	.0002	.0018	.46	.1380	.0000	1.7	.005
Marblehead, . .	Wells and brook, filtered, .	.30	46.57	.0010	.0109	15.02	.0156	.0000	15.6	.029

Averages of Chemical Analyses of Ground-water Sources, etc. — Continued.

[Parts in 100,000.]

City or Town.	Source.	Color.	Residue on Evaporation.	Ammonia.		Chlorine.	Nitrogen as		Hardness.	Iron.
				Free.	Albu-minoid.		Nitrates.	Nitrites.		
Marion,	Tubular wells,	.00	3.86	.0004	.0015	.67	.0176	.0000	1.1	005
Marshfield,	Well,	.01	19.47	.0006	.0037	6.67	.1575	.0000	5.0	.004
Medfield,	Spring,	.00	3.73	.0005	.0023	.36	.0047	.0000	1.2	.003
Medway,	Tubular wells,	.00	7.14	.0004	.0019	.56	.0497	.0000	3.0	.004
Merrimac,	Tubular wells,	.00	6.02	.0004	.0015	.50	.0207	.0000	2.4	.007
Methuen,	Tubular wells,	.25	7.91	.0026	.0082	.45	.0134	.0001	3.3	.051
Middleborough,	Well,	.25	6.42	.0058	.0061	.66	.0320	.0001	2.5	.184
Millbury,	Well,	.06	5.23	.0007	.0039	.42	.0282	.0000	2.2	.014
Millis,	Spring,	.00	9.12	.0003	.0015	.78	.1975	.0000	3.7	.009
Monson,	Large well,	.00	3.72	.0007	.0020	.18	.0075	.0000	1.2	.004
Natick,	Large well,	.00	9.27	.0003	.0027	.72	.0275	.0000	4.7	.003
Needham,	Well No. 1,	.00	6.65	.0005	.0028	.71	.1017	.0000	2.6	.003
	Well No. 2,	.00	6.03	.0006	.0030	.72	.0933	.0000	2.6	.003
	Hicks Spring,	.02	6.27	.0007	.0032	.70	1283	.0000	2.4	.004
Newburyport,	Wells and springs,	.06	7.39	.0012	.0078	.92	.0153	.0000	3.1	.018
Newton,	Tubular wells and filter-gallery.	.07	7.30	.0018	.0074	.59	.0378	.0000	3.1	.020
No. Attleborough,	Wells,	.00	5.04	.0006	.0023	.45	.0174	.0000	2.2	.010
Norton,	Tubular wells,	.00	4.56	.0005	.0019	.41	.0011	.0000	1.2	.007
Norwood,	Tubular wells,	.05	18.27	.0009	.0040	.57	.0482	.0001	9.4	.038
Oak Bluffs,	Springs,	.00	4.02	0008	.0030	.93	.0117	.0000	0.7	005
Oxford,	Tubular wells,	.00	4 94	.0005	.0017	.36	.0606	.0000	1.7	003
Palmer (Bondsville),	Tubular wells,	.01	5.04	.0007	.0018	.17	.0142	.0000	1.9	.040
Peabody,	Tubular wells,	.35	12.43	.0166	.0079	.69	.0028	.0000	5.2	.417
Pepperell,	Tubular wells,	.00	3.49	.0004	.0020	.21	.0007	.0000	1.6	.005
Plainville,	Tubular wells,	.01	5.19	.0003	.0018	.35	.0003	.0000	2.2	.032
Provincetown,	Tubular wells in Truro,	.00	9.76	.0004	.0015	3.56	.0039	.0000	1.8	.005
Reading,	Filter-gallery,	.71	13.31	.0224	.0175	3.17	.0030	.0001	3.2	.219
	Filtered water,	.28	22.79	.0017	.0121	3.10	.0085	.0031	11.7	.022
Scituate,	Tubular wells,	.00	17.15	.0006	.0018	3.59	.2333	.0000	6.2	.005
Sharon,	Well,	.00	11.45	.0003	.0013	1.41	.2700	.0000	4.7	.002
Sheffield,	Spring,	.01	3.45	.0012	.0019	.09	.0037	.0000	1.7	.004
Shirley,	Well,	.00	4.60	.0005	.0016	.45	.0863	.0000	1.3	.003
South Hadley (Fire District No. 2).	Large well,	.00	3.85	.0005	.0019	.15	.0300	.0000	1.2	.004
Tisbury,	Well,	.01	4.72	.0005	.0017	.97	.0022	.0000	0.4	.007

Averages of Chemical Analyses of Ground-water Sources, etc. — Concluded.

[Parts in 100,000.]

City or Town.	Source.	Color.	Residue on Evaporation.	Ammonia.		Chlorine.	Nitrogen as		Hardness.	Iron.
				Free.	Albu-minoid.		Nitrates.	Nitrites.		
Uxbridge,	Tubular wells,	.00	5.49	.0004	.0026	.62	.0901	.0000	1.9	.003
Walpole,	Tubular wells,	.00	5.25	.0003	.0019	.41	.0298	.0000	1.8	.003
Waltham,	Old well,	.05	8.12	.0020	.0046	.95	.0262	.0000	3.7	.021
	New well,	.00	8.26	.0011	.0047	.75	.0223	.0000	3.6	.005
Ware,	Wells,	.00	6.32	.0004	.0017	.40	.1208	.0000	2.3	.003
Wareham (Fire District).	Tubular wells,	.00	3.40	.0007	.0017	.59	.0010	.0000	0.6	.005
Webster,	Wells,	.01	4.27	.0011	.0029	.35	.0205	.0000	1.8	.013
Wellesley,	Tubular wells,	.00	9.72	.0004	.0024	1.05	.0772	.0000	4.4	.003
	Well at Williams Spring,	.00	14.53	.0027	.0028	1.41	.6400	.0000	5.6	.005
Westborough,	Filter basin,	.02	3.35	.0016	.0099	.30	.0002	.0000	0.8	.015
Westford,	Tubular wells,	.00	3.99	.0005	.0014	.18	.0036	.0000	1.8	.006
Weston,	Well,	.01	7.82	.0006	.0030	.73	.0920	.0000	2.9	.004
Winchendon,	Wells,	.17	4.10	.0023	.0062	.15	.0050	.0000	1.2	.036
Woburn,	Wells,	.00	10.93	.0011	.0046	1.48	.0280	.0000	4.8	.005
Worthington,	Springs,	.06	2.49	.0014	.0043	.10	.0047	.0000	0.9	.023
Wrentham,	Tubular wells,	.00	3.72	.0004	.0017	.32	.0260	.0000	1.0	.003

EXAMINATION OF RIVERS.

EXAMINATION OF RIVERS.

All of the important rivers of the State have been examined during the year, and the condition of each is described on pages 22 to 38.

The rainfall in the year 1913 was higher than the average and was almost exactly the same as in the year 1912. The distribution was also much the same up to near the end of September, when a heavy rainfall set in, and the excess of precipitation in the month of October amounted to 3.33 inches. The effect of this distribution of the rainfall was to produce a slightly higher flow of streams in the late winter and early spring, and a somewhat less flow during the summer months, than in the previous year. The average flow was much the same as in the previous year. Under these conditions, with the very low flow of the streams in the warm summer months, the effect upon the more seriously polluted streams was very noticeable during the warmer part of the year.

On nearly all of the important streams of the State, stations were established many years ago at which samples of water have been collected for chemical examination to determine the changes taking place from time to time in the condition of the water. The samples are for the most part collected during the six drier months of the year, from June to November inclusive, since in that part of the year the dilution of sewage in polluted streams is least and the effect of pollution most noticeable. In a few cases samples are collected monthly throughout the year. During the year 1913 chemical analyses were made of samples of water collected from the following streams at monthly intervals, in some cases during the entire year: —

Assabet.	Miller's.
Blackstone.	Nashua.
Charles.	Nemasket.
Chicopee.	Neponset.
Concord.	Quaboag.
Connecticut.	Quinebaug.
Deerfield.	Salisbury Plain.
French.	Shawsheen.
Green.	Sudbury.
Hoosick.	Taunton.
Housatonic.	Ten Mile.
Merrimack.	Ware.
Mill (Northampton).	Westfield.

Blackstone River.

A general statement of the condition of this river in the year 1913 will be found on pages 30–38.

BLACKSTONE RIVER.

Chemical Examination of Water from Blackstone River. — Averages for Six Months, from June to November, inclusive.

Blackstone River, below Cherry Valley.

[Parts in 100,000.]

Year.	Color.	Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen consumed.	Hardness.
					Albuminoid.							
		Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Suspended.		Nitrates.	Nitrites.		
1908, . . .	–	20.57	3.83	.1531	.0624	.0508	.0116	5.76	.0020	.0007	–	–
1909, . . .	.35	13.93	3.34	.0681	.0470	.0334	.0136	3.70	.0125	.0003	.80	–
1910, . . .	.32	16.42	3.92	.0633	.0489	.0387	.0102	4.02	.0146	.0002	.85	–
1911, . . .	–	21.02	4.40	.1277	.0726	.0559	.0167	5.70	.0080	.0005	1.15	–
1912,[1] . . .	–	44.10	11.04	.2514	.2884	.1023	.1861	10.70	.0002	.0004	3.08	–
1913, . . .	–	32.32	6.52	.2591	.1628	.1122	.0506	8.18	.0015	.0004	2.06	–

[1] August omitted.

Blackstone River, between Mill Brook Channel and the Sewage Precipitation Works of the City of Worcester.

[Parts in 100,000.]

Year.	Color.	Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Hardness.
					Albuminoid.						
		Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Suspended.		Nitrates.	Nitrites.	
1887, ...	0.91	–	–	.2686	.1741	–	–	1.35	.0160	–	–
1888, ...	0.76	–	–	.2658	.1112	.0557	.0555	1.50	.0382	.0041	–
1889, ...	0.86	–	–	.3980	.1430	.0772	.0658	1.32	.0177	.0026	–
1890, ...	1.14	9.92	3.03	.2107	.1246	.0673	.0573	1.07	.0250	.0015	2.9
1891, ...	1.10	17.42	5.59	.4913	.1950	.1127	.0823	2.29	.0192	.0037	5.0
1892, ...	0.52	20.75	6.30	.3547	.1433	.0708	.0725	2.43	.0227	.0108	6.1
1893, ...	0.40	16.98	4.55	.1480	.0588	.0240	.0348	1.01	.0115	.0015	6.3
1894, ...	0.66	16.93	4.76	.0548	.0380	.0236	.0144	0.74	.0115	.0005	4.4
1895, ...	0.49	14.17	4.50	.0613	.0414	.0243	.0171	0.92	.0163	.0006	3.4
1896, ...	0.51	12.90	2.93	.0780	.0415	.0282	.0133	0.97	.0147	.0015	3 4
1897, ...	0.85	26 45	7.68	.1130	.0674	.0362	.0312	0.89	.0090	.0024	4.2
1898, ...	0.33	17.42	5.62	.0857	.0619	.0260	.0359	0.96	.0053	.0010	4 6
1899, ...	0.14	34.38	10.60	.2583	.0788	.0390	.0398	–	–	.0004	14.3
1900, ...	0.05	16.48	3.38	.1068	.0518	.0210	.0308	1.03	.0107	.0012	3.6
1901, ...	0.23	31.03	11.68	.1410	.0548	0309	.0239	–	–	.0023	13.8
1902, ...	0.10	46.15	12.47	.2453	.0728	.0274	.0454	–	–	.0010	16.5
1903, ...	0.18	24.06	6.80	.2836	.0750	.0472	.0278	–	–	.0027	8.4
1904, ...	0.12	44.68	17.08	.1228	.0434	.0225	.0209	–	–	.0008	14.7
1905, ...	0.21	50.36	19.49	.0952	.0492	.0203	.0289	–	–	.0003	29.3
1906, ...	0.11	40.07	15.25	.0688	.0421	.0189	.0232	–	.0032	.0002	20.3
1907, ...	0.04	44.07	17.67	.0613	.0343	.0180	.0163	–	–	.0003	–
1908, ...	0.16	23.67	5.55	.0990	.0291	.0153	.0138	3.23	.0134	.0014	–
1909, ...	–	52.97	18.55	.1865	.0381	.0239	.0142	4.80	.0033	.0010	–
1910, ...	0.15	50.92	18.97	.1933	.0545	.0309	.0236	4.07	.0023	.0009	–
1911, ...	0.11	44.64	15.70	.1920	.0449	.0212	.0237	4 03	.0170	.0009	–
1912, ...	0.10	40.05	10.91	.2047	.0352	.0225	.0127	3.58	.0027	.0011	–
1913, ...	0.10	35.17	10.34	.2767	.0491	.0285	.0206	3.18	.0003	.0008	–

BLACKSTONE RIVER.

Chemical Examination of Water from Blackstone River, etc. — *Continued.*

Blackstone River, below Sewage Precipitation Works.

[Parts in 100,000.]

Year.	Color.	Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Hardness.
					Albuminoid.						
		Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Suspended.		Nitrates.	Nitrites.	
1890,	0.97	11.36	3 10	.2907	.1492	.0722	.0770	1.46	.0270	.0018	3.9
1891,	1.05	22.25	6.60	.6367	.1508	.0883	.0625	2.61	.0233	.0040	6.2
1892,	0.63	26.80	7.75	.5240	.1810	.0958	.0852	3.13	.0137	.0050	10.3
1893,	0.51	30.00	7.13	.5680	.1453	.0900	.0553	2.76	.0285	.0126	10.9
1894,	0.40	29.30	5.86	.6189	.1390	.1113	.0277	2.63	.0212	.0071	10.6
1895,	0.71	22.15	5.18	.3246	.0898	.0597	.0301	1.86	.0267	.0063	7.3
1896,	0.30	26.03	6.53	.2831	.0898	.0600	.0298	2.10	.0217	.0118	9.7
1897,	0.73	25.98	4.97	.3650	.1122	.0782	.0340	1.61	.0207	.0063	6.9
1898,	0.23	25.63	6.73	.3064	.0868	.0560	.0308	1.55	.0132	.0119	9.2
1899,	0.14	44.02	9.67	.5251	1707	.0912	.0795	3.26	.0108	.0068	16.1
1900,	0.22	24.57	4 48	.4430	.1249	0621	.0628	2.13	.0110	.0145	7.3
1901,	0.09	31.12	6.90	.4580	.1293	.0772	.0521	3.42	.0090	.0058	10.8
1902,	0.15	49.62	13.38	.7296	.1284	.0736	.0548	2.97	–	.0033	12.5
1903,	0.39	31.08	9.48	.3880	.1080	.0545	.0535	–	–	.0062	10.4
1904,	–	50.25	13.73	.6381	.1523	0601	.0922	–	–	.0027	16.9
1905,	0.19	59.84	17.97	.4936	.0985	0597	.0388	–	–	.0008	29.3
1906,	0.19	49.69	11.42	.6330	.1818	.0580	.1238	–	0055	.0130	15 0
1908,	0.30	38.80	7.63	.9407	.1490	.0781	.0709	5.34	.0040	.0033	–
1909,	–	53.79	12.12	1.0567	.1282	.0792	.0490	6.92	.0067	.0075	–
1910,	–	52.15	12.52	1.0090	.1654	0817	.0837	5.68	.0015	.0034	–
1911,	0.21	53.25	13.15	.9967	.1608	0651	.0957	6.54	.0152	.0072	–
1912,	0.23	48.90	10.08	1.1700	.1673	.0904	.0769	6.12	.0137	.0096	–
1913,[1]	0.28	40.68	10.46	.9320	.1286	0719	.0567	4.49	.0158	.0084	–

[1] September omitted.

BLACKSTONE RIVER.

Chemical Examination of Water from Blackstone River, etc. — *Continued.*

Blackstone River, at Uxbridge.

[Parts in 100,000.]

Year.	Color.	Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Hardness.
					Albuminoid.						
		Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Suspended.		Nitrates.	Nitrites.	
1887,	.39	–	–	.1129	.0271	–	–	0.79	.0360	–	–
1888,	.38	6.42	1.52	.1155	.0288	.0222	.0066	0.68	.0310	.0007	–
1889,	.32	–	–	.1133	.0296	.0192	.0104	0.66	.0333	.0009	–
1890,	.26	8.86	2.12	.1629	.0231	.0174	.0057	0.79	.0259	.0005	2.9
1891,	.20	10.16	2.61	.2280	.0175	.0117	.0058	1.04	.0425	.0007	3.6
1892,	.13	9.36	1.88	.2840	.0227	.0162	.0065	0.99	.0313	.0007	3.1
1893,	.24	11.74	2.37	.1985	.0207	.0140	.0067	1.20	.0623	.0050	4.2
1894,	.35	13.07	2.03	.1456	.0243	.0183	.0060	1.57	.0673	.0050	4.9
1895,	.56	12.95	2.69	.0906	.0258	.0182	.0076	1.34	.0631	.0065	4.7
1896,	.33	12.68	2.67	.1129	.0257	.0221	.0036	1.38	.0477	.0091	5.0
1897,	.48	11.60	2.47	.1029	.0280	.0215	.0065	1.32	.0652	.0051	4.3
1898,	.49	10.59	2.78	.0801	.0264	.0219	.0045	1.00	.0470	.0076	3.8
1899,	.18	18.34	3.11	.2490	.0359	.0310	.0049	2.17	.0510	0141	7.4
1900,	.19	13.42	2.04	.2260	.0347	.0257	.0090	1.76	.0558	.0060	5.0
1901,	.22	13.91	2.67	.3159	.0285	.0240	.0045	1.50	.0195	.0035	5.0
1902,	.15	14.17	2.56	.3462	.0270	.0218	.0052	1.95	.0210	.0018	4.9
1903,	.30	13.16	2.52	.3030	.0262	.0215	.0047	1.74	.0210	.0024	4.4
1904,	.20	13.78	2.74	.2399	.0282	.0214	.0068	2.12	.0408	.0022	4.6
1905,	.21	16.34	2.55	.3928	.0246	.0203	.0043	2.65	.0175	.0025	5.0
1906,	.19	14.73	3.10	.2218	.0242	.0200	.0042	2.10	.0252	.0009	4.2
1907,	.37	14.23	2.58	.2331	.0238	.0182	.0056	2.36	.0330	0040	4.5
1908,	.31	16.33	4.07	.2387	.0253	.0196	.0057	3.05	.0408	.0071	–
1909,	.22	18.31	4.35	.3473	.0273	.0216	.0057	3.64	.0325	.0066	–
1910,	.26	22.53	4.69	.4963	.0356	.0302	.0054	4.62	.0498	.0043	–
1911,	.26	23.10	3.85	.3717	.0293	0225	.0068	4.15	.0558	.0173	–
1912,	.21	21.91	3.06	.4897	0345	.0288	.0057	4.06	.0497	.0137	6.5
1913,	.29	19.48	3.70	.3880	0355	.0281	0074	3.34	.0382	.0107	5 5

BLACKSTONE RIVER.

CHEMICAL EXAMINATION OF WATER FROM BLACKSTONE RIVER, ETC. — *Concluded.*

Blackstone River, at Millville.

[Parts in 100,000.]

Year.	Color.	Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Hardness.
					Albuminoid.						
		Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Suspended.		Nitrates.	Nitrites.	
1887,	.31	–	–	.0468	.0220	–	–	0.51	.0210	–	–
1888,	.41	5.22	1.40	.0467	.0296	.0233	.0063	0.50	.0278	.0004	–
1889,	.38	–	–	.0499	.0273	.0213	.0060	0.45	.0167	.0003	–
1890,	.26	6.71	2.24	.0736	.0196	.0152	.0044	0.53	.0229	.0003	2.3
1891,	.24	7.48	2.35	.1105	.0384	.0234	.0150	0.72	.0308	.0006	2.2
1892,	.37	6.70	1.62	.1143	.0294	.0210	.0084	0.63	.0217	.0002	2.0
1893,	.23	7.43	1.73	.0677	.0119	.0087	.0032	0.77	.0385	.0011	2.6
1894,	.47	8.42	2.16	.0510	.0172	.0139	.0033	0.89	0273	.0012	2.8
1895,	.51	8.67	2.55	.0356	.0233	.0180	.0053	0.90	.0383	.0024	3.2
1896,	.35	8.53	1.69	0484	.0237	.0180	.0057	0.97	.0413	.0027	3.3
1897,	.45	7.66	1.98	.0509	.0258	.0210	.0048	0.92	.0445	.0019	3.1
1898,	.51	7.12	2.17	0325	.0240	.0193	.0047	0.63	.0240	.0023	2.5
1899,	.20	12.50	2.44	.1310	.0301	.0247	.0054	1.31	.0310	.0049	4.6
1900,	.29	9.33	1.82	.1168	.0254	.0219	.0035	1.15	.0417	.0039	3.4
1901,	.31	8.62	2.13	.1420	.0288	.0227	.0061	0.87	.0155	.0006	3.1
1902,	.28	9.43	2.24	.1623	.0284	.0238	.0046	1.20	.0195	.0010	2.8
1903,	.33	8.46	1.85	.1397	.0233	.0189	.0044	1.10	.0192	.0010	2.9
1904,	.29	8.71	2.06	.1079	.0235	.0201	.0034	1.26	.0337	.0009	2.9
1905,	.28	10.76	2.03	.1956	.0311	.0222	.0089	1.67	.0207	.0008	2.9
1906,	.37	9.02	2.15	.1526	.0306	.0251	.0055	1.27	.0188	.0006	2.4
1907,	.37	10.43	2.21	.1521	.0240	.0181	.0059	1.61	.0247	.0014	3.1
1908,	.33	9.85	2.53	.1295	.0232	.0185	.0047	1.78	.0258	.0024	3.4
1909,	.24	11.87	3.17	.1595	.0267	.0220	.0047	2.27	.0225	.0019	–
1910,	.30	13.94	3.32	.2350	.0277	.0234	.0043	3.01	.0290	.0013	–
1911,	.33	14.35	2.79	.1787	.0268	.0222	.0046	2.94	.0355	.0051	–
1912,	.29	15.20	2.18	.2433	.0283	.0249	.0034	2.91	.0421	.0064	–
1913,	.37	12.92	2.38	.1631	.0281	.0237	.0044	2.44	.0345	.0063	–

NOTE. — The sewage purification works of the city of Worcester were put in operation in 1890, since which time a portion of the sewage of the city has been treated. The works were enlarged in 1893, and since that time practically all of the dry-weather flow of sewage has been treated.

CHARLES RIVER.

A general statement of the condition of this river in the year 1913 will be found on page 23.

CHARLES RIVER.

CHEMICAL EXAMINATION OF WATER FROM CHARLES RIVER. — AVERAGES FOR SIX MONTHS, FROM JUNE TO NOVEMBER, INCLUSIVE.

Charles River, above Milford.

[Parts in 100,000.]

Year.	Color.	Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen consumed.	Hardness.
					Albuminoid.							
		Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Suspended.		Nitrates.	Nitrites.		
1899,	.28	3.98	1.70	.0017	.0248	.0223	.0025	.27	.0027	.0003	.48	0.6
1900,	.49	3.93	1.67	.0017	.0251	.0231	.0020	.25	.0030	.0000	.64	0.5
1901,	.46	4.30	2.48	.0066	.0286	.0247	.0039	.25	.0060	.0002	.65	0.6
1902,	.58	4.42	1.90	.0025	.0248	.0210	.0038	.29	.0057	.0001	.70	1.1
1903,[1]	.55	4.17	1.86	.0015	.0203	.0171	.0032	.28	.0080	.0001	.68	0.8
1904,[2]	.49	3.95	1.83	.0117	.0267	.0209	.0058	.33	.0035	.0001	.62	1.1
1905,[3]	.55	3.77	1.62	.0020	.0229	.0201	.0028	.31	.0033	.0001	.56	0.8
1906,[3]	.62	4.05	1.90	.0032	.0257	.0230	.0027	.30	.0073	.0001	.68	0.6
1907,	.43	3.79	1.59	.0020	.0198	.0173	.0025	.32	.0047	.0001	.48	0.8
1908,	.36	3.11	1.43	.0023	.0198	.0171	.0027	.33	.0025	.0001	.42	0.5
1909,	.31	3.52	1.62	.0030	.0207	.0176	.0031	.32	.0012	.0000	.39	0.7
1910,	.37	3.47	1.34	.0042	.0231	.0204	.0027	.37	.0011	.0001	.46	0.8
1911,	.40	3.94	1.48	.0036	.0210	.0183	.0027	.42	.0007	.0000	.56	1.1
1912,	.38	3.62	1.29	.0037	.0226	.0182	.0044	.37	.0018	.0001	.45	1.0
1913,[3]	.47	4.40	1.50	.0060	.0245	.0222	.0023	.39	.0023	.0002	.49	0.9

[1] October omitted. [2] Two months. [3] Three months.

Charles River, below Milford.

Year.	Color.	Residue Total.	Loss on Ignition.	Ammonia Free.	Albuminoid Total.	Dissolved.	Suspended.	Chlorine.	Nitrates.	Nitrites.	Oxygen consumed.	Hardness.
1898,	.63	10.47	3.08	.1195	.0597	.0422	.0175	2.47	.0473	.0064	.69	2.4
1899,	.50	12.52	3.12	.3487	.1345	.0803	.0542	3.00	.0053	.0008	1.12	2.6
1900,	.56	12.85	2.65	.7123	.0764	.0563	.0201	2.74	.0140	.0055	.93	3.1
1901,	.63	9.52	3.37	.1419	.0451	.0317	.0134	1.40	.0422	.0048	.86	2.6
1902,	.52	10.74	3.38	.2118	.0658	.0406	.0252	2.21	.0236	.0049	1.02	2.7
1903,[1]	.49	9.03	2.85	.2237	.0479	.0277	.0202	1.36	.0396	.0050	.66	2.5
1904,[2]	.50	9.20	2.94	.2105	.0508	.0350	.0158	1.44	.0513	.0055	.63	2.6
1906,[3]	.68	8.76	2.90	.1536	.0568	.0427	.0141	1.64	.0160	.0012	.92	2.0
1907,	.54	12.95	2.83	.4607	.0864	.0525	.0339	2.94	.0352	.0021	.86	3.2
1908,	.48	10.81	3.48	.3925	.0598	.0347	.0251	1.79	.0218	.0049	.64	–
1909,	.50	12.66	4.07	.5658	.0479	.0399	.0080	1.89	.0273	.0064	.72	–
1910,	.57	15.21	3.83	.8038	.0640	.0499	.0141	3.01	.0248	.0082	.88	4.2
1911,	.58	14.12	3.64	.2881	.0447	.0323	.0124	2.51	.0785	.0114	.75	4.4
1912,	.47	15.99	3.24	.5413	.0480	.0370	.0110	2.67	.0880	.0101	.64	5.5
1913,	.58	13.58	3.65	.2918	.0536	.0361	.0175	1.94	.0505	.0108	.96	3.8

[1] November omitted. [2] Four months. [3] June omitted.

CHARLES RIVER.

Chemical Examination of Water from Charles River, etc. — *Concluded.*

Charles River, opposite Pumping Station of Brookline Water Works.

[Parts in 100,000.]

Year.	Color.	Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen consumed.	Hardness.
					Albuminoid.							
		Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Suspended.		Nitrates.	Nitrites.		
1887,	.83	5.37	1.62	.0013	.0282	–	–	.44	.0087	–	–	–
1888,	.98	4.87	1.92	.0014	.0264	.0240	.0024	.37	.0062	.0002	–	–
1895,	.74	4.91	2.08	.0004	.0237	.0207	.0030	.48	.0055	.0001	.75	1.5
1897,	1.02	5.36	2.45	.0012	.0288	.0262	.0026	.43	.0067	.0001	.86	1.5
1898,	.87	5.22	2 40	.0012	.0303	.0281	.0022	.39	.0035	.0001	.92	1.4
1899,	.46	5.03	1.92	.0011	.0262	.0230	.0032	.45	.0025	.0001	.62	1.5
1900,	.56	4.96	1.60	.0018	.0252	.0229	.0023	.46	.0020	.0000	.70	1.4
1901,	.92	5.45	2.60	.0020	.0314	.0275	.0039	.41	.0047	.0001	.95	1.4
1902,	.52	5.46	2.03	.0031	.0234	.0211	.0023	.57	.0045	.0001	.64	1.6
1903,	.71	6.22	2.30	.0031	.0240	.0223	.0017	.53	.0065	.0001	.80	1.5
1904,	.51	5.24	2.17	.0021	.0224	.0208	.0016	.55	.0060	.0001	.67	1 6
1905,[1]	.84	5.93	2.60	.0029	.0318	.0277	.0041	.54	.0056	.0002	.92	1.5
1906,[1]	1.05	6.00	2.77	.0039	.0294	.0267	.0027	.53	.0032	.0001	1.17	1.4
1907,[1]	.63	6.15	2.40	.0022	.0246	.0228	.0018	.64	.0026	.0001	.73	1.7
1908,[1]	.55	5.93	2.29	.0035	.0248	.0222	.0026	.65	.0036	.0002	.61	1.7
1909,[2]	.65	5.75	2.00	.0023	.0254	.0236	.0018	.69	.0015	.0001	.75	1.5
1910,	.60	6.71	2.79	.0028	.0289	.0260	.0029	.83	.0013	.0001	.72	1.8
1911,	.85	7.42	3.02	.0040	.0302	.0258	.0044	.80	.0032	.0001	1.10	2 0
1912,	.56	6.30	2.07	.0043	.0298	.0237	.0061	.85	.0012	.0001	.69	2.1
1913,	.74	7.32	2.27	.0053	.0342	.0300	.0042	.85	.0043	.0002	.86	2.0

[1] Five months. [2] Two months.

Charles River, opposite Pumping Station of Waltham Water Works.

Year.	Color.	Residue: Total.	Residue: Loss on Ignition.	Ammonia: Free.	Albuminoid: Total.	Albuminoid: Dissolved.	Albuminoid: Suspended.	Chlorine.	Nitrates.	Nitrites.	Oxygen consumed.	Hardness.
1887,	.67	6.02	1.62	.0029	.0274	–	–	.48	.0043	–	–	–
1888,	.82	5.47	1.88	.0035	.0310	.0265	.0045	.41	.0087	.0002	–	–
1897,	.95	6.06	2.45	.0056	.0322	.0299	.0023	.53	.0073	.0002	.83	1.9
1898,	.81	5.74	2.46	.0050	.0329	.0296	.0033	.44	.0043	.0001	.85	1.6
1899,	.41	5.50	1.81	.0047	.0264	.0248	.0016	.51	.0051	.0002	.52	1.9
1900,	.52	5.93	1.68	.0064	.0282	.0259	.0023	.53	.0070	.0002	.58	1.7
1901,	.82	5.93	2.72	.0065	.0322	.0289	.0033	.44	.0067	.0002	.85	1.8
1902,	.45	6.21	1.97	.0084	.0258	.0228	.0030	.62	.0077	.0003	.59	2.0
1903,	.64	6.06	2.21	.0078	.0267	.0239	.0028	.58	.0084	.0003	.71	2.0
1904,	.55	6.08	2.22	.0062	.0317	.0266	.0051	.62	.0095	.0002	.62	2.0
1905,	.79	6.29	2.54	.0077	0363	.0308	.0055	.58	.0075	.0002	.80	1.7
1906,	1.00	6.70	2.58	.0063	.0335	.0297	.0038	.59	.0038	.0002	.98	1.8
1907,[1]	.58	6 22	2.24	.0067	.0278	.0247	.0031	.63	.0058	.0002	.65	2.0
1908,	.62	6.50	2 49	.0048	.0344	.0284	.0060	.69	.0027	.0001	.64	1.9
1909,	.54	6.79	2.36	.0063	.0349	.0298	.0051	.76	.0026	.0002	.53	2.0
1910,	.59	7.37	2.87	.0078	.0336	.0299	.0037	.81	.0037	.0003	.56	2.4
1911,	.75	7.47	2.95	.0086	.0343	.0308	.0035	.85	.0030	0003	.87	2.3
1912,	.57	7.59	2.32	.0095	.0320	.0280	.0040	.92	.0038	.0002	.63	2.6
1913,[2]	.68	7.68	2.54	.0083	.0437	.0378	.0059	.91	.0041	.0003	.74	2.3

[1] July omitted. [2] June omitted.

Chicopee River.

A general statement of the condition of this river and its tributaries during the year 1913 will be found on pages 23 and 28.

CHICOPEE RIVER.

Chemical Examination of Water from Chicopee River and its Tributaries. — Averages for Six Months, from June to November, inclusive.

Ware River, below Ware.

[Parts in 100,000.]

Year.	Color.	Residue on Evaporation. Total.	Residue on Evaporation. Loss on Ignition.	Ammonia. Free.	Ammonia. Albuminoid. Total.	Ammonia. Albuminoid. Dissolved.	Ammonia. Albuminoid. Suspended.	Chlorine.	Nitrogen as Nitrates.	Nitrogen as Nitrites.	Oxygen consumed.	Hardness.
1898,	.64	4.42	1.94	.0028	.0332	.0250	.0082	.19	.0025	.0003	.77	1.0
1899,	.46	4.82	1.77	.0052	.0371	.0268	.0103	.25	.0015	.0004	.66	0.9
1900,	.51	4.93	1.64	.0066	.0321	.0243	.0078	.25	.0030	.0003	.73	1.1
1901,	.73	4.79	2.15	.0082	.0300	.0242	.0058	.18	.0044	.0002	.84	1.3
1902,	.76	4.86	2.17	.0071	.0348	.0252	.0096	.23	.0040	.0003	.93	1.0
1903,[1]	.68	4.83	2.18	.0072	.0345	.0240	.0105	.25	.0034	.0003	.78	0.8
1904,[1]	.60	5.60	2.36	.0043	.0411	.0285	.0126	.29	.0046	.0004	.72	1.1
1908,	.56	7.38	2.86	.0265	.0418	.0264	.0154	.37	.0033	.0005	.80	–
1909,[1]	.61	8.63	3.05	.0354	.0569	.0357	.0212	.44	.0015	.0006	.98	–
1910,	.57	9.82	4.39	.0655	.0622	.0426	.0196	.60	.0040	.0011	.84	–
1911,	.70	9.15	3.37	.0396	.0554	.0375	.0179	.48	.0015	.0003	.98	–
1912,	.62	10.93	3.23	.0592	.0717	.0491	.0226	.61	.0015	.0014	.95	–
1913,	.66	9.74	2.97	.0525	.0634	.0432	.0202	.51	.0023	.0005	.96	–

[1] September omitted.

Quaboag River, below Palmer.

1899,	.35	4.54	1.68	.0048	.0252	.0208	.0044	.26	.0060	.0002	.44	1.1
1900,	.40	4.56	1.58	.0038	.0218	.0176	.0042	.26	.0062	.0001	.48	1.2
1901,	.42	4 32	1.74	.0043	.0255	.0202	.0053	.23	.0052	.0002	.53	1.1
1902,	.41	4.55	1.64	.0077	.0242	.0196	.0046	.33	.0085	.0002	.53	1.2
1903,	.44	4.36	1.67	.0090	.0242	.0186	.0056	.27	.0092	.0033	.51	1.0
1904,	.40	4.68	1.70	.0191	.0253	.0195	.0058	.31	.0082	.0002	.50	1.1
1908,	.36	5.31	1.98	.0061	.0207	.0149	.0058	.40	.0070	.0003	.42	–
1909,	.31	5.43	1.95	.0068	.0211	.0165	.0046	.41	.0058	.0003	.47	–
1910,	.44	6.05	2.28	.0043	.0238	.0168	.0070	.52	.0057	.0003	.73	–
1911,[1]	.39	5.94	2.08	.0060	.0191	.0145	.0046	.44	.0032	.0002	.53	–
1912,	.40	7.63	2.08	.0087	.0209	.0144	.0065	.46	.0068	.0001	.58	–
1913,[2]	.58	7.67	1.81	.0108	.0278	.0164	.0114	.46	.0042	.0001	.61	–

[1] Four months. [2] June omitted.

Swift River, below Bondsville.

1908,[1]	.34	5.45	2.42	.0047	.0217	.0132	.0085	.21	.0013	.0002	.44	–
1909,[2]	.40	4.60	1.70	.0016	.0196	.0139	.0057	.22	.0000	.0001	.60	–
1910,	.33	5.28	2.05	.0031	.0261	.0196	.0065	.25	.0010	.0001	.60	–
1911,	.48	5.05	2.12	.0021	.0278	.0193	.0085	.21	.0007	.0000	.74	–
1912,	.28	5.02	1.92	.0047	.0268	.0184	.0084	.21	.0008	.0001	.54	–
1913,	.36	5.32	1.95	.0024	.0296	.0204	.0092	.26	.0008	.0001	.58	–

[1] Three months. [2] Two months.

CHICOPEE RIVER.

CHEMICAL EXAMINATION OF WATER FROM CHICOPEE RIVER AND ITS TRIBUTARIES, ETC. — *Concluded.*

Chicopee River, at Indian Orchard.

[Parts in 100,000.]

Year.	Color.	Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen consumed.	Hardness.
					Albuminoid.							
		Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Suspended.		Nitrates.	Nitrites.		
1908,[1]	.42	5.21	1.98	.0100	.0240	.0177	.0063	.33	.0056	.0003	.62	–
1909,[2]	.38	5.82	2.08	.0094	.0220	.0162	.0058	.36	.0046	.0004	.46	–
1910,	.45	6.14	2.06	.0099	.0239	.0191	.0048	.44	.0052	.0003	.50	–
1911,	.48	6.12	2.10	.0081	.0275	.0184	.0091	.42	.0067	.0004	.57	–
1912,	.41	6.83	2.03	.0159	.0287	.0221	.0066	.50	.0108	.0005	.47	–
1913,	.43	6.68	2.13	.0146	.0302	.0211	.0091	.44	.0067	.0006	.50	–

[1] October omitted. [2] September omitted.

CONCORD RIVER.

A general statement of the condition of this river and its tributaries during the year 1913 will be found on pages 22, 23 and 27.

CONCORD RIVER.

CHEMICAL EXAMINATION OF WATER FROM CONCORD RIVER AND ITS TRIBUTARIES. — AVERAGES FOR SIX MONTHS, FROM JUNE TO NOVEMBER, INCLUSIVE.

Sudbury River, below Saxonville.

[Parts in 100,000.]

Year.	Color.	Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen consumed.	Hardness.
					Albuminoid.							
		Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Suspended.		Nitrates.	Nitrites.		
1901,	.84	7.22	3.37	.0073	.0624	.0431	.0193	.38	.0050	.0005	1.05	1.9
1902,	.38	6.39	2.57	.0150	.0424	.0272	.0152	.60	.0103	.0005	.55	2.2
1903,	.52	7.77	2.78	.0028	.0549	.0296	.0253	.65	.0080	.0002	.83	2.1
1904,	.48	9.58	3.57	.0569	.0587	.0385	.0202	.87	.0193	.0032	.88	2.5
1906,[1]	.67	6.88	2.90	.0258	.0525	.0381	.0144	.56	.0058	.0004	.92	1.9
1907,[2]	.65	9.07	3.28	.1357	.0653	.0347	.0306	.84	.0063	.0004	.84	2.1
1908,[3]	.44	9.67	3.72	.0039	.0634	.0374	.0260	1.06	.0128	.0009	.69	–
1909,	.43	6.81	2.59	.0174	.0330	.0256	.0074	.64	.0043	.0005	.64	–
1910,	.49	9.78	3.45	.0454	.0606	.0345	.0261	.83	.0040	.0010	.65	–
1911,	.37	9.03	3.08	.0287	.0410	.0281	.0129	.92	.0120	.0009	.54	–
1912,	.49	8.83	2.75	.0238	.0366	.0253	.0113	1.19	.0137	.0031	.72	–
1913,	.69	7.28	2.56	.0152	.0347	.0291	.0056	.90	.0185	.0023	.77	–

[1] June omitted. [2] Three months. [3] August omitted.

CONCORD RIVER.

CHEMICAL EXAMINATION OF WATER FROM CONCORD RIVER AND ITS TRIBUTARIES, ETC. — *Continued.*

Assabet River, above Westborough.

[Parts in 100,000.]

Year.	Color.	Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen consumed.	Hardness.
					Albuminoid.							
		Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Suspended.		Nitrates.	Nitrites.		
1909, ...	.56	6.01	2.20	.0048	.0217	.0194	.0023	.36	.0015	.0001	.69	–
1910, ...	.90	7.37	3.12	.0029	.0251	.0229	.0022	.38	.0035	.0001	.86	–
1911, ...	.97	8.02	3.39	.0061	.0441	.0354	.0087	.45	.0023	.0002	1.20	–
1912, ...	.72	7.00	2.36	.0073	.0255	.0228	.0027	.44	.0061	.0002	.87	–
1913, ...	1.25	8.26	3.73	.0095	.0469	.0392	.0077	.46	.0007	.0002	1.55	–

Assabet River, below Westborough.

Year.	Color.	Residue Total.	Loss on Ignition.	Ammonia Free.	Albuminoid Total.	Dissolved.	Suspended.	Chlorine.	Nitrates.	Nitrites.	Oxygen consumed.	Hardness.
1909, ...	1.70	19.24	8.91	.4140	.2281	.1616	.0665	1.94	.0005	.0005	2.90	–
1910, ...	2.23	17.07	7.00	.2898	.1334	.1018	.0316	2.16	.0078	.0018	2.20	–
1911, ...	.83	12.09	4.01	.0556	.0460	.0373	.0087	1.87	.0967	.0121	1.24	–
1912, ...	.66	12.71	4.01	0975	.0419	.0357	.0062	2.20	.1998	.0132	.95	–
1913, ...	1.15	9.67	4.21	.0152	.0448	.0401	.0047	1.08	.1078	.0016	1.37	–

Assabet River, above Hudson.

Year.	Color.	Residue Total.	Loss on Ignition.	Ammonia Free.	Albuminoid Total.	Dissolved.	Suspended.	Chlorine.	Nitrates.	Nitrites.	Oxygen consumed.	Hardness.
1908,[1]	.49	5.97	2.16	.0044	.0241	.0200	.0041	.54	.0072	.0003	.59	–
1909, ...	.39	6.37	2.33	.0070	.0306	.0261	.0045	.52	0037	.0002	.50	–
1910, ...	.57	6.90	3.08	.0058	.0346	.0296	.0050	.61	.0055	.0002	.67	–
1911, ...	.57	6.82	2.51	.0059	.0295	.0248	.0047	.57	.0077	.0002	.81	–
1912, ...	.45	6.51	2.13	.0075	.0297	.0234	.0063	.62	.0108	.0002	.59	–
1913,[2]	.65	8.48	2.81	.0168	.0386	.0327	.0059	.70	.0046	.0002	.79	–

[1] September omitted. [2] November omitted.

CONCORD RIVER.

CHEMICAL EXAMINATION OF WATER FROM CONCORD RIVER AND ITS TRIBUTARIES, ETC. — *Continued.*

Assabet River, below Hudson.

[Parts in 100,000.]

Year.	Color.	Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen consumed.	Hardness.
					Albuminoid.							
		Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Suspended.		Nitrates.	Nitrites.		
1898,	.79	5.61	2.38	.0062	.0335	.0291	.0044	.39	.0063	.0003	.87	1.6
1899,	.50	8.30	3.01	.0205	.0457	.0383	.0074	.80	.0020	.0004	.73	2.1
1900,	.48	8.05	2.05	.0382	.0501	.0362	.0139	1.27	.0028	.0007	.72	2.0
1901,	.66	5.47	2.38	.0193	.0375	.0295	.0080	.79	.0107	.0005	.91	1.8
1902,	.64	7.06	2.69	.0189	.0464	.0330	.0134	.84	.0077	.0005	.74	1.9
1903,[1]	.51	5.71	2.17	.0092	.0287	.0222	.0065	.56	.0073	.0006	.60	1.7
1904,[2]	.44	7.67	2.60	.0329	.0375	.0312	.0063	1.43	.0073	.0005	.64	1.9
1908,	.51	9.17	3.50	.0198	.0396	.0294	.0102	1.32	.0072	.0005	.82	–
1909,	.51	8.81	3.26	.0161	.0403	.0296	.0107	.98	.0022	.0002	.64	–
1910,	.69	13.83	3.83	.0413	.0428	.0337	.0091	1.27	.0048	.0002	1.24	–
1911,	.64	12.83	4.30	.0817	.0532	.0400	.0132	.90	.0043	.0003	1.06	–
1912,	.78	18.08	3.99	.0939	.0752	.0494	.0258	1.02	.0053	.0002	1.28	–
1913,[3]	.76	13.29	3.34	.0727	.0704	.0577	.0127	1.07	.0036	.0004	1.28	–

[1] June omitted. [2] Three months. [3] November omitted.

Assabet River, above Maynard.

1904,	.53	5.65	2.30	.0046	.0275	.0231	.0044	.64	.0035	.0001	.63	1.6
1906,	.75	5.53	2.26	.0065	.0290	.0254	.0036	.48	.0035	.0002	.97	1.5
1907,[1]	.68	5.35	1.80	.0047	.0255	.0211	.0044	.50	.0043	.0002	.73	1.6
1908,	.52	6.91	2.32	.0093	.0288	.0248	.0040	1.03	.0030	.0002	.62	–
1909,	.43	6.18	2.13	.0068	.0343	.0277	.0066	.72	.0023	.0001	.62	–
1910,	.54	7.70	2.82	.0098	.0337	.0291	.0046	.98	.0017	.0003	.64	–
1911,	.57	7.67	2.33	.0087	.0327	.0277	.0050	.85	.0065	.0004	.73	–
1912,	.57	7.92	2.15	.0058	.0316	.0242	.0074	1.06	.0032	.0002	.65	–
1913,	.60	7.85	2.27	.0085	.0372	.0296	.0076	1.03	.0028	.0003	.73	–

[1] Four months.

CONCORD RIVER.

Chemical Examination of Water from Concord River and its Tributaries, etc. — *Concluded.*

Assabet River, below Maynard.

[Parts in 100,000.]

Year.	Color.	Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen consumed.	Hardness.
					Albuminoid.							
		Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Suspended.		Nitrates.	Nitrites.		
1898,	.77	5.93	2.59	.0020	.0387	.0301	.0086	.43	.0030	.0003	.89	1.5
1899,	.51	6.70	2.21	.0185	.0414	.0327	.0087	.73	.0043	.0003	.62	1.7
1900,	.50	5.72	1.73	.0217	.0386	.0304	.0082	.70	.0031	.0002	.59	1.4
1901,	.73	6.57	2.67	.0211	.0428	.0351	.0077	.45	.0052	.0002	.90	1.6
1902,	.69	7.27	2.87	.0099	.0592	.0381	.0211	.57	.0033	.0002	.83	1.6
1903,	.61	6.40	2.58	.0170	0457	.0322	0135	.48	0037	.0003	.83	1.6
1904,	–	8.48	3.21	.0143	.0678	.0412	.0266	.74	0043	.0002	1.05	1.7
1906,	.88	6.68	2.64	.0290	0448	.0312	.0136	.58	.0047	0003	.91	1.6
1907,[1]	.79	7.64	2.76	.0299	.0391	.0274	.0117	.69	.0060	0003	.86	1.6
1908,	.45	11.46	3.98	.0675	.0684	.0381	.0303	1.37	.0028	.0012	.89	–
1909,	–	13.97	4.21	.1208	.0991	.0529	.0462	1.22	.0007	.0006	1.34	–
1910,	.59	13.15	4.68	.0708	.0685	.0446	.0239	1.82	.0038	.0006	.85	–
1911,	.58	12.73	4.17	.0738	.0650	.0408	.0242	1.41	.0060	.0006	1.08	–
1912,	–	12.94	3.92	.1205	.0771	.0494	.0277	1.46	.0026	.0010	1.04	–
1913,	.60	10.60	3.01	.0746	0597	.0394	.0203	1.34	.0311	.0007	.85	–

[1] Four months.

Concord River, at Billerica.

1902,	.68	5.98	2.18	.0091	0347	.0272	.0075	.53	0052	0004	.78	1.7
1903,	.64	5.71	2.26	0097	.0317	.0258	.0059	.49	.0058	.0005	.72	1.8
1904,	.64	6.05	2.31	.0077	.0341	0255	.0086	.55	.0072	.0002	.75	1.7
1908,	.37	8.04	2.65	.0107	.0251	.0216	.0035	.96	.0104	.0005	.54	–
1909,	.49	7.71	2.78	.0128	.0298	.0267	0031	.75	.0058	.0013	.65	–
1910,	.49	7.31	3.00	0142	.0325	.0292	.0033	1.01	.0055	.0004	.58	–
1911,	.45	11.14	4.05	.0181	.0525	.0287	.0238	1.16	.0132	.0008	1.14	–
1912,[1]	.53	10.90	3.08	.0187	.0433	.0274	.0159	.97	.0140	.0008	.82	–
1913,	.57	7.63	2.38	0089	0355	.0312	.0043	.98	.0073	.0003	.77	–

[1] September omitted.

Connecticut River.

A general statement of the condition of this river during the year 1913 will be found on page 24.

CONNECTICUT RIVER.

Chemical Examination of Water from Connecticut River. — Averages for Six Months, from June to November, inclusive.

Connecticut River, at Northfield Farms.

[Parts in 100,000.]

Year.	Color.	Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen consumed.	Hardness.
		Total.	Loss on Ignition.	Free.	Albuminoid. Total.	Albuminoid. Dissolved.	Albuminoid. Suspended.		Nitrates.	Nitrites.		
1899,	.30	7.32	2.17	.0016	.0189	.0158	.0031	.11	.0023	.0001	.85	3.6
1900,	.47	6.24	2.11	.0023	.0190	.0154	.0036	.09	.0030	.0001	.95	2.9
1901,	.31	6.12	2.39	.0016	.0146	.0122	.0024	.10	.0037	.0002	.72	3.2
1902,	.30	5.57	2.02	.0014	.0124	.0110	.0014	.08	.0057	.0001	.60	2.9
1903,	.23	6.83	2.18	.0037	.0169	.0143	.0026	.14	.0028	.0002	.68	3.4
1904,[1]	.27	6 44	2.44	.0023	.0158	.0130	.0028	.12	.0038	.0001	.73	3.4
1906,	.34	6 50	2.17	.0040	.0201	.0181	.0020	.14	.0023	.0002	.76	3.2
1907,[2]	.36	5.91	2.06	.0020	.0141	.0122	.0019	.16	.0048	.0002	.66	3.0
1908,[3]	.28	8.33	2.78	.0058	.0200	.0177	.0023	.22	.0018	.0001	.70	–
1909,	.29	7.32	2.89	.0031	.0142	.0124	.0018	.16	.0017	.0002	.82	–
1910,	.31	7.52	3.10	.0064	.0174	.0152	.0022	.17	.0018	.0001	.77	–
1911,	.32	7.28	2.44	.0066	.0172	.0143	.0029	.16	.0022	.0001	.70	–
1912,	.36	7.43	1.63	.0066	.0185	.0148	.0037	.16	.0012	.0001	.70	–
1913,	.31	7.78	2 31	.0077	.0174	.0131	.0043	.17	.0020	.0002	.65	–

[1] July omitted. [2] Four months. [3] June omitted.

Connecticut River, below Springfield.

1888,	.35	5.34	1.24	.0032	.0182	.0143	.0039	.15	.0082	.0002	–	–
1899,	.33	6.61	1.99	.0093	.0238	.0195	.0043	.23	.0042	.0003	.67	3.1
1900,	.44	6.64	1.90	.0098	.0250	.0176	.0074	.20	.0034	.0002	.89	3.1
1901,	.32	6.03	2.34	.0061	.0190	.0153	.0037	.18	.0048	.0003	.65	3.0
1902,	.31	5.83	2.13	.0062	.0180	.0140	.0040	.16	.0055	.0005	.61	3 0
1903,	.30	6.12	2.04	.0098	.0202	.0147	.0055	.24	.0058	.0004	.61	2.7
1904,[1]	.22	5 22	1.87	.0098	.0187	.0125	.0062	.21	.0047	.0002	.48	2.4
1906,[2]	.35	7.14	2.61	.0082	.0204	.0161	.0043	.24	.0026	.0004	.71	2.8
1907,[3]	.38	6.27	2.46	.0069	.0163	.0131	.0032	.24	.0050	.0003	.67	2.9
1908,	.32	8.58	2.61	.0214	.0223	.0165	.0058	.38	.0040	.0004	.81	–
1909,	.29	6.02	2.25	.0079	.0156	.0118	.0038	.22	.0018	.0003	.65	–
1910,	.33	8.67	3.60	.0155	.0241	.0188	.0053	.37	.0028	.0003	.89	–
1911,	.38	7.66	2.56	.0140	.0181	.0147	.0034	.28	.0018	.0005	.70	–
1912,	.31	8.22	3.02	.0136	.0228	.0161	.0067	.16	.0022	.0004	.74	–
1913,[4]	.31	7.96	2.50	.0178	.0242	.0181	.0061	.35	.0038	.0004	.68	–

[1] Three months. [2] June omitted. [3] Four months. [4] September omitted.

Deerfield River.

A general statement of the condition of this river in the year 1913 will be found on page 28.

DEERFIELD RIVER.

Chemical Examination of Water from Deerfield River and Tributary. — Averages for Six Months, from June to November, inclusive.

Deerfield River, at Shelburne Falls.

[Parts in 100,000.]

Year.	Color.	Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen consumed.	Hardness.
					Albuminoid.							
		Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Suspended.		Nitrates.	Nitrites.		
1901,	.34	4.02	1.82	.0057	.0200	.0171	.0029	.09	.0078	.0001	.63	1.7
1902,	.29	3.62	1.46	.0051	.0151	.0126	.0025	.08	.0055	.0002	.51	1.7
1903,[1]	.26	3.74	1.35	.0023	.0131	.0113	.0018	.09	.0038	.0002	.44	1.5
1904,	.24	4.15	1.52	.0040	0115	.0097	.0018	.11	.0110	.0001	.39	2 1
1908,	.33	4.93	1.93	.0017	.0128	.0108	.0020	.14	0030	.0001	.44	–
1909,	.26	4.56	1.62	.0009	.0150	.0129	.0021	.12	.0005	.0001	.47	–
1910,	.26	4.62	1.69	.0025	.0141	.0108	.0033	.13	.0010	.0001	.45	–
1911,	.35	4.80	1.88	.0035	.0156	.0119	.0037	.13	0027	0000	.59	–
1912,[2]	.29	4.48	1.65	.0024	.0149	.0122	.0027	.11	.0008	.0001	.42	–
1913,	.39	4.55	1.30	.0049	.0213	.0164	.0049	.12	.0007	.0000	.53	–

[1] Four months. [2] October omitted.

Green River, below Greenfield.

Year.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Suspended.	Chlorine.	Nitrates.	Nitrites.	Oxygen consumed.	Hardness.
1903,	.05	7.75	2.23	.0152	.0143	.0086	.0057	.21	.0078	.0005	.15	3.9
1904,	.07	6.93	2.01	.0151	.0382	.0138	.0244	.28	.0100	.0006	.22	3.8
1908,	.17	11.06	2.97	.0665	.0337	.0131	.0206	.45	.0043	.0011	.33	–
1909,	.14	7.82	2.54	.0459	.0333	.0151	.0182	.37	.0038	.0011	.23	–
1910,	.17	8.33	3.16	.0775	.0284	.0169	.0115	.37	.0025	0012	.23	–
1911,	.21	9.23	2.44	.0684	.0228	.0115	.0113	.48	.0033	.0014	.37	–
1912,	.17	18.02	2.71	.0099	.0352	.0092	.0260	.23	.0017	.0003	.44	–
1913,	.12	8.25	2.25	.0203	.0198	.0103	.0095	.26	.0030	.0003	.22	–

Deerfield River, below Green River.

Year.	Color.	Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Suspended.	Chlorine.	Nitrates.	Nitrites.	Oxygen consumed.	Hardness.
1908,	.26	7.35	2.28	.0075	.0154	.0098	.0056	.20	.0025	.0002	.37	–
1909,	.28	5.55	1.83	.0043	.0121	.0104	.0017	.14	.0012	.0001	.41	–
1910,	.24	5.82	2.37	0093	.0128	.0112	.0016	.16	.0008	.0003	.31	–
1911,	.34	5.82	2.06	.0078	.0143	.0106	.0037	.16	.0025	.0005	.52	–
1912,	.25	5.23	1.63	.0070	.0140	.0107	.0033	.17	.0030	.0001	.37	–
1913,	.28	5.39	1.60	.0113	.0257	.0183	.0074	.17	.0063	.0002	.39	–

French River.

A general statement of the condition of this river in the year 1913 will be found on page 24.

FRENCH RIVER.

Chemical Examination of Water from French River. — Averages for Six Months, from June to November, inclusive.

French River, below Webster.

[Parts in 100,000.]

Year.	Color.	Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen consumed.	Hardness.
					Albuminoid.							
		Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Suspended.		Nitrates.	Nitrites.		
1899,	.44	5.67	2.07	.0238	.0612	.0384	.0228	.42	.0024	.0007	.66	1.6
1900,	.52	5.79	2.10	.0202	.0475	.0357	.0118	.46	.0062	.0007	.78	1.5
1901,	.50	5.29	2.25	.0090	.0390	.0265	.0125	.33	.0044	.0002	.75	1.2
1902,	.42	4.92	1.99	.0057	.0391	.0264	.0127	.39	.0038	.0002	.65	1.2
1903,	.48	4.67	1.88	.0049	.0352	.0241	.0111	.40	.0058	.0002	.72	0.9
1904,	.44	6.02	2.18	.0267	.0434	.0281	.0153	.58	.0042	.0004	.70	1.3
1906,	.61	5.08	2.19	.0063	.0353	.0246	.0107	.40	.0038	.0003	.81	0.9
1907,[1]	.54	6.28	2.62	.0117	.0544	.0304	.0240	.49	.0035	.0004	.69	1.2
1908,	.44	7.17	2.82	.0086	.0507	.0310	.0197	.61	.0037	.0010	.81	–
1909,	.50	7.42	2.61	.0267	.0638	.0385	.0253	.77	.0055	.0012	.72	–
1910,	.44	8.27	3.55	.0512	.0527	.0321	.0206	.78	.0016	.0021	.79	–
1911,	.57	10.23	3.17	.0219	.0652	.0405	.0247	.89	.0015	.0004	.94	–
1912,	.49	9.78	3.77	.0420	0745	.0399	.0346	.82	.0060	.0021	.87	–
1913,	.53	8.42	2.93	.0345	.0641	.0358	.0283	.72	.0042	.0007	.86	–

[1] Four months.

Hoosick River.

A general statement of the condition of this river in the year 1913 will be found on page 24.

HOOSICK RIVER.

Chemical Examination of Water from Hoosick River. — Averages for Six Months, from June to November, inclusive.

Hoosick River, at Williamstown.

[Parts in 100,000.]

Year.	Color.	Residue on Evaporation. Total.	Residue on Evaporation. Loss on Ignition.	Ammonia. Free.	Ammonia. Albuminoid. Total.	Ammonia. Albuminoid. Dissolved.	Ammonia. Albuminoid. Suspended.	Chlorine.	Nitrogen as Nitrates.	Nitrogen as Nitrites.	Oxygen consumed.	Hardness.
1887, ...	.22	12.05	1.22	.0065	.0190	–	–	.23	.0232	–	–	–
1888, ...	.12	10.82	1.90	.0026	.0210	.0142	.0068	.27	.0247	.0015	–	–
1894, ...	.37	13.56	2.74	.0166	.0361	.0224	.0137	.50	.0102	.0014	.42	9.0
1895, ...	.34	14.20	3.26	.0190	.0424	.0241	.0183	.63	.0090	.0020	.53	9.0
1896, ...	.21	11.71	2.39	.0295	.0267	.0172	.0095	.39	.0133	.0018	.33	8.6
1897, ...	.26	11.32	2.39	.0174	.0312	.0173	.0139	.30	.0265	.0011	.31	7.9
1898, ...	.27	10.46	2.38	.0223	.0311	.0210	.0101	.31	.0170	.0007	.34	6.6
1899, ...	.30	15.21	3.31	.0252	.0622	.0379	.0243	.64	.0070	.0029	.62	8.3
1900, ...	.28	14.20	2.79	.0433	.0547	.0301	.0246	.60	.0087	.0043	.58	7.8
1901, ...	.27	13.02	3.70	.0400	.0520	.0250	.0270	.43	.0152	.0024	.53	7.3
1902, ...	.22	10.62	2.87	.0069	.0307	.0172	.0135	.34	.0123	.0014	.40	6.4
1903, ...	.17	10.50	2.37	.0272	.0264	.0151	.0113	.29	.0183	.0019	.33	7.5
1904, ...	.13	12.30	3.23	.0677	.0310	.0191	.0119	.45	.0203	.0024	.29	8.3
1905, ...	.20	11.09	2.81	.0295	.0265	.0156	.0109	.32	.0123	.0015	.31	5.6
1906, ...	.31	13.28	3.63	.0415	.0489	.0252	.0237	.47	.0147	.0030	.43	6.0
1907, ...	.25	11.80	2.93	.0431	.0390	.0231	.0159	.47	.0135	.0021	.39	7.9
1908, ...	.23	14.00	3.86	.0559	.0323	.0195	.0128	.54	.0085	.0023	.37	–
1909, ...	.23	15.46	4.09	.0496	.0382	.0243	.0139	.62	.0060	.0035	.41	–
1910, . . .	.30	13.06	4.43	.0320	.0336	.0219	.0117	.52	.0102	.0018	.41	–
1911, ...	.26	12.38	3.77	.1153	.0492	.0232	.0260	.58	.0065	.0022	.43	–
1912, ...	.24	15.05	3.35	.0365	.0464	.0280	.0184	.73	.0058	.0025	.45	9.3
1913, ...	.13	17.57	3.78	.0638	.0489	.0310	.0179	.88	.0053	.0024	.49	9.2

Housatonic River.

A general statement of the condition of this river in the year 1913 will be found on page 24.

HOUSATONIC RIVER.

Chemical Examination of Water from Housatonic River and its Branches. — Averages for Six Months, from June to November, inclusive.

East Branch, below Pittsfield.

[Parts in 100,000.]

Year.	Color.	Residue on Evaporation. Total.	Residue on Evaporation. Loss on Ignition.	Ammonia. Free.	Ammonia. Albuminoid. Total.	Ammonia. Albuminoid. Dissolved.	Ammonia. Albuminoid. Suspended.	Chlorine.	Nitrogen as Nitrates.	Nitrogen as Nitrites.	Oxygen consumed.	Hardness.
1903,	.32	9.75	2 92	.0118	.0226	.0153	.0073	.25	.0142	.0006	.56	6.8
1904,[1]	.28	9.02	3.15	.0117	.0248	.0175	.0073	.26	.0113	.0005	.47	6.2
1907,[2]	.42	9.40	3.00	.0286	.0284	.0186	.0098	.28	.0060	.0010	.50	6.4
1908,[3]	.29	12.76	3.57	.0327	.0250	.0177	.0073	.40	.0140	.0011	.47	–
1909,	.26	12.60	4.37	.0431	.0305	.0215	.0090	.33	.0087	.0007	.44	–
1910,	.30	12.98	5.26	.0437	.0233	.0182	.0051	.40	.0080	.0012	.48	–
1911,[1]	.29	12.03	4.26	.0231	.0253	.0169	.0084	.37	.0060	.0011	.54	–
1912,[1]	.28	13.08	3.18	.0358	.0337	.0236	.0101	.43	.0123	.0010	.62	–
1913,	.32	15 34	3.60	.0526	.0405	.0259	.0146	.48	.0073	.0019	.69	–

[1] Three months. [2] Two months. [3] November omitted.

West Branch, below Pittsfield.

1903,	.29	10.43	2.83	.0100	.0210	.0143	.0067	.23	.0143	.0006	.46	7.4
1904,[1]	.15	12 27	3.50	.0137	.0423	.0217	.0206	.35	.0050	.0004	.35	7.8
1908,[2]	.20	13.28	3 68	.0210	.0301	.0194	.0107	.26	.0026	.0009	.36	–
1909,	–	11.00	2.87	.0070	.0283	.0175	.0108	.24	.0010	.0003	.25	–
1910,	.22	13.85	4.98	.0218	0446	.0218	.0228	.40	.0012	.0011	.40	–
1911,[1]	.19	12.73	4 70	.0090	0317	.0184	.0133	.26	.0030	.0005	.37	–
1912,[1]	.17	12 60	2.70	.0081	0360	.0197	.0163	.29	.0037	.0005	.41	–
1913,	.30	18.72	5.10	0870	.0779	.0397	.0382	.78	.0020	.0008	.82	–

[1] Three months. [2] November omitted.

HOUSATONIC RIVER.

Chemical Examination of Water from Housatonic River and its Branches, etc. — *Concluded.*

Southwest Branch, at Pittsfield.

[Parts in 100,000.]

Year.	Color.	Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen consumed.	Hardness.
					albuminoid.							
		Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Suspended.		Nitrates.	Nitrites.		
1899, ...	.17	14.92	2.58	.0040	.0353	.0211	.0142	.16	.0108	.0004	.37	9.2
1900, ...	.14	14.87	2.15	.0192	.0335	.0229	.0106	.21	.0107	.0008	.35	10 2
1901, ...	.14	13.20	3.87	.0051	.0302	.0197	.0105	.16	.0096	.0004	.41	9.4
1902, ...	.11	12.30	3.09	.0057	.0224	.0136	.0088	.12	.0108	.0005	.37	8.7
1903, ...	.10	11.63	2.37	.0045	.0162	.0109	.0053	.11	.0115	.0003	.25	8.8
1904,[1]	.15	12.45	3.63	.0116	.0455	.0223	.0232	.34	.0040	.0018	.35	7.8
1907,[2]	.31	10.78	2.30	.0040	0258	.0168	.0090	.20	.0025	.0003	.39	8.2
1908,[3]	.18	15.17	4.89	.0216	.0269	.0159	.0110	.23	.0036	.0007	.38	–
1909, ...	.17	14 82	4.41	.0041	.0265	.0153	.0112	.23	.0082	.0005	.37	–
1910, ...	.17	14.45	5.25	.0049	.0196	.0135	.0061	.17	.0045	.0006	.30	–
1911,[1]	.14	12.62	3.35	.0013	.0224	.0131	.0093	.19	.0110	.0005	.34	–
1912,[1]	.12	15.02	3.08	.0017	.0172	.0111	.0061	.21	.0170	.0007	.31	–
1913, ...	.13	15.97	3.34	.0037	.0221	.0157	.0064	.20	.0115	.0009	.32	–

[1] Three months. [2] Two months. [3] November omitted.

Housatonic River, below Great Barrington.

1908, ...	.18	14.97	3.69	.0106	.0269	.0172	.0097	.43	.0107	.0011	.36	–
1909, ...	.16	14.91	4.41	.0067	.0247	.0173	.0074	.47	.0078	.0012	.35	–
1910, ...	.22	14.97	5.32	.0128	.0233	.0181	.0052	.51	.0090	.0021	.34	–
1911, ...	.19	14.42	5.29	.0178	.0217	.0157	.0060	.45	.0087	.0045	.40	–
1912,[1]	.22	14.56	3.79	.0123	.0272	.0189	.0083	.47	.0120	.0028	.42	–
1913, ...	.21	18.60	5.48	.0117	.0444	.0265	.0179	.67	.0085	.0030	.77	–

[1] August omitted.

Merrimack River.

A general statement of the condition of this river during the year 1913 will be found on page 26.

MERRIMACK RIVER.

Chemical Examination of Water from Merrimack River. — Averages for Six Months, from June to November, inclusive.

Merrimack River, above Lowell.

[Parts in 100,000.]

Year.	Color.	Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen consumed.	Hardness.
		Total.	Loss on Ignition.	Free.	Albuminoid. Total.	Albuminoid. Dissolved.	Albuminoid. Suspended.		Nitrates.	Nitrites.		
1887, ...	.45	4.08	1.10	.0024	.0156	-	-	.17	.0078	-	-	-
1888, ...	.32	3.47	1.01	.0014	.0161	.0137	.0024	.16	.0082	.0002	-	-
1889, ...	.37	-	-	.0028	.0166	.0143	.0023	.17	.0067	.0001	-	-
1890, ...	.34	3.85	1.58	.0025	.0148	.0123	.0025	.14	.0106	.0002	-	1.4
1891, ...	.27	3.73	1.47	.0029	.0147	.0111	.0036	.17	.0080	.0002	-	1.4
1892, ...	.39	3.75	1.37	.0028	.0139	.0106	.0033	.15	.0097	.0002	-	1.6
1893, ...	.25	3.47	1.13	.0028	.0141	.0110	.0031	.17	.0072	.0001	.38	1.1
1894, ...	.29	3.86	1.32	.0037	.0140	.0114	.0026	.19	.0042	.0001	.36	1.2
1895, ...	.43	3.97	1.61	.0019	.0197	.0151	.0046	.24	.0054	.0001	.55	1.2
1896, ...	.44	3.85	1.41	.0049	.0181	.0149	.0032	.18	.0053	.0002	.66	1.0
1897, ...	.54	3.62	1.68	.0030	.0181	.0148	.0033	.16	.0077	.0001	.52	0.9
1898, ...	.39	3.93	1.74	.0032	.0197	.0171	.0026	.19	.0047	.0001	.51	1.0
1899, ...	.20	3.88	1.45	.0050	.0205	.0166	.0039	.22	.0055	.0002	.38	1.2
1900, ...	.23	3.72	1.21	.0068	.0215	.0158	.0057	.23	.0038	.0002	.44	1.3
1901, ...	.38	4.32	1.98	.0060	.0208	.0172	.0036	.20	.0042	.0002	.69	1.2
1902, ...	.38	3.81	1.59	.0056	.0163	.0142	.0021	.17	.0043	.0001	.64	0.9
1903, ...	.30	4.00	1.55	.0058	.0171	.0129	.0042	.23	.0040	.0002	.59	1.1
1904, ...	.33	4.61	1.92	.0077	.0194	.0153	.0041	.23	.0047	.0002	.69	1.3
1905, ...	.40	4.30	1.95	.0112	.0202	.0160	.0042	.25	.0038	.0002	.71	1.1
1906, ...	.37	4.64	1.84	.0100	.0201	.0174	.0027	.26	.0032	.0002	.71	1.2
1907, ...	.38	4.60	1.88	.0079	.0194	.0135	.0059	.28	.0043	.0002	.62	1.2
1908, ...	.29	4.67	1.80	.0125	.0195	.0141	.0054	.36	.0048	.0003	.64	1.3
1909, ...	.31	5.16	2.38	.0185	.0213	.0161	.0052	.36	.0018	.0002	.68	1.5
1910, ...	.37	5.11	1.78	.0242	.0221	.0180	.0041	.35	.0035	.0007	.68	1.4
1911, ...	.39	5.32	2.09	.0166	.0219	.0165	.0054	.36	.0033	.0006	.65	1.5
1912, ...	.40	5.16	1.94	.0165	.0223	.0175	.0048	.32	.0013	.0003	.88	2.0
1913,[1]	.36	5.56	1.66	.0162	.0277	.0189	.0088	.39	.0030	.0003	.70	1.8

[1] June omitted.

MERRIMACK RIVER.

Chemical Examination of Water from Merrimack River, etc. — *Concluded.*

Merrimack River, above Lawrence.

[Parts in 100,000.]

Year.	Color.	Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen consumed.	Hardness.
					Albuminoid.							
		Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Suspended.		Nitrates.	Nitrites.		
1887,	.47	4.82	1.24	.0027	.0211	–	–	.22	.0097	–	–	–
1888,	.32	3 64	1.13	.0029	.0197	0153	.0044	.18	.0074	.0003	–	–
1889,	.35	–	–	.0047	.0212	.0176	.0036	.20	.0053	.0002	–	–
1890,	.37	4.27	1.56	.0061	.0187	.0148	.0039	.19	.0068	.0002	–	1.6
1891,	.21	4.06	1.37	.0066	.0179	.0138	.0041	.21	.0090	.0002	–	1.4
1892,	.46	4.25	1.50	.0054	.0186	.0155	.0031	.19	.0087	.0002	–	1.5
1893,	.40	4.25	1.62	.0084	.0172	.0138	.0034	.23	.0057	.0003	.52	1.3
1894,	.32	3.82	1.35	.0086	.0174	.0142	.0032	.25	.0043	.0001	.40	1.3
1895,	.52	4 45	1.97	.0068	.0251	.0194	.0057	.30	.0067	.0003	.60	1.5
1896,	.46	4 24	1.70	.0100	.0224	.0181	.0043	.25	.0067	.0005	.57	1.3
1897,	.58	4 06	1.67	.0061	.0222	.0190	.0032	.21	.0053	.0002	.53	1.0
1898,	.44	4.46	1.87	.0076	.0262	.0208	.0054	.25	.0050	.0005	.59	1.3
1899,	.24	4.42	1.57	.0138	.0277	.0207	.0070	.32	.0052	.0004	.43	1.3
1900,	.27	4.22	1.35	.0126	.0249	.0190	.0059	.32	.0050	.0003	.46	1.3
1901,	.44	4.73	1.90	.0100	.0280	.0205	.0075	.28	.0070	.0006	.65	1.5
1902,	.42	4.40	1.85	.0110	.0231	.0180	.0051	.26	.0038	.0003	.65	1.1
1903,	.37	4.66	1.73	.0111	.0226	.0166	.0060	.31	.0052	.0005	.64	1.4
1904,	.31	4.67	1.80	.0211	.0247	.0170	.0077	.33	.0053	.0004	.62	1.4
1905,	.44	4 92	2.01	.0177	.0242	.0183	.0059	.38	.0040	.0005	.74	1 2
1906,	.39	5.30	2.12	.0170	.0263	.0215	.0048	.40	.0027	.0005	.72	1.4
1907,	.40	4.92	1.80	.0293	.0253	.0175	.0078	.41	.0047	.0005	.59	1.3
1908,	.33	5.61	2.19	.0354	.0303	.0196	.0107	.57	.0052	.0006	.74	1.5
1909,	.33	6.28	2.04	.0336	.0262	.0196	.0066	.53	.0025	.0007	.67	1.7
1910,	.39	–	–	.0266	.0242	.0183	.0059	.53	.0125	.0008	.57	1.6
1911,	.23	8.22	3.10	.0240	.0286	.0227	.0059	.53	.0118	.0007	.65	1.6
1912,	.21	6.49	2.62	.0241	.0225	.0188	.0037	.52	.0151	.0006	.59	1.3
1913,	.25	7.46	2.93	.0245	.0224	.0185	.0039	.57	.0167	.0007	.61	1.5

MILLER'S RIVER.

MILLER'S RIVER.

CHEMICAL EXAMINATION OF WATER FROM MILLER'S RIVER. — AVERAGES FOR SIX MONTHS, FROM JUNE TO NOVEMBER, INCLUSIVE.

Miller's River, below Miller's Falls.

[Parts in 100,000.]

Year.	Color.	Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen consumed.	Hardness.
					Albuminoid.							
		Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Suspended.		Nitrates.	Nitrites.		
1908, . . .	.54	4.59	2.06	.0054	.0233	.0181	.0052	.34	.0060	.0002	.64	–
1909, . . .	.54	4.38	1.84	.0035	.0207	.0181	.0026	.34	.0030	.0002	.60	–
1910, . . .	.55	5.48	2.28	.0068	.0231	.0202	.0029	.44	.0075	.0002	.68	–
1911, . . .	.66	5.98	2.58	.0056	.0258	.0220	.0038	.35	.0052	.0002	.90	–
1912, . . .	.51	5.30	2.17	.0047	.0242	.0202	.0040	.42	.0060	.0002	.61	–
1913, . . .	.59	5.65	1.88	.0056	.0315	.0231	.0084	.36	.0081	.0002	.69	–

Nashua River.

A general statement of the condition of this river in the year 1913 will be found on page 27.

NASHUA RIVER.

Chemical Examination of Water from Nashua River. — Averages for Six Months, from June to November, inclusive.

North Branch of Nashua River, below Fitchburg.

[Parts in 100,000.]

Year.	Color.	Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen consumed.	Hardness.
					Albuminoid.							
		Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Suspended.		Nitrates.	Nitrites.		
1893,	.70	8.32	2.38	.0562	.0405	.0289	.0116	.73	.0097	.0030	.73	2.2
1894,	.66	9.18	2.22	.0987	.0425	.0308	.0117	.99	.0123	.0034	.64	2.4
1895,	.71	9.42	2.72	.1387	.0493	.0381	.0112	1.08	.0088	.0014	.82	2.6
1896,	.57	9.27	2.62	.0898	.0537	.0384	.0153	.95	.0127	.0030	.71	2.4
1897,	.67	7.62	2.50	.0512	.0518	.0389	.0129	.71	.0112	.0009	.79	2.1
1898,	.56	7.02	2.37	.0688	.0629	.0399	.0230	.56	.0097	.0016	.72	1.8
1899,	.53	10.12	2.95	.1507	.0848	.0537	.0311	1.03	.0055	.0013	.83	2.4
1900,	.42	9.55	2.42	.1575	.0825	.0479	.0346	1.03	.0080	.0015	.73	2.6
1901,	.42	8.45	2.58	.0964	.0508	.0347	.0161	.67	.0080	.0013	.69	2.2
1902,	.39	7.83	2.42	.1070	.0557	.0407	.0150	.68	.0072	.0012	.71	1.9
1903,	.38	7.21	2.10	.1200	.0471	.0281	.0190	.73	.0095	.0014	.62	1.7
1904,	.33	9.05	2.70	.1858	.0596	.0341	.0255	.88	.0077	.0015	.70	2.1
1905,	.48	7.66	2.33	.1284	.0568	.0354	.0214	.73	.0053	.0008	.89	2.1
1906,	.47	7.68	2.16	.1037	.0558	.0356	.0202	.75	.0083	.0020	.68	2.0
1907,	.50	10.77	2.72	.2180	.0654	.0350	.0304	1.24	.0065	.0012	.72	2.8
1908,	.52	15.05	3.60	.2605	.0861	.0494	.0367	1.58	.0033	.0016	1.04	–
1909,	.52	15.85	3.42	.3220	.0958	.0563	.0395	1.87	.0027	.0014	1.02	–
1910,	.60	20.11	4.90	.4047	.1235	.0789	.0446	2.29	.0017	.0009	1.03	–
1911,	.51	19.38	5.57	.2848	.1035	.0566	.0469	2.37	.0027	.0015	1.15	–
1912,	.57	19.52	4.99	.2380	.1007	.0560	.0447	2.20	.0032	.0019	1.22	–
1913,	.40	23.45	4.97	.2770	.1064	.0561	.0503	2.02	.0028	.0013	1.42	5.0

NASHUA RIVER.

CHEMICAL EXAMINATION OF WATER FROM NASHUA RIVER, ETC. — *Concluded.*

North Branch of Nashua River, at Lancaster.

[Parts in 100,000.]

Year.	Color.	Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen consumed.	Hardness.
					Albuminoid.							
		Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Suspended.		Nitrates.	Nitrites.		
1892,	.48	9.75	2 10	.0422	.0274	.0237	.0037	1 11	.0450	.0010	–	3.0
1894,	.49	8.07	1.97	.0215	.0226	.0182	.0044	.97	.0295	.0011	.49	2 2
1895,	.51	8.28	2.39	.0318	.0272	.0214	.0058	1.01	.0284	.0034	.56	2.3
1896,	.57	6.97	2.17	.0253	.0322	.0253	.0069	.66	.0167	.0034	.60	2.0
1897,	.65	5.45	2.03	.0225	.0290	.0221	.0069	.40	.0153	.0015	.68	1.5
1898,	.48	6.33	2.10	.0409	.0345	.0263	.0082	.56	.0227	.0033	.51	1.7
1899,	.39	7.60	2.33	.0739	.0365	.0305	.0060	.75	.0153	.0028	.60	2.0
1900,	.29	7.17	1.55	.0545	.0326	.0264	.0062	.81	.0202	.0039	.52	2.1
1901,	.37	6.72	2.14	.0432	.0329	.0240	.0089	.54	.0087	.0021	.58	1.9
1902,	.40	7.96	2 66	.0757	.0324	.0267	.0057	.70	.0188	.0043	.58	1 8
1903,	.36	6.95	2.35	.0473	.0260	.0201	.0059	.58	.0258	.0034	.52	1.6
1904,	.32	8.01	2.18	.0803	.0318	.0267	.0051	.80	.0267	.0040	.53	2.0
1905,	.34	7.20	2.13	.0616	.0296	.0227	.0069	.70	.0207	.0044	.50	1.9
1906,	.44	7.34	2.12	.0519	.0311	.0240	.0071	.72	.0238	.0027	.56	2 0
1907,	.44	8.34	2.33	.0600	.0294	.0232	.0062	.89	.0333	.0084	.53	2.1
1908,	.40	10.69	2.73	.1075	0309	.0259	.0050	1.28	.0405	.0090	.58	–
1909,	.44	12.26	3.41	.1556	.0330	.0284	.0046	1.46	.0360	0066	.60	–
1910,	.45	13.44	3.82	.1655	.0462	.0366	.0096	1.63	.0388	.0108	.70	–
1911,	.51	15.64	4.10	.3067	.0828	.0408	.0420	1.95	.0208	.0083	.92	–
1912,	.45	12.65	3.10	.1252	.0438	.0275	.0163	1.68	.0343	.0083	.72	–
1913,	.43	15.45	3.02	.2292	.0533	.0386	.0147	1.75	.0133	.0053	.80	4.2

Nashua River, at Pepperell.

1899,	.28	6.91	2.19	.0167	.0248	.0221	.0027	.78	.0137	.0008	.46	2 1
1901,	.37	6.00	2.06	.0154	.0266	.0230	.0036	.45	.0092	.0005	.55	1.9
1902,	.37	5.81	2.07	.0118	.0184	.0167	.0017	.49	.0162	.0006	.51	1.7
1903,	.35	5.15	1.57	.0097	.0180	.0152	.0028	.44	.0128	.0008	.55	1.6
1904,[1]	.30	6.23	1.93	.0111	.0206	.0171	.0035	.58	.0243	.0008	.44	1.9
1908,	.32	10.85	3.40	.0317	.0295	.0202	.0093	1.45	.0194	.0008	.63	–
1909,	.38	14 29	4.62	.0354	.0376	.0291	.0085	1.95	.0211	.0017	.92	–
1910,	.37	14 77	4.14	.0128	.0329	.0252	.0077	1.93	.0207	.0008	.81	–
1911,	.40	12.10	3.77	.0423	.0393	.0293	.0100	1.31	.0213	.0048	.62	–
1912,[2]	.48	12.52	3 28	.0223	.0409	.0254	.0155	1.46	.0204	.0017	.75	–
1913,[3]	.43	11.99	2.79	.0515	.0405	.0276	.0129	1 15	0164	.0019	.73	–

[1] Three months. [2] November omitted. [3] Four months.

NEPONSET RIVER.

NEPONSET RIVER.

CHEMICAL EXAMINATION OF WATER FROM NEPONSET RIVER. — AVERAGES FOR SIX MONTHS, FROM JUNE TO NOVEMBER, INCLUSIVE.

Neponset River, at Hyde Park.

[Parts in 100,000.]

Year.	Color.	Residue on Evaporation. Total.	Residue on Evaporation. Loss on Ignition.	Ammonia. Free.	Ammonia. Albuminoid. Total.	Ammonia. Albuminoid. Dissolved.	Ammonia. Albuminoid. Suspended.	Chlorine.	Nitrogen as Nitrates.	Nitrogen as Nitrites.	Oxygen consumed.	Hardness.
1887, . . .	1.18	8.20	2.22	.0053	.0402	–	–	.98	.0077	–	–	–
1888, . . .	1.12	7.77	2.37	.0040	.0392	.0358	.0034	1.08	.0074	.0003	–	–
1893, . . .	1.27	8.60	2.68	.0233	.0370	.0282	.0088	1.47	.0045	.0009	1.00	2.6
1894, . . .	1.19	12.87	3.03	.0196	.0466	.0333	.0133	2.31	.0033	.0002	1.03	4.1
1895, . . .	.97	10.01	3.07	.0341	.0440	.0373	.0067	1.51	.0042	.0001	1.05	3.7
1896, . . .	1.26	10.41	3.12	.0162	.0431	.0395	.0036	1.68	.0033	.0001	1.26	3.3
1897, . . .	1.30	11.64	3.34	.0336	.0494	.0417	.0077	1.81	.0037	.0001	1.31	4.0
1898, . . .	1.28	8.82	3.52	.0161	.0505	.0398	.0107	1.02	.0023	.0002	1.30	2.7
1899, . . .	1.14	16.24	4.51	.0264	.0936	.0693	.0243	2.20	.0032	.0002	1.76	5.7
1900, . . .	1.10	10.59	2.99	.0400	.0576	.0381	.0195	1.45	.0048	.0005	1.07	3.2
1901, . . .	1.43	13.26	5.09	.0224	.0802	.0591	.0211	1.69	.0036	.0006	1.82	4.2
1902, . . .	1.02	12.57	4.19	.0360	.0640	.0547	.0093	1.72	.0035	.0004	1.29	4.0
1903, . . .	1.29	14.21	4.95	.0278	.0811	.0638	.0173	1.86	.0034	.0010	1.71	4.5
1904, . . .	1.08	16.22	5.68	.0631	.1007	.0777	.0230	2.07	.0037	.0005	1.67	5.6
1905, . . .	1.22	21.88	6.68	.0813	.1043	.0861	.0182	3.44	.0028	.0006	2.22	6.6
1906, . . .	1.35	13.47	4.42	.0549	.0875	.0674	.0201	2.21	.0025	.0008	1.85	3.9
1907, . . .	.90	22.58	6.31	.1201	.1412	.0961	.0451	3.81	.0042	.0004	1.94	6.9
1908, . . .	–	25.40	7.19	.1132	.1209	.0844	.0365	5.08	.0027	.0006	2.01	8.8
1909, . . .	–	28.69	9.08	.1723	.1218	.0898	.0320	5.35	.0027	.0009	2.02	10.0
1910, . . .	–	31.37	10.16	.1740	.1333	.1000	.0333	5.84	.0010	.0002	2.96	10.4
1911, . . .	1.24	18.82	5.49	.0786	.0727	.0539	.0188	3.36	.0025	.0007	1.86	7.1
1912, . . .	.82	26.02	6.45	.1241	.1020	.0707	.0313	4.18	.0017	.0012	2.31	9.2
1913, . . .	1.02	26.13	6.22	.0533	.0757	.0494	.0263	3.93	.0020	.0007	2.29	7.9

QUINEBAUG RIVER.

QUINEBAUG RIVER.

CHEMICAL EXAMINATION OF WATER FROM QUINEBAUG RIVER. — AVERAGES FOR SIX MONTHS, FROM JUNE TO NOVEMBER, INCLUSIVE.

Quinebaug River, below Southbridge.

[Parts in 100,000.]

Year.	Color.	Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen consumed.	Hardness.
					Albuminoid.							
		Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Suspended.		Nitrates.	Nitrites.		
1898, . . .	.64	4.18	2.00	.0064	.0372	.0309	.0063	.18	.0050	.0003	.66	0.8
1899, . . .	.44	4.32	1.72	.0071	0298	.0229	.0069	.23	.0048	.0002	.54	1.2
1900, . . .	.40	4.31	1.56	.0168	0324	.0211	.0113	.25	.0024	0003	.52	1.0
1901, . . .	.42	4.52	1 67	.0147	.0232	.0158	.0074	.19	.0050	0005	.45	1.7
1902, . . .	.36	4.12	1.45	.0068	.0224	.0179	.0045	.24	.0054	0002	.43	1.2
1903,[1] . . .	.39	3.84	1.37	.0076	.0225	.0181	.0044	.24	.0043	0002	.52	1.0
1904, . . .	.40	4.17	1.57	0086	.0247	.0189	0058	.26	.0068	.0002	.53	1.2
1908, . . .	.46	6.82	2.31	.0075	.0277	.0174	.0103	.33	.0038	.0003	.57	–
1909, . . .	.40	5.48	1.99	.0087	.0275	.0219	.0056	.37	.0077	0003	.56	–
1910, . . .	.40	6.20	2.27	.0104	.0334	.0246	.0088	.42	0032	.0004	.53	–
1911,[1] . . .	.50	5.92	2.09	.0180	.0308	.0240	.0068	.41	.0067	.0002	.66	–
1912,[2] . . .	.41	7.35	2.40	.0152	.0397	.0272	.0125	.52	.0025	.0004	.59	–
1913,[1] . . .	.39	6.08	1.88	.0201	.0283	.0219	.0064	.59	.0075	.0007	.53	–

[1] Four months. [2] Two months.

Taunton River.

A general statement of the condition of this river and its tributaries in the year 1913 will be found on pages 27 and 28.

TAUNTON RIVER.

Chemical Examination of Water from Taunton River. — Averages for Six Months, from June to November, inclusive.

Taunton River, below Taunton.

[Parts in 100,000.]

Year.	Color.	Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen consumed.	Hardness.
					Albuminoid.							
		Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Suspended.		Nitrates.	Nitrites.		
1898,	1.56	6.64	3.30	.0109	.0345	.0314	.0031	.61	.0082	.0003	1.51	1.3
1899,	.93	6.31	2.48	.0176	.0317	.0279	.0038	.72	.0060	.0004	1.04	1.2
1900,	.71	6.89	1.91	.0205	.0286	.0258	.0028	1.06	.0112	.0006	.76	1.5
1901,	1.01	6.15	2.45	.0293	.0275	.0255	.0020	.76	.0134	.0005	.92	1.6
1902,[1]	.94	6.92	2.36	.1902	.0363	.0308	.0055	1.29	.0116	.0012	.90	1.4
1903,	.96	7.06	2.60	.0542	.0270	.0234	.0036	1.10	.0177	.0013	1.02	1.7
1904,	.95	6.49	2.60	.0855	.0319	.0264	.0055	.94	.0137	.0008	1.06	1.3
1906,[2]	1.41	7.37	3.11	.0401	.0385	.0331	.0054	.95	.0162	.0008	1.36	1.4
1907,[3]	.94	7.16	2.62	.1031	.0343	.0282	.0061	1.05	.0115	.0009	1.05	1.7
1908,	.73	7.66	2.52	.0469	.0278	.0226	.0052	1.31	.0108	.0011	.74	–
1909,	.90	12.97	3.87	.0416	.0303	.0263	.0040	3.49	.0105	.0014	.88	–
1910,	1.04	19.62	5.69	.0658	.0376	.0305	.0071	6.82	.0110	.0027	.93	–
1911,	1.04	9.65	2.80	.0385	.0330	.0270	.0060	1.73	.0205	.0015	1.04	–
1912,	1.17	10.35	2.95	.0461	.0366	.0295	.0071	1.76	.0173	.0015	1.03	–
1913,	1.09	18.58	4.24	.0506	.0377	.0334	.0043	5.94	.0130	.0015	1.07	–

[1] September omitted. [2] June omitted. [3] Four months.

Ten Mile River.

A general statement of the condition of this river in the year 1913 will be found on page 28.

Chemical Examination of Water from Ten Mile River. — Averages for Six Months, from June to November, inclusive.

Ten Mile River, below Attleborough.

[Parts in 100,000.]

Year.	Color.	Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen consumed.	Hardness.
					Albuminoid.							
		Total.	Loss on Ignition.	Free.	Total.	Dissolved.	Suspended.		Nitrates.	Nitrites.		
1899,	.71	6.39	2.15	.0072	.0379	.0288	.0091	.62	.0133	.0004	.74	1.7
1900,	.47	6.19	1.60	.0125	.0363	.0241	.0122	.84	.0155	.0004	.49	1.8
1901,	.46	6.09	2.12	.0084	.0290	.0202	.0088	.71	.0222	.0004	.51	1.8
1902,	.41	6.49	1.83	.0073	.0394	.0237	.0157	.88	.0212	.0004	.52	1.9
1903,	.36	7.48	2.39	.0282	.0346	.0200	.0146	.84	.0315	.0020	.53	1.8
1904,	.44	8.89	2.97	.0931	.0527	.0332	.0195	1.03	.0532	.0033	.58	3.5
1906,[1]	.48	17.57	6.45	.1586	.0914	.0490	.0424	1.07	.0638	.0121	.92	7.9
1907,[1]	.42	19.07	6.14	.6036	.1471	.0830	.0641	1.73	.2014	.0100	1.18	7.5
1908,	.40	10.89	3.27	.1108	.0483	.0294	.0189	1.37	.0364	.0035	.61	–
1909,	.47	11.23	2.88	.4322	.0626	.0380	.0246	1.51	.0263	.0086	.78	–
1910,	.29	12.05	3.32	.2422	.0545	.0330	.0215	1.98	.0357	.0051	.48	–
1911,	.76	11.94	3.58	.0604	.0506	.0302	.0204	1.55	.0382	.0036	.94	–
1912,	.39	28.98	11.42	.1056	.0750	.0287	.0463	1.92	.0368	.0075	.75	3.6
1913,	.64	13.55	3.33	.0951	.0630	.0303	.0327	1.90	.0242	.0069	.84	–

[1] June omitted.

Westfield River.

A general statement of the condition of this river in the year 1913 will be found on page 28.

WESTFIELD RIVER.

Chemical Examination of Water from Westfield River. — Averages for Six Months, from June to November, inclusive.

Westfield River, below Westfield.

[Parts in 100,000.]

Year.	Color.	Residue on Evaporation.		Ammonia.				Chlorine.	Nitrogen as		Oxygen consumed.	Hardness.
		Total.	Loss on Ignition.	Free.	Albuminoid. Total.	Albuminoid. Dissolved.	Albuminoid. Suspended.		Nitrates.	Nitrites.		
1902,	.22	4.21	1.60	.0062	.0144	.0118	.0026	.14	.0062	.0002	.39	1.9
1903,	.15	3.68	1.30	.0037	.0127	.0105	.0022	.16	.0088	.0003	.28	1.8
1904,	.21	4.16	1.59	.0067	.0152	.0119	.0033	.16	.0068	.0001	.38	1.9
1906,[1]	.21	4.65	1.48	.0086	.0161	.0135	.0026	.18	.0035	.0003	.29	2.1
1907,	.24	4.49	1.63	.0053	.0137	.0111	.0026	.21	.0075	.0003	.31	2.0
1908,	.17	5.27	2.19	.0218	.0161	.0116	.0045	.27	.0063	.0006	.28	–
1909,	.22	5.56	1.68	.0179	.0187	.0143	.0044	.26	.0075	.0005	.34	–
1910,	.13	6.71	2.39	.0214	.0143	.0120	.0023	.30	.0304	.0010	.21	–
1911,	.25	5.86	2.03	.0272	.0162	.0133	.0029	.28	.0077	.0008	.38	–
1912,[2]	.13	6.40	2.08	.0286	.0189	.0130	.0059	.34	.0204	.0014	.24	–
1913,	.23	6.75	1.78	.0247	.0215	.0147	.0068	.30	.0292	.0012	.36	–

[1] Four months. [2] September omitted.

WATER SUPPLY STATISTICS;

ALSO

RECORDS OF RAINFALL AND FLOW OF STREAMS.

WATER SUPPLY STATISTICS.

During the year 1913 public water supplies were introduced into the towns of East Longmeadow (population 1,553), Egremont (population 605), Mattapoisett (population 1,233), Warren (population 4,188), and West Brookfield (population 1,327). The works in East Longmeadow, Mattapoisett and West Brookfield are owned by the town, but those in Egremont are owned by the South Egremont Water Company and water is supplied only in the village of South Egremont, while in Warren the works are owned by the Warren Cotton Mills and supply water only in the village of West Warren. A public water supply was also introduced into the town of Agawam (population 3,501), a very small portion of which had previously been supplied with water by a private company.

Of the 353 cities and towns in Massachusetts, all of the 33 cities and 174 of the towns are provided with public water supplies. The following table gives a classification by population of the cities and towns having and not having public water supplies at the end of the year: —

Population, 1910.	Number of Places of Given Population having Public Water Supplies.	Total Population of Places in Preceding Column.	Number of Places of Given Population not having Public Water Supplies.	Total Population of Places in Preceding Column.
Under 500,	–	–	39	13,020
500–999,	7	5,538	40	29,344
1,000–1,499,	21	26,237	29	35,526
1,500–1,999,	13	22,798	20	35,293
2,000–2,499,	21	46,583	12	26,710
2,500–2,999,	12	33,334	2	5,726
3,000–3,499,	8	26,167	1	3,078
3,500–3,999,	5	18,164	2	7,506
Above 4,000,	120	3,027,014	1	4,378
Totals,	207	3,205,835	146	160,581

From the above table it will be seen that although but 59 per cent. of the cities and towns in the State have a public water supply, the total population of the places supplied is 95 per cent. of the total population of the State. The populations given in this table were obtained by using the total population of the cities and towns supplied and are somewhat greater than the actual number of persons to whom the public water supply is available, but the difference is not great. All of the towns in the State having a population in excess of 5,000 are now supplied with water, and there are only 6 towns having a population in excess of 2,500 which are not provided with public water supplies. These towns are as follows: —

Town.	Population, 1910.	Town.	Population, 1910.
Dartmouth,	4,378	Sutton,	3,078
Templeton,	3,756	Westport,	2,928
Tewksbury,	3,750	Somerset,	2,798

At the present time the water works are owned either by the municipality or by a water, water supply or fire district in all of the cities and 131 of the towns, while in 43 towns the works are owned by private companies. The following table gives the classification by population of the cities and towns which own their water works and those which are supplied with water by water companies: —

Population, 1910.	Number of Places of Given Population owning Water Works.	Total Population of Places in Preceding Column.	Number of Places of Given Population supplied with Water by Private Companies.	Total Population of Places in Preceding Column.
Under 1,000,	3	2,251	4	3,287
1,000-1,999,	25	35,804	9	13,231
2,000-2,999,	22	52,273	11	27,644
3,000-3,999,	8	27,212	5	17,119
4,000-4,999,	12	55,128	5	22,675
5,000-5,999,	16	87,513	3	15,939
6,000-6,999,	8	52,608	–	–
7,000-7,999,	5	36,945	1	7,688
Above 8,000,	65	2,696,170	5	52,348
Totals,	164	3,045,904	43	159,931

From the above table it will be seen that the total population of all places supplied by private companies is only 5 per cent. of the total population of all of the cities and towns supplied with water, and there are only 9 towns having a population in excess of 5,000 which are supplied by private companies, namely, Milford, Southbridge, Dedham, Northbridge, Palmer, Bridgewater, Grafton, Fairhaven and Amherst.

Consumption of Water.

Records of the consumption of water are kept in nearly all of the cities and towns where water is pumped, and in several places supplied by gravity Venturi meters are used to measure the quantity supplied.

The following table gives statistics with regard to the consumption of water in the year 1913 in those cities and towns from which records could be obtained. The populations for the year 1913 as given in the table were obtained by adding three-fifths of the increase in population between 1905 and 1910 to the population as determined by the census of the latter year. The daily consumption of water per inhabitant has been obtained by dividing the average daily consumption by the estimated total population of the city or town in 1913. The quantity obtained in this manner is somewhat less than the actual consumption per person using the water because there are in all cities and towns a greater or less number of persons who do not use the public supply. The difference between the number of inhabitants and the number of consumers would account to a large extent for the low rate per inhabitant in some of the towns which contain villages to which the public water supply has not been extended and in towns where works have been in operation but a short time, and where, in consequence, water has not come into general use. In some towns the population during the summer months is much greater than that shown by the census returns, and in such cases the consumption per inhabitant as given in the table is higher than it would be if allowance were made for the increased population in the summer. With a few exceptions, however, the difference is not great.

Statistics relating to the Consumption of Water in Various Cities and Towns.

City or Town.	Estimated Population, 1913.	Average Daily Consumption (Gallons), 1913.	Daily Consumption per Inhabitant (Gallons), 1913.	City or Town.	Estimated Population, 1913.	Average Daily Consumption (Gallons), 1913.	Daily Consumption per Inhabitant (Gallons), 1913.
Metropolitan Water District:[1] —	1,149,752	106,737,000	93	Cambridge,	109,282	10,549,000	97
Arlington,	12,098	786,000	65	Chelmsford,	5,464	56,000	10
Belmont,	6,251	464,000	74	Clinton,	13,057	613,000	47
Boston,	731,813	79,391,000	108	Concord,	7,021	505,000	72
Chelsea,	37,758	2,880,000	76	Danvers and Middleton.	10,779	1,237,000	115
Everett,	36,108	2,436,000	67	Dedham,	10,190	1,121,000	110
Lexington,	5,151	359,000	70	Dudley,	4,536	152,000	34
Malden,	48,224	2,226,000	46	Easton,	5,277	145,000	27
Medford,	25,228	1,234,000	49	Edgartown,	1,201	57,000	47
Melrose,	16,567	1,137,000	69	Fairhaven,	5,654	395,000	70
Milton,	8,446	332,000	39	Fall River,	127,415	5,636,000	44
Nahant,	1,341	169,000	126	Falmouth,	3,086	475,000	154
Quincy,	35,382	2,699,000	76	Foxborough,	4,162	230,000	55
Revere,	21,555	1,385,000	64	Framingham,	13,788	775,000	56
Somerville,	82,014	5,958,000	73	Franklin,	5,879	307,000	52
Stoneham,	7,545	414,000	55	Gardner,	16,311	774,000	47
Swampscott,	6,842	420,000	61	Gloucester,	23,430	1,263,000	54
Watertown,	13,845	869,000	63	Grafton,	6,097	123,000	20
Winthrop,	11,991	690,000	58	Groton,	2,096	97,000	46
Abington and Rockland.	12,992	706,000	54	Holliston,	2,740	64,000	23
Amesbury,	10,526	503,000	48	Holyoke,	62,408	6,900,000	111
Andover,	7,702	676,000	88	Hudson,	7,059	296,000	42
Ashland,	1,733	24,000	14	Ipswich,	6,120	285,000	47
Athol,	9,339	748,000	80	Lancaster,	2,499	100,000	40
Attleborough,	18,323	995,000	54	Lawrence,	95,397	3,898,000	41
Avon,	2,080	92,000	44	Lincoln,	1,207	207,000	172
Ayer,	3,044	171,000	56	Littleton,	1,235	41,000	33
Bedford,	1,245	33,000	27	Lowell,	113,137	5,799,000	51
Beverly,	20,706	1,827,000	88	Lynn and Saugus,	105,836	6,366,000	60
Billerica,	2,757	166,000	60	Manchester,	2,706	383,000	142
Braintree,	8,778	545,000	62	Mansfield,	5,746	502,000	87
Bridgewater and East Bridgewater.	11,728	325,000	28	Marblehead,	7,415	479,000	65
Brockton,	62,328	2,585,000	41	Marion,	1,719	125,000	73
Brookline,	30,406	2,708,000	89	Marlborough,	14,883	561,000	38

[1] Including Newton, which is within the district but supplied from independent works.

Statistics relating to the Consumption of Water in Various Cities and Towns — Concluded.

City or Town.	Estimated Population, 1913.	Average Daily Consumption (Gallons), 1913.	Daily Consumption per Inhabitant (Gallons), 1913.	City or Town.	Estimated Population, 1913.	Average Daily Consumption (Gallons), 1913.	Daily Consumption per Inhabitant (Gallons), 1913.
Maynard, . .	6,737	267,000	40	Reading, . .	5,900	244,000	41
Merrimac, . .	2,393	97,000	41	Rockport, . .	4,069	303,000	74
Methuen, . .	13,111	600,000	46	Rutland, . .	1,761	109,000	62
Middleborough, .	9,010	338,000	38	Salem, . . .	47,339	3,889,000	82
Milford and Hopedale.	15,897	854,000	54	Sharon, . . .	2,445	145,000	59
Millbury, . .	4,805	166,000	35	Shirley, . . .	2,407	66,000	27
Montague and Erving.	7,957	607,000	76	Southbridge, . .	13,547	744,000	55
Nantucket, . .	2,981	223,000	75	Springfield, . .	99,458	10,710,000	108
Natick, . .	10,020	556,000	55	Stoughton, . .	6,530	282,000	43
Needham, . .	5,471	344,000	63	Taunton, . .	36,234	2,338,000	65
New Bedford, .	110,026	7,761,000	71	Wakefield, . .	12,086	684,000	57
Newburyport, .	15,113	1,130,000	75	Walpole, . .	5,426	564,000	104
Newton, . .	41,593	2,889,000	69	Waltham, . .	28,765	2,714,000	94
North Andover, .	6,078	251,000	41	Ware, . . .	8,882	455,000	51
North Attleborough,	10,572	447,000	42	Wareham, . .	4,367	184,000	42
North Brookfield, .	3,350	202,000	60	Webster, . .	12,404	478,000	39
Norton, . . .	2,823	104,000	37	Wellesley, . .	4,947	389,000	79
Norwood, . .	8,784	708,000	81	West Bridgewater, .	2,366	65,000	27
Oak Bluffs, . .	1,052	195,000	185	Westfield, . .	17,504	1,822,000	104
Orange, . . .	5,104	133,000	26	Weston, . . .	2,115	126,000	60
Peabody, . .	17,295	2,587,000	150	Whitman, . .	7,755	252,000	32
Pepperell, . .	2,764	115,000	42	Winchendon, . .	5,525	171,000	31
Plainville, . .	1,436	31,000	22	Woburn, . .	15,852	1,744,000	110
Plymouth, . .	12,754	1,308,000	103	Worcester, . .	156,697	11,749,000	75
Provincetown, .	4,373	196,000	45	Wrentham, . .	1,932	93,000	48
Randolph and Holbrook.	7,461	476,000	64				

Rainfall.

The normal rainfall in Massachusetts, as deduced from long-continued observations in various parts of the State, is 44.73 inches. The average rainfall for the year 1913 in these places was 41.18 inches, a deficiency of 3.55 inches. The year was the tenth in succession in which the rainfall was less than the normal, the accumulated deficiency at the end of the year being 41.95 inches. There was an excess of precipitation in the months of March, April and October, and a deficiency in the other nine months. The greatest excess in any month occurred in October, when the rainfall was 7.21 inches, or 3.33 inches greater than the normal, and the greatest deficiency occurred in June, when the rainfall was 1.06 inches, or 2.18 inches less than the normal.

The following table gives the normal rainfall in the State for each month, as deduced from observations at various places for a long period of years, together with the average rainfall at those places for each month during the year 1913 and the departure from the normal: —

Month.	Normal Rainfall (Inches).	Rainfall in 1913 (Inches).	Excess or Deficiency in 1913 (Inches).	Month.	Normal Rainfall (Inches).	Rainfall in 1913 (Inches).	Excess or Deficiency in 1913 (Inches).
January, . .	3.73	3.15	—0.58	August, . .	4.23	3.22	—1.01
February, .	3.60	3.03	—0.57	September, .	3.50	3.38	—0.12
March, . .	3.94	5.04	+1.10	October, . .	3.88	7.21	+3.33
April, . .	3.59	3.99	+0.40	November, .	3.90	2.42	—1.48
May, . .	3.71	3.44	—0.27	December, .	3.67	3.49	—0.18
June, . .	3.24	1.06	—2.18	Total, .	44.73	41.18	—3.55
July, . .	3.74	1.75	—1.99				

Flow of Streams.

Sudbury River.

The average flow of the Sudbury River during the year 1913 was 733,000 gallons per day per square mile, or 73 per cent. of the normal flow for the past thirty-nine years. The flow was in excess of the normal in the months of April and October but less than the normal in the other ten months of the year. The greatest excess occurred in the month of April and the greatest deficiency in the months of February, March and June. During the months of July and August the flow was less than the evaporation from the water surfaces of the reservoirs, so that the flow in those months is represented by a minus quantity. The average flow for the driest six months, June to November, inclusive, was 180,000 gallons per day per square mile, which is the largest flow recorded for a similar period since 1907.

In order to show the relation between the flow of the Sudbury River during each month of the year 1913 and the normal flow of that stream, as deduced from observations during thirty-nine years, from 1875 to

1913, inclusive, the following table has been prepared. The area of the watershed of the Sudbury River above the point of measurement is 75.2 square miles.

Table showing the Average Monthly Flow of the Sudbury River for the Year 1913, in Cubic Feet per Second per Square Mile of Drainage Area, and in Million Gallons per Day per Square Mile of Drainage Area; also, Departure from the Normal Flow.

Month.	Normal Flow.		Actual Flow in 1913.		Excess or Deficiency.	
	Cubic Feet per Second per Square Mile.	Million Gallons per Day per Square Mile.	Cubic Feet per Second per Square Mile.	Million Gallons per Day per Square Mile.	Cubic Feet per Second per Square Mile.	Million Gallons per Day per Square Mile.
January,	1.844	1.192	1.611	1.041	—0.233	—0.151
February,	2.625	1.696	1.166	0.754	—1.459	—0.942
March,	4.302	2.780	3.233	2.090	—1.069	—0.690
April,	3.097	2.002	3.453	2.232	+0.356	+0.230
May,	1.644	1.063	1.342	0.867	—0.302	—0.196
June,	0.756	0.489	0.230	0.149	—0.526	—0.340
July,	0.238	0.154	—0.096	—0.062	—0.334	—0.216
August,	0.351	0.226	—0.083	—0.054	—0.434	—0.280
September,	0.363	0.235	0.136	0.088	—0.227	—0.147
October,	0.678	0.438	0.749	0.484	+0.071	+0.046
November,	1.205	0.779	0.743	0.480	—0.462	—0.299
December,	1.540	0.995	1.132	0.732	—0.408	—0.263
Average for whole year,	1.548	1.000	1.134	0.733	—0.414	—0.267

In the annual report of the State Board of Health for the year 1911 (pages 254 to 260) and for the year 1912 (page 258) tables were presented giving the record of the rainfall upon the Sudbury River watershed and the yield expressed in inches in depth on the watershed (inches of rainfall collected) for thirty-eight years, from 1875 to 1912, inclusive. The corresponding record for the year 1913, together with the average for the whole period of thirty-nine years, is given in the following table: —

Rainfall, in Inches, received and collected on the Sudbury River Watershed.

Month.	For the Year 1913.			Mean for Thirty-nine Years, 1875-1913.		
	Rainfall.	Rainfall collected.	Per Cent. collected.	Rainfall.	Rainfall collected.	Per Cent. collected.
January,	3.17	1.857	58.5	4.08	2.126	52.1
February,	2.82	1.215	43.1	4.13	2.756	66.7
March,	5.75	3.727	64.8	4.46	4.959	111.2
April,	4.25	3.852	90.6	3.54	3.456	97.7
May,	3.97	1.547	39.0	3.33	1.895	57.0
June,	1.98	0.257	13.0	3.03	0.843	27.8
July,	3.60	—0.111	—3.1	3.55	0.274	7.7
August,	3.64	—0.095	—2.6	3.85	0.404	10.5
September,	3.77	0.152	4.0	3.46	0.405	11.7
October,	5.53	0.863	15.6	3.92	0.782	19.9
November,	2.65	0.828	31.3	3.82	1.345	35.2
December,	3.18	1.305	41.1	3.82	1.775	46.5
Totals and averages,	44.31	15.397	34.8	44.99	21.020	46.7

The following table gives the record of the yield of the Sudbury River watershed for each of the past thirty-nine years, the flow being expressed in gallons per day per square mile of watershed, in order to render the table more convenient for use in estimating the probable yield of watersheds used as sources of water supply: —

Yield of the Sudbury River Watershed in Gallons per Day per Square Mile.[1]

Month.	1875.	1876.	1877.	1878.	1879.	1880.
January,	103,000	643,000	658,000	1,810,000	700,000	1,121,000
February,	1,496,000	1,368,000	949,000	2,465,000	1,711,000	1,787,000
March,	1,604,000	4,435,000	4,813,000	3,507,000	2,330,000	1,374,000
April,	3,049,000	3,292,000	2,394,000	1,626,000	3,116,000	1,168,000
May,	1,188,000	1,139,000	1,391,000	1,394,000	1,114,000	514,000
June,	870,000	222,000	597,000	506,000	413,000	176,000
July,	321,000	183,000	202,000	128,000	158,000	177,000
August,	396,000	405,000	121,000	475,000	395,000	119,000
September,	207,000	184,000	60,000	160,000	141,000	80,000
October,	646,000	234,000	632,000	516,000	71,000	101,000
November,	1,302,000	1,088,000	1,418,000	1,693,000	206,000	205,000
December,	584,000	454,000	1,289,000	3,177,000	462,000	175,000
Average for whole year,	972,000	1,135,000	1,214,000	1,452,000	894,000	578,000
Average for driest six months,	574,000	384,000	502,000	532,000	230,000	143,000

[1] The area of the Sudbury River watershed used in making up these records included water surfaces amounting to about 2 per cent. of the whole area, from 1875 to 1878, inclusive, subsequently increasing by the construction of storage reservoirs to about 3 per cent. in 1879, to 3.5 per cent. in 1885, to 4 per cent. in 1891 and to 6.5 per cent. in 1893. The watershed also contains extensive areas of swampy land, which, though covered with water at times, are not included in the above percentages of water surfaces.

Yield of the Sudbury River Watershed in Gallons per Day per Square Mile — Continued.

Month.	1881.	1882.	1883.	1884.	1885.	1886.
January,	415,000	1,241,000	335,000	995,000	1,235,000	1,461,000
February,	1,546,000	2,403,000	1,033,000	2,842,000	1,354,000	4,800,000
March,	4,004,000	2,839,000	1,611,000	3,785,000	1,572,000	2,059,000
April,	1,546,000	867,000	1,350,000	2,853,000	1,815,000	1,947,000
May,	965,000	1,292,000	938,000	1,030,000	1,336,000	720,000
June,	1,338,000	529,000	300,000	417,000	426,000	203,000
July,	276,000	86,000	115,000	224,000	62,000	115,000
August,	148,000	55,000	78,000	257,000	240,000	94,000
September,	197,000	306,000	91,000	44,000	121,000	118,000
October,	186,000	299,000	186,000	83,000	336,000	146,000
November,	395,000	210,000	205,000	175,000	1,178,000	673,000
December,	775,000	314,000	193,000	925,000	1,174,000	1,020,000
Average for whole year,	979,000	862,000	533,000	1,129,000	901,000	1,087,000
Average for driest six months,	330,000	211,000	145,000	200,000	391,000	223,000

Month.	1887.	1888.	1889.	1890.	1891.	1892.
January,	2,589,000	1,053,000	2,782,000	1,254,000	3,018,000	1,870,000
February,	2,829,000	1,951,000	1,195,000	1,529,000	3,486,000	943,000
March,	2,868,000	3,237,000	1,339,000	3,643,000	4,453,000	1,955,000
April,	2,620,000	2,645,000	1,410,000	1,875,000	2,397,000	871,000
May,	1,009,000	1,632,000	880,000	1,366,000	582,000	1,259,000
June,	414,000	422,000	653,000	568,000	414,000	428,000
July,	114,000	117,000	633,000	108,000	149,000	214,000
August,	214,000	380,000	1,432,000	132,000	163,000	280,000
September,	111,000	1,155,000	824,000	458,000	203,000	229,000
October,	190,000	1,999,000	1,230,000	2,272,000	210,000	126,000
November,	368,000	2,758,000	1,941,000	1,215,000	305,000	697,000
December,	643,000	3,043,000	2,241,000	997,000	544,000	485,000
Average for whole year,	1,154,000	1,697,000	1,383,000	1,285,000	1,315,000	781,000
Average for driest six months,	234,000	953,000	944,000	747,000	239,000	327,000

Yield of the Sudbury River Watershed in Gallons per Day per Square Mile — Continued.

Month.	1893.	1894.	1895.	1896.	1897.	1898.
January,	433,000	693,000	1,034,000	1,084,000	845,000	1,638,000
February,	1,542,000	991,000	541,000	2,676,000	1,067,000	3,022,000
March,	3,245,000	2,238,000	2,410,000	3,835,000	2,565,000	2,604,000
April,	2,125,000	1,640,000	2,515,000	1,494,000	1,515,000	1,829,000
May,	2,883,000	840,000	636,000	360,000	915,000	1,246,000
June,	440,000	419,000	174,000	399,000	962,000	530,000
July,	158,000	161,000	231,000	95,000	658,000	231,000
August,	181,000	209,000	229,000	57,000	591,000	1,107,000
September,	108,000	150,000	89,000	388,000	182,000	369,000
October,	221,000	374,000	1,379,000	592,000	94,000	1,160,000
November,	319,000	836,000	2,777,000	659,000	909,000	1,986,000
December,	797,000	716,000	1,782,000	657,000	1,584,000	1,799,000
Average for whole year,	1,037,000	770,000	1,152,000	1,019,000	991,000	1,450,000
Average for driest six months,	237,000	356,000	460,000	314,000	564,000	777,000

Month.	1899.	1900.	1901.	1902.	1903.	1904.
January,	2,288,000	794,000	437,000	1,763,000	1,736,000	477,000
February,	1,381,000	3,800,000	300,000	1,674,000	2,279,000	882,000
March,	4,205,000	3,654,000	2,755,000	4,199,000	3,454,000	2,999,000
April,	2,521,000	1,350,000	4,204,000	1,885,000	2,261,000	3,294,000
May,	511,000	1,312,000	2,954,000	743,000	351,000	1,745,000
June,	66,000	316,000	753,000	303,000	1,987,000	419,000
July,	19,000	—18,000	306,000	66,000	445,000	62,000
August,	—35,000	—34,000	424,000	135,000	307,000	170,000
September,	94,000	65,000	305,000	178,000	130,000	397,000
October,	115,000	186,000	412,000	506,000	492,000	191,000
November,	304,000	663,000	474,000	444,000	363,000	289,000
December,	220,000	1,096,000	2,695,000	1,779,000	582,000	269,000
Average for whole year,	973,000	1,082,000	1,342,000	1,140,000	1,190,000	931,000
Average for driest six months,	93,000	194,000	445,000	271,000	388,000	228,000

Yield of the Sudbury River Watershed in Gallons per Day per Square Mile — Concluded.

Month.	1905.	1906.	1907.	1908.	1909.	1910.
January,	1,410,000	1,128,000	1,351,000	1,925,000	392,000	1,490,000
February,	330,000	1,041,000	624,000	1,536,000	2,286,000	1,849,000
March,	2,497,000	2,409,000	1,658,000	2,257,000	1,734,000	1,954,000
April,	1,643,000	1,949,000	1,607,000	1,117,000	1,721,000	667,000
May,	297,000	1,059,000	888,000	1,046,000	1,004,000	277,000
June,	467,000	707,000	761,000	194,000	239,000	516,000
July,	177,000	398,000	9,000	—14,000	—121,000	—102,000
August,	114,000	180,000	—104,000	102,000	—45,000	—73,000
September,	1,246,000	19,000	541,000	—82,000	149,000	5,000
October,	158,000	301,000	741,000	47,000	—51,000	—51,000
November,	279,000	483,000	1,998,000	71,000	82,000	176,000
December,	887,000	659,000	2,032,000	136,000	263,000	221,000
Average for whole year,	795,000	860,000	1,010,000	694,000	625,000	570,000
Average for driest six months,	403,000	341,000	471,000	44,000	40,000	29,000

Month.	1911.	1912.	1913.	Mean for Thirty-nine Years, 1875-1913.
January,	519,000	728,000	1,041,000	1,192,000
February,	700,000	1,197,000	754,000	1,696,000
March,	1,144,000	3,092,000	2,090,000	2,780,000
April,	1,426,000	2,235,000	2,232,000	2,002,000
May,	318,000	1,447,000	867,000	1,063,000
June,	213,000	148,000	149,000	489,000
July,	—14,000	—77,000	62,000	154,000
August,	20,000	—29,000	54,000	226,000
September,	76,000	—28,000	88,000	235,000
October,	296,000	—14,000	484,000	438,000
November,	593,000	165,000	480,000	779,000
December,	908,000	494,000	732,000	995,000
Average for whole year,	514,000	779,000	733,000	1,000,000
Average for driest six months,	152,000	26,000	180,000	385,000

NOTE. — The recorded yields, subsequent to the year 1897, are less accurate than those for previous years, particularly during months of small yield, due to unavoidable inaccuracies in the measurement of large quantities of water received from the Wachusett Reservoir.

Nashua River.

The average flow of the South Branch of the Nashua River above Clinton during the year 1913 was 879,000 gallons per day per square mile, or 81 per cent. of the normal flow for the past seventeen years. The flow was in excess of the normal in the months of January and October, but less than the normal in the other ten months of the year. The greatest excess occurred in the month of January, and the greatest deficiency in the months of February, March and June. The average flow for the driest six months, June to November, inclusive, was 318,000 gallons per day per square mile, or 60 per cent. of the normal flow for such a period during the last seventeen years.

In order to show the relation between the flow of the Nashua River during each month of the year 1913 and the normal flow of that stream, as deduced from observations during seventeen years, from 1897 to 1913, inclusive, the following table has been prepared. The area of the watershed of the Nashua River above the point of measurement was 119 square miles from 1897 to 1907, inclusive, and 118.19 square miles since the latter year.

Table showing the Average Monthly Flow of the South Branch of the Nashua River for the Year 1913, in Cubic Feet per Second per Square Mile of Drainage Area, and in Million Gallons per Day per Square Mile of Drainage Area; also, Departure from the Normal Flow.

Month.	Normal Flow.		Actual Flow in 1913.		Excess or Deficiency.	
	Cubic Feet per Second per Square Mile.	Million Gallons per Day per Square Mile.	Cubic Feet per Second per Square Mile.	Million Gallons per Day per Square Mile.	Cubic Feet per Second per Square Mile.	Million Gallons per Day per Square Mile.
January,	1.854	1.198	2.188	1.414	+0.334	+0.216
February,	2.115	1.367	1.342	0.867	—0.773	—0.500
March,	4.136	2.673	3.501	2.263	—0.635	—0.410
April,	3.334	2.154	3.224	2.083	—0.110	—0.071
May,	1.829	1.182	1.607	1.038	—0.222	—0.144
June,	1.161	0.750	0.433	0.280	—0.728	—0.470
July,	0.582	0.376	0.030	0.019	—0.552	—0.357
August,	0.590	0.382	0.092	0.060	—0.498	—0.322
September,	0.556	0.359	0.338	0.219	—0.218	—0.140
October,	0.824	0.532	1.049	0.678	+0.225	+0.146
November,	1.237	0.800	1.021	0.660	—0.216	—0.140
December,	1.879	1.214	1.478	0.955	—0.401	—0.259
Average for whole year,	1.672	1.081	1.360	0.879	—0.312	—0.202

In the annual report of the State Board of Health for the year 1911 (pages 265 to 267) and for the year 1912 (page 264) tables were presented giving the record of the rainfall upon the Nashua River watershed and the yield expressed in inches in depth upon the watershed (inches of rainfall collected) for sixteen years, from 1897 to 1912, inclusive. A corresponding record for the year 1913, together with the average for the entire period of seventeen years, is given in the following table: —

Rainfall, in Inches, received and collected on the Nashua River Watershed.

Month.	For the Year 1913.			Mean for Seventeen Years. 1897–1913.		
	Rainfall.	Rainfall collected.	Per Cent. collected.	Rainfall.	Rainfall collected.	Per Cent. collected.
January,	3.38	2.522	74.7	3.65	2.137	58.5
February,	2.55	1.397	54.7	3.73	2.216	59.4
March,	5.58	4.037	72.4	4.38	4.768	108.8
April,	3.90	3.597	92.2	3.88	3.719	96.0
May,	3.71	1.852	49.9	3.48	2.109	60.6
June,	0.90	0.483	53.5	3.64	1.295	35.5
July,	2.37	0.034	1.4	3.92	0.670	17.1
August,	3.05	0.107	3.5	4.15	0.681	16.4
September,	4.44	0.377	8.5	3.81	0.620	16.3
October,	6.02	1.209	20.1	3.56	0.950	26.7
November,	2.59	1.139	43.9	3.43	1.381	40.3
December,	2.73	1.704	62.5	4.21	2.166	51.5
Totals and averages,	41.22	18.458	44.8	45.84	22.712	49.5

The following table gives a record of the yield of the Nashua River watershed for each of the past seventeen years, the flow being expressed in gallons per day per square mile of watershed: —

Yield of the Nashua River Watershed in Gallons per Day per Square Mile. [1]

Month.	1897.	1898.	1899.	1900.	1901.	1902.
January,	796,000	1,563,000	2,092,000	796,000	519,000	1,676,000
February,	931,000	1,635,000	1,090,000	4,054,000	356,000	1,401,000
March,	2,760,000	3,088,000	2,776,000	3,722,000	2,718,000	3,992,000
April,	1,632,000	2,027,000	3,376,000	1,580,000	4,986,000	2,159,000
May,	1,163,000	1,390,000	862,000	1,382,000	2,729,000	1,031,000
June,	1,181,000	828,000	561,000	578,000	985,000	410,000
July,	1,442,000	333,000	354,000	217,000	477,000	292,000
August,	896,000	1,325,000	236,000	197,000	512,000	297,000
September,	380,000	676,000	250,000	127,000	320,000	241,000
October,	243,000	1,509,000	245,000	282,000	647,000	950,000
November,	1,283,000	2,170,000	430,000	875,000	517,000	635,000
December,	2,275,000	2,061,000	359,000	1,570,000	3,234,000	1,848,000
Average for whole year,	1,253,000	1,551,000	1,051,000	1,264,000	1,507,000	1,248,000
Average for driest six months,	886,000	1,013,000	312,000	377,000	576,000	471,000

[1] The area of the watershed used in making up these records included water surfaces amounting to 2.2 per cent. of the whole area from 1897 to 1902, inclusive, to 2.4 per cent. in 1903, to 3.6 per cent. in 1904, to 4.1 per cent. in 1905, to 5.1 per cent. in 1906, to 6 per cent. in 1907, to 7 per cent. in 1908, 1909 and 1910, to 6.5 per cent. in 1911, to 6.8 per cent in 1912 and to 6.9 per cent. in 1913.

Yield of the Nashua River Watershed in Gallons per Day per Square Mile — Concluded.

Month.	1903.	1904.	1905.	1906.	1907.	1908.
January,	1,265,000	659,000	1,266,000	1,132,000	1,458,000	1,738,000
February,	2,133,000	927,000	452,000	1,027,000	692,000	1,736,000
March,	3,423,000	3,008,000	3,004,000	1,860,000	1,697,000	2,192,000
April,	2,238,000	2,984,000	1,617,000	2,109,000	1,436,000	1,269,000
May,	569,000	1,498,000	445,000	1,533,000	965,000	1,415,000
June,	2,131,000	762,000	542,000	1,184,000	773,000	403,000
July,	624,000	497,000	365,000	728,000	335,000	220,000
August,	474,000	355,000	321,000	591,000	87,000	443,000
September,	375,000	494,000	1,228,000	277,000	810,000	88,000
October,	689,000	347,000	367,000	530,000	1,382,000	158,000
November,	634,000	343,000	442,000	749,000	2,540,000	125,000
December,	954,000	440,000	1,018,000	794,000	1,961,000	387,000
Average for whole year,	1,285,000	1,025,000	926,000	1,043,000	1,180,000	847,000
Average for driest six months,	626,000	413,000	541,000	613,000	725,000	238,000

Month.	1909.	1910.	1911.	1912.	1913.	Mean for Seventeen Years, 1897-1913
January,	592,000	1,846,000	773,000	780,000	1,414,000	1,198,000
February,	2,556,000	1,845,000	625,000	927,000	867,000	1,367,000
March,	2,129,000	2,639,000	1,339,000	2,831,000	2,263,000	2,673,000
April,	2,422,000	1,034,000	1,393,000	2,281,000	2,083,000	2,154,000
May,	1,212,000	608,000	461,000	1,797,000	1,038,000	1,182,000
June,	632,000	824,000	351,000	331,000	280,000	750,000
July,	233,000	62,000	57,000	135,000	19,000	376,000
August,	193,000	186,000	188,000	125,000	60,000	382,000
September,	208,000	145,000	181,000	89,000	219,000	359,000
October,	90,000	68,000	718,000	145,000	678,000	532,000
November,	363,000	354,000	1,035,000	442,000	660,000	800,000
December,	537,000	391,000	1,067,000	793,000	955,000	1,214,000
Average for whole year,	918,000	828,000	682,000	891,000	879,000	1,081,000
Average for driest six months,	271,000	201,000	327,000	210,000	318,000	532,000

Merrimack River.

The flow of the Merrimack River has been measured for many years at Lawrence, above which place the river has a total watershed area of 4,663 square miles, which includes 118 square miles on the South Branch of the Nashua River, 75 square miles on the Sudbury River and 18 square miles tributary to Lake Cochituate, or a combined area of 211 square miles from which water is drawn at the present time for the supply of the Metropolitan Water District. The flow as measured at Lawrence includes the water wasted from these three watersheds, which, in the wet months of the year, is very considerable, but which becomes very small in the dry months. Records of the quantity of water wasted have been kept by the Boston Water Board and by the Metropolitan

Water Board, and these quantities have been deducted from the flow as measured at Lawrence. The area of the three watersheds has also been deducted from the watershed area at Lawrence, so that the net area was 4,570 square miles up to 1898, at which time the Nashua River was diverted, 4,451 square miles from March 1, 1898, to Jan. 1, 1908, and 4,452 square miles since the latter date.

The average flow of the Merrimack River during the year 1913 was 83 per cent. of the normal flow for the past twenty-six years for which records are available. The flow was in excess of the normal in the months of January and March, but less than the normal in the other ten months of the year.

In order to show the relation between the flow of this stream during each month of the year 1913 and the normal flow as deduced from observations during twenty-six years, from 1888 to 1913, inclusive, the following table has been prepared: —

Table showing the Average Monthly Flow of the Merrimack River for the Year 1913 in Cubic Feet per Second per Square Mile of Drainage Area; also, Departure from the Normal Flow.

Month.	Normal Flow. Cubic Feet per Second per Square Mile.	Actual Flow in 1913. Cubic Feet per Second per Square Mile.	Excess or Deficiency. Cubic Feet per Second per Square Mile.
January,	1.323	1.775	+0.452
February,	1.278	0.987	—0.291
March,	2.911	3.372	+0.461
April,	3.641	2.490	—1.151
May,	2.188	1.442	—0.746
June,	1.214	0.899	—0.315
July,	0.685	0.393	—0.292
August,	0.622	0.306	—0.316
September,	0.670	0.387	—0.283
October,	0.920	0.791	—0.129
November,	1.194	0.967	—0.227
December,	1.306	1.046	—0.260
Average for whole year,	1.496	1.238	—0.258

The following table gives the record of the net flow of the Merrimack River for each of the past twenty-six years, the flow being expressed in cubic feet per second per square mile of drainage area: —

Flow of the Merrimack River at Lawrence in Cubic Feet per Second per Square Mile of Drainage Area.

Month.	1888.	1889.	1890.	1891.	1892.	1893.	1894.
January,	1.388	2.619	1.492	2.823	1.836	0.645	0.661
February,	1.818	1.345	1.656	2.851	0.888	1.081	0.933
March,	2.168	2.385	3.326	5.042	1.562	2.281	3.115
April,	5.377	2.408	3.728	4.645	1.774	3.359	2.401
May,	4.539	1.437	3.096	1.601	2.215	4.202	1.525
June,	1.228	1.164	1.716	0.990	0.834	0.963	1.317
July,	0.548	0.782	0.691	0.633	1.040	0.522	0.498
August,	0.577	1.087	0.745	0.538	1.051	0.564	0.370
September,	1.540	0.750	1.833	0.556	0.863	0.608	0.400
October,	2.656	1.220	2.648	0.467	0.467	0.790	0.493
November,	2.896	1.924	1.918	0.540	1.420	0.736	0.772
December,	3.181	2.812	1.418	0.899	0.859	1.166	0.661
Average for whole year,	2.326	1.661	2.022	1.799	1.234	1.410	1.095
Average for driest six months,	1.574	1.073	1.542	0.606	0.946	0.697	0.532

Month.	1895.	1896.	1897.	1898.	1899.	1900.	1901.
January,	0.626	1.419	0.745	1.613	1.657	0.748	0.753
February,	0.507	1.941	1.000	1.638	1.032	3.520	0.546
March,	1.258	4.510	2.294	4.043	2.479	3.441	2.064
April,	4.289	3.967	3.839	3.317	5.758	4.088	5.569
May,	1.360	0.971	2.209	2.400	2.121	2.185	3.335
June,	0.664	0.769	2.769	1.417	0.667	0.878	1.657
July,	0.565	0.446	2.359	0.585	0.556	0.407	0.646
August,	0.477	0.441	1.105	0.776	0.468	0.420	0.989
September,	0.366	0.683	0.603	0.636	0.447	0.338	0.588
October,	0.863	1.142	0.482	1.371	0.401	0.564	0.913
November,	2.047	1.454	1.274	2.094	0.625	1.304	0.663
December,	2.025	0.952	2.262	1.871	0.622	1.498	2.053
Average for whole year,	1.254	1.558	1.745	1.813	1.403	1.616	1.648
Average for driest six months,	0.716	0.741	1.347	1.146	0.520	0.652	0.909

Flow of the Merrimack River at Lawrence in Cubic Feet per Second per Square Mile of Drainage Area — Concluded.

MONTH.	1902.	1903.	1904.	1905.	1906.	1907.	1908.
January,	2.268	1.684	0.584	0.855	1.696	1.411	1.946
February,	1.195	1.979	0.644	0.503	1.133	0.667	1.648
March,	6.011	6.032	2.719	2.350	1.678	1.728	2.499
April,	3.801	3.375	4.495	3.616	3.591	2.923	2.652
May,	2.256	0.979	3.844	1.169	2.269	2.034	2.570
June,	1.187	2.224	1.032	0.931	2.262	1.190	0.932
July,	0.971	1.032	0.624	0.600	1.106	0.749	0.522
August,	0.844	0.734	0.573	0.606	0.741	0.431	0.668
September,	0.774	0.530	0.653	1.706	0.422	0.664	0.379
October,	1.600	0.823	0.816	0.727	0.549	1.433	0.330
November,	1.285	0.665	0.604	0.760	0.707	2.914	0.354
December,	1.756	0.825	0.408	1.274	0.567	2.177	0.420
Average for whole year,	1.996	1.740	1.416	1.258	1.393	1.527	1.243
Average for driest six months,	1.110	0.767	0.613	0.888	0.682	1.083	0.445

MONTH.	1909.	1910.	1911.	1912.	1913.	Mean for Twenty-six years, 1888–1913.
January,	0.677	1.043	0.624	0.802	1.775	1.323
February,	1.563	0.973	0.482	0.706	0.987	1.278
March,	1.695	3.611	1.248	2.773	3.372	2.911
April,	3.404	2.445	3.045	4.323	2.490	3.641
May,	1.951	1.509	1.360	2.297	1.442	2.188
June,	0.948	1.077	0.551	1.304	0.899	1.214
July,	0.447	0.398	0.266	0.412	0.393	0.685
August,	0.376	0.458	0.328	0.499	0.306	0.622
September,	0.369	0.397	0.435	0.485	0.387	0.670
October,	0.422	0.300	0.918	0.733	0.791	0.920
November,	0.388	0.457	1.049	1.239	0.967	1.194
December,	0.504	0.335	1.284	1.069	1.046	1.306
Average for whole year,	1.062	1.084	0.966	1.387	1.238	1.496
Average for driest six months,	0.418	0.391	0.591	0.740	0.624	0.884

Sudbury, Nashua and Merrimack Rivers.

The following table shows the weekly fluctuation during the year 1913 in the flow of the three streams just described, namely, the Sudbury River at Framingham, the South Branch of the Nashua River above Clinton, and the Merrimack River at Lawrence. The flow of these streams, particularly that of the Sudbury and of the South Branch of the Nashua River, serves to indicate the flow of other streams in eastern Massachusetts. The area of the Sudbury River watershed is 75.2 square miles and of the South Branch of the Nashua River 118.19 square miles. The net watershed area of the Merrimack River is 4,452 square miles.

Table showing the Average Weekly Flow of the Sudbury, South Branch of the Nashua and Merrimack Rivers for the Year 1913 in Cubic Feet per Second per Square Mile of Drainage Area.

Week ending Sunday.	Flow in Cubic Feet per Second per Square Mile.			Week ending Sunday.	Flow in Cubic Feet per Second per Square Mile.		
	Sudbury River.	South Branch Nashua River.	Merrimack River.		Sudbury River.	South Branch Nashua River.	Merrimack River.
Jan. 5,	2.939	3.321	1.984	July 6,	—0.074	0.039	0.381
12,	1.815	2.431	1.766	13,	—0.273	—0.082	0.454
19,	1.532	2.146	1.512	20,	—0.178	—0.031	0.424
26,	1.373	2.071	1.970	27,	—0.113	—0.063	0.338
Feb. 2,	0.971	1.514	1.373	Aug. 3,	0.287	0.282	0.326
9,	0.827	1.085	1.124	10,	—0.121	0.062	0.348
16,	0.526	0.867	0.781	17,	—0.419	—0.034	0.327
23,	1.328	1.555	0.802	24,	—0.178	0.094	0.327
				31,	—1.022	0.291	0.252
Mar. 2,	2.643	2.378	1.228				
9,	1.696	1.639	1.142	Sept. 7,	1.433	0.340	0.364
16,	2.763	3.135	2.247	14,	—0.169	—0.066	0.323
23,	2.752	2.696	4.726	21,	0.044	0.553	0.273
30,	5.636	6.487	5.870	28,	0.492	0.606	0.549
Apr. 6,	3.241	3.215	3.627	Oct. 5,	0.138	0.340	0.472
13,	3.471	4.515	2.371	12,	0.223	0.507	0.553
20,	5.649	3.969	2.730	19,	0.438	0.432	0.492
27,	2.225	1.791	1.770	26,	1.542	2.270	0.996
May 4,	1.831	1.746	1.746	Nov. 2,	1.136	1.295	1.377
11,	0.500	0.918	1.180	9,	0.427	1.035	0.776
18,	0.710	0.753	0.846	16,	0.937	1.170	1.446
25,	2.148	2.196	1.130	23,	0.661	1.052	0.909
				30,	0.965	0.939	0.779
June 1,	1.598	2.713	2.649				
8,	1.040	0.718	1.487	Dec. 7,	0.788	1.756	0.908
15,	0.309	0.290	0.764	14,	1.392	1.443	1.426
22,	0.085	0.415	0.593	21,	0.679	0.899	0.946
29,	—0.154	0.198	0.556	28,	1.831	1.938	0.908

REPORT

OF THE

Lawrence Experiment Station

1913.

Work of the Lawrence Experiment Station for 1913 — the Purification of Sewage and Water and Investigations upon Allied Subjects.[1]

By H. W. Clark and Stephen DeM. Gage.

During the year ending Nov. 30, 1913, the following main lines of work and study were carried on at the experiment station: (1) Studies upon the aeration of sewage in a new form of tank. These studies showed that by aeration in tanks constructed and operated like the one described beyond, a remarkable reduction of suspended and colloidal matters in sewage can be obtained at a cost certainly no greater than by chemical precipitants and probably considerably less. The sewage, owing to a reduction of its suspended and colloidal matters and partial oxidation by aeration, can be purified at very high rates of filtration through sand and trickling filters. The sewage, moreover, after aeration has lost its offensive odor and filtration can proceed without nuisance from the dissemination of these odors in the neighborhood of the filters. If sufficient aeration is given, the sewage is rendered nonputrefactive and stable. (2) Studies upon clarification of sewage by the ordinary methods of sedimentation, chemical precipitation and straining. (3) Studies of the disposal of sludge in tanks from 17 to 30 feet in depth. These studies were made with sewages of various kinds and had for their chief object the determination of the physical character and the odor of the sludge when drawn from such tanks after varying periods of storage and decomposition. It was shown by these studies that the deeper the tank, other things being equal, the less the odor of the sludge and the more easily it is handled, drained and dried owing to improvement in its physical character. Other features of this study are described beyond, such as the effect of added iron and lime, of fermentation, agitation, the

[1] The work has been carried on under the general supervision of Hiram F. Mills, A.M., C.E., member of the State Board of Health, with Mr. H. W. Clark, chemist to the Board, in direct charge. Mr. Stephen DeM. Gage, biologist, and Mr. George O. Adams, chemist, are the principal assistants at the station. A full account of the experiments at the Lawrence Experiment Station during the years 1888 and 1889 is contained in a special report of the State Board of Health upon the purification of sewage and water (1890). A similar account for the years 1890 and 1891 is contained in the report of the Board for 1891. Since 1891 the results have been published yearly in the annual reports. A review of twenty-one years' experiments upon the purification of sewage was published in the report for 1908 and a similar review of experiments upon the purification of manufactural wastes was published in the report for 1909.

destruction of fatty matters, the percentage of water in the various sludges after treatment, the loss of nitrogen, changes in nitrogenous matters, etc. (4) A study and review of the fertilizer value of sewage and sewage sludge, including studies of the availability of the fertilizing materials in agriculture. (5) Continued studies of intermittent sand, contact and trickling filter methods of purifying sewage. This included, besides the operation of sand, contact and trickling filters, an investigation concerning the relative capacity for purification and volume of sewage filtered per acre daily of trickling filters with depths of from 4 to 10 feet. (6) Studies of manufacturing wastes. These studies included an interesting investigation in regard to a new method for the disposal of tannery sewage. (7) Studies of the oxygen requirement of different sewages and the point to which dissolved oxygen in a stream can be reduced by sewage matters without producing a nuisance. (8) Studies of the influence of carbon in sugar and other carbohydrates upon nitrification with reference to the disposal of wastes from breweries, sugar refineries, etc. (9) Studies of water filtration by different types of filters, together with special laboratory studies of the tolerance for considerable amounts of hypochlorite disinfectants which certain types of bacteria apparently acquire in swimming pools. (10) Studies to determine the effect of various amounts of CO_2 and other constituents of water upon the length of life of fecal and other bacteria in water. (11) Bacterial examinations of 1,800 samples of water forwarded to the station by the engineering department of the Board.

At the station, moreover, typical examples of the various established processes for the treatment of water and sewage are kept in operation, and their method of procedure and relative efficiency is often demonstrated to city and town officials who are concerned with the installation and management of water or sewage purification works and to students and others who are interested in the subject. That this feature is appreciated is evident from the large number of persons who visit the station each year in search of information and from the number of engineering schools in this State that have made a visit to the station a regular part of their instruction to students in sanitary engineering.

Character of the Sewage used in the Experiments.

The sewage used at the experiment station is pumped through a 2½-inch pipe about 4,400 feet long, from the Lawrence Street sewer which drains the streets, houses and stores of the most densely populated section of the city of Lawrence. The inlet to this pipe is located well above the entrance of any of the large mills, and is provided with a strainer with perforations about ¾ of an inch in diameter, by which paper, rags, etc., are largely strained out of the sewage. As received at the station the sewage is a strong domestic sewage in which the suspended matters have been quite thoroughly disintegrated during passage through the pipe.

"Lawrence Street sewage" is the average of samples collected weekly from the sewer near the point where the sewage enters the pipe through which it is drawn to the experiment station; "regular station sewage" is the average of samples collected four times each day of the sewage as it reaches the experiment station; "sewage applied to Filters Nos. 1, 6 and 9A" is the average of daily samples of all the sewage applied to the large intermittent filters situated out of doors.

The average analyses of the various representative samples of sewage collected during the year are shown in the following table: —

Lawrence Street Sewage.

[Parts per 100,000.]

Temperature (Degrees F.).	Ammonia.			Kjeldahl Nitrogen.		Chlorine.	Nitrogen as		Oxygen consumed.	Bacteria per Cubic Centimeter.
		Albuminoid.								
	Free.	Total.	In Solution.	Total.	In Solution.		Nitrates.	Nitrites.		
64	2.08	.59	.38	2.23	1.60	11.45	.07	.0061	6.86	2,707,000
Regular Station Sewage.										
-	3.67	.58	.28	1.20	0.55	13.36	-	-	4.73	3,724,000
Sewage applied to Filters Nos. 1, 6 and 9A.										
-	3.79	.52	-	1.07	-	12.57	-	-	4.19	-

Average Solids.

Regular Sewage.

[Parts per 100,000.]

Unfiltered.			Filtered.			In Suspension.		
Total.	Loss on Ignition.	Fixed.	Total.	Loss on Ignition.	Fixed.	Total.	Loss on Ignition.	Fixed.
71.4	31.6	39.8	48.0	15.4	32.6	23.4	16.2	7.2

Preliminary Treatments for the Clarification of Sewage.

Studies upon the clarification of sewage as a preliminary to filtration by sedimentation in open tanks and in a tank filled with layers of slate, by straining through a layer of anthracite coal and by chemical precipitation with sulphate of alumina, were continued during 1913. Studies were also made upon the clarification of sewage by aeration and sedimentation.

Sedimentation in Open Tanks.

The chief settling tank at the station is cylindrical in form with a bottom sloping at an angle of 60°. Sewage enters this tank near the bottom and rises slowly to an outlet near the top, the period of sedimentation while sewage is flowing through being about two hours and the vertical velocity about 1 inch per minute. About 1,000 gallons of sewage were treated daily in this tank throughout the year. The sludge deposited in the tank is drawn off through a blow-off valve at the bottom three times each week. The average removal of suspended matter occurring in this tank during the year was about 46 per cent., as shown by Kjeldahl nitrogen in suspension, and about 68 per cent., as shown by the total and organic solids in suspension. The total removal of organic matter from the sewage was about 31 per cent., as shown by total Kjeldahl nitrogen, and about 35 per cent., as shown by the total organic solids. The composition of the wet sludge was as follows: —

Average Sludge.

[Parts per 100,000.]

	Average.	Maximum.	Minimum.
Solids: —			
Total,	2,766	4,316	545
Organic,	1,678	2,891	278
Insoluble matters: —			
Total,	2,529	4,121	471
Organic,	1,601	2,769	250
Organic nitrogen: —			
Total,	66.5	115.3	11.7
Insoluble,	59.3	101.0	9.5
Free ammonia,	14.8	24.0	5.2
Oxygen consumed,	201	310	47
Fats,	422	805	70

Sedimentation in Tanks filled with Layers of Slate.

Tank No. 376, having a superficial area of $\frac{1}{4200}$ of an acre, was first put into operation on July 9, 1909, and contains 27 horizontal layers of roofing slate spaced $\frac{3}{4}$ of an inch apart, separated by small concrete blocks, the exposed surface available for the deposition and destruction of sludge being about 314 square inches for each gallon of sewage contained within the tank. During December this tank was dismantled and the amount of sludge present and its distribution upon the various slate layers were determined. At this time the total amount of sludge present was equivalent to about 354,000 pounds per acre, or about 594 pounds for each million gallons of sewage which had been passed through the tank. The tank was then rebuilt and a portion of the sludge which had been removed was uniformly redistributed over the various slate layers, the amount of sludge returned being equivalent to about 50,000 pounds per acre. Operation was begun again on Jan. 1, 1913, the tank being operated like a contact filter as in previous years. It was completely filled with sewage once each day, allowed to stand one hour, then drained slowly and allowed to rest one week in every six. During the year there was a loss of open space in the tank of about 13 per cent. During three of the one-week resting periods there was no appreciable change in the capacity, but during each of the other resting periods there was a small decrease in the proportion of the open space occupied by deposited matters, the increase in open space during these periods averaging about 2 per cent.

As has been explained in previous reports, although this tank is operated like a contact filter, other than in the removal of matters in suspension there is comparatively little change in the character of the sewage which is passed through it. For this reason, this process has been classed with the clarification processes rather than with the contact filters. During February and March, after the tank was rebuilt, a small amount of nitrification was noticed, the average amount of nitrates produced averaging .18 and .21 parts per 100,000, respectively. During following months, however, nitrification was very feeble and at no time during the year was a stable effluent obtained. So far as actual purification was concerned, the practice of resting the tank one week in six appeared to have little effect. In a settling tank as usually constructed and operated, the outlet is so located that the sludge is not distributed to any extent by the outflowing sewage or by the flow of sewage over it. In a tank of this kind, however, the sludge deposited upon the slates is very likely to be disturbed by the sewage flowing across it while the tank is being emptied, this being especially true of any sludge which has been deposited on the bottom of the tank in the vicinity of the outlet. For this reason sewage clarified by this method usually contains somewhat more suspended matters than ordinary settled sewage, while the effluent is frequently heavily charged with suspended matters for a short time after the outlet is opened.

Precipitation with Sulphate of Alumina.

Throughout the year sewage was treated daily with sulphate of alumina in the proportion of 1,000 pounds per million gallons (7 grains per gallon) and allowed to stand for four hours before the clarified supernatant sewage was drawn off from the precipitated sludge. The average removal of suspended organic matters from the sewage by this process was about 71 per cent., as shown by determinations of loss on ignition, and about 66 per cent., as shown by Kjeldahl nitrogen determinations. The total removal of organic matters averaged about 47 per cent., as shown by loss on ignition, and 37 per cent., as shown by Kjeldahl nitrogen determinations.

Precipitation with Ferrous Sulphate.

During December and January the experiments upon the precipitation of sewage with ferrous sulphate and caustic soda were continued. As explained in the last report these experiments were primarily designed to furnish a sludge of high iron content and larger amounts of coagulant were used than would ordinarily be considered necessary had clarification of the sewage been the only object in view. The ferrous sulphate used was the form commercially known as sugar sulphate of iron, containing about 65 per cent. of actual ferrous sulphate, and caustic soda was used instead of lime to produce the necessary alkalinity on account of the greater ease with which its strength can be controlled in experiments where small amounts of caustic alkalinity are needed. The average amount of ferrous sulphate added during these two months was about 877 pounds per million gallons (6 grains per gallon), and the average amount of caustic used was about 728 pounds (5.1 grains per gallon).

As the chemicals were added in excess of the amounts needed for clarification, the removal of suspended matters was very complete, averaging about 90 per cent., as shown by the total solids in suspension; and the removal of organic matters in suspension was about 95 per cent., as shown by loss on ignition, and about 91 per cent., as shown by Kjeldahl nitrogen determinations.

Straining through Anthracite Coal.

Strainer E. — This strainer, containing 12 inches in depth of buckwheat coal, and first put into operation on Feb. 1, 1901, was continued in operation throughout the year at a rate of 1,000,000 gallons per acre daily. As has been explained in previous reports, this strainer continues to be operated at this rate year after year without renewal of material or any appreciable amount of surface treatment being necessary, and at the same time removes a considerably greater amount of suspended matters from the sewage than is the case with any of the other preliminary clarification processes which are under investigation. During 1913 surface treatment was required but once, the strainer being raked to a depth of 3 inches on February 14. The average removal of suspended matters during the year was about 76 per cent., as shown by total solids, and the removal of organic matters in suspension was about 74 per cent., as shown by loss on ignition, and about 72 per cent., as shown by Kjeldahl nitrogen determinations.

Average Analyses.

Settled Station Sewage.

[Parts per 100,000.]

Temperature (Degrees F.).	Ammonia.			Kjeldahl Nitrogen.		Chlorine.	Nitrogen as		Oxygen consumed.	Bacteria per Cubic Centimeter.
	Free.	Albuminoid.								
		Total.	In Solution.	Total.	In Solution.		Nitrates.	Nitrites.		
65	3.76	.43	.25	.83	.48	13.37	–	–	3.19	2,301,000
Effluent from Slate Tank No. 376.										
–	4.24	.52	.38	.97	–	12.96	.11	.0002	3.25	2,707,000
Sewage precipitated with Sulphate of Alumina.										
–	4.93	.41	.28	.76	.54	12.28	–	–	2.62	1,383,000
Effluent from Strainer E.										
–	3.86	.40	.30	.75	.57	13.12	–	–	2.78	3,257,500
Sewage precipitated with Ferrous Sulphate.[1]										
–	4.62	.22	.16	.40	.32	11.90	–	–	1.72	–

[1] Two months, December and January.

Average Solids.

Settled Station Sewage.

[Parts per 100,000.]

Unfiltered.			Filtered.			In Suspension.		
Total.	Loss on Ignition.	Fixed.	Total.	Loss on Ignition.	Fixed.	Total.	Loss on Ignition.	Fixed.
56.6	20.7	35.9	49.0	15.6	33.4	7.6	5.1	2.5
Sewage precipitated with Sulphate of Alumina.								
52.5	16.9	35.6	46.1	12.2	33.9	6.4	4.7	1.7
Effluent from Strainer E.								
54.8	19.1	35.7	49.2	14.9	34.3	5.6	4.2	1.4
Sewage precipitated with Ferrous Sulphate. [1]								
68.1	14.0	54.1	65.0	11.9	53.1	3.1	2.1	1 0

[1] Two months, December and January.

Studies of the Effect upon Sewage Sludge of Storage in Deep Tanks.

The first suggestion in regard to the retention of sludge in compartments separated from the main settling or septic tank was made at the Lawrence Experiment Station in 1899,[1] and tanks constructed after this manner were operated there in that and the following years and have been described in the Lawrence reports. From this early Lawrence work, the Hampton tank of Travis and the so-called Imhoff tank have been developed. This was stated many years ago by Dr. Travis and more recently by Dr. Imhoff in a paper read last year before the International Congress of Demography and Hygiene at Washington.

The imperial patent office of Germany in the case of Imhoff *v.* Travis, more than a year ago, made the following statements regarding the claims presented in this case and quoted below: —

Claim 1. — Process for the biological treatment of sewage by means of separate treatment of the solid and liquid constituents characterized by the following: The sewage passing through one or more closed or open settling spaces at such a speed as to permit the lighter particles to come to the surface and the heavier to sink to the bottom and to pass through openings in

[1] H. W. Clark. Report of Lawrence Experiment Station, 1899–1900, etc.

it with a portion of the liquid into a liquefying space situated below the settling spaces, in which they are partly decomposed and liquefied through biological action, whence the liquid passes out of the liquefying space over weirs, etc.

Claim 2. — Apparatus for carrying out Claim 1 characterized as follows: Combining the settling chamber (*a*) and the liquefying chamber (*b*) in a closed tank, etc.

These and other contentions of the various parties to this suit are long and need not be quoted here. The judgment rendered a year ago, however, states in part as follows: —

It need not be settled here whether these differences are material or not, as it is clear that compared with the purification plant described in the report of the experimental station at Lawrence of the State Board of Health of Massachusetts, Boston, 1899 (thirty-first annual report, page 422), the protected process contains nothing new, which is contended by the claimant. The purification process there employed according to this report is exactly the same as that of the patent attacked. The sewage was passed through ordinary settling tanks and the sludge collected at its bottom was at the same time flushed into a septic tank, where alone it was subject to septicization. The defendants contend, however, from the fact that only ordinary settling spaces are mentioned in the Boston report, and that nothing is said about the continuous removal of the sludge out of the settling spaces, it must be concluded that the process described in the report was only worked intermittently and that a continuous flow through the plant as in the case of the patent attacked, had not taken place. These contentions are, however, not justified, etc.

In many published data in regard to the results of the Imhoff tank, claims are made that the sludge from tanks of this construction is more easily disposed of than sludge from ordinary settling and septic tanks, and that it is almost invariably odorless. While it is true that sludge from any sewage may under some conditions become odorless by long-continued bacterial decomposition whereby the organic and mineral matters are rendered of a humus-like consistency, it has seemed possible that the lack of odor noted in the sludge from many Imhoff tanks is due rather to the composition of the sewage entering these tanks than to the construction and operation of such tanks. Attention was called some years ago [1] to the fact that the sludge from the septic tanks at Birmingham, England, was odorless and the theory was advanced that this characteristic was due largely to the fact that large quantities of copper and iron salts entered the Birmingham sewage owing to the main industries

[1] H. W. Clark. Some Observations of Methods, Cost and Results of Sewage Purification Abroad.

of the city. Recently, attention has been called to this, also, by Mr. Watson, engineer of the sewage-disposal works of Birmingham. Essen, Germany, where the Imhoff tank was first used, and the surrounding district are devoted to iron industries, and much iron must be present in the sewage. At Worcester, Mass., also, the sludge from an acid iron sewage has been successfully treated experimentally by this process.

Certain studies upon this subject of differences in sludge were begun at the station early in 1912, five tanks 17 feet in depth being put into operation, each receiving sludge from a different sewage or sludge to which iron had been applied. These tanks are not claimed to be Imhoff tanks but seemed suitable for this study, and into each of them sludge was introduced through a pipe reaching some distance below the surface. This sludge when introduced contained from 93 to 99 per cent. of water, as will be explained later.

A portion of the data obtained during 1912 was presented in the report for that year. These experiments were continued through 1913 with various additional tanks, and the complete results covering the studies during both years are summarized in the following pages.

Operation of Sludge Tanks.

Ten of the tanks used in the experiments were 17 feet in depth and one, Tank S, 30 feet in depth. Each was completely filled with wet sludge from the sedimentation or chemical precipitation of sewage or with sludge to which certain chemicals were added and, after filling, portions of wet sludge of the same kind were added to the tanks at weekly intervals, displacing an equal volume of the supernatant liquid which collected above the sludge formed by the settlement of the heavy solid matters. These weekly additions to the tank were made through a pipe extending well below the surface, thus effectively preventing any of the suspended matters of the wet sludge added from being carried off with the overflowing liquid. After the sludge had been held in the tank for a period of two months, and at regular monthly intervals thereafter, portions of the heavy sludge were withdrawn from the bottom of the tank for examination. By this procedure the conditions were similar to those obtained in the Imhoff tank, the sludge being subjected to storage and decomposition action under gradually increasing pressure as it worked its way to the bottom of the tank. The details of operation of the various tanks were as follows: —

Tank I was operated from Jan. 17, 1912, to April 19, 1913, with sludge from the settling tank receiving Lawrence sewage at the experiment station. During the last eight months of the experiment a small amount of water was forced in at the outlet at intervals to stir up the sludge and to help the elimination of matters which had been rendered soluble. Fermentation became active in this tank after it had been in operation about seven months.

Tank J was operated from Jan. 20, 1912, to Jan. 8, 1913, receiving sludge obtained by precipitation of Lawrence sewage with copperas and caustic soda. As applied to the tank this sludge contained iron (FeO_2H_2) equivalent to about 20 per cent. of the total solids, and had the odor of hydrocarbons so noticeable when cast iron is dissolved in acid. Fermentation became established in this tank during the first two months and continued until the experiment was stopped.

Tank K, operated from Feb. 4, 1912, to Jan. 8, 1913, received sludge from the sedimentation of the waste liquors from a tannery. As applied to this tank this sludge contained a large amount of chemicals from the tanning process. Little or no active fermentation was observed in this tank although there was a marked change in the character of the sludge.

Tank L was operated from March 22, 1912, to Jan. 8, 1913, with a mixture of three parts of the settled sewage sludge applied to Tank I and one part of the iron-precipitated sludge applied to Tank J. The amount of iron (FeO_2H_2) in this sludge was equivalent to about 8 per cent. of the total solids. Fermentation occurred in this tank, but never became very active.

Tank M was operated from May 3, 1912, to Oct. 29, 1913, with sludge from the settling tank at the Andover filtration area. On December 16 lime equivalent to about 1 per cent. by weight was mixed with the sludge in the tank, and after that date a similar amount of lime was added to the sludge entering the tank, to increase the alkalinity of the sludge and hasten the breaking down of insoluble organic matters. After April 10, 1913, a small amount of water was forced in through the outlet at intervals to stir up the sludge and to remove some of the organic matter which had been rendered soluble. Active fermentation was not observed in this tank at any time during the period of about eighteen months it was in operation.

Tank N was operated from Jan. 17 to May 9, 1913, with sludge from the settling tank at the experiment station, to which hydrate of alumina had been added. In the amounts added the AlO_3H_3 produced a similar alkalinity to that produced in the sludge for Tank J by the ferrous hydrate present, but unlike the latter the aluminum does not form combinations with the sulphur compounds. Fermentation became active in this tank after about four months.

Tank O was operated from Jan. 20 to April 10, 1913. with sludge from the Andover settling tank. In this tank the experiment was tried of blowing air in at the outlet for a short time each day to stir up the sludge. The experiment proved unsuccessful. No fermentation was noted in this tank at any time and the sludge drawn from it was always in a very offensive condition.

Tank P was operated from Jan. 20 to Oct. 29, 1913, with sludge from the Andover settling tank. A small amount of water was forced in at the outlet occasionally to stir up the sludge and assist in the elimination of soluble matters. No active fermentation occurred at any time in this tank, but after the first four or five months more or less gas came to the surface when the tank was jarred.

Tank Q was operated from April 11 to Oct. 29, 1913, with sludge from the settling tank at the experiment station, to which lime in the proportion of about 154 grains per gallon had been added. Fermentation became active in this tank during the second month and continued until the experiment was discontinued.

Tank R was operated from April 18 to Oct. 29, 1913, with sludge from the Andover settling tank, to which sufficient copperas and caustic soda had been added to make the amount of FeO_2H_2 in the sludge equivalent to about 20 per cent. of the total solids. Although no noticeable fermentation occurred in this tank there was a marked improvement in the character of the sludge withdrawn after the first two months.

Tank S was operated from May 23 to Oct. 29, 1913, with sludge from the settling tank at the station. In order to study the effect of higher pressures this tank was made 30 feet in depth instead of 17 feet in depth, as was the case with the tanks previously described, thus doubling the hydrostatic pressure upon the sludge in the bottom of the tank. Fermentation became active in this tank during the second month of operation.

Effect of Storage upon Odor of Sludge.

As a result of these experiments it was evident that the production of an inoffensive sludge by storage in deep tanks is in a considerable measure dependent upon the character of the sludge placed in the tanks, but that in certain cases, at least, slight changes in the operation of the tank or the addition of certain chemicals to the sludge may be sufficient to make the process effective so far as the production of a comparatively odorless sludge is concerned. In practically every instance where an odorless sludge was produced, fermentation was more or less active within the tank. In Tank S, which was 30 feet deep and started during warm weather, sludge from the settling tank at the experiment station always became odorless after two months' storage. In Tank I sludge from the same source continued to be decidedly offensive through seven months' operation of the tank, and although the latter part of this period was in warm weather, fermentation was not active. When the contents of Tank 1 were agitated occasionally, however, by forcing a small quantity of water in at the bottom of the tank, fermenting action increased and the sludge drawn from the tank was odorless, but whether the fermentation started as the result of the agitation or whether it would have started as the result of warmer weather, could not be determined. Storage was not effective in producing any appreciable reduction in offensiveness of the sludge from the Andover settling tank, and even stirring the contents of this tank, as was tried in Tanks M and P or by forcing air up through the tank as was tried in Tank O, also caused no appreciable decrease of odor. The presence of considerable amounts of chemicals appears, in some cases at least, to have assisted in the production of a nonodorous sludge during storage. The tannery sludge which contained large amounts of the chemicals from the tanning process became odorless after a short storage in Tank K, and the sludge obtained by precipitation of Lawrence sewage with iron and caustic soda became practically odorless during storage in Tank J. The addition of iron to the sludge from the Andover settling tank before treatment in Tank R, and the addition of lime to the sludge from the Lawrence settling tank before treatment in Tank Q, also appeared to assist in the production of odorless sludges, while the Lawrence sludge to which hydrate of alumina was added developed a benzol-like odor and became inoffensive after storage in Tank N. In the case of the mixed sludges of relatively low iron content treated in Tank L and in the case of addition of lime to the Andover sludge treated in Tank M, the odor became somewhat ammoniacal and less offensive than previously, but in neither case was an odorless sludge produced.

Sulphides in Sludge.

It is well known that many organic compounds found in sewage contain sulphur, and that the offensive odors resulting from putrefying organic matter are in a greater or less measure due to the breaking down of these sulphur compounds and to the liberation of hydrogen sulphide or other ill-smelling sulphur compounds. As already stated, it is quite possible that the fact that an odorless sludge is produced by bacterial forces in certain cases and an offensive sludge is produced under similar conditions at other places may be due to the fact in the first case that the sewage or sludge contains certain substances such as hydrate of iron, which will combine with and fix these malodorous sulphur compounds as fast as they are liberated. Throughout these experiments samples of the various sludges were treated with acid, and the H_2S driven off and determined by absorption with standard iodine solution. By this method, both H_2S and sulphur present as sulphides are shown as H_2S, but other forms or combinations of sulphur which might be present in the sludge are not shown.

From the results of these tests little or no relation between the amount of sulphides present in the sludge and the offensiveness or nonoffensiveness of that sludge is apparent. The Andover sludge after treatment in Tanks M and P contained very small amounts of H_2S, but was always very offensive, while the sludge from the Lawrence sewage after treatment in Tanks I and S was practically odorless, although yielding more than three times as much H_2S as the sludges from Tanks M and P. The amounts of H_2S found in the sludges from Tanks J and R, which were of high iron content, were considerably larger than the amounts found in the same sludges after treatment in other tanks, but without the addition of chemicals. Both of these sludges were comparatively odorless. The sludge from Tank L, containing some iron, never became inoffensive, but yielded about three times the amounts of H_2S as the sludges from Tanks J and R, which were practically odorless and contained about four times as much iron. The sludge in Tanks N and Q contained large proportions of aluminum hydrate and lime, respectively, the latter of which would combine with H_2S to form stable sulphides, while the former would not form such combinations. Both of these sludges became odorless, and the H_2S found in each was practically the same and much less in amount than was found in sludges from Tanks I and S which contained no added chemicals.

The average amount of sulphides in each of these various sludges was as follows: —

Tank.	Parts per 100,000 (H_2S).	Tank.	Parts per 100,000 (H_2S).
I,	35	N,	27
J,	51	P,	11
K,	27	Q,	29
L,	120	R,	17
M,	15	S,	36

Water Content and Ease of Draining.

A point of very practical importance when considering the disposal of sludge is the amount of water carried by that sludge, and the proportion of that water which may be eliminated when the sludge is drawn off onto draining beds. A reduction in the water content of a sludge from 98 per cent. to 96 per cent. will result in a reduction of about 50 per cent. in the bulk of that sludge, while a further reduction in water content to 90 per cent. will cause a shrinkage in the amount of sludge to be handled to about one-tenth its original volume. Throughout these experiments careful determinations have been made of the amount of water in the various sludges before and after storage in the different tanks, and in the sludge drawn from the tanks after draining for a period of ten days on a filter of coarse sand.

There are two different methods used in expressing the moisture content of sludge. Most writers upon sewage treatment consider the water and the soluble matters which it contains as component parts of the sludge, and in determining water content include the matters dissolved in the water as a part of the dry sludge. Other writers, however, consider the suspended or nonsoluble matters only as sludge, and include everything in solution in the water as part of the water content of the sludge. As to which method is correct depends upon the viewpoint and the purpose of the results. The soluble matters add a certain weight to the sludge if it has to be handled in a wet condition, but in draining a certain proportion of the loss of weight is due to the soluble matters which have drained away with the water. The amount of soluble matters in ordinary sewage sludge is such a small proportion of the total weight that the difference in the water content expressed upon either basis is relatively small, but in order that the results obtained in different places may be compared, the basis on which those results were computed should be known.

The percentage of water in the sludges applied to the various tanks at different times varied from 93 per cent. to over 99 per cent., the average water content of most of them being about 98 per cent. After storage in the tanks, the percentage of water in each sludge was always much reduced, the greatest reduction during storage occurring in the tannery sludge treated in Tank K, in which the water content was reduced to about 88 per cent., corresponding to a reduction in bulk of about 75 per cent. This sludge was of such consistency after tank treatment that, when piled up in irregular heaps upon the draining bed, it would retain its form, — a condition which was obtained with none of the other sludges studied. A much smaller compaction and reduction of water content occurred when considerable proportions of iron were present, and the same fact was observed in the case of the Lawrence sludges, to which considerable amounts of lime or aluminum hydrate had been added. The average water content of the untreated sludges after storage was about 91 per cent., and the average proportion of water in the heavily chemically treated sludges after storage was about 93 to 94 per cent.

The occurrence or nonoccurrence of active fermentation in these tanks, which as previously pointed out was an important factor in the production of an inoffensive sludge, apparently had little effect upon the water content of the sludge as drawn from the tanks. On the other hand, an improvement in the drainability of the sludge almost always followed the occurrence of fermentation in any of the tanks. Stirring the sludge and removal of soluble matters by forcing water in at the outlet also appears to have favorably affected the drainability of the sludge in the case of Tanks I and M, although it apparently was of little effect in the case of Tank P. The lowest water content obtained after draining any of the sludge drawn from the various tanks was about 55 per cent., this being the proportion of moisture in the drained sludge from Tank K, in November, 1912, and in that from Tank L in July, 1912. The lowest average moisture content was obtained in the case of the tannery sludge from Tank K, which contained about 61 per cent. water after draining. The chemically treated sludges from Tanks L, N and Q, and the natural sludge from the 30-foot Tank S, all averaged less than 68 per cent. water after draining. On the other hand, the heavily iron-treated sludge from Tank J and the natural sludges from the Andover and Lawrence sewages treated in Tanks M and I, respectively, averaged 77 and 78 per cent. water even after being drained for ten days.

The water content of the various sludges before and after storage and after draining are shown in the following table: —

Tank.	Per Cent. Water in Sludges.								
	Sludge Entering Tank.			Sludge Drawn from Tank.			Sludge after Draining Ten Days.		
	Average.	Maximum.	Minimum.	Average.	Maximum.	Minimum.	Average.	Maximum.	Minimum.
I,	98.3	99.5	95.1	91.3	93.2	89.7	76.6	84.0	70.8
J,	98.2	99.8	95.0	93.3	96.5	85.7	76.8	84.0	54.9
K,	97.7	99.2	93.3	88.1	96.6	84.4	69.3	78.0	55.2
L,	98.2	99.6	96.0	91.1	95.8	88.7	67.1	75.0	55.7
M,	98.8	99.4	98.1	91.6	98.6	89.2	77.6	81.8	68.0
N,	96.9	97.4	96.4	94.3	97.0	91.6	63.8	65.0	62.7
P,	98.7	99.2	98.1	91.2	92.7	90.3	72.5	77.0	63.1
Q,	97.9	99.6	95.9	93.7	95.5	92.1	63.6	65.0	62.7
R,	98.1	98.1	98.1	95.2	97.8	92.6	60.9	61.7	60.0
S,	97.9	98.8	96.4	91.3	92.1	90.1	65.9	68.0	64.6

Changes in the Composition of Sludge during Storage.

The changes occurring in the composition of sewage sludge during storage result from two entirely different causes, one mechanical and the other biochemical. During storage the particles of sludge in the bottom of the tank, under the influence of gravity and the pressure of the sludge and water above, are compacted and pressed together and more or less water and water-soluble matters are squeezed out mechanically. At the same time, bacteria and other microscopical life may be active in breaking down the complex-suspended solids into simpler forms, some of which are soluble in water and others of which are in the form of free gases, which, when sufficiently large in amount, tend to overcome the mechanical effect of gravity and pressure and to loosen up and in some cases float the sludge. The two forces, mechanical and biolytic, or biochemical, are at work simultaneously, and it is impossible to entirely separate the results of one process from the other. The major effect of the mechanical forces is in the reduction of the water content, which is discussed in another chapter, although even in the change in the water content the biolytic action undoubtedly plays an important part by changing the size and shape and also the specific gravity of the particles of insoluble matter which make up the sludge mass. The composite effect of these two forces is to be noted in the analyses of the sludge before and after storage in the various tanks. In every case a large increase is to be observed in the total and suspended solids and in the organic nitrogen, oxygen consumed and fats in the sludge after passage through the tank, which are due in a large measure to the concentration of the sludge and the elimination of water. In every case, also, there was a large increase in the soluble organic matters and in the free ammonia in the sludge after storage, which must be attributed to the breaking down of the organic matter by biolytic action.

In order to determine the whole amount of decomposition occurring in the various tanks, it is necessary to take into consideration, also, the average composition of all the sludge which remained in the tank at the end of each experiment and of the supernatant liquid displaced by the addition of fresh sludge to the tanks, and also the soluble matters washed out of the sludge by the introduction of water at the outlet where such practice was tried. These various factors have been included in the computations of the efficiency of the various sludge tanks, as shown in a following table. There was a great difference in the effect of storage in the different tanks. The total reduction of suspended solids in the untreated Lawrence sludge in 16-foot Tank I was about 19 per cent., and in 30-foot Tank S was nearly 30 per cent. Fermentation was more active in the latter tank, so that the superior results obtained cannot be entirely attributed to the use of the deeper tank. In the case of Tank I, breaking down of the suspended matters was apparently hastened to some extent during the latter portion of the experiment by the occasional introduction of water at the outlet. In the case of the Lawrence sludges containing hydrate of iron in Tanks J and L, and the sludge containing hydrate of alumina in Tank N, the reduction in insoluble matters during storage was somewhat less than in the case of the sludges from the same source without added chemicals. Treatment with lime, however, appears to have helped the breaking down of the suspended matters, the average reduction in Tank Q being over 50 per cent. In the case of the Andover sludge in Tanks M and P, there was practically no reduction in the amount of insoluble matters, and addition of lime in the case of Tank M, and the introduction of water at the outlet in the case of Tank P, apparently had little effect. In the Andover sludge which had been treated with hydrate of iron (Tank R), however, the reduction in insoluble matters was about 78 per cent., the largest reduction observed in any of the tanks.

The changes in the fat content are of particular interest, as the fats are among the most resistant to hydrolytic action of the organic compounds in sewage, while their presence in considerable amounts unfavorably affects the consistency and drainability of the sludge. With one exception there was a considerable reduction in fat content of the different sludges during storage. In the case of the tannery sludge in Tank K, there is an apparent increase in fat content which cannot be satisfactorily explained. In Tanks M and R the proportion of fats destroyed was between 30 and 44 per cent., in Tanks I and L it was between 40 and 50 per cent., while in Tanks J and N the destruction of fats amounted to about 70 per cent., and in Tanks Q and S about 80 per cent. of the fats in the sludge was destroyed. So far as can be determined from the results, there is little apparent relation between the character of the sludge treated or the method of operation and the destruction of fats in the various tanks.

While there was a marked change in the nitrogenous constituents of the various sludges, there was much less variation in the reduction of total and insoluble inorganic nitrogen in the various tanks than was the case in the total insoluble matters and fats. The smallest reduction in total organic nitrogen was about 22 per cent. in Tanks M and S, and the largest was about 48 per cent. in Tank R. In seven of the tanks the reduction in insoluble organic nitrogen was between 30 and 40 per cent., while in Tanks P and S the reduction was about 26 and 23 per cent., respectively, and in Tank Q the reduction was about 42 per cent. The presence of lime, aluminum hydrate and ferrous hydrate in considerable amounts appears to a certain extent to have assisted in the breaking down of the insoluble organic matters of the sludges, in each case the chemical sludge showing a greater reduction in insoluble organic nitrogen than the same sludge without added chemicals. Judging from the results, lime was somewhat more effective in this respect than either of the other chemicals, and in the one case where it was tried, the aluminum hydrate was somewhat more effective than the ferrous hydrate. In nearly all of the tanks more than half of the nitrogen released by the breaking down of organic nitrogen was found as free ammonia either in the water mixed with the sludge or in the overflow from the tank. In the case of the aluminum-treated sludge in Tank N, however, only about one-sixth of the nitrogen from the decomposition of organic matters was found as free ammonia, while in Tanks P and S there was an increase in free ammonia considerably larger than can be accounted for by the reduction in the organic nitrogen. In six of the ten tanks included in the computations there was apparently an increase in total nitrogen. In every case except one, this apparent increase is small and might have been due to sampling errors. The results on Tank P, however, show an apparent increase in total nitrogen in the tank of about 19 per cent., which is too large to be attributed to sampling errors, but which cannot be otherwise explained. In the case of Tanks M, Q, R and N there was a loss in total nitrogen of about 10, 14, 18 and 25 per cent., respectively.

The average analysis of the various sludges before and after storage in the different tanks, and the amount of decomposition effected in those tanks, are shown in the following tables: —

Sludges Applied to Tanks.

[Parts per 100,000.]

Tank.	Solids.				Free Ammonia.	Kjeldahl Nitrogen.		Oxygen consumed.	Fats.
	Total.		In Solution.						
	Total.	Loss on Ignition.	Total.	Loss on Ignition.		Total.	In Solution.		
I, . . .	1,783	1,151	67.4	28.5	8.46	48.1	0.72	133	294
J, . . .	1,867	882	76.0	24.3	7.46	39.6	0.34	216	108
K, . . .	2,483	1,342	170.0	53.7	11.29	50.3	0.82	238	274
L, . . .	1,858	1,075	69.9	26.7	8.37	42.1	0.52	155	210
M, . . .	1,361	978	138.9	62.7	9.16	45.0	3.71	120	240
N, . . .	3,217	1,953	104.9	30.4	11.37	77.9	0.67	211	479
P, . . .	1,455	1,151	109.2	61.7	7.50	45.0	2.80	106	407
Q, . . .	2,209	1,154	106.9	45.7	13.35	48.4	2.92	163	262
R, . . .	2,509	1,306	642.8	110.4	8.00	54.6	11.74	172	552
S, . . .	2,148	1,082	59.1	20.9	10.86	49.8	0.61	189	251

Effluent from Sludge Tanks.

[Parts per 100,000.]

Tank.	Solids. Total. Total.	Solids. Total. Loss on Ignition.	Solids. In Solution. Total.	Solids. In Solution. Loss on Ignition.	Free Ammonia.	Kjeldahl Nitrogen. Total.	Kjeldahl Nitrogen. In Solution.	Oxygen consumed.	Fats.
I, ...	8,908	5,244	240.1	120.0	52.00	192.9	1.99	619	1,015
J, ...	6,848	2,912	126.4	64.2	40 20	123.9	1.67	732	236
K, ...	12,269	6,677	385.6	182.8	54.00	170.3	2.40	924	2,137
L, ...	9,003	3,875	131.1	68.3	52.74	141.6	1.65	708	426
M, ...	8,788	5,825	588.8	324.5	49.86	163.6	23.56	571	1,031
N, ...	5,094	2,823	123.5	53.9	18.83	87.7	1.00	299	302
P, ...	7,603	5,439	210.6	100.6	30 50	179.7	2.29	618	1,756
Q, ...	7,230	3,346	195.9	89 2	70.25	135.9	1.61	577	873
R, . . .	4,121	2,056	470.3	175.7	33.53	68.8	0.76	295	806
S, ...	7,465	2,992	163.6	39 6	53.00	150.0	1.34	625	451

Efficiency of Various Sludge Tanks.

Tank.	Per Cent. Reduction. Total Insoluble Matters.	Per Cent. Reduction. Total Organic Nitrogen.	Per Cent. Reduction. Insoluble Organic Nitrogen.	Per Cent. Reduction. Fats.	Per Cent. Organic Nitrogen changed to Free Ammonia.
I, ...	18.6	28.9	30.3	49.0	19 0
J, ...	11.6	32.9	33.7	69.8	27.9
K, ...	16.8	31.6	32.5	13.2[1]	19.7
L, ...	14 3	29.1	30.0	43.4	19 7
M, ...	3 6	22 4	37.7	30.5	11.1
N, ...	16 9	34.5	36.0	71 7	6 0
P, ...	3 2	23.6	26.2	17.9	45 0
Q, ...	51.5	42.2	42.3	80.5	31 1
R, ...	78 1	48.3	35.7	33.1	28 3
S, ...	29 9	21.7	22.7	79.3	30.8

[1] Increase.

Bacteriology of Sludges.

Throughout the investigation counts have been made of the total numbers of bacteria and of anaerobic bacteria on agar after four days at room temperature and of the total and red colonies on litmus-lactose agar after twenty-four hours at body temperature on the various sludges before and after treatment in the tanks, and tests for B. coli have been made on all samples in successive dilutions.

There was a large fluctuation in the bacterial content of the various sludges which may be attributed in part to the fact that the sludges not only contained large numbers of bacteria but were also of such consistency that it was difficult to obtain representative samples. In all but two of the tanks the average bacterial results show a reduction in the numbers of bacteria in the sludge during storage ranging from about 73 per cent. in the case of Tank S to nearly 99 per cent. in the case of Tank P. A similar reduction is also to be noted in the numbers of anaerobes in these sludges, and a somewhat larger reduction in the numbers of bacteria of the types growing at body temperature. In the case of Tanks Q and R, not only was the reduction in body temperature bacteria much less than in the other tanks, but there was an increase in the total bacteria in the sludge in both tanks and a small increase in the anaerobic bacteria in the case of Tank R. From a sanitary viewpoint the most interesting fact is the marked reduction in bacteria of the colon type. The greatest destruction of B. coli is to be observed in the case of Tank M. In nearly 40 per cent. of the samples of sludge applied to this tank, 1,000,000 or more bacteria of this type were found, while in the tank effluent, B. coli could not be found in 1 cubic centimeter in over 40 per cent. of the samples examined and was absent in 10 cubic centimeters in about one-fourth of the samples. Even in the case of Tank Q, from which no sample of the stored sludge was obtained containing less than 100 B. coli, the average reduction was about 99.6 per cent.

On certain of the sludge samples counts were also made of the numbers of sulphide-producing bacteria by the use of agar to which a suspension of bismuth subnitrate had been added. The number of such samples was much smaller than those analyzed by the regular procedure and for this reason the average results of these special tests are not strictly comparable with the other bacterial averages. In the majority of instances the numbers of bacteria determined on the bismuth media were very much smaller than on the regular media, and this fact must also be taken into account in considering the results of these tests, as it is quite probable that the sulphide-forming bacteria may also have been reduced in similar proportion. In the sludge from Tank P, however, the numbers of bacteria on the bismuth media were higher than on the regular media. In general, omitting the apparently abnormal results obtained in the case of Tank P, the sludges in which the largest numbers of sulphide bacteria were found were also those in which the largest amounts of sulphides were found by analysis. Furthermore, in the case of the sludges from Tanks I and S from which 35 and 36 parts H_2S were obtained, the numbers of sulphide bacteria found were about 11 and 16 per cent., respectively, of the total bacterial count, while in the case of sludges M and R from which only about one-half as much H_2S was obtained, the numbers of sulphide bacteria were only 6 and 3 per cent., respectively, of the total numbers of bacteria in the sludge.

The average results of the various bacterial examinations are shown in the following tables: —

Average Numbers of Bacteria.

Tank.		Bacteria per Cubic Centimeter.				
		20° C.		40° C.		Sulphide-producing Bacteria.
		Total.	Anaerobes.	Total.	Red.	
I,	Applied,	19,019,000	8,461,500	1,372,200	1,183,600	1,600,000
	Effluent,	473,600	516,800	9,400	5,300	120,000
J,	Applied,	3,681,000	838,100	157,700	133,900	-
	Effluent,	383,500	51,500	8,400	3,500	-
K,	Applied,	9,370,000	914,200	676,100	262,300	-
	Effluent,	1,419,300	16,600	42,100	16,800	-
L,	Applied,	12,257,000	4,058,500	661,800	599,000	-
	Effluent,	732,500	47,600	8,800	2,800	-
M,	Applied,	19,057,000	13,658,600	5,452,400	4,863,600	1,200
	Effluent,	1,239,500	158,200	25,700	19,300	950
N,	Applied,	25,514,000	17,457,000	1,124,000	912,900	-
	Effluent,	1,045,000	792,500	12,200	850	69,000
P,	Applied,	39,083,000	26,867,000	8,652,000	7,632,000	-
	Effluent,	474,500	347,300	9,700	1,425	128,000
Q,	Applied,	8,063,000	6,759,000	210,500	161,800	235,000
	Effluent,	9,090,000	5,663,000	166,500	45,800	1,305,000
R,	Applied,	360,000	620,000	52,000	36,000	-
	Effluent,	528,800	660,700	22,200	13,900	20,000
S,	Applied,	11,580,000	15,540,000	626,000	514,000	657,500
	Effluent,	3,090,000	6,993,000	112,600	74,100	750,000

Summary of Bacterial Results.

Tank.	Per Cent. Reduction.				Per Cent. of Bacteria in Stored Sludge producing Sulphides.
	20° C.		40° C.		
	Total.	Anaerobes.	Total.	Red.	
I,	97.5	99.3	99.6	93.9	16.0
J,	89.6	94.7	97.4	93.9	–
K,	84.9	93.8	93.6	98.2	–
L,	94.1	98.7	99.5	98.8	–
M,	93.5	98.8	99.5	99.6	5.9
N,	95.9	95.5	98.9	99.9	6.6
P,	93.8	98.7	99.9	99.9	73.6[1]
Q,	12.8[2]	16.2	20.8	71.8	8.1
R,	47.0[2]	6.6[2]	57.3	61.4	3.1
S,	73.4	55.0	82.0	85.6	11.1

[1] Probably abnormal. [2] Increase.

Results of B. Coli Tests.

Tank.		Per Cent. of Samples containing B. Coli.							
		10 c. c.	1 c. c.	0.1 c. c.	.01 c. c.	.001 c. c.	.0001 c. c.	.00001 c. c.	.000001 c. c.
I,	Applied,	100	100	100	96	96	93	44	11
	Effluent,	100	73	27	18	9	0	0	0
J,	Applied,	100	100	100	100	88	59	6	0
	Effluent,	100	78	67	44	22	11	0	0
K,	Applied,	100	100	78	67	33	11	0	0
	Effluent,	100	86	29	14	14	14	0	0
L,	Applied,	100	100	100	100	100	74	42	5
	Effluent,	100	100	50	17	0	0	0	0
M,	Applied,	100	88	81	75	69	63	56	38
	Effluent,	75	58	25	8	0	0	0	0
N,	Applied,	100	100	100	100	100	100	72	0
	Effluent,	100	100	100	0	0	0	0	0
P,	Applied,	100	72	43	29	29	14	0	0
	Effluent,	100	100	0	0	0	0	0	0
Q,	Applied,	100	100	88	75	63	50	25	13
	Effluent,	100	100	100	100	50	0	0	0
R,	Applied,	100	72	43	29	29	14	0	0
	Effluent,	100	100	50	25	25	0	0	0
S,	Applied,	100	100	80	80	80	80	60	20
	Effluent,	100	100	100	75	25	0	0	0

Aeration of Sewage.

During an investigation on the effect of pollution of water on fish life during 1911 and 1912, it was observed that a marked clarification resulted after air had been blown through sewage for a time, and that when growths of certain green algæ occurred in the aerated sewage, it remained saturated with oxygen without further aeration. The results of certain preliminary experiments which were made during 1912 for the further study of these points were described on pages 290 to 292 of the report for that year. During 1913 experiments along this line were continued and a method of treating sewage by aeration in tanks containing layers of slate was evolved, by which not only was the putrescibility of the sewage very largely reduced but a very complete removal of suspended and colloidal matters was also obtained. This aerated, clarified sewage can be further purified by filtration at higher rates than have hitherto been practical in sewage disposal. Furthermore, the sludge resulting from the collected suspended and other matters is nonoffensive, easily drainable and can be readily disposed of without creating a nuisance.

Former Studies.

The idea of using mechanical aeration in sewage purification is not new. More than thirty years ago the value of aeration in connection with precipitation with lime was extensively studied by Dr. Angus Smith, and in his report to the Local Government Board (England) in 1882, he shows that putrefaction is delayed and the subsequent formation of nitrates is facilitated by agitation of the treated sewage with a current of air.

In 1884 aeration of sewage was studied by Dupre and Dibdin,[1] who concluded that aeration had comparatively little effect upon the sewage and waters with which they experimented. In 1888 a British patent was issued to Messrs. Hartland and Kaye-Parry for a process of sewage treatment which included a chamber in which air was blown through the sewage. In 1890 and 1891 investigations on the effect of agitation and aeration upon the organic content of water and of mixtures of water and sewage were made by the late Dr. Drown [2] in the laboratories of the Massachusetts State Board of Health, and by Mason and Hine [3] at Rensselaer Polytechnic Institute, and studies of the change in the character of the Niagara River after passing over Niagara Falls were made by Professor Leeds.[4] In each of these investigations it was concluded that the oxi-

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[1] Report of Royal Commission on Metropolitan Sewage Discharge, Vol. 2, 1884.

[2] Twenty-third Annual Report of Massachusetts State Board of Health, 1891.

[3] Journal of American Chemical Society, Vol 14, 1891.

[4] Quoted by Mason.

dation of organic matters in water was not hastened to any great extent by agitation and aeration. The late Colonel Waring,[1] after a series of experiments at Newport, R. I., from 1892 to 1894, constructed a plant at Wayne, Pa., in which sewage in a tank had a current of air blown through it for several hours, and was then passed through filters which were also artificially aerated.

Investigations on the value of artificial aeration of sewage filters of coarse material were begun at the Lawrence Experiment Station [2] in 1891 and continued until 1898, and similar experiments were made by Lowcock [3] in England in 1892. These experiments were upon the aeration of filters, however, and not of sewage held in tanks.

In 1910 experiments upon aeration of sewage were made upon a somewhat larger scale by Black and Phelps [4] in connection with investigations on the discharge of sewage into New York harbor. In these latter studies a change in the degree of stability or putrescibility rather than a change in the organic content of the sewage appears to have been the principal object, and it was shown that under proper conditions of aeration a considerable reduction in putrescibility could be accomplished. In none of these various investigations does any change in the character of the suspended matters or any clarification of the sewage appear to have been noted.

Development of the Lawrence Process.

The process developed at the Lawrence Experiment Station, however, as regards its efficiency in collecting suspended and colloidal matters and thereby producing a clarification of the sewage, which is fully as important as the reduction in putrescibility, is entirely new.

Method and Results of First Aeration Experiments.

On April 16, 1912, new experiments were started at Lawrence to study the effect of aeration of sewage and also the effect of aeration combined with the action of green algæ. At the same time, three small sand filters were started to determine the effect of these preliminary treatments upon the subsequent purification of the sewage by filtration, one of the filters being operated as a control with unaerated sewage and the other two receiving sewage after treatment by these different methods. For convenience the sewage prepared according to each of these different methods will be designated by the number of the filter to which it was applied.

[1] Rafter and Baker. Sewage Disposal in the United States, 1894, p. 535.
[2] Reports of Massachusetts State Board of Health, 1891 to 1898, inclusive.
[3] Proceedings of the Institute of Civil Engineers, 1893.
[4] Report to Board of Estimate and Apportionment on Discharge of Sewage into New York Harbor, March 23, 1911.

Sewage clarified by straining was used. The sewage for Filter No. 446 was aerated continuously for twenty-four hours and then allowed to settle for one hour, and the sewage for Filter No. 447 was seeded with 20 per cent. of sewage containing a strong growth of green algæ (mainly Scenedesmus and Protococcus), the mixture being aerated for twenty-four hours, and then allowed to stand an additional twenty-four hours to permit further growth of algæ. Throughout this experiment, aeration was carried out in gallon bottles, air being supplied by an ordinary Richards pump. During the first three months the bottles used were cleaned at frequent intervals but during the greater part of the experiment the bottles used in aerating the sewage for Filter No. 446 were cleaned only when green growths occurred on the glass, while after these first months those used in aerating the sewage for Filter No. 447 were not cleaned.

The effect upon the sewage of aeration and of aeration combined with algal inoculation was quite different, especially during 1912, when the culture of algæ was active. From April 16 to July 28, when settled sewage was used, aeration reduced the free ammonia 32 per cent. and the Kjeldahl nitrogen 38 per cent., while inoculation and aeration gave a reduction of about 44 per cent. in free ammonia and about 23 per cent. in Kjeldahl nitrogen. In both processes the reduction in oxygen consumed was about 43 per cent. The reduction in soluble nitrogen, however, in both sewages during this period was remarkable, averaging about 45 per cent. in the aerated sewage and about 50 per cent. in the inoculated sewage. During this period, nitrification of the sewage in either set of bottles was not suspected, and no tests were made for nitrates and nitrites. During August, however, the aerated sewage contained nitrites and small amounts of nitrates, and the inoculated sewage contained over 1.5 parts per 100,000 nitrates, and judging from the low free ammonia, it is evident that nitrification was active in the "green growth" bottles during the greater part of this period. After July 29 settled sewage was used instead of strained sewage for these experiments. Up to Feb. 4, 1913, the aerated sewage was prepared as before, but after October 2 the extra twenty-four-hour period allowed for the growth of algæ after aeration of the inoculated sewage was discontinued, a large number of experiments having shown that practically all of the oxidation and nitrification of this sewage occurred during the twenty-four-hour aeration period. Comparing the effect of these two treatments during the period from July 29, 1912, to Feb. 4, 1913, it will be noted that the purification of the sewage by combined aeration and algal inoculation was somewhat better than when aeration alone was practiced. In the oxidation of carbonaceous matters, as shown by the oxygen consumed, both processes were of equal efficiency, the average reduction in oxygen consumed being about 64 per cent. in each case. The reduction in total nitrogen and in free ammonia in the inoculated sewage, however, — about 66 per cent. and 39 per cent., respectively, — is somewhat greater than the reduction in these constituents, 61 and 31 per cent., respectively, in the plain aerated sewage. A considerable part of the greater efficiency of the combined process in the reduction of nitrogenous matters can be attributed to the much greater amount of nitrification which occurred in the sewage containing algæ, the average amount of nitrates in the aerated sewage being about 0.13 parts per 100,000, while in the inoculated and aerated sewage the nitrates averaged 1.14 parts per 100,000, or nearly nine times as high. In August, 1912, when the nitrates in the inoculated sewage averaged 1.68 parts per 100,000, there was a reduction of over 86 per cent. in the free ammonia and over 60 per cent. in the organic nitrogen and oxygen consumed.

Owing to a decrease of vigor in the culture of algæ used to inoculate the sewage, the growths during the greater part of 1913 were very feeble, and during this period nitrification was much less active in the inoculated sewage. Notwithstanding the less active nitrification, however, the reduction in free ammonia in this sewage during the period from February to November, inclusive, averaged 52 per cent., or about 13 per cent. higher than during the preceding period. The reduction in other forms of unoxidized nitrogen and in carbonaceous matters during this last period, although better than during the first period when strained sewage was used, was somewhat less than in the second period when nitrification was most active. It was particularly noted in this experiment that the heavier the green growth on the sides of the aerating bottles, the clearer the aerated sewage; in fact, in many instances the sewage prepared by this process compared favorably in appearance with effluents from sand filters.

On February 4 the period of aeration for the sewage for Filter No. 446 was reduced from twenty-four to twelve hours. On March 1 the aeration period was reduced to eight hours, and on May 1 it was further reduced to six hours. The change from twenty-four hours' to twelve hours' aeration was manifested by a reduction in oxidized nitrogen (that is, nitrates and nitrites together) from about 0.38 parts per 100,000 to about 0.06 parts per 100,000, and with the further reduction in aeration to eight hours or less, the amount of oxidized nitrogen in the aerated sewage became inappreciable. The reduction in free ammonia became successively less with the reduction in the amount of aeration, the percentage removal of this body dropping from 31 to 24 per cent. with the change from twenty-four hours' to twelve hours' aeration and to 14 per cent. with the change to eight hours' aeration. Little change is to be noted in the removal of organic nitrogen or carbonaceous matters as the results of cutting the aeration period to twelve hours, but with the change in aeration from twelve hours to eight hours and then to six hours, the elimination of organic nitrogen dropped from 67 per cent. to 42 per cent. and then to 24 per cent., and the elimination of carbonaceous matters as shown by oxygen consumed dropped from 63 per cent. to 48 per cent. and then to 24 per cent.

Aerating Tank.

Following up the observation that an extremely well clarified sewage was obtained when there was a heavy growth upon the sides of the aerating bottles, a new aeration tank was put into operation on January 2 in order to study the effect of aeration upon a somewhat larger scale and to furnish a supply of aerated sewage for the operation of a trickling filter. This tank as originally constructed contained layers of roofing slate placed in a horizontal position 1 inch apart for the deposition and collection of suspended and colloidal matters. The air, supplied by a small motor-driven blower, is distributed through a perforated pipe laid on the bottom of the tank. At the start the sewage was aerated twenty-four hours. On February 10 the aeration period was reduced to ten hours. On March 20 and again on April 22 the deposits on the slates were washed off with a stream of city water. On May 1 the period of aeration was reduced to eight hours, and on May 9 it was further reduced to seven hours. On May 13 the slates were again washed off with city water. On May 17 the aeration period was reduced to six hours. Up to June 26 the volume of air used was equivalent to about 200,000 cubic feet per hour per million gallons. On June 27 the aeration period was reduced to five hours and the flow of air was reduced to 100,000 cubic feet per million gallons of sewage. On July 8 the tank was reconstructed, the slates being removed, washed and replaced in a vertical position 1 inch apart. About ½ inch of sludge was found deposited on each of the slates, this sludge being well fermented and nonoffensive. After reconstruction the tank was operated as before, the sewage being aerated five hours with a volume of air equivalent to about 150,000 cubic feet per million gallons per hour. On September 9 the volume of air applied was reduced to 25,000 cubic feet per million gallons per hour. After September 9 the sewage entering the tank was passed through an aerator of the dash-plate type in order that there might be some dissolved oxygen in the sewage when the air-blast was started.

The various changes in the methods of operating this tank produced far less difference in the efficiency of the process than might be expected from the wide difference in the period of aeration, and in the volume of air used at different times. At no time during the year was the efficiency of this tank equal to the efficiency of the similar process carried out in bottles described above. The greatest efficiency was obtained during the second period when the sewage was aerated for ten hours with air equivalent to 200,000 cubic feet per million gallons of sewage. During this period the average reduction in free ammonia was about 20 per cent., and the reduction in Kjeldahl nitrogen and in oxygen consumed was about 56 and 61 per cent., respectively. The fact that the efficiency was greater during this period than during the preceding period when the sewage was aerated for twenty-four hours can probably be attributed to the fact that the period of five weeks was insufficient for the establishment of the gelatinous film upon the slates upon which the efficiency of the process in a large measure depends. With the gradual reduction in the length of aeration from ten hours to six hours, a lessening of the proportion of free ammonia and organic matters removed from the sewage is to be observed. During July and part of August, after the slates had been placed in a vertical position and the aeration reduced to five hours with air equivalent to 100,000 cubic feet per hour per million gallons, the reduction in free ammonia was about 15 per cent., but the reduction in organic nitrogen and in carbonaceous matters was less than during any of the previous periods. Here again the value of the gelatinous growths is to be observed, *the reduction in Kjeldahl nitrogen during the part of August after the gelatinous film had been re-established being more than five times as great as in July when the slate surfaces were comparatively clean.* During the last four months of the year when only 25,000 cubic feet of air per million gallons were used for five hours, the reduction in Kjeldahl nitrogen was about 56 per cent., or equal to the best of any of the preceding periods, and there was also a slight increase in the elimination of carbonaceous matters.

Stability of Tank Effluent. — Progressive Effect of Aeration.

During the early part of the operation of this tank, when the aeration period was ten hours or more, a considerable proportion of the samples of the aerated sewage showed no signs of putrefaction even after incubation. During the latter part of the experiment, however, with greatly reduced aeration, the results of stability tests were less satisfactory. Unlike the bottle experiments there was never any appreciable amount of nitrification within this tank, the largest amount of nitrates found in any sample being .07 parts per 100,000.

A number of series of samples have been collected from this tank at hourly intervals in order to study the progressive effect of aeration. The results of two such series, one with a rather weak sewage and one with a sewage of about average strength are shown in the following table. It will be noted that there was a progressive reduction in both albuminoid ammonia and oxygen consumed in each series, but that the greatest reduction was obtained during the first few hours. On the other hand there was little or no change in the free ammonia for some hours, and only during the latter part of the aeration period is any reduction to be observed. These results serve to confirm and explain the very different results obtained with different periods of aeration in both this tank and in the bottle experiments.

Progressive Change in Sewage during Aeration.

[Parts per 100,000.]

	Weak Sewage.			Average Sewage.		
	Free Ammonia.	Albuminoid Ammonia.	Oxygen consumed.	Free Ammonia.	Albuminoid Ammonia.	Oxygen consumed.
Start, . . .	1.40	.57	3.80	4.70	.46	3.70

Per Cent. Reduction.

After one hour, . .	0	16	21	0	5	30
After two hours, .	0	35	38	0	13	41
After three hours, .	0	46	49	0	26	45
After four hours, .	7	53	55	0	41	47
After five hours, .	14	58	58	0	44	51
After six hours, .	29	58	59	4	44	51

Effect of Tank on Clarification.

Soon after the tank was put into operation the slates and sides of the tank became covered with a heavy brownish gray growth of a gelatinous consistency, which appeared to collect mechanically the suspended matters and a large part of the colloidal matters of the sewage. After aeration was stopped, clear sewage could be drawn from the tank immediately, the suspended matters being practically held by the growth upon the slates. Without taking into consideration the value of oxidation, which is amply shown in the results of the filtration of this sewage, the process as carried out in this tank produced a much better clarification of the sewage than did any of the clarification processes operated at the station with the single exception of the one in which the sewage was precipitated with excessively large quantities of copperas and lime. The smallest average removal of total and organic matters in suspension was over 77 per cent., and during the earlier portions of the experiment when air was applied at a high rate for from ten to twenty-four hours, the removal of suspended matters averaged over 90 per cent. During the last four months of the year when only 25,000 cubic feet of air per million gallons of sewage was applied for only five hours, the removal of total and organic matters in suspension averaged 82 and 80 per cent., respectively.

Character of Sludge in Tank.

With the slates in horizontal position it was necessary to remove the accumulated matters from them by flushing at intervals, but during the latter portion of the experiment with the slates in a vertical position the jelly-like masses sloughed off from time to time in large flakes and settled almost immediately to the bottom of the tank. The sludge which is contained in the last inch or so of sewage in the bottom of the tank has been run to waste in these experiments. This sludge, owing to the fact that it is formed under strictly aerobic conditions, is inoffensive, of much lower water content than the sludge from other clarification processes, and resembles quite closely the sediment discharged from trickling filters. In practice it should be possible to dispose of this sludge with much less trouble than is the case with the sludges resulting from the usual preliminary treatments.

Depth of Sewage and Cost of Treatment.

In this experimental tank the working depth of sewage was only about 15 inches. In practice, however, it would probably prove more economical to use tanks of greater depth, since the increased cost of power to force the air through a deeper layer of sewage would probably be more than offset by the reduced cost of construction and by the fact that a given volume of air would be brought in contact with a much greater volume of sewage. For this reason the volumes of air used in these experiments have been computed and stated on the basis of a working depth of sewage of 5 feet. With this depth of sewage, assuming electric power at 4 cents per kilowatt, it would cost about $1.85 to treat 1,000,000 gallons of sewage for five hours with 25,000 cubic feet of air per hour.

The average results of these various experiments are shown in the following tables: —

Relative Efficiency of Different Aeration Processes.

Aerated Sewage applied to Filter No. 446.[1]

Period.	Hours. Aerated.	Hours. Settled.	Volume of Air used.[2]	Per Cent. Reduction. Free Ammonia.	Per Cent. Reduction. Kjeldahl Nitrogen. Total.	Per Cent. Reduction. Kjeldahl Nitrogen. In Solution.	Per Cent. Reduction. Oxygen consumed.
April 16 to July 28, 1912, .	24	1	Unlimited	32	37	45	43
July 29, 1912 to Feb. 3, 1913,	24	1	Unlimited	31	61	61	64
Feb. 4 to 28, 1913, . .	12	1	Unlimited	24	67	67	63
March 1 to April 30, 1913, .	8	1	Unlimited	14	42	32	48
May 1 to Nov. 30, 1913, .	6	1	Unlimited	20	24	26	34
Inoculated and Aerated Sewage applied to Filter No. 447.[1]							
April 16 to July 28, 1912, .	24	24	Unlimited	44	23	50	43
July 29, 1912, to Jan. 31, 1913,	24	24[3]	Unlimited	39	66	67	64
Feb. 1 to Nov. 30, 1913,[4] .	24	0	Unlimited	52	59	55	59
Effluent Aeration Tank applied to Filter No. 449.[5]							
Jan. 2 to Feb. 9, 1913, .	24	0	200,000	7	41	30	59
Feb. 10 to April 30, 1913, .	10	0	200,000	20	56	27	61
May 1 to May 16, 1913, .	7½[6]	0	200,000	3	51	7	41
May 17 to June 26, 1913, .	6	0	200,000	8	42	25	51
July 1 to Aug. 31, 1913, .	5	0	100,000	15	37	29	41
Sept. 1 to Nov. 30, 1913, .	5	0	25,000	13	56	35	44

1 Strained sewage used up to July 29; settled sewage after that date.
2 Cubic feet per million gallons per hour based on tank 5 feet in depth.
3 Extra twenty-four hours allowed for growth of algæ until Oct. 3, 1912.
4 Algæ culture very feeble.
5 Raw sewage used throughout.
6 Eight hours' aeration May 1 to 8; seven hours' aeration May 9 to 16.

Average Analyses of Sewages before and after Aeration.

Strained Sewage before Aeration applied to Filter No. 445.

[Parts per 100,000.]

Period.	Ammonia.			Kjeldahl N.		Nitrogen as		Oxygen consumed.
	Free.	Albuminoid.						
		Total.	In Solution.	Total.	In Solution.	Nitrates.	Nitrites.	
April 16 to July 28, 1912,	3.08	.33	.25	.65	.54	–	–	2.24

Settled Sewage before Aeration applied to Filter No. 445.

July 29, 1912, to Nov. 30, 1913,	3.59	.40	.26	.75	.48	–	–	2.86

Raw Sewage before Aeration applied to Filter No. 449.

Jan. 2 to Nov. 30, 1913,	3.83	.60	.34	1.17	.63	–	–	4.07

Aerated Sewage applied to Filter No. 446.

April 16 to July 28, 1912,	2.08	.22	.17	.41	.30	–	–	1.28
July 29, 1912, to Feb. 1, 1913,	2.47	.16	.12	.29	.20	0.13	.2547	1.04
Feb. 4 to 28, 1913,	2.28	.20	.14	.32	.22	0.06	.0020	1.26
March 1 to April 30, 1913,	3.08	.26	.18	.44	.34	0.02	.0040	1.42
May 1 to Nov. 30, 1913,	2.92	.28	.17	.54	.32	0.02	.0003	1.79

Inoculated and Aerated Sewage applied to Filter No. 447.

April 16 to July 28, 1912,	1.73	.25	.13	.50	.27	–	–	1.27
July 29, 1912, to Jan. 31, 1913,	1.46	.15	.10	.25	.17	1.14	.0542	1.05
Feb. 1 to Nov. 30, 1913,	1.72	.17	.11	.31	.21	0.69	.0505	1.16

Effluent Aeration Tank applied to Filter No. 449.

Jan. 2 to Feb. 9, 1913,	4.63	.43	.34	.98	.62	0.02	.0001	2.20
Feb. 10 to April 30, 1913,	2.84	.30	.23	.56	.41	0.02	.0000	1.89
May 1 to 16, 1913,	3.70	.25	.23	.42	.39	0.02	.0000	1.76
May 17 to June 26, 1913,	4.95	.33	.25	.63	.48	0.03	.0001	1.82
July and August, 1913,	2.75	.23	.17	.45	.32	0.04	.0015	1.72
September, October and November, 1913.	3.15	.31	.26	.51	.44	0.01	.0001	2.09

Average Solids.

Raw Sewage before Aeration applied to Filter No. 449.

[Parts per 100,000.]

Period.	Unfiltered.			Filtered.		
	Total.	Loss on Ignition.	Fixed.	Total.	Loss on Ignition.	Fixed.
Jan. 2 to Nov. 30, 1913,	66.6	27.1	39.5	48.7	16.4	32.3

Effluent from Aeration Tank applied to Filter No. 449.

Jan. 2 to Feb. 9, 1913,	–	–	–	–	–	–
Feb. 10 to April 30, 1913,	41.3	13.2	28.1	39.5	11.8	27.7
May 1 to 16, 1913,	44.3	13.4	30.9	40.9	11.8	29.1
May 17 to June 26, 1913,	47.4	13.6	33.8	45.7	12.2	33.5
July and August, 1913,	42.4	10.5	31.9	41.1	9.5	31.6
September, October and November, 1913.	48.6	15.3	33.3	45.7	13.3	32.4

Filtration of Aerated Sewage.

Intermittent Sand Filters Nos. 445, 446 and 447 and Trickling Filter No. 449.

On April 16, 1912, three small filters, each containing 42 inches in depth of sand of an effective size of 0.25 millimeter, were put into operation to study the purification of sewage which had been treated by aeration and by combined aeration and inoculation with algæ. At the start each filter was operated at the rate of 50,000 gallons per acre daily, Filter No. 445 receiving strained sewage, Filter No. 446 receiving strained sewage which had been aerated for twenty-four hours and allowed to settle for one hour, and Filter No. 447 receiving strained sewage which had been inoculated with algæ and then aerated twenty-four hours and allowed to stand for twenty-four hours more for the development of algæ growth. Active nitrification commenced in all of these filters within a short time after they were put into operation. On May 17 the rate of the two filters receiving aerated sewage was increased to 75,000 gallons; on May 31 to 100,000 gallons; on June 17 to 120,000 gallons; and on July 1 to 175,000 gallons per acre daily. On this latter date the amount of strained sewage applied to Filter No. 445 was increased to 75,000 gallons per acre daily. Beginning on July 29, settled sewage was applied to Filter No. 445 and was used in preparing the sewages applied to Filters Nos.

446 and 447. On August 9 and August 23, respectively, the rates of Filters Nos. 446 and 447 were increased to 200,000 and then to 225,000 gallons, and on August 30 the volume of unaerated sewage for Filter No. 445 was increased to 100,000 gallons per acre daily. On September 5 the volume of inoculated sewage applied to Filter No. 447 was increased to 250,000 gallons per acre daily. On October 23 the method of preparing the sewage for Filter No. 447 was changed and after this date the inoculated sewage was applied to this filter after being aerated twenty-four hours, the additional twenty-four hours previously allowed for algæ growth being discontinued. Up to about the 1st of September the various filters had readily adjusted themselves to the gradually increasing rates at which the sewage was applied, and the effluents continued to be of excellent quality. Early in October, however, the quality of the effluents from Filters Nos. 446 and 447 began to deteriorate and it became evident that the rates of 225,000 and 250,000 gallons, respectively, at which these filters were being operated were somewhat too high. On October 10, therefore, the rates of these two filters were temporarily reduced to 175,000 and 200,000 gallons, respectively. On October 20 the amount of inoculated sewage applied to Filter No. 447 was increased to 225,000 gallons, and on October 31 the amount of aerated sewage for Filter No. 446 was increased to 200,000 gallons per acre daily. Filter No. 447 was not prepared to assimilate its dose at this rate, and on December 6 it was again necessary to reduce the rate of this filter to 200,000 gallons. On this date, also, the amount of unaerated sewage for Filter No. 445 was increased to 125,000 gallons per acre daily. On Jan. 3, 1913, the rates of Filters Nos. 446 and 447 were increased to 225,000 gallons per acre daily, and after this date the sewage for these filters was applied in two doses some hours apart instead of in a single large dose as formerly.

The rate of 125,000 gallons at which the unaerated sewage was applied to Filter No. 445 during the greater part of December proved to be too high, and the effluent from this filter was of very poor quality during the latter part of December and the early part of January. On January 10 this rate was reduced to 100,000 gallons. At this rate little improvement in the effluent occurred, and on February 7 the amount of sewage for this filter was further reduced to 50,000 gallons per acre daily. At this low rate a gradual improvement in the efficiency of the filter was noted, and on March 21 it was again attempted to apply the sewage at a rate of 100,000 gallons per acre daily. With the higher rate, however, the effluent again became of poor quality, and it became evident that the filter had become overloaded with stored organic matter and that the rates at which it had been attempted to operate it were excessive. On

April 11, therefore, the rate was again reduced to 50,000 gallons, and little improvement being noted during the next two months, on June 6 the rate was reduced to 25,000 gallons per acre daily. No appreciable improvement in the work of the filter occurred even at this low rate and from June 23 to June 30 the filter was rested. After resting, with the filter operated at a rate of 25,000 gallons, nitrification again became active, and on July 12 the amount of settled sewage applied was increased to 50,000 gallons, at which rate the filter was operated with reasonably good success during the remainder of the year.

On January 24 the rates of Filters Nos. 446 and 447 were increased to 250,000 gallons, and on February 1 these rates were further increased to 275,000 gallons per acre daily. Prior to February 4 the sewages for both of these filters had been aerated twenty-four hours. After this date, however, the aeration period for the sewage for Filter No. 446 was reduced a number of times from February 4 to February 28, the aeration period being twelve hours, from March 1 to April 24, 8 hours, and from April 25 to the end of the year, 6 hours. The result of reducing the period of aeration, as has already been shown, was that the sewage applied to this filter during the last ten months of the year contained much larger amounts of organic matter and this organic matter was less completely oxidized than was the case previous to this time. Notwithstanding this fact the effluent from the filter continued to be of excellent quality, and on June 25 it was possible to increase the rate to 300,000 gallons and to operate the filter from August 20 to the end of the year at a rate of 350,000 gallons per acre daily without any appreciable reduction in efficiency.

The reduction in the vitality of the algæ growth in the inoculated sewage, and the consequent decrease in the nitrification in this sewage during aeration which was noted during the greater part of 1913, appears to have had comparatively little effect upon the quality of the effluent obtained from Filter No. 447. On March 28 the rate of this filter was increased to 325,000 gallons; on April 4 to 400,000 gallons; and on April 11 to 450,000 gallons per acre daily. The increase in the volume of sewage applied daily from 275,000 gallons to 450,000 gallons in a period of about two weeks proved to be somewhat more than the filter could accommodate, and on April 18 the rate was decreased to 350,000 gallons per acre daily. On April 25, however, it was possible to again increase the rate to 400,000 gallons, and on August 20 to 450,000 gallons, without affecting the efficiency of the filter.

At the end of the year analyses of the sand from these filters showed that the penetration of organic matter into the filter material was somewhat greater in the case of the two filters which received the comparatively clear aerated sewage than in the case of the filter which received the unaerated sewage at a very much lower rate. The total amount of organic matter accumulated within these filters during their twenty months of operation was not widely different, however, Filter No. 445 which received unaerated sewage at an average rate of about 68,000 gallons per acre daily containing stored matters equivalent to about 1,850 pounds nitrogen per acre, while Filter No. 446, which received the aerated sewage and was operated at a rate which averaged somewhat more than three times as high, contained about 2,170 pounds nitrogen, and Filter No. 447, which was operated with the inoculated sewage at an average rate more than four times as high, contained about 1,900 pounds nitrogen per acre.

Filter No. 449, containing 10 feet in depth of pieces of broken stone, all of which will pass through a 2-inch ring and none through a 1-inch ring, was put into operation on Jan. 2, 1913. Throughout the year the sewage applied to this filter was clarified and partially oxidized by treatment in the aeration tank filled with slate described previously. One of the principal objects of this portion of the investigation was to determine at what rate a filter of this type could be successfully operated with such a sewage, and throughout the year it was the practice to increase the rate whenever an improvement in the quality of the effluent seemed to indicate that a larger volume of the aerated sewage could be handled by the filter. At the start the rate of operation was 1,000,000 gallons per acre daily, and the sewage was aerated twenty-four hours. During the last week in January nitrification became established within the filter, and on February 6 the rate was increased to 1,500,000 gallons per acre daily. On February 10 the aeration period was reduced to ten hours. This reduction in aeration appeared to have little effect on the work of the filter, and on February 14, 21 and 28 and on March 7 and 13, or at intervals of about one week for five weeks, the volume of sewage applied was increased to 500,000 gallons per acre daily. Following this last increase it required about three weeks for the filter to adjust itself to the 4,000,000 gallon rate at which it was being operated. On April 4 the rate was increased to 4,500,000 gallons, on April 11 to 5,000,000 gallons, and on April 17 it was increased to 6,000,000 gallons per acre daily. During May the period of aeration which the sewage received was reduced from ten hours to eight hours, then to seven and finally to six hours, and on June 26 the time of aeration was reduced to five hours and the volume of air used reduced from 200,000 to 100,000 cubic feet per hour per million gallons. On May 22, or after being operated for five weeks at a 6,000,000-gallon rate, the volume of sewage applied to this filter daily was increased to 7,000,000 gallons per acre daily, and five weeks later on June 26 this rate was increased to 7,500,000 million gallons. On July 7 a further increase in the rate to 8,000,000 gallons was made. On July 8 the tank in which the sewage was aerated was rebuilt, and the slates cleaned and placed in a vertical position, and, as previously explained, for a time the aerated sewage was less well oxidized and contained a greater proportion of suspended matter than previously. The various changes in the operation of the aeration tank, however, appear to have had comparatively little effect upon the efficiency of the filter, and on August 4 and August 11 the rate was increased to 8,500,000 and then to 9,000,000 gallons, and on October 1 a still further increase to 10,000,000 gallons per acre daily was made, at which rate the filter was satisfactorily operated until the end of the year.

The average rates and quality of the effluents from these various filters throughout their entire periods of operation are shown in the following tables: —

Effluent from Filter No. 445.

[Parts per 100,000.]

Date.	Quantity applied. — Gallons per Acre Daily.	Color.	Ammonia.		Nitrogen as		Oxygen consumed.	Alkalinity.
			Free.	Albuminoid.	Nitrates.	Nitrites.		
1912.								
April,	50,000	.09	1.2600	.0260	1.13	.0080	0.28	4.0
May,	50,000	.05	1.7660	.0388	2.00	.0190	0.16	3.4
June,	50,000	.04	0.2506	.0146	3.78	.0037	0.10	2.2
July,	75,000	.04	0.2028	.0130	2.54	.0018	0.11	2.1
August,	100,000	.03	0.0616	.0116	2.94	.0018	0.11	2.1
September,	100,000	.03	0.3140	.0177	2.06	.0009	0.16	3.5
October,	100,000	.04	0.1399	.0138	3.31	.0012	0.11	3.2
November,	100,000	.04	0.0250	.0150	2.90	.0008	0.15	4.3
December,	121,000	.06	0.2063	.0349	3.24	.0003	0.19	4.7
1913.								
January,	107,400	.06	0.4987	.0364	3.25	.0002	0.19	5.0
February,	60,900	.09	3.4400	.0555	0.44	.0001	0.32	14.4
March,	67,300	.06	2.7700	.0345	5.36	.0005	0.19	7.2
April,	68,000	.05	2.3000	.0430	0.34	.0002	0.28	12.6
May,	50,000	.10	4.6800	.0532	0.76	.0002	0.31	16.7
June,	30,900	.09	4.2300	.0493	0.33	.0009	0.27	14.6
July,	41,300	.05	4.8400	.0328	4.14	.0066	0.19	6.8
August,	50,000	.04	1.1900	.0260	1.83	.0032	0.22	5.7
September,	50,000	.06	2.0050	.0285	0.61	.0026	0.32	11.2
October,	50,000	.06	3.2860	.0376	1.52	.0000	0.22	12.6
November,	50,000	.03	1.2200	.0190	1.32	.0001	0.19	10.0

Effluent from Filter No. 446.

[Parts per 100,000.]

Date.	Quantity applied. — Gallons per Acre Daily.	Color.	Ammonia.		Nitrogen as		Oxygen consumed.	Alkalinity.
			Free.	Albuminoid.	Nitrates.	Nitrites.		
1912.								
April,	50,000	.02	0.9000	.0200	0.46	.0002	0.13	2.7
May,	62,500	.03	0.8760	.0218	2.59	.0073	0.11	2.3
June,	111,500	.03	0.0216	.0115	3.02	.0003	0.08	1.7
July,	158,700	.03	0.0622	.0106	2.62	.0004	0.10	1.7
August,	200,900	.04	0.0254	.0110	2.50	.0049	0.10	2.0
September,	225,000	.05	0.0394	.0200	2 30	.0996	0.10	2.2
October,	191,300	.08	0.0646	.0320	2.35	.0008	0.21	2.9
November,	200,000	.07	0.0105	.0286	2.84	.0004	0.21	3.4
December,	200,000	.08	0.0163	.0375	3.14	.0134	0.21	2.9
1913.								
January,	229,800	.04	0.0105	.0254	2.82	.0051	0.17	2.7
February,	275,000	.06	0.1013	.0367	3.38	.0003	0.23	4.0
March,	275,000	.12	0.1778	.0478	3.07	.0004	0.31	3.8
April,	275,000	.09	0.0386	.0356	2.84	.0004	0.27	3.5
May,	275,000	.12	0.0170	.0366	2.94	.0003	0.26	3.4
June,	295,800	.15	0.0420	.0366	3.28	.0004	0.30	3.3
July,	300,000	.16	0.0211	.0297	2.29	.0004	0.37	3.9
August,	319,200	.15	0.0170	.0234	2.11	.0005	0.40	3.7
September,	350,000	.14	0.0096	.0264	2.84	.0005	0.36	4.9
October,	350,000	.19	0.0379	.0366	2.84	.0003	0.39	3.8
November,	350,000	.18	0.0941	.0425	2.67	.0004	0.40	3.0

Effluent from Filter No. 447.

1912.								
April,	50,000	.05	1.1400	.0260	0.50	.0010	0.22	2.9
May,	62,500	.03	0.3398	.0175	3.09	.0047	0.11	2.0
June,	111,500	.03	0.0314	.0114	2.92	.0004	0.08	1.9
July,	158,700	.02	0.0440	.0110	2.25	.0003	0.09	1.5
August,	200,900	.02	0.0079	.0109	2.14	.0004	0.09	1.5
September,	247,900	.05	0.0167	.0168	2.00	.0009	0.15	1.9
October,	225,000	.11	0.0224	.0268	2.17	.0008	0.20	2.6
November,	225,000	.11	0.1096	.0359	2.79	.0041	0.23	3 4
December,	204,000	.09	0.0411	.0400	2.95	.0129	0.22	2.3
1913.								
January,	229,700	.05	0.0110	.0256	2.62	.0005	0.17	2.5
February,	275,000	.05	0.0402	.0308	2.94	.0003	0.18	3.2
March,	280,800	.10	0.0184	.0398	2.90	.0003	0.30	2.8
April,	393,000	.13	0.4640	.0404	2 43	.0006	0.37	4.8
May,	400,000	.09	0.0306	.0302	2.79	.0002	0.26	4.8
June,	400,000	.10	0.0478	.0348	2.56	.0021	0.26	4.6
July,	400,000	.11	0.0090	.0230	2.03	.0004	0.28	2.5
August,	419,200	.17	0.0067	.0218	2.07	.0004	0.33	3.1
September,	450,000	.12	0.0388	.0244	2.63	.0003	0.37	4.3
October,	450,000	.13	0.0178	.0252	2.57	.0024	0.34	4.0
November,	450,000	.14	0.0359	.0228	2.21	.0003	0.40	3.5

Aerated Sewage applied to Filter No. 449.

[Parts per 100,000.]

Ammonia.			Kjeldahl Nitrogen.		Chlorine.	Nitrogen as		Oxygen consumed.	Bacteria per Cubic Centimeter.
Free.	Albuminoid. Total.	Albuminoid. In Solution.	Total.	In Solution.		Nitrates.	Nitrites.		
3.42	.30	.25	.57	.43	11.92	.02	.0003	1.93	1,684,000

Effluent from Filter No. 449.

[Parts per 100,000.]

Date.	Quantity applied. Gallons per Acre Daily.	Appearance.		Ammonia.			Kjeldahl Nitrogen.	Chlorine.	Nitrogen as		Oxygen consumed.	Bacteria per Cubic Centimeter.
		Turbidity.	Color.	Free.	Albuminoid. Total.	Albuminoid. In Solution.			Nitrates.	Nitrites.		
1913.												
January, .	1,000,000	0.5	.50	4.4700	.2437	.1747	.5433	11.87	0.26	.0463	1.45	795,000
February, .	1,854,000	0.3	.33	2.4300	.1250	.0970	.2525	8.75	1.57	.0219	1.02	855,000
March, .	3,714,000	0.4	.37	1.9574	.2540	.1380	.4760	11.68	1.58	.0094	1.66	90,300
April, .	5,037,000	0.4	.33	.6170	.1488	.1016	.3124	11.52	2.28	.0180	1.20	160,000
May, . .	6,282,000	0.6	.32	1.7900	.1356	.0956	.2580	12.96	2.54	.0312	1.21	122,500
June, . .	6,800,000	0.5	.33	2.3300	.1100	.0767	.2637	14.53	2.28	.0413	1.17	46,000
July, . .	7,055,000	0.3	.34	.6620	.0724	.0608	.1938	14.60	2.22	.1152	1.01	150,000
August, .	8,117,000	1.4	.32	.7676	.1036	.0660	.2426	11.40	1.39	.0376	1.15	750,000
September, .	8,602,000	1.0	.33	1.0650	.1180	.0705	.2440	13.65	2.05	.0256	1.78	360,000
October, .	10,000,000	1.4	.31	1.1120	.1132	.0892	.2446	11.32	1.42	.0460	1.07	55,000
November, .	9,869,000	1.3	.36	1.5600	.2030	.0970	.5098	12.30	1.33	.0285	1.91	24,000
Average,	6,212,000	0.7	.35	1.7055	.1479	.0970	.3219	12.23	1.72	.0383	1.33	309,800

Studies of the Effect of Carbon upon Nitrification.

Filters Nos. 403 and 416.

In the report for 1911 the results of certain experiments were given in which it was shown that nitrification in sand filters was checked or entirely prevented when the applied sewage contained excessive amounts of carbonaceous matters, and it was further shown that there is apparently a certain ratio between the carbon and nitrogen which cannot be exceeded for any length of time without impairing nitrification, but that sand filters may continue to nitrify even when the applied sewage contains enormous amounts of carbon, provided that the carbon content of the sewage be increased slowly so that the filter may gradually adapt itself to the changing conditions, and provided, also, that the nitrogen content of the sewage be also increased so that the amount of carbon shall not be more than ten to twelve times the amount of nitrogen.

Filters Nos. 403 and 416, each containing 42 inches in depth of sand of an effective size of 0.25 millimeter, were first put into operation on Nov. 10, 1910, receiving settled sewage from which the suspended matters had been removed by filtering through paper, at a rate of 50,000 gallons per acre daily. From Feb. 2 to Aug. 10, 1911, these filters were used in the carbon-nitrogen studies, cane sugar and ammonium chloride being added to the sewage applied to Filter No. 403, and cane sugar alone being added to the sewage for Filter No. 416, the results obtained during this period being included in the discussion in the report for 1911. From Aug. 11 to Nov. 15, 1911, the filters were continued in operation without sugar being added to the applied sewage to eliminate the effect of any carbonaceous matters which had been stored during the period when sugar was added. On Nov. 16, 1911, the application of sugar to Filter No. 416 was resumed, Filter No. 403 being continued in operation with the same sewage, without added sugar as a control. During the following thirteen months the amounts of sugar regularly added to the sewage for this filter were equivalent to 35 parts carbon per 100,000, the total carbon in the sewage varying between 38 and 43 parts and the ratio of carbon to nitrogen fluctuating between 9.5 and 19.2. During the first eight months nitrification continued within the filter unimpaired. In July when the carbon-nitrogen ratio was over 19, nitrification began to decrease, and the nitrates in the effluent continued to decrease through August and the greater part of September, although both the total carbon applied and the carbon-nitrogen ratio were much lower than in the previous months. Early in October, however, nitrification again increased and continued active through November. Beginning Dec. 16, 1912, and continuing through 1913, the practice was to add gradually increasing amounts of sugar until nitrification was checked, then to stop the application of sugar until nitrification was re-established. On December 16 the carbon added as sugar was increased to 60 parts, and on Jan. 3, 1913, to 70 parts per 100,000. With this large amount of carbon, and a carbon-nitrogen ratio of about 18, the nitrates in the effluent decreased rapidly, and on January 22 nitrification had practically ceased. On January 24 the added carbon was reduced to 35 parts, and, no increase in nitrification being noted, on January 31 the application of sugar was stopped. During February nitrification again became established, and beginning February 28 sugar equivalent to 35 parts carbon was added to the applied sewage. During March the nitrates in the effluent never fell below 4 parts per 100,000, although the sugar was increased to 50 parts on March 7, to 70 parts on March 14, and to 100 parts per 100,000 on March 28, the corresponding carbon-nitrogen ratios being thereby increased to 15, then to 21 and finally to 29. With the application of sewage of this character, nitrification gradually decreased, and on April 18, when the nitrates had dropped to about ¼ part, the sugar was reduced to 70 parts per 100,000. During the ensuing two weeks, with sewage containing over twenty times as much carbon as nitrogen, nitrification steadily increased, and on May 1 the effluent contained nearly 3 parts nitrates per 100,000. On May 2 the sugar was again increased to 100 parts, but as the nitrates began to decrease the added carbon was again reduced to 70 parts on May 16. One week later, however, the nitrates in the effluent had increased to over 4 parts per 100,000, and the amount of sugar added was again raised to 100 parts per 100,000, and on June 6 the added carbon was increased to 125 parts per 100,000, making the carbon-nitrogen ratio of the sewage over 33. Even with this large proportion of carbon in the sewage, nitrification continued in the filter for about three weeks in gradually decreasing amounts, but during the first three weeks in July the nitrates in the effluent dropped to less than 0.1 part per 100,000. From July 25 to August 8 sugar was omitted from the applied sewage, and during this period nitrification again became active within the filter. From August 9 to the end of the year sugar equivalent to 70 parts carbon per 100,000 was added to the sewage each day. During the last three weeks in August with a nitrogen-carbon ratio of over 23, the nitrates in the effluent averaged about 0.85 part per 100,000. In September the ratio dropped to 20, owing to an increase in the nitrogen content of the sewage, and the nitrates in the effluent increased to an average of 1.67 parts per 100,000. During October and November, however, when the carbon-nitrogen ratios were about 25 and 22, respectively, a number of samples were obtained in which practically no nitrates were found. Throughout the entire two years of this experiment Filter No. 403, which was operated at the same rate as a control, receiving the same sewage without added sugar, continued to furnish an effluent containing high nitrates.

There are a number of points of interest to be noted in the results of this experiment during the past two years. In a certain measure the results confirm the observations made in the report for 1910 as to the close connection between the ratio of carbon to nitrogen in the sewage and the occurrence of nitrification within the filter. In a number of instances, however, nitrification continued to be active in this filter when the carbon-nitrogen ratios were much higher than those which caused a cessation of this function in the filters experimented with during 1910, and also it was possible to operate this filter successfully through long periods during the past year with a sewage in which the proportion of carbonaceous matter was much higher than that which caused a total cessation of nitrification during the earlier portion of the experiment. In many instances the amounts of sugar were increased so rapidly as to check nitrification completely, but in every case a return to sewage without added sugar, or a reduction in the amount of sugar added, for a short period resulted in a re-establishment of nitrification. In numerous experiments in previous years it has been proved that nitrification may continue in the presence of an excess of a variety of substances which are apparently detrimental to that process, provided that the filter be accustomed to the presence of such substances in the sewage by applying them in gradually increasing amounts, although nitrification will be checked or completely destroyed by the sudden appearance of much less amounts of the same substance. In a certain measure this fact has been confirmed in these experiments, and there is every reason to believe that the filter might have been successfully operated with sewage containing even greater proportions of carbonaceous matter had the carbon content been increased more gradually. The effect of an excess of sugar and possibly of other carbonaceous matters appears to be cumulative, as in many cases nitrification continued for some weeks in the presence of a considerable excess and then rapidly decreased as though checked by the accumulation of some substance within the filter in whose presence the formation of nitrates could not proceed. When the application of an excessive amount of carbonaceous matter was stopped, nitrification usually was re-established within a short time, and the nitrates continued to increase sometimes for a number of weeks after the application of sugar was resumed. Subsequently, however, a diminution in nitrification frequently occurred, although no increase had been made in the carbon content of the applied sewage. It should be noted, also, that the effluent from the filter which received sugar contained larger amounts of free ammonia than did that from the filter which received no sugar. The difference in free ammonia, however, is not sufficient to account for the lower amount of nitrates, as during the last two years only about 69 per cent. of the applied nitrogen has been found in the effluent from Filter No. 416, while about 89 per cent. of the nitrogen applied to Filter No. 403 has been found in the effluent.

Analyses of the sand at the end of 1913 showed that there was a considerable difference in the stored nitrogen in these two filters. At this time Filter No. 403, which received sewage low in carbon, contained nitrogen equivalent to about 1,260 pounds per acre, while Filter No. 416, which received the same amount of nitrogen each day with the addition of considerable carbon, contained about 5,810 pounds nitrogen per acre, or more than four times as much. Attention should be called to the fact that the amount of organic nitrogen stored in Filter No. 416 at the end of the year was nearly three times as great as the total amount of organic nitrogen applied to this filter during its entire period of operation. As all of the organic matter applied was in the soluble form, this large amount of stored nitrogen cannot but indicate that not only was a considerable proportion of the soluble organic nitrogen converted into the insoluble form but also that more or less free ammonia or elementary nitrogen or both must have been changed to insoluble organic nitrogen. It is well known that free ammonia and atmospheric nitrogen may under certain conditions be converted into proteid nitrogen, and the probability that this action may occur to a certain extent in sewage filters has been stated in previous reports a number of times. In the case of Filter No. 403, which was operated as a control with the same sewage without added carbon, no such phenomenon occurred, nor has it been previously observed with any of the numerous sewage filters which have been studied at the experiment station during the past twenty-six years. It is quite possible, however, that the clogging which has been noted at the station and elsewhere when sand filters were operated with sewage containing an undue proportion of highly carbonaceous trades wastes may have been due to a phenomenon similar to that noted in the case of Filter No. 416.

The results of the operation of these two filters are shown in the following tables: —

Sewage applied to Filter No. 403.

Period.	Free Ammonia.	Kjeldahl Nitrogen.	Total Nitrogen.	Chlorine.	Carbon added as Sugar.	Total Carbon.	Ratio of Carbon to Nitrogen.
Nov. 16, 1911, to Nov. 30, 1913,	3.70	.52	3.57	13.10	0	6.2	1.7

Sewage applied to Filter No. 416.

Period.	Free Ammonia.	Kjeldahl Nitrogen.	Total Nitrogen.	Chlorine.	Carbon added as Sugar.	Total Carbon.	Ratio of Carbon to Nitrogen.
Nov. 16, 1911, to Dec. 15, 1912,	3.61	.53	3.50	13.61	35	41.2	11.8
Dec. 16, 1912, to Jan. 30, 1913,	4.35	.63	4.21	10.20	60	67.2	15.9
Feb. 1 to 27, 1913,	3.00	.66	3.13	10.60	0	7.1	2.3
Feb. 28 to July 24, 1913,	3.72	.46	3.52	13.52	96	101.7	29.0
July 25 to Aug. 8, 1913,	3.50	.32	3.20	16.00	0	5.2	1.62
Aug. 9 to Nov. 30, 1913,	3.55	.43	3.35	13.85	70	76.2	22.8

Effluent from Filter No. 403.

[Parts per 100,000.]

Period.	Ammonia.		Nitrogen as	
	Free.	Albuminoid.	Nitrates.	Nitrites.
Nov. 16, 1911, to Nov. 30, 1913, . .	.3087	.0202	3.39	.0005

Effluent from Filter No. 416.

Period.	Free.	Albuminoid.	Nitrates.	Nitrites.
Nov. 16, 1911, to Dec. 15, 1912, . .	0.4895	.0206	1.54	.0003
Dec. 16, 1912, to Jan. 30, 1913, . .	0.1126	.0197	0.69	.0001
Feb. 1 to 27, 1913, ...	2.5600	.0480	0.71	.0001
Feb. 28 to July 24, 1913, ...	1.2898	.0360	2.45	.0031
July 25 to Aug. 8, 1913, ...	1.7000	.0340	0.63	.0017
Aug. 9 to Nov. 30, 1913, ...	1.6450	.0286	0.77	.0004

Intermittent Sand Filters operated with Untreated Sewage.

Filters Nos. 1, 2, 4, 5C, 6, 9A and 10.

These seven sand filters are each 1/200 of an acre in area, and are situated out of doors. At the end of 1913 Filters Nos. 1, 2, 4 and 6 had been operated continuously for nearly twenty-six years, and Filters Nos. 9A and 10 had been operated twenty-three and nineteen years, respectively. Regular station sewage without preliminary clarification has always been applied to these filters, and for some years it has been the practice to apply only as much sewage to each filter as can be treated without increasing the amount of organic matter stored within the filter. Since 1893, a period of twenty years, all of these filters have been operated without the removal of any sand from the surface. The depth and size of sand of which each of these filters is constructed, the date when first put into operation, the total volume of sewage treated upon each filter since it was started, and the volume of sewage applied daily during 1913, are shown in the following table: —

Filter Number.	Depth (Feet).	Effective Size of Sand (Millimeter).	Date first operated.	Actual Volume of Sewage applied since Start (Gallons).	Volume of Sewage applied Daily during 1913 (Gallons per Acre).
1, ...	5	0.48	Jan. 10, 1888	2,617,312	47,900
2, ...	5	0.08	Dec. 19, 1887	1,477,871	38,500
4, ...	5	0.04	Dec. 19, 1887	901,756	20,900[1]
5C, ...	5	0.22	July 20, 1905	632,260	47,700
6, ...	3 2-3	0.35	Jan. 12, 1888	2,147,584	46,600
9A, ...	5	0.17	Nov. 18, 1890	2,160,289	47,400
10, ...	5	0.35	July 18, 1894	775,100	12,500[2]

[1] Three times each week. [2] Fifty thousand gallons applied daily to one-fourth of the surface.

Temperature of Air.

The air temperatures at Lawrence for each month from 1904 to 1913, inclusive, are shown in the following tables: —

Temperature of Air at Lawrence for Ten Years, 1904–1913 inclusive (Fahrenheit Degrees).

	1904.				1905.				1906.				1907.			
	Average Maximum.	Average Minimum.	Highest.	Lowest.	Average Maximum.	Average Minimum.	Highest.	Lowest.	Average Maximum.	Average Minimum.	Highest.	Lowest.	Average Maximum.	Average Minimum.	Highest.	Lowest.
January,	27	9	39	−17	30	13	47	−8	40	20	65	4	33	11	53	−11
February,	28	9	46	−11	30	9	44	−5	36	13	54	−4	29	6	49	−13
March,	41	24	66	−1	43	23	69	6	58	20	52	3	43	24	68	9
April,	53	33	70	19	57	35	78	25	57	34	75	22	51	31	74	21
May,	72	48	89	34	69	45	84	32	70	44	88	32	63	40	79	30
June,	75	53	92	39	76	53	90	38	77	54	87	40	78	52	93	38
July,	82	61	93	46	85	61	96	48	82	62	92	51	83	61	90	51
August,	79	56	90	41	78	56	88	42	83	61	92	48	81	56	95	44
September,	70	51	84	30	69	50	79	31	73	51	88	31	72	53	84	36
October,	56	36	68	18	60	36	78	23	59	39	71	21	58	35	71	19
November,	44	22	55	8	47	24	61	9	45	30	64	18	50	29	57	18
December,	30	11	44	0	39	20	59	2	31	15	46	−5	41	23	61	11

The first two columns under each year are averages, respectively, of the maximum and minimum temperatures registered by a self-recording thermometer which is read each day at 4 P.M. The highest and lowest temperatures in each month are shown in the third and fourth columns.

	1908.				1909.				1910.			
	Average Maximum.	Average Minimum.	Highest.	Lowest.	Average Maximum.	Average Minimum.	Highest.	Lowest.	Average Maximum.	Average Minimum.	Highest.	Lowest.
January,	38	18	58	−3	36	16	57	−5	36	18	49	−8
February,	34	13	57	−7	42	18	54	−7	37	13	58	−8
March,	47	24	66	9	42	25	52	15	51	27	76	12
April,	57	32	83	18	58	34	82	21	65	38	77	28
May,	71	46	87	31	70	43	83	31	71	46	85	36
June,	83	55	91	37	81	55	93	42	77	53	90	42
July,	87	61	97	47	84	59	95	43	87	63	95	52
August,	80	57	90	40	82	56	94	43	79	57	89	47
September,	78	52	88	36	73	48	82	35	74	51	84	39
October,	65	38	82	23	62	25	80	21	65	43	85	22
November,	49	30	67	18	54	31	72	17	45	34	59	19
December,	39	19	64	−2	34	18	51	−4	40	19	52	0

Temperature of Air at Lawrence for Ten Years, 1904–1913 inclusive (Fahrenheit Degrees) — Concluded.

	1911.				1912.				1913.			
	Average Maximum.	Average Minimum.	Highest.	Lowest.	Average Maximum.	Average Minimum.	Highest.	Lowest.	Average Maximum.	Average Minimum.	Highest.	Lowest.
January,	39	19	61	1	27	10	49	-9	45	22	58	7
February,	34	14	54	1	35	14	52	-5	35	11	58	-4
March,	46	22	64	7	40	23	63	4	53	27	74	1
April,	62	32	89	17	58	34	76	23	59	35	80	22
May,	81	49	103	28	72	46	87	31	68	42	82	33
June,	80	53	89	46	81	51	91	37	81	50	91	40
July,	92	62	107	49	85	67	100	45	86	59	98	50
August,	82	57	94	48	78	54	88	40	82	54	97	42
September,	73	49	85	32	74	50	87	34	74	47	88	30
October,	61	38	70	24	64	40	81	28	62	45	70	29
November,	49	29	67	18	54	32	68	18	53	31	69	19
December,	44	27	65	11	43	25	63	9	41	18	53	10

During recent years the surfaces of Filters Nos. 1, 5C, 6 and 9A have been leveled during the greater part of the summer, but have been thrown up into trenches and ridges about 1 foot wide and 1 foot deep, respectively, during the winter. When the surface is leveled, the applied sewage is distributed over the entire surface of these filters, but when trenched, the sewage is applied only to the trenches. The surfaces of Filters Nos. 2 and 4 are arranged in circular trenches, which are filled with coarser sand than that of which the filters are constructed. The trenches in Filter No. 2 are 1 foot wide and 2 feet deep, filled with sand of an effective size of 0.19 millimeter, while those in Filter No. 4 are about 14 inches wide and 1 foot deep, filled with sand of an effective size of 0.48 millimeter, the surface of the sand in the trenches of each filter being below that of the remainder of the filter. The sewage is applied to these trenches of coarser sand throughout the year and grass is permitted to grow on the ridges in the summer. Filter No. 10 differs from the other filters in the fact that no underdrains are beneath the sand except immediately around the outlet pipe. A partition, extending 3 feet below the surface of the filter, separates the quarter of the surface which is farthest from the underdrains from the remainder of the surface and to this quarter of the surface the sewage is applied, the other three quarters of the surface being covered with a layer of loam 8 inches in depth, except for a strip about 2 feet wide extending across the filter which is left open to provide ventilation. During the winter the surfaces of all these filters, except No. 10, were protected to some extent by loose board covers placed over the trenches.

The principal features in the operation of these filters during 1913 were as follows: From December 7 to March 15 the trenches of all the filters except No. 10 were covered with boards. On January 27, that portion of Filter No. 10 to which sewage is applied was dug over to a depth of 6 inches and the rate of this filter was reduced to 10,000 gallons per acre daily. On March 24 the surface of that portion of Filter No. 10 to which sewage was applied and the sand in the trenches of each of the other filters was dug over to a depth of 6 inches, and Filters Nos. 1, 5C, 6 and 9A were leveled. From August 25 to August 31, inclusive, all of the filters were rested, and on August 30 the surfaces of Filters Nos. 1, 5C, 6 and 9A, the trenches of Filters Nos. 2 and 4, and the working surface of Filter No. 10, were dug over to a depth of 6 to 8 inches. On November 17 the working surface of each of these filters was again dug over to a depth of 6 inches and the surfaces of Filters Nos. 1, 5C, 6 and 9A were trenched for the winter. That portion of the surface of each filter to which sewage was applied was raked 1 inch deep seven times during the period from December 7 to March 15, and once each week during the remainder of the year. A total depth of 13 inches of snow and about 1 inch of ice was removed from the surface of Filter No. 10, which was unprotected by board covers during the winter.

As in previous years, when the practice of applying only so much organic matter as could be assimilated by each filter was followed, the work of these filters has been very satisfactory. For a number of years the effluent from Filter No. 10 has been of somewhat inferior quality to that from other filters containing a similar grade of sand, and during the early part of the winter a still further deterioration in the quality of this effluent was noted. Although the total volume of sewage applied daily to this filter during the past few years has been only about 30,000 gallons per acre daily, that sewage has been applied to only one-fourth of the surface, and the net rate, therefore, on the working surface of the filter for some years has been about 120,000 gallons per acre daily, a much higher rate than it has been found to be good practice with the other outdoor filters at the station. It is quite evident, therefore, that this filter has been overworked during the past few years. The effect of reducing the rate of this filter to a figure corresponding more nearly to the rates of the other filters, that is, to 10,000 gallons per acre daily for the entire filter, or 40,000 gallons per acre daily for the actual working surface of the filter, became evident in the rapidly improved quality of the effluent, and throughout the greater part of the year this effluent has been of much better quality than in preceding years, and has compared favorably with those obtained from the other outdoor filters.

The average analyses of the effluents from these filters are shown in the following tables: —

Average Analyses.

Effluent from Filter No. 1.

[Parts per 100,000.]

Quantity applied. — Gallons per Acre Daily for Six Days in a Week.	Temperature (Degrees F.).		Length of Time Sewage remained on Surface (Minutes).	Appearance.		Ammonia.		Chlorine.	Nitrogen as		Oxygen consumed.	Alkalinity.	Bacteria per Cubic Centimeter.
	Sewage.	Effluent.		Turbidity.	Color.	Free.	Total Albuminoid.		Nitrates.	Nitrites.			
47,900	60	56	21	0.1	.13	.4515	.0435	11.95	4.24	.0007	.47	1.5[1]	6,600
Effluent from Filter No. 2.													
38,500	60	53	51	0.1	.11	.1246	.0246	11.92	3.31	.0003	.39	1.2[1]	560
Effluent from Filter No. 4.													
20,900	60	53	18	0.0	.05	.0400	.0173	11.35	3.94	.0002	.25	0.9[1]	280
Effluent from Filter No. 5C.													
47,700	60	55	38	0.2	.15	.4395	.0431	11.43	4.12	.0002	.49	1.2[1]	9,300
Effluent from Filter No. 6.													
46,600	60	55	65	0.1	.15	.3509	.0459	11.38	3.76	.0013	.50	1.4[1]	13,100
Effluent from Filter No. 9A.													
47,400	59	56	87	0.0	.15	.2947	.0342	11.87	3.26	.0001	.47	1.3[1]	1,970
Effluent from Filter No. 10.													
12,500	60	57	28	0.4	.13	.5547	.0938	11.05	2.74	.0008	.79	3.7	18,100

[1] Acid.

Intermittent Sand Filters operated with Clarified Sewage.

Filters Nos. 429, 430, 431 and 432.

These four filters were first put into operation on Feb. 1, 1911, to study the effect of operating a series of filters with different sewages at such rates that the amounts of organic matter applied to each filter shall be practically the same. Each of these filters is $\frac{1}{20000}$ of an acre in area and is constructed of 5 feet in depth of sand of an effective size of 0.25 millimeter. Regular station sewage has been applied to Filter No. 429 at a rate of 80,000 gallons per acre daily throughout the year. Each of the other filters received the same sewage after a portion of the organic matters had been removed by processes for preliminary clarification, Filter No. 430 receiving settled sewage, Filter No. 432 receiving the effluent from coal Strainer E, and Filter No. 432 receiving sewage which had been clarified by precipitation with sulphate of alumina, the volume of clarified sewage applied to each of these filters being so adjusted that the amount of organic matter applied to each should be approximately the same as that applied to Filter No. 429, which received the unclarified sewage. As a convenient and quickly determined basis of comparison, the Kjeldahl nitrogen of the sewages was used to compute the rates of the filters receiving clarified sewage, and those rates fluctuated from time to time as the nitrogen of the different sewages varied. The nitrogen content of the untreated sewage applied to Filter No. 429 varied from .77 part per 100,000 to 1.85 parts per 100,000, averaging about 1.34 parts. The nitrogen of the settled sewage applied to Filter No. 430 varied between .52 part per 100,000 and .96 part per 100,000 and averaged .79 part per 100,000. The nitrogen content of the strained sewage for Filter No. 431 varied from .53 part per 100,000 to 1.01 parts per 100,000 and averaged .75 part per 100,000, while that of the chemically precipitated sewage applied to Filter No. 432 fluctuated between .41 part and 1.21 parts, the average for the year being .76 part per 100,000. The average rate of Filter No. 429 for the year was 79,800 gallons per acre daily. The rate of Filter No. 430 varied from 106,000 to 190,000 gallons per acre daily at different times, the average rate for the year being 145,800 gallons. The rate of Filter No. 431 varied between 80,000 gallons and 250,000 gallons, and averaged 120,300 gallons per acre daily, and the rate of Filter No. 432 varied between 92,000 gallons and 225,000 gallons, the average rate for the year being 140,900 gallons per acre daily.

It has not always been possible to predict the nitrogen content of these various sewages with any degree of accuracy and to adjust the rates in advance in accordance with the difference in the strength of the different sewages, and in some months there has been a wide difference in the amount of nitrogen applied to the different filters. In order to eliminate the effect of this error, it has been the practice to carry a plus and minus nitrogen account for each filter from month to month and to correct for any decided excess or deficiency in the nitrogen applied by raising or lowering the rates during the following months. At the end of the year organic nitrogen equivalent to about 6,850 pounds per acre had been applied to Filter No. 429 during the period of thirty-four months which it has been operated, while Filter No. 430 had received about 25 pounds and 35 pounds less, respectively. In the case of Filter No. 431, however, the deficiency in total nitrogen applied amounted to about 300 pounds, which will have to be corrected during the ensuing year.

All of these effluents were highly nitrified throughout the year, the amount of nitrates produced being greater than the alkalinity of the sewage could care for, with the result that the effluents were acid during the greater part of the year. As was the case during 1912, the effluent from the filter receiving untreated sewage contained considerably more nitrates than that from the filters receiving clarified sewage, while the effluent from the filter receiving chemically precipitated sewage was more highly nitrified than that from the filters receiving strained or settled sewage. On the basis of the total amount of nitrogen oxidized to nitrates, however, the filters receiving the precipitated and the settled sewage have been more active during the past two years, the average number of units of nitrates produced during the year being 398 for Filter No. 429, 530 for Filter No. 430, 461 for Filter No. 431, and 585 for Filter No. 432.

During the year the surface of Filter No. 429 was dug over to a depth of 3 inches six times to relieve clogging, and the surface of each of the other filters was treated in the same manner four times.

The average results of the analyses of average samples of the applied sewages, and the effluents from each of these filters, are shown in the following tables: —

Average Analyses.

Untreated Sewage applied to Filter No. 429.

[Parts per 100,000.]

Ammonia.			Kjeldahl Nitrogen.				
	Albuminoid.						
Free.	Total.	In Solution.	Total.	In Solution.	Chlorine.	Oxygen consumed.	Bacteria per Cubic Centimeter.
4.85	.71	.40	1.34	.76	12.55	4.68	3,724,000
Settled Sewage applied to Filter No. 430.							
3.81	.44	.32	.79	.60	12.63	3.07	2,301,000
Strained Sewage applied to Filter No. 431.							
3.86	.40	.30	.75	.57	13.12	2.78	3,257,500
Chemically Precipitated Sewage applied to Filter No. 432.							
4.93	.41	.28	.76	.54	12.28	2.62	1,383,000

Average Solids.

Untreated Sewage applied to Filter No. 429.

[Parts per 100,000.]

Unfiltered.			Filtered.			In Suspension.		
Total.	Loss on Ignition.	Fixed.	Total.	Loss on Ignition.	Fixed.	Total.	Loss on Ignition.	Fixed.
71.4	31.6	39.8	48.0	15.4	32.6	23.4	16.2	7.2
Settled Sewage applied to Filter No. 430.								
56.6	20.7	35.9	49.0	15.6	33.4	7.6	5.1	2.5
Strained Sewage applied to Filter No. 431.								
54.8	19.1	35.7	49.2	14.9	34.3	5.6	4.2	1.4
Chemically Precipitated Sewage applied to Filter No. 432.								
52.5	16.9	35.6	46.1	12.2	33.9	6.4	4.7	1.7

Average Analyses.

Effluent from Filter No. 429.

[Parts per 100,000.]

Quantity applied. — Gallons per Acre Daily.	Temperature (Degrees F.).	Appearance.		Ammonia.		Chlorine.	Nitrogen as		Oxygen consumed.	Bacteria per Cubic Centimeter.
		Turbidity.	Color.	Free.	Total Albuminoid.		Nitrates.	Nitrites.		
79,800	54	0 0	.04	.3006	.0262	12.23	4.99	.0008	.28	450

Effluent from Filter No. 430.

145,800	55	0.2	.05	.2358	.0339	12.98	3.63	.0005	.33	17,400

Effluent from Filter No. 431.

120,300	57	0.1	.05	.2943	.0320	13 22	3.92	.0008	.34	8,650

Effluent from Filter No. 432.

140,900	54	0.1	.06	.7666	.0417	12.41	4.24	.0030	.36	2,000

Operation of Trickling Filters.

Filters Nos. 135, 136, 248, 360, 449, 452, 453, 454 and 455.

During 1913 nine trickling filters were in operation at the station. Two of these filters, Nos. 135 and 136, have been in operation fourteen years; Filter No. 248, nine years, and Filter No. 360 has been operated continuously for about five years. All of these filters received sewage clarified by settling during the whole or greater part of the year. Filter No. 449, which was started at the beginning of the year to determine to what extent the rate of a trickling filter might be increased by thorough aeration of the sewage applied to it, has already been described and discussed on page 301 of this report. Filters Nos. 452 and 455, inclusive, were started during 1913 to determine at what rate trickling filters of different depths must be operated in order to obtain effluents of equal quality. The results obtained with these four filters are given in a following chapter.

Filters Nos. 135, 136 and 248 are each constructed of broken stone of such size that all the pieces will pass through a screen with a 1-inch mesh, 40 per cent. through a screen with a ½-inch mesh and only 4 per cent.

through a screen with a ¼-inch mesh. Each of these filters is $\frac{1}{20000}$ of an acre in area and is contained in a tank with openings for ventilation in the sides. Filters Nos. 135 and 136 are each 10.5 feet in depth and were first put into operation in November, 1899; Filter No. 248 is 6 feet in depth and was first put into operation in May, 1904. Filter No. 360, first put into operation in November, 1908, is square in section, has a superficial area of $\frac{1}{10000}$ of an acre and is constructed of 8 feet, 9 inches in depth of pieces of broken stone having a mean diameter between 1 and 2 inches. As originally constructed the stone was held in place by open cobwork sides, but on December 1 the sides of the filter were closed. The sewage applied is uniformly distributed over the surface of each of these filters by automatic tipping basins discharging into perforated pans. Filters Nos. 135 and 136 were operated seven days each week with a rest of one hour each morning and afternoon, while filters Nos. 248 and 360 were operated continuously six days each week and allowed to rest on Sunday. Filters Nos. 135, 248 and 360 were operated at rates of 2,000,000 gallons per acre daily throughout the year.

During 1912 Filter No. 136 was operated at a gradually increasing rate with sewage which had been very completely clarified by precipitation with ferrous sulphate. This was to determine to what extent the rate of a trickling filter may be increased and still produce a satisfactory effluent when the sewage applied to it has been so treated as to remove practically all suspended matters. During December the clarified sewage was applied to this filter at a rate of 4,750,000 gallons per acre daily, and the effluent continued to be highly nitrified and entirely stable. On January 1 the rate was further increased to 5,250,000 gallons per acre daily. Following this last increase in rate, nitrification within the filter decreased rapidly, and the effluent became heavily charged with iron. On January 14 the surface of the filter was dug over to a depth of 3 inches to relieve clogging. On January 24 a gradual reduction in the rate was begun in an endeavor to re-establish active nitrification. On February 1 the rate had been reduced to 1,000,000 gallons per acre daily without any appreciable improvement in the quality of the effluent. On February 12 the surface was dug over to a depth of about 6 inches and the filter was rested for one week; on March 17 the filter was again rested for one week. With this treatment and the application of settled sewage at a rate of 1,000,000 gallons per acre daily, nitrification improved and the effluent became of satisfactory quality and remained so during the remainder of the year.

Early in February the upper layers of material in Filter No. 248 became so badly clogged that the applied sewage would not enter. On February 7, 4 inches of stone were removed from the surface, the material remaining in the filter was dug over 8 inches deep and the filter was rested for one week. After drying for one week, the 4 inches of stone which had been removed had so improved in appearance that it was returned to the surface without washing. With this treatment the filter was successfully continued in operation throughout the remainder of the year.

With the exceptions noted, the effluents from the deep filters, Nos. 135 and 136, were highly nitrified and entirely stable throughout the year. The effluents from Filters Nos. 248 and 360 were also well nitrified but often putrescible. As explained in previous reports, the underdrain system of Filter No. 360 is divided into three distinct collecting areas of equal size, and analyses of the effluent from each of these sections, as well as the average effluent from the entire filter, are shown in the accompanying tables: —

Average Analyses.

Effluent from Filter No. 135.

[Parts per 100,000.]

Quantity applied. — Gallons per Acre Daily.	Appearance.		Ammonia.			Kjeldahl Nitrogen.	Chlorine.	Nitrogen as		Oxygen consumed.	Bacteria per Cubic Centimeter.
				Albuminoid.							
	Turbidity.	Color.	Free.	Total.	In Solution.			Nitrates.	Nitrites.		
1,867,000	1 6	.30	0.7852	.2405	.1462	0 4534	13.03	3.67	.0045	1.70	66,800
Effluent from Filter No. 136.											
1,402,000	1.6	.29	1.4617	.3166	.1607	.5864	12.88	2 66	.0173	2.05	124,400
Effluent from Filter No. 248.											
1,855,000	2 6	.34	1.9980	.4371	.2083	.8253	13.58	1 73	.0103	2.53	356,000
Effluent from Filter No. 360 (Section A.)											
–	2.7	.36	1 8167	.4013	.2020	.7247	13 25	1 26	.0143	2.39	699,100
Effluent from Filter No. 360 (Section B).											
–	2 6	.36	1.9367	.4246	.2043	.7444	13 08	1.07	.0137	2.41	969,100

Average Analyses — Concluded.

Effluent from Filter No. 360 (Section C).

[Parts per 100,000.]

Quantity applied. — Gallons per Acre Daily.	Appearance.		Ammonia.			Kjeldahl Nitrogen.	Chlorine.	Nitrogen as		Oxygen consumed.	Bacteria per Cubic Centimeter.
				Albuminoid.							
	Turbidity.	Color.	Free.	Total.	In Solution.			Nitrates.	Nitrites.		
–	2.6	.36	1.9604	.4146	.2103	.7379	12.93	.94	.0123	2.37	851,800

Effluent from Filter No. 360 (Entire Filter).

1,708,000	2.6	.36	1.9043	.4135	.2028	.7357	13.09	1.09	.0134	2.39	746,600

Stability of Effluents from Trickling Filters, 1913.[1]

Filter Number.	Depth of Filter (Broken Stone).	Nitrates (Parts per 100,000).	Per Cent. of Samples.		
			Putrescible.	Doubtful.	Stable.
135,	10.5 Feet.	3.67	0.0	0.0	100.0
136,	10.5 Feet.	2.66	0.0	0.0	100.0
248,	6.0 Feet.	1.73	37.1	2.9	60.0
248,[2]	6.0 Feet.	1.73	6.5	0.0	93.5
360A,	8.0 Feet.	1.26	54.0	0.0	46.0
360B,	8.0 Feet.	1.07	59.5	8.1	32.4
360C,	8.0 Feet.	0.94	62.2	2.7	35.1
360,[2]	8.0 Feet.	1.13	20.0	3.3	76.7
449,[3]	10.0 Feet.	0.02	79.2	4.2	16.6
449,	10.0 Feet.	1.72	0.0	0.0	100.0
452,	4.0 Feet.	1.08	16.7	0.0	83.3
453,	6.0 Feet.	1.04	0.0	0.0	100.0
454,	8.0 Feet.	1.53	0.0	0.0	100.0
455,	10.0 Feet.	1.85	5.9	0.0	94.1

[1] Putrescibility is determined by incubating a sample in a full, tightly stoppered bottle at 80° F. If no odor or blackening of sample is noted within five days, sample is recorded as stable. If odor is produced without blackening, sample is recorded as doubtful. Both odor and blackening indicate putrescibility.

[2] After settling.

[3] Aerated sewage applied.

Relative Rates Necessary to obtain Effluents of Equal Quality from Trickling Filters of Different Depths.

Filters Nos. 452, 453, 454 and 455.

On May 1, 1913, four new filters were put into operation to determine at what rates trickling filters constructed of different depths of the same material must be operated in order to obtain effluents of equal quality. Each of these filters is $\frac{1}{20000}$ of an acre in area and is constructed of pieces of broken stone between $\frac{3}{4}$ inch and $1\frac{1}{2}$ inches in size. Filter No. 452 is 4 feet in depth; Filter No. 453, 6 feet; Filter No. 454, 8 feet; and Filter No. 455, 10 feet. Sewage clarified by sedimentation was applied to each of these filters. After maturing, it was attempted to operate each filter at such a rate that the effluent would contain about 1.5 parts per 100,000 nitrates, this being the amount of nitrification which previous experience at the station has shown to be necessary in order to insure effluents which will be completely stable at all times. At the start, each filter was operated at a rate of 1,000,000 gallons per acre daily. On August 15 the two deep filters, Nos. 454 and 455, were producing well-nitrified effluents, and the rate of each was increased to 1,250,000 gallons per acre daily. As the effluents from the two shallow filters had not up to this time contained the prescribed amount of nitrates, the rate of Filter No. 452 was reduced to 500,000 gallons and that of Filter No. 453 to 800,000 gallons per acre daily. At these rates the amount of nitrification in the deep filters continued to increase, and during October and the early part of November the rate of the 8-foot filter was gradually increased to 2,000,000 gallons per acre daily and that of the 10-foot filter to 2,500,000 gallons per acre daily. Even with the low rates employed, however, the effluents from the two shallow filters did not average up to the required standard, and during the last two months of the year the rates of these two filters were gradually reduced until during November the average rate of the 4-foot filter was only about 140,000 gallons and that of the 6-foot filter 400,000 gallons per acre daily. Practically the whole period since these filters were started has been consumed in establishing proper nitrification within the two shallow filters. At the end of the year all of the filters were yielding effluents of satisfactory quality, but it is probable that the discrepancy between the rates of the shallow and deep filters is much too great and that the former, now that they have been properly matured, can without doubt be operated at considerably higher rates without affecting the quality of the effluent. This can only be determined by the operation of the filters during the ensuing year.

Analyses of the effluents from these filters, when operated at the different rates, are shown in the following tables: —

Effluent from Filter No. 452.

[Parts per 100,000.]

1913.	Quantity applied. — Gallons per Acre Daily.	Appearance.		Ammonia.			Kjeldahl Nitrogen.	Chlorine.	Nitrogen as		Oxygen consumed.	Bacteria per Cubic Centimeter.
		Turbidity.	Color.	Free.	Albuminoid. Total.*	Albuminoid. In Solution.			Nitrates.	Nitrites.		
May, . .	963,000	–	–	–	–	–	–	–	0.27	.1914	–	–
June, . .	972,000	4.0	.35	1.1000	.3500	.2400	.6800	14.60	0.76	.0380	1.80	–
July, . .	985,000	2.0	.26	1.6750	.3800	.2320	.6800	15.40	0.82	.0480	2.68	860,000
August, .	692,000	1.0	.25	0.9500	.3050	.2040	.7500	17.20	1.60	.1200	2.20	250,000
September, .	460,000	3.0	.25	1.9000	.1900	.1520	.3800	13.60	0.61	.1080	1.60	370,000
October, .	246,000	1.5	.30	1.2500	.2500	.1680	.4700	12.00	1.61	.0280	2.12	80,000
November, .	142,000	2.0	.40	1.5750	.2400	.1720	.4000	13.20	1.88	.0040	1.50	305,000
Average, .	637,100	2.2	.30	1.4083	.2858	.1947	.5600	14.33	1.08	.0768	1.98	373,000

Effluent from Filter No. 453.

May, . .	963,000	–	–	–	–	–	–	–	0.35	.1229	–	–
June, . .	1,076,000	3.0	.35	1.0500	.3100	.1920	.5000	14.60	1.03	.0060	1.33	–
July, . .	1,000,000	1.0	.24	1.5250	.1650	.1120	.2600	15.00	1.22	.0440	1.34	250,000
August, .	831,000	2.0	.20	1.9000	.2000	.1720	.3300	17.00	1.13	.0450	1.60	140,000
September, .	736,000	3.0	.25	1.6400	.1900	.1440	.3400	13.80	0.85	.1160	1.48	220,000
October, .	556,000	1.5	.30	0.9000	.1400	.1240	.2800	12.40	0.93	.0280	1.28	160,000
November, .	424,000	1.0	.35	1.0500	.1700	.1360	.2800	12.60	1.75	.0070	1.16	83,000
Average, .	798,000	1.9	.28	1.3442	.1958	.1467	.3317	14.23	1.04	.0527	1.37	170,600

Effluent from Filter No. 454.

May, . .	963,000	–	–	–	–	–	–	–	0.62	.1129	–	–
June, . .	1,000,000	4.0	.35	0.6000	.2100	.1600	.4000	15.00	1.73	.0036	1.28	–
July, . .	1,000,000	1.0	.28	1.0500	.1300	.1080	.2500	15.00	1.74	.0280	1.30	240,000
August, .	1,038,000	1.5	.20	1.3500	.1650	.1240	.3200	16.80	1.73	.0350	1.68	110,000
September, .	1,150,000	3.0	.25	0.8000	.1760	.1600	.3700	14.40	1.90	.1200	1.32	140,000
October, .	1,528,000	1.5	.30	0.8500	.2900	.1680	.5200	11.00	1.52	.0320	2.36	180,000
November, .	1,940,000	2.0	.30	1.0750	.3300	.2160	.6500	12.60	1.45	.0220	1.96	610,000
Average, .	1,231,300	2.2	.28	0.9542	.2168	.1560	.4183	14.14	1.53	.0505	1.65	256,000

Effluent from Filter No. 455.

[Parts per 100,000.]

1913.	Quantity applied. Gallons per Acre Daily.	Appearance.		Ammonia.			Kjeldahl Nitrogen.	Chlorine.	Nitrogen as		Oxygen consumed.	Bacteria per Cubic Centimeter.
		Turbidity.	Color.	Free.	Albuminoid. Total.	Albuminoid. In Solution.			Nitrates.	Nitrites.		
May,	963,000	–	–	–	–	–	–	–	0.07	.2903	–	–
June,	1,100,000	4.0	.35	0.9000	.2800	.2200	.4800	14.00	1.73	.2100	1.60	–
July,	963,000	1.0	.28	0.5750	.2150	.1240	.4400	15.20	3.04	.0720	1.88	500,000
August,	1,038,000	1.5	.23	1.2500	.1650	.0800	.3400	16.80	1.54	.0150	1.64	230,000
September,	1,150,000	3.0	.28	0.6750	.2600	.1840	.4400	13.60	2.00	.0960	2.00	300,000
October,	1,833,000	2.0	.30	0.9500	.2200	.1680	.4600	12.40	2.04	.0240	2.00	130,000
November,	2,440,000	3.0	.40	1.5500	.3800	.2880	.6500	11.20	2.51	.0120	2.20	420,000
Average,	1,355,300	2.4	.31	0.9833	.2533	.1773	.4683	13.87	1.85	.1028	1.89	316,000

Operation of Contact Filters.

Contact Filters Nos. 175 and 421 to 428, inclusive, and Secondary Contact Filter No. 443.

Filter No. 175, first put into operation in June, 1901, is constructed of pieces of coke of such size that all will pass through a sieve having a 1-inch mesh, 75 per cent. through a ½-inch mesh, and practically none through a sieve with a ¼-inch mesh. This filter has always received sewage that has passed through a coal strainer, being filled once daily in one dose, allowed to stand full two hours before draining, and being allowed to rest every sixth week. The material in this filter was removed, washed and replaced in December, 1911, the working depth of material after rebuilding being 49 inches. Nitrification was active in this filter throughout the year, and with the exception of a short time in February the effluent was completely stable at all times.

Filters Nos. 421 to 428, inclusive, were first put into operation on Jan. 18, 1911, to study the effect of operating similar contact filters by different methods. Each is $\frac{1}{20000}$ of an acre in area, is constructed of 33 inches in depth of pieces of soft coal cinders having a diameter between ¼ and 1¼ inches, and is operated with settled sewage. In these particulars, all of the filters are identical. Each filter differs from the others, however, either in the manner in which the sewage is applied, in the number of times it is filled daily, or in the time the sewage is allowed to remain within the filter. Filters Nos. 421 to 426, inclusive, are filled from the top, the sewage being run directly on to the surface of the filters at such rates that the filter is completely filled in about two minutes. Filter No. 427 is filled at the same rate, the sewage entering at the bottom of the filter and rising gradually through the material, thus displacing the air. Filter No. 428 is filled by means of a tipping basin discharging into a perforated pan placed 1 foot above the surface, the sewage entering the filter in small well-distributed doses, the rate of application being so regulated that about one hour is required to fill the filter. Filters Nos. 424 to 428, inclusive, are each allowed to stand full one hour before draining; Filter No. 423 is allowed to stand full two hours; and Filters Nos. 422 and 421 are allowed to stand full four hours and eight hours, respectively, before draining. Filter No. 425 is filled twice daily; Filter No. 426 is filled three times daily, and each of the other filters is filled once daily. In this series of eight filters, therefore, comparative studies are in progress of the effect of different details of operation. In Filters Nos. 421 to 424, inclusive, the effect of contact periods varying from one to eight hours in length are being studied on filters operated one cycle daily; in Filters Nos. 424, 425 and 426 the effect of operating filters one, two and three complete cycles daily is being compared; and in Filters Nos. 424, 427 and 428 we have a comparison of the effect of different methods of applying the sewage to filters which are otherwise operated in the same manner. The differences in the operating details of these filters are shown in the following table: —

Filter Number.	Method of Filling.	Contact Period (Hours).	Number of Cycles Daily.
421	Rapidly from surface, ...	8	1
422	Rapidly from surface, ...	4	1
423	Rapidly from surface, ...	2	1
424	Rapidly from surface, ...	1	1
425	Rapidly from surface, ...	1	2
426	Rapidly from surface, ...	1	3
427	Rapidly from bottom, ...	1	1
428	Slowly from surface, with distributor 12 inches above surface, .	1	1

In the accompanying tables a regular gradation may be noticed in the various nitrogenous constituents of the effluents from the four filters in which the sewage was allowed to remain for different lengths of time, the smallest amounts of both free and albuminoid ammonia and also of nitrates being found in the effluent from the filter in which the contact period was eight hours, while the largest amounts of each of these ingredients was found in the effluent from that filter in which the sewage remained only one hour. Unlike the results obtained with trickling and other filters in which the purification process is mainly oxidation, however, the results of stability tests do not follow the nitrates, about half of the samples from the filter yielding the highest nitrates being putrescible, while no putrescible samples were obtained during the year from the filter in which the sewage was held for eight hours and in which any nitrates which had been formed during the resting stage had been again reduced during the long period the sewage was standing within the filter. In the case of the three filters operated, respectively, one, two and three cycles daily, there was comparatively little difference between the quality of the effluents of the filters operated one and two cycles, but while the amount of nitrates produced by the filter operated three cycles daily was slightly less than the amounts produced by the filters operated a lesser number of cycles, the reduction in the ammonias by this filter was slightly greater and the proportion of stable samples obtained was considerably greater. Filter No. 427, which was filled from the bottom, produced an effluent of slightly poorer quality than either of the other filters operated in the study of methods of applying sewage, while nitrification was slightly more active in the filter which received sewage which had been aerated, although the proportion of stable samples obtained from this filter was somewhat less than in the case of the filter operated in the usual manner.

Double Contact Filtration.

Filter No. 443. — $\frac{1}{20000}$ of an acre in area and constructed of 21 inches in depth of broken stone pebbles, all of which will pass a screen with a $\frac{1}{2}$-inch mesh, 43 per cent. through a screen with a $\frac{1}{4}$-inch mesh and practically none of which will pass a screen with a $\frac{1}{8}$-inch mesh was put into operation on April 21, 1912, to study the purification resulting from the treatment of settled Lawrence sewage by filtration through two successive contact filters. The effluent from Filter No. 425, which is described above, was applied to this filter at an average rate of about 549,000 gallons per acre daily, the filter being filled twice each day and allowed to stand one hour before draining. As the two filters are arranged, the effluent from Filter No. 425 falls about 2 feet, striking upon a dash plate on the surface of Filter No. 443, and flows thence into the filter, thereby receiving a certain amount of aeration in its passage from the primary to the secondary filter. Nitrification was active in this filter throughout the year and the effluent was completely stable at all times.

Average analyses of the effluents from these various contact filters are shown in the following table: —

Average Analyses.

Effluent from Filter No. 175.

[Parts per 100,000.]

Quantity applied. — Gallons per Acre Daily.	Appearance.		Ammonia.			Kjeldahl Nitrogen.	Chlorine.	Nitrogen as		Oxygen consumed.	Bacteria per Cubic Centimeter.
	Turbidity.	Color.	Free.	Albuminoid. Total.	Albuminoid. In Solution.			Nitrates.	Nitrites.		
495,400	4.3	.37	1.2100	.2265	.1643	.4058	13.43	2.09	.0275	1.49	770,800

Effluent from Filter No. 421.

279,300	3.7	.32	1.4958	.2617	.2067	.4854	13.25	.13	.0009	1.66	869,600

Effluent from Filter No. 422.

277,700	4.0	.34	1.6792	.2679	.2023	.5053	13.23	.37	.0082	1.69	927,500

Effluent from Filter No. 423.

312,300	4.4	.34	1.8313	.2967	.2323	.5891	13.15	.41	.0276	1.98	1,171,700

Effluent from Filter No. 424.

304,900	4.4	.34	1.8667	.3004	.2307	.6108	13.00	.55	.0360	2.14	1,166,300

Effluent from Filter No. 425.

548,700	4.9	.35	1.8719	.3450	.2546	.6821	12.78	.56	.0161	2.26	1,415,300

Effluent from Filter No. 426.

599,000	5.2	.35	1.6921	.3092	.2361	.6482	12.78	.44	.0238	2.18	1,106,700

Effluent from Filter No. 427.

324,200	5.4	.35	1.8792	.3085	.2467	.6522	13.20	.34	.0157	2.34	1,279,200

Average Analyses — Concluded.

Effluent from Filter No. 428.

[Parts per 100,000.]

Quantity applied. — Gallons per Acre Daily.	Appearance.		Ammonia.			Kjeldahl Nitrogen.	Chlorine.	Nitrogen as		Oxygen consumed.	Bacteria per Cubic Centimeter.
	Turbidity.	Color.	Free.	Albuminoid. Total.	Albuminoid. In Solution.			Nitrates.	Nitrites.		
304,100	4.6	.33	1.7896	.2971	.2173	.5968	12.65	0.89	.0789	1.98	962,100
Effluent from Secondary Filter No. 443.											
548,700	3.3	.32	1.2583	.3042	.2143	.6171	12.90	1.52	.0312	2.00	919,200

Stability of Effluents from Contact Filters, 1913.

Filter Number.	Nitrates (Parts per 100,000).	Per Cent. of Samples. Putrescible.	Per Cent. of Samples. Doubtful.	Per Cent. of Samples. Stable.
175,	2.09	0.0	3.1	96.9
376,	.11	100.0	0.0	0.0
421,	.01	0.0	33.3	66.7
422,	.37	5.5	22 2	72.3
423,	.41	44.4	11.2	44.4
424,	.55	55.6	5.6	38.8
425,	.56	55.6	16.6	27.8
426,	.44	5.6	16.6	77.8
427,	.34	38.8	5.6	55.6
428,	.89	33.3	5.6	61.1
Secondary contact Filter No. 443,	1.52	0.0	0.0	100.0

Clogging of Contact Filters and Effect of Resting.

At the present time Filters Nos. 421 to 428, inclusive, have been in operation nearly three years; secondary Filter No. 443, about twenty months; and Filter No. 175, about two years since the material was removed and washed.

The loss of capacity by Filter No. 175 during the year was about 8 per cent., and at the end of the year the original capacity of the filter had been reduced about 29 per cent. In the case of secondary Filter No. 443, accumulated matters occupied about one-fourth of the original open space at the end of the year, although there was a slight gain in capacity during 1913. The results of capacity measurements on Filters Nos. 421 to 428, inclusive, however, are of particular interest since in this series of filters we may compare directly the effect of different operating details upon the deposition and retention of solids within the filter materials. In the four filters in which the sewage was held for different periods the two filters in which the contact period was eight hours and four hours, respectively, have lost about one-third of their capacity during the thirty-four months they have been in operation, while the two filters in which the contact period was one and two hours, respectively, have lost only about one-fourth of their capacity. During the year there was a slight loss in open space in each of these filters, but no regular difference which can be attributed to difference in operation can be detected in the results. In the series in which the three filters, Nos. 424, 425 and 426, are filled once, twice and three times daily, respectively, the greatest reduction in capacity, 53 per cent., occurred in the filter filled three times daily, and the least reduction, 26 per cent., occurred in the one filled only once each day. The total volume of the deposit in these filters is not strictly proportional to the volume of sewage which each receives daily. The filter operated three complete cycles daily lost considerably more capacity during 1913 than did either of its companion filters, but the accumulation of deposited matters in these other two filters during the past year is not in agreement with the volumes of sewage applied to them.

All of these contact filters were rested one week in every six throughout the year, capacity measurements being made immediately before and after each resting period. Except in a very few instances there was a regain in capacity in each of these contact filters as a result of resting. The largest average regain, 7 per cent., was obtained on Filter No. 426, which contained the greatest amount of deposited matters, and this filter also showed the largest individual regain as the result of any single resting period. Filter No. 175 showed an average regain of nearly 5 per cent. during resting, but in the case of the other filters the regain was somewhat less. Filters Nos. 175, 421 and 443 all show individual regain in capacity amounting to over 7 per cent., and Filter No. 425 showed a regain of over 6 per cent. on one occasion. In a few individual instances it was found that the capacity of a tank decreased slightly during the resting period, and at the present time no satisfactory explanation can be given for such an apparently abnormal occurrence. The comparatively small loss of open space by these filters during the year was undoubtedly in a large measure the result of the practice of resting such filters systematically.

The loss of capacity of each of these filters and the effect of resting upon the capacity are shown in the following table: —

Loss of Capacity of Contact Filters and Effect of Resting (Per Cent.).

Filter Number.	Time operated (Months).	Total Loss since Start.	Loss during 1913.	Regain after Resting One Week.		
				Average.	Maximum.	Minimum.
175, ...	23[1]	29[1]	8.3	4.7	7.3	1.6
421, ...	34	32	5.6	1.5	7.5	4.4[2]
422, ...	34	33	4.3	1.7	4.5	0.0
423, ...	34	25	3.8	1.5	4.0	0.0
424, ...	34	26	5.1	1.5	2.7	0.0
425, ...	34	33	2.9	2.8	6.4	1.5[2]
426, ...	34	53	12.9	7.0	10.9	1.9
427, ...	34	21	3.7	2.0	3.8	0.0
428, ...	34	25	1.3	1.5	2.7	0.0
443, ...	20	25	3.4[2]	2.5	7.3	0.0

[1] Since washing material. [2] Gain.

Sedimentation and Refiltration of Effluents from Contact and Trickling Filters.

Filters Nos. 442, 444 and 448.

During 1913 three experiments upon the further purification of effluents from filters of coarse material by sedimentation and refiltration were continued. In one of these experiments the effluent from trickling Filter No. 360 was passed through a continuous-flow settling tank and applied to secondary Filter No. 442. In another, the effluent from the double contact system, consisting of contact Filters Nos. 425 and 443, was settled and applied to intermittent sand Filter No. 444, while in the third, the effluent from trickling Filter No. 248 was passed through Filter No. 448, in which a settling tank and upward flow filter are combined.

Sedimentation of Effluents.

Since March 1, 1912, the effluent from trickling Filter No. 360 has been passed through a settling tank preparatory to refiltration on Filter No. 442. This tank, which is a modified form of Imhoff tank, is cylindrical, with a conical bottom sloping at an angle of 60°, inside of which is a smaller tank of similar design. The inner, or settling chamber, is provided with a slot in the bottom through which the deposited solids pass into the outer or digestion chamber. The effluent from the trickling filter enters and flows to the bottom of the inner tank through a central pipe, is there deflected to the outer rim of the tank and rises slowly to the top, where it overflows to a storage tank from which it is drawn, as required for application to the secondary filter. The average rate of vertical flow in the settling tank is about 0.9 inch per minute, the effluent being about thirty minutes in passing through the tank. The upper side of the central deflector is cone shaped, to facilitate the flow of any deposited matters toward the opening into the digestion chamber. The outer or digestion chamber has a capacity of about two and one-half times the capacity of the settling compartment. The average removal of suspended matters in the tank during the year, as shown by albuminoid ammonia determinations, was about 42 per cent. On April 22, 1913, there was a heavy scum about one inch thick in the digestion chamber and heavy sludge nearly up to the opening from the settling compartment. On this date the tank was emptied. On August 7 heavy sludge equivalent to about 7 per cent., and on October 7 heavy sludge equivalent to about 4 per cent. of the capacity of this chamber, was withdrawn. Sludge equivalent to about 97 pounds of dry matter per million gallons of effluent was deposited in this tank.

The composition of the various samples of sludge from this tank is shown in the following table: —

	1913.	Per Cent. Water.	Per Cent. of Dry Sludge.		
			Organic Matter.	Organic Nitrogen.	Fats.
Floating matter,	April 22,	93.3	73.1	4.23	7.8
Bottom sludge,	April 22,	94.6	48.3	2.93	2.3
Bottom sludge,	August 7,	97.3	54.0	3.31	1.4
Bottom sludge,	October 7,	96.5	58.6	4.11	0.1
Bottom sludge,	December 3,	95.0	57.1	3.43	1.8

Throughout the year the effluent from secondary Filter No. 443 was passed into a settling tank and allowed to settle for one hour before being applied to intermittent sand Filter No. 444. The sludge was withdrawn from this tank each day. The average removal of suspended matters by this tank, as shown by albuminoid ammonia determinations, was about 43 per cent.

Intermittent Filtration of Settled Effluents.

Filters Nos. 442 and 444 are each $\frac{1}{20000}$ of an acre in area, and are constructed of 4 feet in depth of sand of an effective size of 0.26 millimeter. Filter No. 442 was first put into operation on March 1, 1912, and received the settled effluent from trickling Filter No. 360 at a rate of 400,000 gallons per acre daily throughout the year. Filter No. 444 was first put into operation on April 1, 1912, and received the settled effluent from secondary contact Filter No. 443 at a rate of 400,000 gallons per acre daily. The settled effluents applied to each of these filters have been divided into two doses applied at intervals four hours apart. The principal points in the operation of these two filters during the year were as follows: The surface of Filter No. 442 was raked to a depth of 3 inches to relieve clogging on January 27, February 10, March 8 and March 26. On April 17 the surface of this filter had become badly clogged and 2 inches of material were removed and the filter allowed to rest one week. The surface of Filter No. 444 was raked to a depth of 3 inches once each month in January, February and March, no surface treatment being required during the remainder of the year. As the contact filter whose effluent is applied to this filter is allowed to rest one week in every six, it was necessary to allow this filter to rest during the corresponding periods, and the systematic resting has undoubtedly been very beneficial to the work of the filter and the ease with which it has been kept in good operating condition. Nitrification was active in both filters throughout the year, and the effluents were of excellent quality at all times.

Combined Sedimentation and Upward Filtration.

Filter No. 448, $\frac{1}{80000}$ of an acre in area, was first put into operation on May 20, 1912. It is constructed of 2 feet in depth of pieces of coke between $\frac{1}{8}$ and $\frac{5}{16}$ inch in diameter, supported 1 foot above the bottom of the tank by a $\frac{1}{8}$-inch mesh wire screen, the filter material being carried in a separate inner tank, which is removable for purposes of inspection. The effluent from trickling Filter No. 248 flows directly to the sedimentation chamber below the coke, where it receives about two hours' storage, then rises through the coke and overflows at the top, the average rate of the filter during the year being about 3,000,000 gallons per acre daily. The filter was operated throughout the year without any treatment to relieve clogging being necessary. The average removal of suspended matters during the year, as shown by albuminoid ammonia determinations, was about 43 per cent. Except in the removal of suspended matters, there has been no further purification of the effluent from Filter No. 248 during its passage through this tank, and the final effluent has always been turbid and highly colored with iron. At the end of the year, after being in continuous operation for about eighteen and one-half months, the filter material was removed, and the amount of sludge held within the sludge compartment and the filter material were determined. The total amount of stored matters was equivalent to about 111 pounds per million gallons of effluent which had been passed through it since it was started, about two-thirds of the stored matters being in the form of sludge in the sedimentation chamber and the other third being contained in the interstices of the filter proper.

The composition of the sludge in the settling compartment and of the clogging matters washed from the filter material was as follows: —

	Per Cent. Water.	Per Cent. of Dry Sludge.		
		Loss on Ignition.	Organic Nitrogen.	Fats.
Sludge in settling compartment, . . .	95.9	44.7	3.85	.25
Sludge washed from filter material, . .	–	40.0	2.20	.15

Average Chemical Analyses.

Settled Effluent from Trickling Filter No. 360 applied to Filter No. 442.

[Parts per 100,000.]

Quantity applied. — Gallons per Acre Daily.	Appearance.		Ammonia.			Kjeldahl Nitrogen.	Chlorine.	Nitrogen as		Oxygen consumed.	Bacteria per Cubic Centimeter.
	Turbidity.	Color.	Free.	Albuminoid. Total.	Albuminoid. In Solution.			Nitrates.	Nitrites.		
–	–	–	1.8700	.3132	.1902	.6154	13.11	1.13	.0145	2.15	2,135,000
Settled Effluent from Contact Filter No. 443 applied to Filter No. 444.											
–	–	–	1.1100	.2327	.1822	.4963	13.58	1.56	.0155	1.69	875,000
Effluent from Filter No. 442.											
375,000	0.5	.20	0.2373	.0535	–	–	12.46	2.86	.0019	0.67	6,600
Effluent from Filter No. 444.											
329,100	0.4	.19	0.0794	.0451	–	–	12.83	2.25	.0034	0.56	17,800
Effluent from Combined Sedimentation and Upward Filtration Tank No. 448.											
3,230,000	1.9	.38	1.8083	.3404	.2097	.7328	13.38	1.12	.0142	2.34	492,100

Average Bacterial Efficiency of Sewage-disposal Systems.

Untreated Sewage.

	Bacteria per Cubic Centimeter.			Per Cent. of Bacteria removed.		
	20° C.	40° C.		20° C.	40° C.	
		Total.	Red.		Total.	Red.
Lawrence street sewage,	2,707,000	400,200	346,800	-	-	-
Lawrence regular sewage,	3,724,000	409,600	358,500	-	-	-

Preliminary Clarification Treatments.

Lawrence settling tank,	2,301,000	244,000	206,800	38.20	40.50	42.30
Slate tank No. 376,	2,707,000	392,500	334,500	27.20	4.00	6.50
Aerated and settled sewage,	1,684,000	151,300	120,600	54.80	63.20	66.30
Chemical precipitation,	1,383,000	200,400	178,800	62.90	51.30	50.20
Strainer E,	3,258,000	333,800	264,600	12.30	18.50	26.20

Intermittent Sand Filters.

No. 1,	6,600	2,700	2,330	99.82	99.34	99.35
2,	560	19	14	99.85	99.99	99.99
4,	280	23	11	99.92	99.99	99.99
5C,	9,300	3,300	2,700	99.75	99.20	99.25
6,	13,100	4,250	3,700	99.65	98.97	98.97
9A,	1,970	193	150	99.95	99.53	99.96
10,	18,100	430	290	99.51	99.89	99.92
429,	450	110	100	99.99	99.73	99.72
430,	17,400	10,800	9,700	99.24	95.57	95.32
431,	8,650	4,450	4,100	99.74	98.67	98.45
432,	2,000	860	790	99.86	99.57	99.56

Trickling Filters.

No. 135,	66,800	8,800	6,950	97.10	96.40	96.65
136,	124,400	37,800	26,300	94.60	84.50	87.30
248,	356,000	56,400	47,000	84.50	76.90	77.30
360A,	699,100	38,000	34,800	69.70	84.50	83.20
360B,	969,100	35,300	30,800	58.00	85.50	85.10
360C,	851,800	38,100	34,800	63.00	84.40	83.20
360 (entire),	746,600	33,300	29,800	67.60	86.40	85.60
449,	309,800	5,230	3,960	81.50	96.54	96.73

Average Bacterial Efficiency of Sewage-disposal Systems — Concluded.

Trickling Filters — Concluded.

	Bacteria per Cubic Centimeter.			Per Cent. of Bacteria removed.		
	20° C.	40° C.		20° C.	40° C.	
		Total.	Red.		Total.	Red.
No. 452,	373,000	31,300	28,800	83.80	87.20	86.10
453,	170,600	21,500	17,600	92.55	91.20	91.50
454,	256,000	41,700	37,200	88.90	82.90	82.00
455,	316,000	19,100	16,300	86.30	92.20	92.10
Contact Filters.						
No. 175,	770,800	136,300	124,400	76.40	59.30	53.20
421,	869,600	138,800	121,000	62.20	43.00	40.00
422,	927,500	151,700	132,100	59.80	37.70	36.20
423,	1,172,000	180,000	154,200	49.20	26.20	25.50
424,	1,166,300	169,200	141,300	49.20	30.70	31.90
425,	1,415,300	184,300	160,000	38.30	24.50	22.70
426,	1,106,700	177,100	152,100	51.80	27.50	26.50
427,	1,279,200	305,800	262,500	44.40	25.00[1]	27.00[1]
428,	962,100	140,600	126,300	58.30	42.20	39.20
Secondary Contact Filter.						
No. 443,	919,200	127,900	111,800	35.40	30.40	30.00
Effluent from Settling Tanks.						
Settled effluent, trickling Filter No. 360,	2,135,000	32,400	29,800	186.00[1]	2.70	0.00
Settled effluent, secondary contact Filter No. 443.	875,000	141,700	134,700	4.80	9.30[1]	20.40[1]
Combined Effluent from Settling Tank and Upward-flow Filter.						
Effluent from Filter No. 448,	492,100	37,500	33,800	26.20[1]	33.50	28.00
Secondary Intermittent Sand Filters.						
No. 442,	6,600	1,160	1,045	99.69	96.42	96.49
444,	17,800	3,230	3,150	97.96	97.73	97.67

[1] Increase.

Further Studies on the Purification of Tannery Waste.

Experiments on the purification of tannery wastes have been in progress at the station since 1895. The results of the experiments during the first fifteen years were summarized in the report for 1909, and the results obtained during 1910 were given in the report for that year. In the following pages are summarized the results of further studies which have been made during the past three years.

The waste liquors from one of the main tanneries investigated consist of a mixture derived chiefly from the processes of wool scouring, skin washing, tanning and dyeing, together with the drainage from the toilet rooms. The mixed wastes are passed through a settling basin, and at times have also been treated with copperas or with alum, to increase the removal of suspended matters. After passing through this settling tank, the waste usually contained a large amount of soluble matter and a small amount of suspended matter and was usually colored by the wastes from the dyeing. Moreover, a large proportion of the total solids remaining after settling were of an inorganic or mineral nature. Experiments at the station in former years indicated that this settled waste could be satisfactorily purified on sand filters, but when it was attempted to carry out this process at the tannery, the sand filters rapidly became clogged and could only be kept in operation by very frequent removal and replacement of the clogged sand. In 1911 studies were started to ascertain what further preliminary treatment was necessary in order that sand filters might be satisfactorily operated.

Sedimentation followed by Sand Filtration.

Filter No. 435, containing 42 inches in depth of sand of an effective size of 0.25 millimeter, was put into operation on May 13, 1911. The effluent from the tannery settling basin, after being settled for an additional twenty-four hours in the laboratory, was applied to this filter at a rate of 75,000 gallons per acre daily. The effect of the extra period of sedimentation was to reduce the organic matters about 15 per cent., as shown by loss on ignition, and about 18 per cent. and 20 per cent., as shown, respectively, by Kjeldahl nitrogen and oxygen consumed determinations. Nitrification became established in the filter during the latter part of June, and the effluent was clear and of good quality throughout the experiment. After the first few months, however, the surface of the filter became clogged by the suspended and colloidal matters which even the extra period of sedimentation had failed to remove, and throughout the remainder of the experiment frequent scraping or other surface treatment was required to keep the filter in good working condition. During the period of two and one-half years this filter was continued in operation, the total depth of sand removed by scraping was about 12 inches. These experiments confirm the results obtained at the tannery and show that even the prolonging of the settling period for an additional twenty-four hours would not sufficiently clarify the waste to enable sand filters to be operated without clogging. The experiments also show the necessity of continuing experiments of this kind over a considerable period, and while the possibility of obtaining a good purification by sand filters was shown by earlier experiments, the filters to which the effluent from the settling tank at this tannery were applied experimentally in former years were operated for too short a period to indicate the very serious difficulties which might be expected through clogging.

Precipitation with Flue Gas or CO_2 followed by Sand Filtration.

Filter No. 441, operated from Jan. 13, 1912, to Sept. 30, 1913, at a rate of 100,000 gallons per acre daily, was an exact duplicate of Filter No. 435. The effluent from the tannery settling tank applied to this filter was treated by blowing flue gas or CO_2 through it for about one-half hour, and then allowing it to settle for about ten to fifteen minutes. When the waste contained the red coloring matter which usually was characteristic of it, the result of the flue gas treatment was to produce rapid coagulation of the colored suspended or colloidal matters, the supernatant liquor after a short period of sedimentation being clear and of a light straw color. During warm weather the characteristic red color was usually absent from the settled waste when received, and as the character of the raw wastes was not materially different, it is possible that the character of the waste had been changed by fermentation in the settling tank. At such times a precipitation similar to that obtained with CO_2 was effected by the addition of a slight excess of hydrochloric acid, the supernatant liquor being again made alkaline before application to the filter. The effect of the precipitation treatment was to reduce the organic matter about one-third, as shown by loss on ignition, and about 30 per cent., as shown by Kjeldahl nitrogen and by oxygen consumed determinations. Nitrification became established shortly after the filter was started, and the effluent was highly nitrified throughout the experiment, although at times it was slightly turbid and of somewhat higher color than the effluent from Filter No. 435. Operating at a higher rate than Filter No. 435, this filter showed no signs of clogging during the period of about twenty months it was operated. The results obtained in this experiment indicate that in the case of this particular waste, treatment with flue gas for a short period may so improve the clarification in the settling tank that the tank effluent may be successfully purified upon sand filters without undue clogging of the filter material.

The average analyses of the effluents from these filters, of the treated waste applied to them, and the condition of the sand in each filter at the end of the experiment, are shown in the following tables: —

Average Chemical Analyses.

Effluent from Tannery Settling Tank as received.

[Parts per 100,000.]

Year.	Solids.			Ammonia.		Kjeldahl Nitrogen.	Nitrogen as		Oxygen consumed.	Chlorine.	Alkalinity.
	Total.	Loss on Ignition.	Fixed.	Free.	Total Albuminoid.		Nitrates.	Nitrites.			
1911, ...	229	56	173	3.08	1.16	2.57	–	–	9.97	40.7	40.7
1912, ...	270	69	201	3.10	1.76	4.03	–	–	12.32	32.4	32.4
1913, ...	354	62	292	3.74	1.29	2.86	–	–	13.74	45.0	45.0

Resettled Waste applied to Filter No. 435.

1911, ...	210	46	164	3.11	0.91	1.97	–	–	7.32	–	–
1912, ...	251	58	193	3.10	1.35	3.05	–	–	10.45	–	–
1913, ...	326	54	272	3.13	1.24	2.73	–	–	10.92	40.7	40.0

Waste precipitated with CO_2 applied to Filter No. 441.

1912, ...	263	47	216	3.08	1.12	2.55	–	–	8.26	36.4	36.4
1913, ...	356	45	311	3.71	0.91	1.98	–	–	10.62	36.5	36.5

Effluent from Filter No. 435.

1911, ...	–	–	–	.7342	.0473	–	2.69	.0348	.41	14.0	14.0
1912, ...	–	–	–	.3354	.0634	–	3.17	.0006	.61	16.4	16.4
1913, ...	–	–	–	.1561	.0685	–	3.87	.0001	.91	18.4	18.4

Effluent from Filter No. 441.

1912, ...	–	–	–	0.5956	.1169	–	3.88	.0028	1.20	16.7	16.7
1913, ...	–	–	–	1.0003	.1775	–	3.37	.0023	1.88	12.8	12.8

Analyses of Sand from Filters.

Filter No. 435.

[Parts per 100,000.]

	Ammonia.		CaCO$_3$.
	Free.	Albuminoid.	
Average of 12 inches removed by scrapings,	0.63	40.4	276
Average of sand remaining in filter,	0.45	13.2	220

Filter No. 441.

Average of upper 12 inches,	0.85	26.5	144
Average of lower 30 inches,	0.25	8.8	144

PURIFICATION OF WATER.

LAWRENCE CITY FILTERS.

The source of the water supply of the city of Lawrence is the Merrimack River. Two filters are in use to purify this water. The older filter was constructed in 1893, and dividing walls separating it into three sections were built in 1902. The average depth of sand in this filter is about 4 feet, and the net filtering area is about 2.2 acres. As originally constructed, this filter contained two different grades of sand, the portions of the filter immediately over the underdrains being of finer sand than the remainder of the filter. Through the operations of scraping, washing and replacing sand, the two grades of sand have become quite thoroughly mixed in the upper layers of the filter, and at the present time this upper sand has an effective size of approximately 0.25 millimeter. This filter is not covered and has an earth bottom through which some ground water finds its way into the underdrains and becomes mixed with the filtered water. The average rate of operation during the past few years has been about 1,000,000 gallons per acre daily.

In November, 1907, a modern covered filter of concrete construction was put into operation to supplement the supply of filtered water from the old filter. This filter is three-quarters of an acre in area and contains about 4½ feet in depth of sand of an effective size of 0.25 millimeter. The average rate of operation during 1913 was about 3,000,000 gallons per acre daily. The effluents from both of these filters flow into the same pump-well from which they are pumped into the distributing reservoir. There was comparatively little difference in the degree of purification produced by these two filters, as shown by the average analyses. As has been the case for the last few years, the effluent from the older filter was slightly better bacterially than that from the covered filter, which is operated at a much higher rate.

The average analyses of the effluents from these two filters, and of samples from other points on the Lawrence water supply system, are shown in the following tables: —

Average Chemical Analyses.

Merrimack River. — Intake of the Lawrence City Filters.

[Parts per 100,000.]

Temperature (Degrees F.).	Appearance.		Ammonia.			Chlorine.	Nitrogen as		Oxygen consumed.	Iron.	Alkalinity.	Soap Hardness.
	Turbidity.	Color.	Free.	Albuminoid.			Nitrates.	Nitrites.				
				Total.	In Solution.							
51	0.3	.33	.0170	.0216	.0180	.45	.020	.0005	.60	.0523	1.3	1.7

Effluent from the Lawrence City Filter (Old Filter).

53	0.1	.18	.0118	.0099	–	.48	.032	.0004	.44	.0973	1.6	2.0

Effluent from the Lawrence City Filter (New Filter).

53	0.0	.17	.0038	.0099	–	.44	.027	.0003	.46	.0294	1.3	1.7

Water from the Outlet of the Distributing Reservoir.

53	0.1	.22	.0062	.0102	–	.47	.034	.0002	.41	.0673	1.5	1.9

Water from a Tap at Lawrence City Hall.

54	0.2	.23	.0038	.0096	–	.47	.036	.0002	.40	.0733	1.5	1.8

Water from a Tap at the Lawrence Experiment Station.

54	0.1	.22	.0030	.0097	–	.47	.037	.0001	.38	.0694	1.5	1.8

Average Bacterial Analyses.

Merrimack River. — Intake of the Lawrence City Filters.

Bacteria per Cubic Centimeter.			Per Cent. of Bacteria removed.			Per Cent of Samples containing B. Coli.	
20° C.	40° C.		20° C.	40° C.		1 c. c.	100 c. c.
	Total.	Red.		Total.	Red.		
7,400	225	175	–	–	–	100.0	100.0

Effluent from the Lawrence City Filter (Old Filter).

41	6	3	99.4	97.3	98.3	15.7	89.8

Average Bacterial Analyses — Concluded.

Effluent from Lawrence City Filter (New Filter).

Bacteria per Cubic Centimeter.			Per Cent. of Bacteria removed.			Per Cent. of Samples containing B. Coli.	
20° C.	40° C.		20° C.	40° C.		1 c. c	100 c. c.
	Total.	Red.		Total.	Red.		
51	8	5	99.3	96.5	97.1	30.5	90.0

Mixed Effluents as pumped to Distributing Reservoir.

45	7	4	-	-	-	25.3	90.7

Water from the Outlet of the Distributing Reservoir.

40	4	2	-	-	-	13.1	87.3

Water from a Tap at Lawrence City Hall.

36	5	2	-	-	-	4.2	81.8

Water from a Tap at the Lawrence Experiment Station.

39	7	2	-	-	-	11.3	78.0

Average Solids.

Merrimack River. — Intake of the Lawrence City Filters.

[Parts per 100,000.]

Unfiltered.			Filtered.			In Suspension.		
Total.	Loss on Ignition.	Fixed.	Total.	Loss on Ignition.	Fixed.	Total.	Loss on Ignition.	Fixed.
6.7	2.7	4.0	6.2	2.4	3.8	0.5	0.3	0.2

Effluent from Lawrence City Filter (Old Filter).

6.4	2.3	4.1	-	-	-	-	-	-

Effluent from Lawrence City Filter (New Filter).

5.8	2.1	3.7	-	-	-	-	-	-

Average Solids — Concluded.

Water from the Outlet of the Distributing Reservoir.

[Parts per 100,000.]

Unfiltered.			Filtered.			In Suspension.		
Total.	Loss on Ignition.	Fixed.	Total.	Loss on Ignition.	Fixed.	Total.	Loss on Ignition.	Fixed.
6.1	2.2	3.9	-	-	-	-	-	-
Water from a Tap at Lawrence City Hall.								
6.2	2.2	4.0	-	-	-	-	-	-
Water from a Tap at the Lawrence Experiment Station.								
6.1	2.2	3.9	-	-	-	-	-	-

Filtration through a Shallow Sand Filter with Disinfection.

Filter No. 8A, $\frac{1}{200}$ of an acre in area and first put into operation on Sept. 26, 1893, contained about 21 inches in depth of sand of an effective size of 0.28 millimeter at the beginning of the year. This filter has been operated with canal water at a rate of 3,000,000 gallons per acre daily. During the year this filter was scraped to relieve clogging eleven times, the average volume of water filtered between scrapings being about 79,000,000 gallons per acre, and the average time between scrapings being about twenty-five days. During the first four months of the year high bacterial counts were obtained on occasional samples of the effluent from this filter, and high body temperature counts were obtained at relatively frequent intervals. Attention was called in the last report to a similar condition during 1912, especially during the first few days after the filter was scraped, and it was stated that this was undoubtedly due to the fact that the effective depth of the filter had been reduced below the limit of safety. In the usual practice of operating slow sand filters, it is customary to replace the sand removed by scraping at reasonably frequent intervals, so that under ordinary conditions the effective depth of the filter never becomes reduced to any great extent. With this and certain other experimental filters at the station, however, the practice has been to continue scraping the filter until an insufficient depth of sand is indicated by the bacterial analyses of the effluent, and then to rebuild the filter to the desired depth with new sand.

Instead of restoring the depth of sand in the spring of 1913, the operation of the filter was continued and hypochlorite of lime was added to the applied water throughout the last eight months of the year in order to study the effect of combined disinfection and filtration through a shallow layer of sand. On April 15, when the application of hypochlorite was begun, the effective depth of sand within the filter was about 18 inches. The disinfectant was added directly to the water as it flowed upon the filter, the volume of water upon the surface being equivalent to about six hours' flow of the filter. The proportion of disinfectant used, one part per million available chlorine, was that which long series of experiments in previous years had shown to be necessary for the treatment of Merrimack River water.

In April and November a number of high counts were obtained on the disinfected water as applied to the filter. As much trouble was experienced with the chemical feed in these months, these high counts can undoubtedly be attributed to irregularities in the amount of disinfectant added to the water. During the six months, May to October, inclusive, the average destruction of bacteria by disinfection was about 99.5 per cent. as shown by room temperature counts, and about 95 per cent. as shown by body temperature counts. In three of these six months, B. coli appear to have been entirely eliminated, judging by tests in 1 cubic centimeter of the disinfected water, but in the other three months, bacteria of the colon type were found in a small proportion of the samples. The effluent from the filter has been of good quality bacterially since the application of disinfected water to it was begun. The average number of bacteria in the effluent during this period was 11 per cubic centimeter, and the highest average in any one month was 23 per cubic centimeter. Only one sample containing more than 50 bacteria per cubic centimeter has been obtained from this filter during this period. In two of the months when the numbers in the disinfected applied water were very low, the effluent from the filter contained more bacteria than the water applied to it, and in one other month the numbers were unchanged by filtration. The average for the eight months, however, shows a removal of nearly 85 per cent. of the total bacteria and of about 58 per cent. of the body temperature types during filtration, a very satisfactory result when the small bacterial content of the applied water is taken into consideration. In three of the eight months B. coli was not found in the disinfected water before or after passing the filter, in three other months there was a reduction by filtration in the proportion of samples containing this organism. In July, however, B. coli was found in the same proportion of samples of both applied water and effluent, and the test organism was found in 11 per cent. of the effluent samples, although not found in any of the samples of the disinfected water applied to the filter.

Average analyses of the river water before and after disinfection, and of the effluent from this filter, are shown in the following tables: —

Average Bacterial Analyses.

Without Disinfection.

1912–13.	Merrimack River Water.							Effluent, Filter No. 8A.			
	Before Disinfection.			After Disinfection.							
	Bacteria per c. c.			Bacteria per c. c.			Per Cent. of 1 Cubic Centimeter Samples containing B. Coli.	Bacteria per c. c.			Per Cent. of 1 Cubic Centimeter Samples containing B. Coli.
	20° C.	40° C. Total.	40° C. Red.	20° C.	40° C. Total.	40° C. Red.		20° C.	40° C. Total.	40° C. Red.	
December,	11,300	570	500	–	–	–	–	115	12	9	50.0
January,	9,800	350	310	–	–	–	–	80	9	7	50.0
February,	19,500	340	240	–	–	–	–	95	12	9	28.6
March,	8,600	240	180	–	–	–	–	58	11	5	0.0
Average,	12,300	375	310	–	–	–	–	87	11	8	32.1

With Disinfection.

1912–13.	20° C.	40° C. Total.	40° C. Red.	20° C.	40° C. Total.	40° C. Red.	Per Cent. B. Coli.	20° C.	40° C. Total.	40° C. Red.	Per Cent. B. Coli.
April,	2,200	80	45	350	29	13	0.0	23	10	3	0.0
May,	1,500	130	90	12	11	2	0.0	10	5	1	0.0
June,	1,900	170	93	8	9	2	5.9	9	4	0	0.0
July,	2,600	240	150	6	8	2	5.6	4	3	1	5.6
August,	500	70	38	6	4	1	0.0	6	1	0	0.0
September,	4,900	170	85	8	6	0	0.0	9	6	1	11.1
October,	11,300	290	230	28	13	5	11.1	12	3	1	5.6
November,	5,450	230	190	160	14	7	33.3	16	8	4	13.3
Average,	3,800	170	115	72	12	4	7.0	11	5	1	4.5

Bacterial Efficiency.

1912–13.	Of Disinfection.			Of Filter.		
	20° C.	40° C. Total.	40° C. Red.	20° C.	40° C. Total.	40° C. Red.
December,	–	–	–	99.9	97.9	98.2
January,	–	–	–	99.2	97.4	97.7
February,	–	–	–	99.5	96.5	96.3
March,	–	–	–	99.3	95.4	97.2
Average,	–	–	–	99.5	96.8	97.4
April,	84.1	63.8	71.1	93.6	65.6	77.0
May,	99.2	91.5	97.8	16.7	54.5	50.0
June,	99.6	94.7	97.8	12.5 [1]	55.5	100.0
July,	99.8	96.7	98.7	33.3	62.5	50.0
August,	98.8	94.3	97.5	0.0	75.0	100.0
September,	99.8	96.6	100.0	12.5 [1]	0.0	–[1]
October,	99.8	95.5	97.8	57.2	77.0	80.0
November,	97.1	93.9	96.3	90.0	42.8	42.8
Average,	97.3	90.9	94.6	39.5	54.1	62.5

[1] Increase.

Sand Filters operated with Merrimack River Water at Different Rates.

Filters Nos. 417 and 419 were first put into operation Dec. 28, 1910, as a part of a study of the effect of the rate upon the hygienic efficiency and economy of operation of sand filters. At the beginning of the year Filter No. 417 contained 49 inches and Filter No. 419 contained 46 inches in depth of sand of an effective size of 0.25 millimeter. Merrimack River water has been applied to Filter No. 417 at a theoretical rate of 2,500,000 gallons per acre daily and to Filter No. 419 at a theoretical rate of 10,000,000 gallons per acre daily throughout the year.

During the greater part of the year the effluent from Filter No. 417 has contained considerably higher numbers of bacteria than has the effluent from Filter No. 419, which is operated at a rate about four times as high, the average numbers for the year being 104 and 72, respectively. This apparently abnormal result has been confined to the room temperature counts, the numbers of bacteria of the body temperature types, and also the proportion of samples containing B. coli in 1 cubic centimeter being about twice as great for Filter No. 419 as for its companion filter operating at a much lower rate. The occurrence of high room temperature counts in the effluents from these filters has been noted and commented upon in previous reports, and has been due to the occurrence of growths of bacteria, usually of a single species within the filter. While of no sanitary importance, in this specific instance the growths of such bacteria have been sufficient to entirely obscure the true effect of the different rates of operation and to destroy the value of the experiment so far as the room temperature counts are concerned. During May attempts were made on two different occasions to eliminate the growths within Filter No. 417 by treating the applied water with a high concentration of calcium hypochlorite. On May 12 disinfectant equivalent to about 10 parts per million available chlorine was added early in the morning to the water on the surface of this filter. Samples collected late in the afternoon and on the following day showed high numbers of practically a pure culture of the organism which we had been trying to eliminate. On May 22 the applied water was treated early in the morning with calcium hypochlorite in the proportion of 20 parts available chlorine per million. Samples collected on the afternoon of this day contained very low numbers of bacteria, but on the following days high counts were obtained and the troublesome species were again very conspicuous. So far as the chemical quality of the water was concerned there was practically no difference in the character of the effluents from these filters during the year. The low-rate filter, however, caused a much greater reduction in the amount of dissolved oxygen in the water during the greater part of the year than did the high-rate filter, although at times, especially during June, July and August, the dissolved oxygen in the river water was practically all used up in passing through either of these filters.

One of the most interesting features of these filters was the relative amount of surface treatment necessary to keep them in operation at the prescribed rates. Prior to Dec. 1, 1912, each filter was surface washed when necessary to relieve clogging. During the present year, however, a method of treatment similar to that in vogue at certain municipal filters has been tried. This method consists in raking the filter to a depth of from 1 to 2 inches on two successive occasions when surface treatment becomes necessary, and scraping the filter to a slightly greater depth than customary under the older scraping practice when the surface becomes clogged for the third time. That is to say, relief by raking is tried twice in every case before scraping is resorted to. Under this procedure, the surface of Filter No. 417 was raked three times and was scraped once during the year. After the first two rakings the filter was operated 74 and 115 days, respectively, before surface treatment was again required, while following the single scraping, the filter was operated for 87 days before surface treatment was again necessary. The average volume of water filtered between raking and the next surface treatment was about 235,000,000 gallons, while following the single scraping, about 219,000,000 gallons were filtered before surface treatment was again required. The attempt to follow the same procedure with Filter No. 419, which was operated at a rate of 10,000,000 gallons per acre daily, resulted in the surface being raked twenty-five times and scraped thirteen times during the year. The average result of raking Filter No. 419 has been to permit an interval of seven days' operation before surface treatment was again necessary, while the average interval following scraping was about nine and one-half days. The longest interval following any single raking was sixteen days, and in two cases the period following was only about two days, and in one case, surface treatment was again required on the next day after raking. The longest operating interval following any scraping was nearly 22 days, but in two cases the interval following was only three days, and in another case this interval was only two days. The average volume of water filtered in the intervals following raking was about 68,000,000 gallons, and the average volume in the intervals following scraping was about 83,000,000 gallons per acre. Comparing the records of these two filters, it will be noted that more than nine times as much surface treatment was required to keep the filter in operation at a 10,000,000 rate as was required to maintain a rate one-fourth as great. On the basis of the volume of water filtered for each surface treatment, the record of the low-rate filter is also much superior, the average volume of water passed by this filter between scraping and the next succeeding surface treatment being about 2.6 times as great, and the average volume filtered in the periods following raking being about 3.4 times as great as the volumes passed by the high-rate filter during similar periods.

The average analyses of the effluents from these two filters are shown in the following tables: —

Average Bacterial Analyses.

Bacteria per Cubic Centimeter.			Per Cent. of Bacteria removed.			Per Cent. of Samples containing B. Coli.
20° C.	40° C.		20° C.	40° C.		
	Total.	Red.		Total.	Red.	1 c. c.
Effluent from Filter No. 417.						
104	6	2	98.4	97.5	98.9	23.9
Effluent from Filter No. 419.						
72	11	6	98.9	95.4	96.7	46.8

Double Filtration.

Upward Filtration through Coarse Material followed by Sand Filtration. Filters Nos. 389 and 286.

Filter No. 389, $\frac{1}{20000}$ of an acre in area, was first put into operation on April 14, 1910. This filter is constructed of 6 inches in depth of wood charcoal, supported upon a $\frac{1}{4}$-inch mesh galvanized-wire screen placed 12 inches above the bottom of the tank. Overlying the charcoal and separated from it by a $\frac{1}{8}$-inch mesh copper screen is 24 inches in depth of broken stone pebbles of an effective size of 4.4 millimeters. The canal water enters at the bottom, passes upward through the filter material and overflows through an orifice placed 3 inches above the surface of the stone, the available loss of head with the filter in operation being about 10 inches. This filter has been operated at a rate of 10,000,000 gallons per acre daily throughout the year. When the filter becomes clogged to such an extent that the water will not pass at the prescribed rate, it has been the practice to reverse the flow through the filter for a short time to remove the clogging matters. During the early part of the year reversal of the flow for a period of about thirty minutes was sufficient to restore the filter to good operating condition, but as the deposited matters have accumulated within the deeper layers of the filter it has been necessary to gradually increase the time of washing, and during the last half of the year about one hour has been required to wash the filter properly. In all, this filter has been washed by reversed flow thirty-two times during the year, or on an average about once in eleven days. The average volume of water filtered between washings was about 109,000,000 gallons per acre. The longest run of the filter lasted from Oct. 23, 1912, to Jan. 3, 1913, a period of sixty-eight days, during which about 700,-000,000 gallons per acre were filtered. The shortest run of the filter, forty-six hours, occurred in April, when less than 16,000,000 gallons per acre were filtered before the filter became clogged. During the year there were twenty periods when the interval between washings was less than ten days, and twelve periods when this interval was five days or less. It is quite evident that only a portion of the clogging matters is removed by reversing the flow, and that it is only a question of a short time before these matters will have accumulated to such an extent that little or no relief will be obtained by washing, and the filtering material will have to be removed and washed. In the last report attention was called to the very remarkable degree of purification accomplished by this filter, especially when the coarse nature and small depth of material and the high rate are taken into consideration. In 1913 the effluent was of even better quality than during the previous year, and during a considerable portion of the time compared favorably with effluents from the other slow sand filters. The average removal of turbidity by the filter was about 67 per cent., the removal of color was about 18 per cent., and the reduction in free and albuminoid ammonia was about 68 per cent. and 39 per cent., respectively. Bacterially, the work of the filter was even more satisfactory. The total removal of bacteria averaged over 96 per cent., and the removal of the bacteria of the body temperature types was about 90 per cent. Throughout the year in only two samples, one collected in February and one in October, was a count of more than 1,000 bacteria per cubic centimeter obtained, while about 92 per cent. of the samples contained less than 500 bacteria per cubic centimeter, and over 36 per cent. contained less than 100 per cubic centimeter.

Secondary Filter No. 286 was first put into operation on Jan. 20, 1906. This filter is $\frac{1}{20000}$ of an acre in area, and during 1913 contained about 29 inches in depth of sand of an effective size of about 0.21 millimeter. The effluent from upward-flow Filter No. 389 has been applied to this filter throughout the year at a rate of 5,000,000 gallons per acre daily. During the year the surface of this filter was scraped eight times to relieve clogging. From July 2, 1912, to Feb. 7, 1913, a period of one hundred and seventy-one working days, the filter was operated without surface treatment of any kind being necessary, and from March 8 to July 11 the filter was operated ninety-four days without scraping, the volume of water filtered during these two periods being about 875,000,000 gallons and 463,000,000 gallons per acre, respectively. During August and September, however, owing to growths of algæ on the surface, it was necessary to scrape the filter at an average interval of about once in seven days. As these filters are arranged, the effluent from roughing Filter No. 389 is collected in a storage tank and thence pumped to a supply tank, from which it flows to the secondary filter, certain portions of the primary effluent receiving twelve to eighteen hours' storage. During this process there is usually a considerable increase in the total bacterial content of the water before it reaches Filter No. 286, and, frequently, there is an increase in the body temperature counts. The resulting water as it reaches the secondary filter usually has a high bacterial content, but being well purified chemically and practically free from suspended matters is an exceedingly difficult water to purify bacterially. The average removal of bacteria by the secondary filter was about 86 per cent., but the final effluent contained slightly more bacteria than did the effluent from the roughing filter. On the basis of the removal of bacteria of the body temperature types and of B. coli, however, the secondary filter and the double filtration system were reasonably satisfactory.

The average chemical and bacterial results obtained by this system of double filtration are shown in the following tables: —

Average Chemical Analyses.

Merrimack River (Canal) Water applied to Experimental Filters.

[Parts per 100,000.]

Quantity applied. — Gallons per Acre Daily.	Temperature (Degrees F.).	Appearance.		Ammonia.			Chlorine.	Nitrogen as		Oxygen consumed.	Dissolved Oxygen (Per Cent. of Saturation).	Alkalinity.
		Turbidity.	Color.	Free.	Albuminoid. Total.	Albuminoid. In Solution.		Nitrates.	Nitrites.			
-	50	0.3	.23	.0151	.0227	.0169	.44	.019	.0004	.58	47.5	1.2

Effluent Slow Sand Filter No. 8A.

2,949,000	50	0.0	.15	.0038	.0103	-	.47	.035	.0000	.43	24.5	1.1

Average Chemical Analyses — Concluded.

Effluent Sand Filter No. 417.

[Parts per 100,000.]

Quantity applied. — Gallons per Acre Daily.	Temperature (Degrees F.).	Appearance.		Ammonia.			Chlorine.	Nitrogen as		Oxygen consumed.	Dissolved Oxygen (Per Cent. of Saturation).	Alkalinity.
		Turbidity.	Color.	Free.	Albuminoid. Total.	Albuminoid. In Solution.		Nitrates.	Nitrites.			
2,488,000	52	0.0	.16	.0062	.0102	–	.44	.030	.0002	.42	21.8	1.3
Effluent Sand Filter No. 419.												
9,680,000	51	0.6	.16	.0040	.0109	–	.44	.029	.0000	.43	28.1	1.1
Effluent Upward Flow Roughing Filter No. 389A.												
9,589,000	51	0.1	.19	.0064	.0139	–	.43	.029	.0003	.47	38.0	1.2
Effluent Secondary Filter No 286.												
4,780,000	53	0.0	.17	.0024	.0113	–	.43	.036	.0001	.43	43.9	1.3

Average Bacterial Analyses.

Effluent from Roughing Filter No. 389.

Bacteria per Cubic Centimeter.			Per Cent. of Bacteria removed.			Per Cent. of Samples containing B. Coli.
20° C.	40° C. Total.	40° C. Red.	20° C.	40° C. Total.	40° C. Red.	1 c. c.
235	26	14	96.4	89.2	92.2	71.5
Effluent from Filter No. 389 after Storage as applied to Filter No. 286.						
1,975	22	14	741.0[1]	15.4	0.0	61.4
Effluent from Secondary Filter No. 286.						
270	10	5	86.3	54.6	64.2	33.9

[1] Percentage increase during storage.

Refiltration of Lawrence City Water.

Filter No. 343A, $\frac{1}{20000}$ of an acre in area and first put into operation in March, 1908, is constructed of 33 inches in depth of sand of an effective size of 0.35 millimeter. In previous years this filter has been operated with river water as No. 343. From December 1 to June 30 the filter was out of operation. Beginning July 1 and continuing throughout the year, filtered water from the Lawrence city mains has been applied to the filter at a rate of 5,000,000 gallons per acre daily, primarily as a study of the removal of iron from water by slow sand filters operated at a reasonably high rate, and also as a continuation of the studies upon double filtration. No surface treatment of this filter has been required during the five months it has been in operation. The removal of iron has varied from about 30 per cent. to about 70 per cent. at different times, the average removal being about 48 per cent. The average removal of color by this filter was about 24 per cent. After the first month of operation the effluent from this filter seldom contained more than 10 bacteria per cubic centimeter, the average bacterial efficiency during the last four months being about 84 per cent., a very satisfactory result when the low numbers of bacteria in the city water applied to it are taken into consideration. There was a slight increase in the numbers of bacteria of body temperature types during two of these months, however, although the actual numbers of bacteria of these types were so very low that the computation of bacterial efficiency from them has little or no practical significance. It should be noted, however, that B. coli were not found in any sample of the effluent, although bacteria of this group were present in about one-fifth of the samples of the applied water.

The average analyses of the effluent from this filter are shown in the following tables: —

Effluent from Filter No. 343A.

[Parts per 100,000.]

1913.	Quantity applied. Gallons per Acre Daily.	Appearance.		Ammonia.		Chlorine.	Nitrogen as		Oxygen consumed.	Dissolved Oxygen (Per Cent. of Saturation).	Alkalinity.	Iron.
		Turbidity.	Color.	Free.	Albuminoid.		Nitrates.	Nitrites.				
July, . .	5,328,000	0.0	.13	.0028	.0080	.74	.019	.0000	.49	48.7	1.9	.0200
August, .	5,322,000	0.0	.15	.0010	.0064	.76	.034	.0000	.42	52.8	2.1	.0200
September, .	5,148,000	0.0	.12	.0032	.0088	.86	.039	.0000	.33	52.2	2.3	.0500
October, .	5,322,000	0.0	.12	.0014	.0054	.76	.033	.0000	.39	57.5	1.8	.0220
November, .	5,269,000	0.0	.13	.0016	.0088	.54	.043	.0000	.40	56.2	1.5	.0500
Average, .	5,277,800	0.0	.13	.0020	.0075	.73	.034	.0000	.41	53.5	1.9	.0324

Effluent from Filter No. 343A.

1913.	Bacteria per Cubic Centimeter.			Per Cent. of Samples containing B. Coli.
	20° C.	40° C.		
		Total.	Red.	1 c. c.
August,	4	3	0	0.0
September,	4	2	0	0.0
October,	8	3	0	0.0
November,	8	2	1	0.0
Average,	6	3	0	0.0

Bacterial Content of Sand in Water Filters at Different Depths.

The question has sometimes been asked as to what extent the bacterial content of the sand within a water filter was influenced by the character of the water applied, or by the rate at which the filter was operated. In a number of the earlier reports tables showing the numbers of bacteria in the sand collected at different depths of certain water filters have been presented and discussed. Most of these studies were made, however, before the tests for bacteria of the colon type and determinations of the numbers of bacteria of the body temperature types had been included in the routine methods for bacterial analysis of water. During the past year studies of the bacterial content of the sand at different depths in a number of different water filters have been made, and the results of one series of analyses from each of five different filters are shown in an accompanying table. All of these samples were collected at an interval of seven days or more after any disturbance of the surface by washing, scraping or raking in order that the results might be comparative so far as possible. Discussion of these results, and of the influence of the various factors which might influence them, will be deferred until further data have been obtained, these results being presented here only to indicate the variations which may possibly be produced by the different factors in the operation of these filters.

Table showing Bacterial Content of Sand at Different Depths in Filters operated with Different Waters.

Filter No. 417. — River Water applied.

A equals less than 1,000; B equals less than 100; C equals less than 50.

Depth.	Per Cent. of Moisture.	Bacteria per Gram of Dry Sand. 20° C.	40° C. Total.	40° C. Red.	Smallest Weight of Dry Sand in which Following Types were found (Grams). Ferment. Organism.	B. Coli.	Sewage Strepto.
Surface,	26.7	176,800	4,800	1,500	.0000733	.0000733	–[1]
1 inch,	17.0	96,000	9,000	120	.000830	.0830	.0083
6 inches,	8.1	6,500	1,000	55	.00919	.00919	.00919
12 inches,	7.8	6,500	1,200	C	.00922	.00922	.922
24 inches,	7.2	4,300	1,500	C	.0928	.0928	.0928
36 inches,	6.7	9,600	375	C	.933	–[1]	–[1]
48 inches,	6.8	5,400	500	C	.0932	.932	–[1]

Filter No. 419. — River Water applied.

Depth.	Per Cent. of Moisture.	20° C.	40° C. Total.	40° C. Red.	Ferment. Organism.	B. Coli.	Sewage Strepto.
Surface,	24.5	1,518,000	8,600	5,900	.0000755	.000755	.0000755
1 inch,	19.5	80,600	5,600	1,000	.000805	.000805	–[1]
6 inches,	14.0	32,500	2,000	600	.00860	.0086	–[1]
12 inches,	11.3	10,700	450	57	.000887	.0887	.0887
24 inches,	8.9	3,000	8,200	550	.0911	.911	–[1]
38 inches,	9.2	3,850	700	C	.00908	.0908	.0908

Filter No. 8A. — Disinfected River Water applied.

Depth.	Per Cent. of Moisture.	20° C.	40° C. Total.	40° C. Red.	Ferment. Organism.	B. Coli.	Sewage Strepto.
Surface,	21.5	44,500	47,000	A	.0000785	.00785	–[1]
1 inch,	17.9	9,200	5,000	B	.0821	.0821	.0821
6 inches,	9.6	4,100	2,200	C	.0904	.904	–[1]
12 inches,	9.3	2,400	3,900	C	.907	.907	.907
18 inches,	17.1	6,100	3,600	C	.829	–[1]	–[1]

[1] Not found in 1 gram of wet sand.

Table showing Bacterial Content of Sand at Different Depths in Filters operated with Different Waters — Concluded.

Filter No. 286. — Effluent from Roughing Filter No. 389 applied.

A equals less than 1,000; B equals less than 100; C equals less than 50.

Depth.	Per Cent. of Moisture.	Bacteria per Gram of Dry Sand.			Smallest Weight of Dry Sand in which Following Types were found (Grams).		
		20° C.	40° C.				
			Total.	Red.	Ferment. Organism.	B. Coli.	Sewage Strepto.
Surface,	25.6	201,000	5,400	135	.00744	.0744	.0744
1 inch,	18.3	24,400	4,300	610	.0817	.0817	.0817
6 inches,	11.0	51,500	2,000	110	.0890	.0890	.0890
12 inches,	9.6	6,100	1,330	110	.0904	.0904	.904
24 inches,	8.0	3,400	2,725	550	.0920	.0920	.0920

Filter No. 343. — Lawrence City Water applied.

Depth.	Per Cent. of Moisture.	20° C.	40° C. Total.	40° C. Red.	Ferment. Organism.	B. Coli.	Sewage Strepto.
Surface,	8.6	25,100	4,600	3,900	.0914	.0914	.914
1 inch,	6.2	35,300	3,000	3,000	.0938	–[1]	–[1]
6 inches,	6.6	3,000	3,700	3,700	.934	–[1]	–[1]
12 inches,	7.4	3,500	22,100	20,000	.0926	.0926	–[1]
26 inches,	5.4	3,700	5,700	3,000	.946	–[1]	–[1]

[1] Not found in 1 gram of wet sand.

EFFECT OF SEWAGE DISPOSAL.

THE EFFECT OF SEWAGE DISPOSAL.

The cities and towns in this State having works for the purification of a part or all of their sewage are 32 in number and contain an aggregate population, according to the census of 1910, of about 450,000, — about 13 per cent. of the total population of the State. Various methods of preliminary treatment of the sewage are employed at these works, but the method of final purification is in each case by intermittent filtration through sand or gravel, and soil of this character well suited for the purpose is found commonly in nearly all parts of this State.

Samples of sewage, settled sewage and effluent have been collected from most of the works as often as once a month for chemical examination, the results of which are summarized in the following tables. In the cases of the smaller towns, such as Billerica, Lenox, Maynard and North Brookfield, no information of special interest has been obtained and no data concerning the works in these towns are given in the tables.

All of the sewage-disposal works have been examined frequently during the year by the engineers of the Board, the efficiency of their operation observed, and recommendations have been made as to the maintenance and operation of the works with a view to securing more satisfactory results.

Several of the disposal works of the State, on account of the increase in the quantity of sewage or from other causes, are of insufficient capacity for the treatment of all of the sewage discharged upon them at all times, and satisfactory results in the treatment of the sewage at these works cannot be effected until they have been materially enlarged. In other cases the chief cause of inefficient operation of sewage-disposal works is lack of proper care in the maintenance of the filters, due commonly to the lack of sufficient funds for the purpose. Mechanical devices must receive proper attention if they are to be maintained in use, and no disposal works can long be maintained in successful operation without adequate care. Moreover, nothing is saved in the end by inadequate attention to filters and other sewage-disposal works, since the cost of restoring such works to proper operation is usually great after a period of neglect. Negligence in maintenance may also lead to damage suits, as has been the case in a number of instances.

Special observations covering several hours' duration have been made during the year of the rate of flow and of the character of sewage at many of the places, and the results of the measurements are given in Table No. 8. These examinations indicate that even in dry weather a considerable quantity of ground water enters the sewers in many places.

A considerable amount of work has been done during the year at Andover in reconstructing the underdrainage system and at Framingham in adding new underdrains. New works are under construction in Franklin, and plans are being prepared to abandon the works at Longmeadow and to discharge the sewage into the Connecticut River. An additional area of sand filters of three acres was constructed during the year at Norwood, but the new beds were not in operation at the end of the year. The sewerage system and the sewage-disposal works at Attleborough were put in operation during the summer, but only nine beds were used and no effluent was collected in the underdrainage system until the end of the year.

The trickling filter at Brockton was put into operation early in the fall, but it had not been in operation a sufficient length of time at the end of the year to furnish efficient results. The revolving screen through which the sewage is passed has given considerable trouble during the year, the sewage having a bad effect on the material of which the screen is constructed, and the operation of the trickling filter was interrupted on two or three occasions on account of the poor preliminary treatment of the sewage. The trickling filter has an area of one-half an acre and is constructed of stone varying between 1½ and 3 inches in size 6 feet deep. The rate of operation at the end of the year was about 1,600,000 gallons per acre per day. The effluent of this filter is passed through a tank which affords an average period of sedimentation of about four and one-half hours, whence it is passed on to sand filters set apart from the sand filtration area for this purpose. The rate of operation of these sand filters was approximately 400,000 gallons per acre per day at the end of the year. The results of the operation of this plant, while given in the following tables, should not be used in comparison with the other results owing to the fact that the filter was in operation simply during the fall at a time when the highest efficiency in the purification of sewage cannot be expected.

Considerable progress has been made during the year on works consisting of five preliminary settling tanks with separate compartments for the digestion of sludge, three acres of trickling filters of crushed stone, 1 to 3 inches in size and 10 feet deep, and four secondary settling tanks for the treatment of the sewage of the city of Fitchburg.

TABLE No. 1. — *Average Results of the Analyses of Samples of Sewage as received at the Disposal Works.*

[Parts in 100,000.]

City or Town.	Residue on Evaporation.						Ammonia.				Chlorine.	Oxygen consumed.		Iron.		Kjeldahl Nitrogen.
	Total residue.			Loss on ignition.				Albuminoid.								
	Total.	Dissolved.	Suspended.	Total.	Dissolved.	Suspended.	Free.	Total.	Dissolved.	Suspended.		Unfiltered.	Filtered.	Unfiltered.	Filtered.	
Amherst,	47.77	39.70	8.07	16.21	10.43	5.78	2.94	.47	.27	.20	13.80	3.70	3.11	.080	.050	.99
Andover,	102.63	46.27	56.36	59.03	18.20	40.83	5.65	1.88	.85	1.03	9.68	11.79	5.86	.592	.132	3.42
Attleborough[1]	42.27	32.60	9.67	19.87	11.60	8.27	3.90	.56	.26	.30	5.93	4.40	2.36	.315	.097	1.11
Brockton,	106.58	56.53	50.05	67.44	22.47	44.97	5.63	1.64	.65	.99	11.98	13.71	9.50	.359	.131	3.03
Clinton,	77.50	49.13	28.37	44.38	21.25	23.13	4.38	1.21	.67	.54	6.45	9.24	6.25	.200	.090	2.27
Concord,	37.60	28.42	9.18	18.72	11.66	7.06	2.03	.48	.27	.21	4.86	4.24	3.18	–	–	1.11
Framingham,	98.57	63.56	35.01	53.33	24.79	28.54	4.54	1.46	.78	.68	10.57	12.32	7.68	.360	.154	2.90
Gardner (Gardner area),	93.92	44.98	48.94	57.90	20.30	37.60	6.05	1.95	.92	1.03	7.48	12.41	7.02	.272	.077	3.72
Gardner (Templeton area),	78.46	47.99	30.47	43.62	17.86	25.76	7.21	1.63	.94	.69	11.32	9.34	6.18	.186	.077	3.23
Hopedale,	65.53	41.83	23.70	37.41	18.28	19.13	6.51	1.32	.72	.60	8.00	8.68	6.03	–	–	2.66
Hudson,	199.35	158.01	41.34	62.00	31.91	30.09	5.64	2.35	1.23	1.12	63.95	14.57	9.35	.246	.066	4.16
Leicester,	63.30	40.90	22.40	34.56	17.50	17.06	3.51	.88	.50	.38	5.64	8.16	5.93	.205	.074	1.81
Marion,	20.91	16.80	4.11	8.22	5.89	2.33	1.09	.26	.15	.11	3.19	1.83	1.40	.121	.057	.62
Marlborough,	90.40	57.74	32.66	47.09	19.79	27.30	7.04	1.57	.75	.82	13.81	10.03	6.32	.253	.101	3.12
Milford,	64.03	46.45	17.58	31.19	16.25	14.94	3.92	.95	.54	.41	10.60	7.10	4.89	.163	.073	2.02
Natick,	56.50	45.12	11.38	23.94	15.10	8.84	3.35	.63	.35	.28	8.93	5.23	3.77	.228	.086	1.38
North Attleborough,	30.63	20.53	10.10	14.23	6.80	7.43	.92	.47	.19	.28	3.94	2.04	1.07	.130	.060	1.01
Northbridge,	48.08	29.53	18.55	25.77	13.03	12.74	3.45	.81	.40	.41	5.37	5.57	4.06	–	–	1.65
Norwood,	154.09	104.66	49.43	58.65	22.63	36.02	4.49	1.42	.47	.95	34.83	14.85	8.79	.675	.267	2.88
Pittsfield,	41.64	32.60	9.04	16.95	11.16	5.79	1.97	.46	.25	.21	4.55	3.84	2.67	.258	.099	1.00
Southbridge,	66.83	40.13	26.70	39.54	16.45	23.09	5.51	1.31	.74	.57	7.75	9.03	5.73	.195	.081	2.59
Spencer,	44.07	31.71	12.36	23.08	13.08	10.00	3.77	.82	.47	.35	5.46	5.60	3.71	.156	.069	1.75
Stockbridge,	28.57	23.80	4.77	12.22	8.52	3.70	1.40	.32	.18	.14	2.13	2.72	2.01	–	–	.69
Westborough,	42.60	27.77	14.83	23.65	12.12	11.53	2.96	.82	.44	.38	4.96	5.35	3.81	.141	.059	1.61
Worcester (day),	100.00	69.36	30.64	39.62	17.12	22.50	3.45	1.23	.44	.79	13.86	11.05	5.49	3.520	.960	2.66
Worcester (night),	85.09	56.71	28.38	33.75	16.27	17.48	2.02	.78	.26	.52	7.81	9.14	4.64	6.500	2.310	1.83

[1] September, October and November only.

TABLE NO. 2. — *Average Results of Analyses of Samples of Sewage as applied to Filter Beds.*

[Parts in 100,000.]

City or Town.	Residue on Evaporation. Total Residue. Total.	Total Residue. Dissolved.	Total Residue. Suspended.	Loss on Ignition. Total.	Loss on Ignition. Dissolved.	Loss on Ignition. Suspended.	Ammonia. Free.	Albuminoid. Total.	Albuminoid. Dissolved.	Albuminoid. Suspended.	Chlorine.	Oxygen Consumed. Unfiltered.	Oxygen Consumed. Filtered.	Iron. Unfiltered.	Iron. Filtered.	Kjeldahl Nitrogen.
Amherst (settled),	45.96	38.05	7.91	16.70	12.03	4.67	1.90	.50	.27	.23	11.99	3.65	2.64	.160	.033	1.02
Andover (settled),	53.42	43.12	10.30	24.52	16.78	7.74	5.20	.83	.54	.29	9.50	6.31	4.90	.202	.083	1.70
Attleborough,[1]	42.27	32.60	9.67	19.87	11.60	8.27	3.90	.56	.26	.30	5.93	4.40	2.36	.315	.097	1.11
Brockton (screened),	75.69	53.39	22.30	37.95	18.85	19.10	5.80	1.24	.60	.64	11.71	12.28	9.04	.210	.100	2.26
Brockton, (trickling filter effluent),[2]	59.13	–	–	–	–	–	6.92	.93	–	–	12.58	5.93	–	.140	–	–
Brockton (outlet of secondary settling basin),[2]	50.67	46.33	4.34	17.33	13.80	3.53	5.99	.62	.44	.18	11.18	4.63	3.69	.134	.123	–
Clinton (settled),	45.67	40.13	5.54	20.25	16.00	4.25	3.47	.59	.40	.19	5.42	4.88	4.23	.140	.100	1.20
Concord,	37.60	28.42	9.18	18.72	11.66	7.06	2.03	.48	.27	.21	4.86	4.24	3.18	–	–	1.11
Framingham,	98.57	63.56	35.01	53.33	24.79	28.54	4.54	1.46	.78	.68	10.57	12.32	7.68	.360	.154	2.90
Gardner (Gardner area),	93.92	44.98	48.94	57.90	20.30	37.60	6.05	1.95	.92	1.03	7.48	12.41	7.02	.272	.077	3.72
Gardner (Templeton area) (settled),	43.81	34.77	9.04	19.08	12.10	6.98	4.42	.76	.48	.28	7.67	4.63	3.51	.130	.081	1.52
Hopedale (settled),	37.88	31.67	6.21	17.10	12.07	5.03	4.93	.63	.41	.22	6.55	4.07	2.98	.170	.090	1.22
Hudson (settled),	106.58	84.26	22.32	31.51	16.14	15.37	4.73	.98	.47	.51	29.43	6.67	3.93	.222	.051	1.94[3]
Leicester (settled),	51.80	38.09	13.71	28.40	16.23	12.17	4.37	.67	.41	.26	6.02	5.91	4.30	.143	.076	1.34
Marion,	20.91	16.80	4.11	8.22	5.89	2.33	1.09	.26	.15	.11	3.19	1.83	1.40	.121	.057	.62
Marlborough (settled),	54.05	43.90	10.15	21.35	14.31	7.04	5.46	.76	.45	.31	9.74	5.29	4.09	.183	.106	1.52
Milford (settled)	48.63	42.94	5.69	17.69	13.59	4.10	3.74	.58	.37	.21	10.68	4.20	3.40	.105	.066	1.18
Natick,	56.50	45.12	11.38	23.94	15.10	8.84	3.35	.63	.35	.28	8.93	5.23	3.77	.228	.086	1.38
North Attleborough (settled),	21.80	19.85	1.95	6.20	4.60	1.60	.64	.16	.09	.07	4.80	1.15	.78	.080	.060	.35
Northbridge (settled),	32.98	26.57	6.41	16.05	11.47	4.58	3.37	.54	.33	.21	5.27	3.66	2.96	–	–	1.11
Norwood (settled),	113.08	96.64	16.44	32.28	20.55	11.73	3.64	.70	.32	.38	32.38	10.18	8.03	.475	.204	1.37
Pittsfield,	41.64	32.60	9.04	16.95	11.16	5.79	1.97	.46	.25	.21	4.55	3.84	2.67	.258	.099	1.00
Southbridge (settled),	32.98	29.63	3.35	13.09	10.65	2.44	2.95	.45	.31	.14	6.34	3.11	2.57	.107	.072	.92
Spencer,	44.07	31.71	12.36	23.08	13.08	10.00	3.77	.82	.47	.35	5.46	5.60	3.71	.156	.069	1.75
Stockbridge,	28.57	23.80	4.77	12.22	8.52	3.70	1.40	.32	.18	.14	2.13	2.72	2.01	–	–	.69
Westborough,	42.60	27.77	14.83	23.65	12.12	11.53	2.96	.82	.44	.38	4.96	5.35	3.81	.141	.059	1.61
Worcester (day),	100.00	69.36	30.64	39.62	17.12	22.50	3.45	1.23	.44	.79	13.86	11.05	5.49	3 520	.960	2.66

[1] September, October and November only. [2] October and 2 in November. [3] Fats, 3.90.

TABLE No. 3. — *Efficiency of Settling Tanks and Other Forms of Preliminary Treatment as indicated by the Foregoing Tables of Analyses (arranged in Order of Per Cent. Removal of Albuminoid Ammonia).*

[Parts in 100,000.]

City or Town.	Suspended Solids.			Total Albuminoid Ammonia.			Oxygen consumed.			Chlorine.		Approximate Period of Sedimentation (Hours).	Frequency of cleaning Tanks.
	Raw Sewage.	Settled Sewage.	Per Cent. removed.	Raw Sewage.	Settled Sewage.	Per Cent. removed.	Raw Sewage.	Settled Sewage.	Per Cent. removed.	Raw Sewage.	Settled Sewage.		
North Attleborough,	10.10	1.95	81	.47	.16	66	2.04	1.15	44	3.94	4.80	–	Yearly.
Southbridge,	26 70	3.35	87	1.31	.45	66	9 03	3 11	66	7.75	6.34	3–7	Monthly, except in winter.
Hudson,	41.34	22.32	46	2 35	.98	58	14.57	6.67	54	63.95	29.43	17–30	Yearly.
Andover,	56.36	10.30	82	1.88	.83	56	11.79	6.31	46	9.68	9.50	½–1¼	Once in two weeks.
Gardner (Templeton),	30.47	9.04	70	1.63	.76	53	9.34	4 63	50	11.32	7.67	6–8	Monthly, except in winter.
Marlborough,	32.66	10.15	69	1.57	.76	52	10.03	5 29	47	13.81	9.74	–[1]	Once in three weeks.
Hopedale,	23.70	6.21	74	1.32	.63	52	8.68	4.07	53	8.00	6.55	–	Yearly.
Clinton,	28 37	5 54	80	1.21	.59	51	9 24	4.88	47	6 45	5.42	2½–4	Weekly, except in winter.
Norwood,	49 43	16 44	67	1.42	.70	51	14.85	10 18	31	34.83	32.38	2¼–3½	Five times a year.
Milford,	17.58	5.69	68	.95	.58	39	7.10	4.20	41	10.60	10.68	3–4¼	Three times a year.
Worcester,[2]	28.38	6.57	77	.78	.49	37	9.44	4.79	49	7.81	8.41	7	Once in two weeks to once in six weeks.
Northbridge,	18.55	6.41	65	.81	.54	33	5 57	3 66	34	5.37	5.27	1½–3	Monthly.
Brockton: —													
Settling tank for trickling filter effluent,[3]	–	–	–	.93	.62	33	5.93	4.63	22	12.58	11.18	4½	– – –
Trickling filter,[3]	–	–	–	1.28	.93	27	12.30	5.93	52	15.08	12 58	–	– – –
Revolving screen,	50.05	22.30	55	1.64	1 24	24	13.71	12.28	10	11.98	11.71	–	– – –
Leicester,	22 40	13.71	39	.88	.67	24	8.16	5.91	28	5.64	6.02	–	Once in two weeks in summer; monthly in winter.
Amherst,	8.07	7.91	2	.47	.50	–	3.70	3.65	1	13.80	11.99	–[4]	Once in three or four weeks in summer.

[1] Usually many hours.

[2] Chemical precipitation. Amount treated, 14,000,000 gallons daily.

[3] Three samples October and November. Filter started in October. Amount treated, about 1,600,000 gallons per acre per day.

[4] Very short period.

TABLE No. 4. — *Character of Sewage.*

City or Town.	Constituents of Sewage other than of Domestic Origin.
Amherst,	Small quantity of dye wastes from straw hat shops. Considerable ground water.
Andover,	Little or no manufacturing waste.
Attleborough,	Little or no manufacturing waste.
Brockton,	Considerable quantity of shoe shop wastes.
Clinton,	Small quantity of wool-scouring and cotton mill wastes.
Concord,	No manufacturing wastes.
Framingham,	Wastes from a factory in which leatherboard is manufactured and from one in which paper is colored, gummed, etc. Small quantity of hat shop wastes.
Gardner,	Very little if any manufacturing wastes. Ground water at times.
Hopedale,	No manufacturing waste.
Hudson,	Wastes from a tannery and factory in which rubber is handled. Also shoe shop wastes.
Leicester,	Considerable ground water.
Marion,	Considerable ground water.
Marlborough,	Shoe shop wastes and small quantity of dyehouse wastes.
Milford,	Shoe shop wastes and small quantity from straw shop and from a factory in which rubber is handled.
Natick,	Shoe shop wastes and considerable ground water.
North Attleborough,	Considerable ground water.
Northbridge,	Little or no manufacturing wastes.
Norwood,	Tannery wastes and bindery wastes.
Pittsfield,	Woolen mill wastes.
Southbridge,	Small amount of wastes from optical works. Roof water.
Spencer,	Shoe shop wastes.
Stockbridge,	Considerable ground water.
Westborough,	Wastes from a hat shop and small amount from a tannery. Considerable ground water in wet weather.
Worcester,	Acid wastes from wire works. Dye wastes. Wastes from tanneries and woolen mills.

TABLE NO. 5. — *Average Results of the Analyses of Samples of Effluent from Filters (arranged in Order of Amount of Albuminoid Ammonia).*

[Parts in 100,000.]

City or Town.	Total Residue on Evaporation.	Ammonia.		Chlorine.	Nitrogen as		Oxygen consumed.	Iron.
		Free.	Total Albuminoid.		Nitrates.	Nitrites.		
North Attleborough,	18.30	.04	.0111	3.18	.6266	.0031	.21	.005
Concord,	25.87	.19	.0137	4.27	.9240	.0207	.21	.008
Marlborough,[1]	43.12	.26	.0252	7.67	2.1528	.0039	.37	.009
Milford,	40.41	.38	.0292	9.02	1.3917	.0067	.43	.037
Clinton,[1]	34.39	.18	.0367	5.07	1.3892	.0044	.52	.078
Marion,	15.44	.29	.0377	3.08	.3042	.0075	.54	.225
Spencer,	25.28	.71	.0381	5.07	.5370	.0036	.52	.277
Stockbridge,[1]	23.19	.25	.0405	2.78	.2274	.0030	.47	.110
Northbridge,	22.73	.31	.0488	4.03	1.0433	.0168	.54	.028
Amherst,	27.70	.98	.0494	10.08	.1078	.0081	.66	.602
Westborough,[1]	29.85	.26	.0509	4.90	1.3336	.0216	.54	.037
Pittsfield,[1]	33.45	.25	.0518	4.58	.8550	.0101	.54	.021
Framingham,[1]	38.64	1.80	.0624	8.68	.2023	.0061	1.00	2.042
Norwood,	76.57	.96	.0639	28.45	.3105	.0707	1.07	1.038
Natick,	34.36	1.13	.0642	7.08	.5463	.0155	.68	.584
Gardner (Gardner area),	41.71	1.36	.0673	6.51	2.1463	.0100	.70	.065
Southbridge,[1]	28.16	1.89	.0725	6.40	.0790	.0078	.96	1.937
Hudson,	92.50	.72	.0770	34.13	1.0267	.0196	.65	.214
Hopedale,	29.79	1.39	.0965	5.34	1.1617	.0069	.78	.084
Worcester,	62.36	2.16	.1143	13.02	.2130	.0181	1.92	2.060
Andover,[1]	29.84	2.15	.1363	7.25	.2169	.0134	1.20	.638
Brockton,[1]	44.29	3.32	.1381	12.10	.1146	.0114	1.87	2.668
Leicester,	27.91	1.05	.1411	5.44	.1786	.0252	1.53	.502
Gardner (Templeton area),[1]	35.72	1.96	.1674	7.74	.8015	.0250	1.33	.077
Brockton (effluent of secondary sand filters),	44.05	2.39	.1695	10.52	.3450	.0135	1.62	.245[2]

[1] Samples from two or more underdrains combined in one average.
[2] Two in October and two in November only.

TABLE NO. 6. — *Efficiency of Sand Filters (arranged in Order of Per Cent. Removal of Albuminoid Ammonia).*

[Parts in 100,000.]

City or Town.	Free Ammonia.			Total Albuminoid Ammonia.			Oxygen consumed.		
	Applied Sewage.	Effluent.	Per Cent. removed.	Applied Sewage.	Effluent.	Per Cent. removed.	Applied Sewage.	Effluent.	Per Cent. removed.
Marlborough,	5.46	.26	95	.76	.0252	97	5.29	.37	93
Concord,	2.03	.19	91	.46	.0137	97	4.24	.21	95
Gardner (Gardner area),	6.05	1.36	78	1.95	.0673	97	12.41	.70	94
Framingham,	4.54	1.80	60	1.46	.0624	96	12.32	1.00	92
Milford,	3.74	.38	90	.58	.0292	95	4.20	.43	90
Spencer,	3.77	.71	81	.82	.0381	95	5.60	.52	91
Westborough,	2.96	.26	91	.82	.0509	94	5.35	.54	90
Clinton,	3.47	.18	47	.59	.0367	94	4.88	.52	89
North Attleborough,	.64	.04	94	.16	.0111	93	1.15	.21	82
Hudson,	4.73	.72	85	.98	.0770	92	6.67	.65	90
Northbridge,	3.32	.30	91	.54	.0488	91	3.66	.54	85
Norwood,	3.64	.96	74	.70	.0639	91	10.18	1.07	90
Worcester,	3.45	2.16	37	1.23	.1143	91	11.05	1.92	83
Amherst,	1.90	.98	48	.50	.0494	90	3.65	.66	82
Natick,	3.35	1.13	66	.63	.0642	90	5.23	.68	87
Pittsfield,	1.97	.25	87	.46	.0518	89	3.84	.54	86
Brockton,	5.80	3.32	43	1.24	.1381	89	12.28	1.87	85
Stockbridge,	1.40	.25	82	.32	.0405	89	2.72	.47	83
Marion,	1.09	.29	74	.26	.0377	86	1.83	.54	70
Hopedale,	4.93	1.39	72	.63	.0965	85	4.07	.78	81
Andover,	5.20	2.15	59	.83	.1363	84	6.31	1.20	81
Southbridge,	2.95	1.89	36	.45	.0725	84	3.11	.96	69
Leicester,	4.37	1.05	76	.67	.1411	79	5.91	1.53	74
Gardner (Templeton area),	4.42	1.96	56	.76	.1674	78	4.63	1.33	71

TABLE No. 7. — *Filter Effluents arranged according to the Amount of Nitrates in the Effluent.*

[Parts in 100,000.]

City or Town.	Nitrogen as		Iron in Effluent.	Total Albuminoid Ammonia in Applied Sewage.
	Nitrates in Effluent.	Nitrites in Effluent.		
Marlborough,	2.1528	.0039	.009	.76
Gardner (Gardner area),	2.1463	.0100	.065	1.95
Milford,	1.3917	.0067	.037	.58
Clinton,	1.3892	.0044	.078	.59
Westborough,	1.3336	.0216	.037	.82
Hopedale,	1.1617	.0069	.084	.63
Northbridge,	1.0433	.0168	.028	.54
Hudson,	1.0267	.0196	.214	.98
Concord,	.9240	.0207	.008	.48
Pittsfield,	.8550	.0101	.021	.46
Gardner (Templeton area),	.8015	.0250	.077	.76
North Attleborough,	.6266	.0031	.005	.16
Natick,	.5463	.0155	.584	.63
Spencer,	.5370	.0036	.277	.82
Norwood,	.3105	.0707	1.038	.70
Marion,	.3042	.0075	.225	.26
Stockbridge,	.2274	.0030	.110	.32
Andover,	.2169	.0134	.638	.83
Worcester,	.2130	.0181	2.060	1.23
Framingham,	.2023	.0061	2.042	1.46
Leicester,	.1786	.0252	.502	.67
Brockton,	.1146	.0114	2.668	1.24
Amherst,	.1078	.0081	.602	.50
Southbridge,	.0790	.0078	1.937	.45

TABLE NO. 8. — *Rate of Discharge of Sewage at Disposal Works.*

City or Town.	Special Measurements. Date.	Duration of Measurement (Hours).	Average (Gallons per Twenty-four Hours).	Maximum (Gallons per Twenty-four Hours).	Minimum (Gallons per Twenty-four Hours).	Method of Measurement.
Amherst,	June 30–July 1,	24	238,000	275,000	200,000	Weir.
Andover,	June 11,	10	240,000	445,000	125,000	Weir.
	Sept. 25,	8	180,000	–	–	Weir.
	Nov. 13,	4	234,000	254,000	223,000	Weir.
Attleborough,	Sept. 5, 10 A.M.,	–	190,000	–	–	Weir.
	Nov. 10, 2 P.M.,	–	370,000	–	–	Weir.
Gardner: —						
Gardner area,	Aug. 6, 10.30 A.M.,	–	250,000	–	–	Weir,
Templeton area,	Aug. 5–6,	24	385,000	595,000	195,000	Weir.
Hopedale,	Sept. 16,	10	110,000	–	–	Rise and fall in pump well.
Hudson,	July 15–16,	25	230,000	325,000	130,000	Discharge of dosing tank.
Leicester,	July 23–24,	24	24,000	43,000	11,000	Weir.
Marion,	Jan. 31,	–	120,000	–	–	Amount pumped.
Marlborough,	July 21,	12	520,000	645,000	390,000	Weir.
North Attleborough,	Sept. 23,	8	640,000	710,000	605,000	Weir.
Northbridge,	Aug. 20,	9	200,000	–	–	Weir.
Norwood,	Aug. 27–28,	24	210,000	390,000	62,000	Kutter's formula.
Pittsfield,	Sept. 9–10,	24	2,740,000	–	–	–[1] –
Southbridge,	May 28, 1–3 P.M.,	–	790,000	–	–	Rise in tank.
	July 2–3,	24	369,000	554,000	220,000	Weir.
Spencer,	Aug. 20–21,	24	195,000	280,000	115,000	Weir.
Westborough,	July 14–15,	24	170,000	325,000	120,000	Kutter's formula.

[1] Amount pumped and amount flowing into river by Kutter's formula.

TABLE No. 9. — *Extent of Works and Rate of Operation.*

City or Town.	Population, Census of 1910.	Length of Sanitary Sewers (Miles).	Estimated Average Quantity Treated (Gallons per Day).	Number of Intermittent Sand Filters, not including Sludge Beds.	Net Filtration Area (Acres).	Estimated Average Rate of Operation with even Distribution (Gallons per Acre per Day).
Amherst,	5,112	7.3	375,000	6	2.00	188,000
Andover,	7,301	11.4	350,000	20	3.65	96,000
Attleborough,	16,215	30.2	250,000	26	15.50	16,000
Brockton,	56,878	71.8	2,175,000[1]	37	37.00	59,000
Clinton,	13,075	19.7	1,090,000[2]	27	26.23	42,000
Concord,	6,421	8.3	422,000[2]	4	3.30	128,000
Framingham,	12,918	20.9	700,000[2]	20	20.75	34,000
Gardner: —						
Gardner area,	14,699	26.3	135,000	20	2.50	54,000
Templeton area,			600,000	26	10.00	60,000
Hopedale,	2,188	4.8	150,000[2]	7	3.25	46,000
Hudson,	6,743	8.5	276,000	23	9.00	31,000
Leicester,	3,237	2.6	70,000	8	.36	194,000
Marion,	1,460	–	110,000[2]	8	.66	167,000
Marlborough,	14,579	26.0	750,000	33	20.90	36,000
Milford,	13,055	17.1	513,000	15	9.30	55,000
Natick,	9,866	14.8	720,000[2]	14	12.60	57,000
North Attleborough,	9,562	16.1	600,000	16	7.00	86,000
Northbridge,	8,807	11.4	244,000	24	6.00	41,000
Norwood,	8,014	13.0	500,000	6	6.64[3]	75,000
Pittsfield,	32,121	–	1,903,000[2]	35[4]	25.90	74,000
Southbridge,	12,592	13.3	900,000	11	8.50	106,000
Spencer,	6,740	11.0	450,000	12	9.30	48,000
Westborough,	5,446	9.5	425,000	12	5.80	73,000
Worcester,	145,986	168.1[5]	3,860,000[6]	75	74.30	52,000

[1] Amount pumped to filters. About 800,000 gallons daily treated by the half acre trickling filter, sedimentation and subsequent filtration through sand during October and November.

[2] Amount pumped.

[3] Three acres of filters under construction.

[4] Includes sludge beds.

[5] Includes 68.7 miles for sewage and surface water.

[6] Amount treated by sand filters only.

TABLE NO. 10. — *General Features.*

CITY OR TOWN.	Year of Construction of and Additions to Works.	Depth of Underdrains (Feet).	Distance Apart of Underdrains (Feet).	Filtering Material.	Attention given to Disposal Works.
Amherst,	1911	4-4.5	25	Rather fine sand; found in place,	Very little attention.
Andover,	1898	4	20	Fair sand, small quantity of gravel; practically all handled in construction.	One man greater part of time.
Attleborough,	1912, 1913	4-7	35	Excellent sand and gravel; found in place,	One man all the time; others when necessary.
Brockton,	1893, 1905 1908, 1912	5.5	30	Good sand and gravel; found in place,	Four men all the time; large force when necessary.
Clinton,	1898, 1899	8	60-70	Good sand and gravel; found in place,	Two men all the time; others when necessary.
Concord,	1899	none	-	Good sand underlaid with gravel; found in place,	One man once a day.
Framingham,	1890	-[1]	-	Surface material badly impregnated with organic matter; good underlying sand. Beds prepared by removal of trees and stumps and leveling where necessary.	Three or more men in summer; only one once a day in winter.
Gardner (Gardner area),	1891	5	20	Good sand; handled in construction,	One man all the time.
Gardner (Templeton area),	1901, 1909	3-4	20-30	Coarse sand; handled in construction,	One man all the time; more when necessary.
Hopedale,	1900	4	35-60	Some good sand, some rather fine sand, some ledge; material found in place.	One man once a day.
Hudson,	1904, 1910	5-6	50-100	Good sand and gravel; found in place,	One man all the time; others when necessary.
Leicester,	1894	4	8	Hard, compact sand; found in place,	Very little attention.
Marion,	1906	5	-	Mostly good sand; pockets of fine sand and some ledge; largely found in place.	One man every day in summer; every other day in winter.
Marlborough,	1891, 1908, 1909, 1910, 1911	4.5-6	30-50	Rather fine sand; found in place,	One man all the time; others when necessary.
Milford,	1907	5	40	Rather fine sand; found in place,	One man every day; others when necessary.
Natick,	1896	6	36	Sand of good quality but strata of very fine sand in places; found in place.	One man all the time; others when necessary.
North Attleborough,	1909, 1910	-	-	Very coarse sand and gravel,	One man every day; others when necessary.
Northbridge,	1906, 1907	4	50-75	Coarse sand and gravel; found in place,	One man all the time; others when necessary.
Norwood,	1909	4-6	40	Good sand and gravel; found in place,	One man every day; others when necessary.
Pittsfield,	1901	4	35	Good sand and gravel; found in place,	Two men all the time; others when necessary.
Southbridge,	1908	4	40	Fair sand and gravel; considerable quantity handled, some found in place.	One man once a day.
Spencer,	1897	-[2]	-	Good sand and gravel; largely found in place,	One man all the time; others when necessary.
Stockbridge,	1899	3-4.5	23	Sand filters, good quality sand,	One man greater part of time.
		3-4.5	30	Irrigation area, rather fine sand,	
Westborough,	1892, 1911	5	30-40	Good sand and gravel; handled during construction,	One man all the time; others when necessary.
Worcester,	1898[3]	4-6	35-50	Good sand and gravel; largely found in place,	Several men all the time; a large force when necessary.

[1] Very little underdrainage. One line extends through certain of the beds 4 to 6 feet deep; 40 feet apart in one bed.
[2] Only three beds underdrained.
[3] Year of first construction of sand filters. Many additions.

FOOD AND DRUG INSPECTION.

FOOD AND DRUG INSPECTION.

The report of the chief analyst presents in detail the work of this department for the year ended Nov. 30, 1913. The following personnel comprised the laboratory force: —

Hermann C. Lythgoe,	*Chief Analyst.*
Charles H. Hickey,	*First Asst. Analyst.*
Lewis I. Nurenberg,	*Second Asst. Analyst.*
Clarence E. Marsh,	*Third Asst. Analyst.*
Horace F. Davis,[1]	*Inspector.*
Daniel E. McCarthy,	*Inspector.*
Frederick L. Marion,	*Inspector.*
Maurice P. Crowe,	*Inspector.*
Patrick T. McDonough,	*Inspector.*

The number of samples examined during this period, together with a summary of work done since the passage of the law in 1882, follows: —

Food and Drug Inspection (1882–1913).

Summary.	Years.	
	1913.	Total, 1882-1913.
Number of samples of milk examined,	6,702	127,296
Number of samples above standard,	5,020	84,851
Number of samples below standard,	1,682	42,445
Number of samples of other kinds of food examined (not milk),	1,632	70,593
Number of samples of good quality,	1,351	57,491
Number of samples adulterated, as defined by the statutes,	281	13,102
Number of samples of drugs examined,	1,393	25,163
Number of samples of good quality,	1,189	17,242
Number of samples adulterated, as defined by the statutes,	204	7,921
Total examination of food and drugs,	9,727	223,052
Total samples of good quality,	7,560	159,584
Total samples not conforming to the statutes,	2,167	63,468

Section 7 of chapter 75 of the Revised Laws provides that the State Board of Health "shall annually report to the general court the number of prosecutions made under the provisions of sections sixteen to twenty-seven, inclusive, and an itemized account of the money expended in carrying out the provisions thereof;" and in accordance with this provision the following report is made.

The total number of prosecutions entered during the fiscal year ended Nov. 30, 1913, was 161. Of these, 116 resulted in conviction, 2 were dismissed by order of the court, 1 dismissed for lack of jurisdiction and 1 nol prossed. There are 28 cases pending on appeal to the Superior Court.

The amount paid in fines was $2,922.75, which brings the sum total to $93,882.39.

[1] H. F. Davis retired March 31, 1913. From April 1 to August 31, the position was filled by F. J. Harrington, and on September 1 P. T. McDonough was appointed permanently.

Prosecutions.

The following table presents the statistics relative to the prosecutions which have been conducted under the food and drug acts since the beginning of work in 1883 (Revised Laws, chapter 75, sections 16 to 27): —

Number of Complaints entered in Court.

Year.	Food and Other Articles (not including Milk).	Drugs.	Milk.	Total.	Convictions.	Fines imposed.
1883,	–	5	4	9	8	–[1]
1884,	2	1	45	48	44	–[1]
1885,[2]	50	1	68	119	103	–[1]
1886,[3]	10	–	10	20	19	–[1]
1887,	30	–	34	64	60	–[1]
1888,	22	–	43	65	61	$2,042 00
1889,	74	–	66	140	124	3,889 00
1890,	78	–	24	102	96	3,919 00
1891,	96	5	49	150	135	2,668 00
1892,	52	12	72	136	123	3,661 70
1893,	26	3	67	93	92	2,476 00
1894,	14	–	76	90	77	2,625 00
1895,	13	11	68	92	86	2,895 30
1896,	7	–	68	75	74	2,812 20
1897,	13	1	51	65	64	2,756 60
1898,	10	–	54	64	62	2,060 98
1899,	19	2	26	47	45	1,432 66
1900,	45	5	44	94	89	1,890 70
1901,	30	–	65	95	90	1,874 70
1902,	25	3	48	76	74	2,617 98
1903,	34	1	44	79	70	1,297 66
1904,	6	6	50	62	57	1,509 00
1905,	209	27	77	313	275	8,486 00
1906,[4]	177	60	171	409	383	7,316 00
1907,	123	63	147	333	290	6,546 00
1908,	76	138	219	433	386	8,300 30
1909,	72	44	180	296	267	5,666 74
1910,	112	26	119	257	244	5,395 21
1911,	49	30	82	161	147	4,015 91
1912,	20	36	65	121	111	2,805 00
1913,	36	19	106[5]	161	116	2,922 75

[1] No record kept.
[2] To May 1, 1886.
[3] Four months only.
[4] Fourteen months, from Sept. 30, 1905.
[5] One case was on account of obstruction of an inspector.

The nature of the offences brought to the attention of the courts during the year, the names of the defendants, the places where the offences were committed, the dates of trial or indictment, and the results of the prosecutions, are set forth in the following table: —

For Sale of Milk not of Good Standard Quality.

Name.	Place.	Percentage of Total Solids.	Date.	Result.
Herbert, Benjamin,	Acushnet,	10.06[1]	Apr. 3, 1913	Conviction.
Blake, Horace S.,	Ashland,	9.64[1]	May 10, 1913	Conviction.
Blake, Horace S.,	Ashland,	10.56[1]	May 10, 1913	Conviction.
Root, Warren H.,	Bernardston,	10.40[1]	Oct. 23, 1913	Conviction.[2]
Cunningham, Paul,	Bolton,	9.78[3]	May 31, 1913	Conviction.
Piercy, F. W.,	Braintree,	10.67	Aug. 21, 1913	Conviction.[2]
Winn, G. Edward,	Burlington,	10.66	May 13, 1913	Conviction.
Baker, John,	Cambridge,	10.47[1]	Apr. 30, 1913	Discharged.
Davis, Palmer,	Carlisle,	11.13[4]	Aug. 23, 1913	Discharged.
Wilson, George,	Cohasset,	11.20[1]	Oct. 3, 1913	Conviction.[2]
Kirchner, Jacob F.,	Dalton,	10.48[1]	Nov. 21, 1913	Conviction.
Seabury, Robt. F.,	Dartmouth,	6.94[1]	July 29, 1913	Conviction.
Souza, Anthony,	Dartmouth,	9.76[1]	July 29, 1913	Conviction.
Farrington, Fred O.,	Dedham,	10.26[1]	Oct. 30, 1913	Conviction.[2]
Bartlett, Walter E.,	Easthampton,	9.54[4]	Nov. 12, 1913	Conviction.
Levonis, John,	Easthampton,	11.20[1]	Nov. 19, 1913	Conviction.
Levonis, John,	Easthampton,	9.74[4]	Nov. 19, 1913	Conviction.
Boucher, August,	Franklin,	10.76[1]	Oct. 9, 1913	Conviction.
Atwater, Jos. A.,	Gloucester,	10.70	Aug. 14, 1913	Conviction.
Rogers, J. King,	Gloucester,	9.66[1]	Oct. 20, 1913	Conviction.[2]
Spittle, Thos. E.,	Gloucester,	8.88[1]	Nov. 29, 1913	Conviction.[2]
United Fisheries Co.,	Gloucester,	11.40[4]	Jan. 15, 1913	Conviction.
Waldron, Geo. E.,	Gloucester,	3.00[1]	Nov. 29, 1913	Conviction.[2]
Waldron, Geo. E.,	Gloucester,	3.00	Nov. 29, 1913	Conviction.[2]
Wilde, G. Fred, Jr.,	Harvard,	9.94[1]	Oct. 7, 1913	Conviction.[2]
Wilde, G. Fred, Jr.,	Harvard,	9.94[1]	Sept. 26, 1913	Dismissed.[5]
Moores, Hersey C.,	Haverhill,	8.84[1]	July 30, 1913	Conviction.[2]
Poplaski, Josephine,	Haverhill,	10.06[1]	July 30, 1913	Conviction.
Burgess, Geo. W.,	Hingham,	10.94[1]	Oct. 10, 1913	Conviction.
Burgess, Geo. W.,	Hingham,	10.88[1]	Oct. 10, 1913	Conviction.

[1] Addition of water alleged in complaint.
[2] Appealed to upper court; case pending.
[3] Skimmed milk; cans not marked.
[4] Removal of cream alleged in complaint.
[5] Dismissed for want of jurisdiction.

For Sale of Milk not of Good Standard Quality — Continued.

Name.	Place.	Percentage of Total Solids.	Date.	Result.
Schnopt, Augustus,	Hinsdale,	11.12[1]	Nov. 21, 1913	Conviction.
Higgins, Charles,	Hopkinton,	12.20[1]	Sept. 3, 1913	Conviction.
Loring, Alfred H.,	Hull,	9.20[1]	Sept. 23, 1913	Conviction.
Sullivan, Eugene,	Lawrence,	9.66[1]	Feb. 7, 1913	Conviction.
Basher, John,	Lexington,	10.50[1]	Jan. 31, 1913	Conviction.
Britt, Patrick,	Lexington,	11.08[2]	Aug. 23, 1913	Conviction.
Wheeler, George,	Lincoln,	10.80[1]	Aug. 25, 1913	Conviction.
Moody, James E.,	Lowell,	9.46[3]	Mar. 15, 1913	Discharged.
Corrigan, Edward P.,	Malden,	10.62[1]	Apr. 18, 1913	Conviction.
Wiseberg, Simon,	Malden,	10.82[2]	Nov. 18, 1913	Conviction.
Lord, Arthur W.,	Maynard,	12.00[2]	Jan. 11, 1913	Conviction.
Forbes, Harvey W.,	Melrose Highlands,	12.70[1]	Nov. 18, 1913	Discharged.
Coffin, Ralph W.,	Mendon,	11.60[1]	Sept. 3, 1913	Conviction.
Dagdigin, Avidis,	Methuen,	10.92[1]	Feb. 7, 1913	Conviction.
Givani, Leo,	Milford,	10.76[1]	Sept. 3, 1913	Conviction.
Johnson, John W.,	Milford,	12.12[1]	Sept. 3, 1913	Conviction.
Rotman, Harris,	Millis,	11.98[2]	Oct. 9, 1913	Conviction.
Cabot, Walter Channing,	Nantucket,	12.30[2]	Sept. 19, 1913	Conviction.
Ewen, H. L.,	Nantucket,	10.46	Aug. 29, 1913	Conviction.
Holdgate, Frank O.,	Nantucket,	12.12[1]	Sept. 11, 1913	Conviction.
Burks, Ernest W.,	Natick,	9.66[3]	Oct. 21, 1913	Conviction.
Sweatt, Fred W.,	Natick,	11.20	Apr. 12, 1913	Conviction.
Lanzon, David,	New Bedford,	10.80[1]	July 29, 1913	Conviction.
Kelleher, Dennis,	Newburyport,	11.44[2]	June 23, 1913	Conviction.[4]
Jasper, George,	Norwood,	10.80[1]	Oct. 30, 1913	Discharged.
Moore, Frank,	Orange,	11.74[1]	Jan. 9, 1913	Conviction.
Benz, Charles,	Pittsfield,	10.00[1]	May 9, 1913	Conviction.
Benz, John C.,	Pittsfield,	10.82[1]	May 9, 1913	Conviction.
Dallava & Co., S.,	Pittsfield,	11.48[1]	Oct. 10, 1913	Conviction.
Foley, James,	Pittsfield,	11.52[1]	Oct. 10, 1913	Conviction.
Kirchner, Nicholas,	Pittsfield,	12.06[1]	Oct. 10, 1913	Conviction.
Savery, Harvey B.,	Pittsfield,	10.58[1]	May 9, 1913	Conviction.
Kennard, Harrison G.,	Quincy,	12.04[2]	May 17, 1913	Conviction.
Kennard, Harrison G.,	Quincy,	7.82[1]	May 17, 1913	Conviction.

[1] Addition of water alleged in complaint.
[2] Removal of cream alleged in complaint.
[3] Skimmed milk; cans not marked.
[4] Appealed to upper court; case pending.

For Sale of Milk not of Good Standard Quality — Concluded.

Name.	Place.	Percentage of Total Solids.	Date.	Result.
Collins, Michael J.,	Randolph,	12.04[1]	July 16, 1913	Conviction.
Arkin, Fannie,	Revere,	10.18[1]	Sept. 12, 1913	Conviction.
Brown, Charles H.,	Revere,	11.50[1]	Oct. 17, 1913	Conviction.
Flynn, Edward,	Revere,	10.70[2]	July 8, 1913	Conviction.[3]
Flynn, Edward,	Revere,	10.80[2]	July 8, 1913	Conviction.[3]
Hirsche, Myron J.,	Revere,	11.30[1]	Sept. 12, 1913	Discharged.
Trask, Howard H.,	Revere,	10.90[1]	Aug. 28, 1913	Conviction.
Deinlein, Albert,	Richmond,	11.06[2]	Oct. 10, 1913	Conviction.
Nugent, Geo. C.,	Rockport,	11.76[2]	Oct. 6, 1913	Conviction.[3]
Higgins, William,	Saugus,	12.40[2]	July 10, 1913	Conviction.
Nicholson, George F.,	Saugus,	12.10[2]	July 10, 1913	Dismissed.[4]
Peterson ,Oscar,	Saugus,	8.58[2]	July 10, 1913	Conviction.
Williams, Edward,	Spencer,	10.30[2]	Nov. 7, 1913	Conviction.
Rugg, Luther W.,	Sterling,	9.68[2]	Jan. 16, 1913	Conviction.
Scott, Warren F.,	Stoneham,	11.54[2]	Nov. 26, 1913	Dismissed.[4]
Wetherbee, Charles W.,	Stow,	11.54[2]	Jan. 11, 1913	Conviction.
Mason, Thos. L.,	Swansea,	11.50[1]	Sept. 30, 1913	Conviction.
Mason, Thos. L.,	Swansea,	9.66[2]	Sept. 30, 1913	Conviction.
Ballou, Albertus H.,	Ware,	7.36[2]	May 22, 1913	Conviction.[3]
Rynn, John,	Wayland,	11.56[1]	Oct. 16, 1913	Conviction.[3]
Simon, Christ V.,	West Boylston,	10.62[2]	May 21, 1913	Conviction.[3]
Crawford, Charles O.,	Westford,	10.20[2]	Mar. 3, 1913	Discharged.
Gates, Lewellyn F.,	Westford,	10.18[2]	Mar. 3, 1913	Conviction.
Dudley, Alvin L.,	Weston,	10.36[2]	Sept. 5, 1913	Conviction.
Perry, Manuel,	Westport,	11.46[2]	Jan. 14, 1913	Conviction.
Carter, Walter D.,	Wilmington,	11.40[2]	Feb. 8, 1913	Conviction.
Carter, Walter D.,	Wilmington,	11.70[2]	Feb. 8, 1913	Conviction.
Holmes, Charles,	Wilmington,	9.56[2]	Feb. 8, 1913	Conviction.
Doucette, Andrew,	Woburn,	7.87[2]	May 14, 1913	Conviction.
Given, James,	Woburn,	11.40[1]	Nov. 1, 1913	Conviction.
McDevitt, Michael,	Woburn,	10.10[2]	Nov. 1, 1913	Conviction.
Winn, G. Edward,	Woburn,	11.76	Nov. 1, 1913	Pending.

[1] Removal of cream alleged in complaint.
[2] Addition of water alleged in complaint.
[3] Appealed to upper court ; case pending.
[4] Dismissed by order of the court.

For Sale of Milk containing Foreign Matter.

Name.	Place.	Percentage of Total Solids.	Date.	Result.
Dudley, Alvin L., . . .	Weston, . . .	10.52[1]	Sept. 5, 1913	Conviction.
Dudley, Alvin L., . . .	Weston, . . .	10.90[2]	Sept. 5, 1913	Dismissed.[3]

For Sale of Milk containing Added Foreign Matter.

Barnes, Thomas W., . . .	Dartmouth (North),	11.88	Dec. 10, 1912	Conviction.[4]
Dudley, Alvin L., . . .	Weston, . . .	13.05	Dec. 27, 1912	Conviction.

For Obstruction of Inspector.

Name.	Place.	Date.	Result.
Breen, Fred, ...	Boston, ...	June 20, 1913	Conviction.

For Sale of Adulterated Cream.

Name.	Place.	Adulterant.	Date.	Result.
Alden Bros. Co., . .	Winthrop, .	Water, ...	Nov. 17, 1913	Conviction.

For Sale of Adulterated Ice Cream.

Name.	Place.	Percentage of Fat.	Date.	Result.
Bushway Ice Cream Co., . .	Waltham, ...	4.48	Sept. 15, 1913	Conviction.
Bushway Ice Cream Co., . .	Waltham, ...	4.34	Sept. 15, 1913	Conviction.
Highley, Samuel, . . .	Woburn, . . .	4.70	Oct. 25, 1913	Conviction.
Todd, Henry, ...	Nantucket, . .	3.58	Sept. 19, 1913	Conviction.

For Sale of Adulterated Foods Other than Milk and Milk Products.

Hamburg Steak.

Name.	Place.	Adulterant.	Date.	Result.
Albany Cash Market, .	Pittsfield, .	Sulphuric acid, . .	Nov. 21, 1913	Conviction.
Barrett, C. H., ...	Gloucester, .	Benzoic acid, . .	Dec. 31, 1912	Discharged.

[1] Contained flies.
[2] Contained dirt.
[3] Dismissed by order of the court.
[4] Appealed to upper court; case pending.

For Sale of Adulterated Foods Other than Milk and Milk Products — Continued.

CANNED HERRING.

NAME.	Place.	Adulterant.	Date.	Result.
Nourse, Newell E.,	Boston,	Decomposed,	Dec. 31, 1912	Conviction.
Siegel Co., Henry,	Boston,	Decomposed,	Jan. 3, 1913	Nol prossed.

CANNED SARDINES.

Houghton & Dutton Co.,	Boston,	Decomposed,	Jan. 7, 1913	Conviction.[1]

SHRIMP.

The Mohican Co.,	Springfield,	Compound of boron,	May 16, 1913	Conviction.
The Mohican Co.,	Springfield,	Compound of boron,	May 16, 1913	Conviction.

LARD.

Livingstone, Geo.,	Chelsea,	Compound,[2]	Oct. 30, 1913	Conviction.
Pike, Samuel P.,	Lowell,	Cotton seed oil,	Mar. 25, 1913	Conviction.

OLEOMARGARINE.

Hull, Lester,	Nantucket,	No sign in store,	Sept. 11, 1913	Conviction.
Hull, Lester,	Nantucket,	No sign on container,	Sept. 11, 1913	Conviction.
Livingstone, Geo.,	Chelsea,	Not marked,	Oct. 30, 1913	Conviction.

BROKEN-OUT EGGS.

Bay State Egg Co.,	Boston,	Decomposed,	Nov. 27, 1912	Conviction.[1]
Bay State Egg Co.,	Boston,	Decomposed,	Feb. 18, 1913	Conviction.[1]
Brown, Morris,	Boston,	Decomposed,	Feb. 18, 1913	Conviction.[1]
Goldsmith, Wall Co.,	Boston,	Decomposed,	July 23, 1913	Pending.
Goldsmith, Wall Co.,	Boston,	Decomposed,	Oct. 28, 1913	Conviction.[1]
Goodrich, John A.,	Boston,	Decomposed,	Jan. 28, 1913	Conviction.
Standard Egg Co.,	Boston,	Decomposed,	Feb. 18, 1913	Conviction.[1]
Standard Egg Co.,	Boston,	Decomposed,	Feb. 18, 1913	Conviction.[1]
White Star Egg & Fruit Co.,	Boston,	Decomposed,	Feb. 18, 1913	Conviction.[1]
White Star Egg & Fruit Co.,	Boston,	Decomposed,	Feb. 18, 1913	Conviction.[1]
White Star Egg & Fruit Co.,	Boston,	Decomposed,	Nov. 27, 1912	Pending.

[1] Appealed to upper court; case pending. [2] Compound; not marked.

For Sale of Adulterated Foods Other than Milk and Milk Products — Concluded.

MAPLE SUGAR.

Name.	Place.	Adulterant.	Date.	Result.
Adams, Oscar D.,	Springfield,	Cane sugar,	Apr. 15, 1913	Conviction.
Adams, Oscar D.,	Springfield,	Cane sugar,	Apr. 15, 1913	Conviction.
Adams, Oscar D.,	Springfield,	Cane sugar,	Apr. 15, 1913	Conviction.
Adams, Oscar D.,	Springfield,	Cane sugar,	Apr. 15, 1913	Conviction.
Adams, Oscar D.,	Springfield,	Cane sugar,	Apr. 15, 1913	Conviction.
Adams, Oscar D.,	Springfield,	Cane sugar,	Apr. 15, 1913	Conviction.

CIDER.

Aquila, John,	Boston,	Benzoic acid,	Jan. 30, 1913	Conviction.
Fay, John J.,	Boston,	Benzoic acid,	Jan. 30, 1913	Conviction.
Hacking, Andrew,	Stoneham,	Benzoic acid,	Nov. 19, 1913	Conviction.[1]
Hession, James W.,	Boston,	Benzoic acid,	Feb. 19, 1913	Conviction.
Rendozzo, John,	Boston,	Benzoic acid,	Jan. 30, 1913	Conviction.
Tekmejian, Agajohn,	Boston,	Benzoic acid,	Jan. 30, 1913	Conviction.

ICE.

North Shore Ice Delivery Co.,	Lynn,	Condemned ice,	July 23, 1913	Conviction.

For Sale of Adulterated Drugs.

ALCOHOL.

Dupree, Hector,	Dudley,	Deficiency in strength,	Mar. 4, 1913	Conviction.
Stanick, John,	Dudley,	Deficiency in strength,	Mar. 4, 1913	Conviction.
Bernier & Co.,	Easthampton,	Deficiency in strength,	Nov. 19, 1913	Conviction.
Ryan, S. A., & Co., Inc.,	Springfield,	Deficiency in strength,	May 29, 1913	Conviction.
Choiniere, Hector,	Ware,	Deficiency in strength,	Apr. 25, 1913	Conviction.
Kokocinski, Waldyslaw,	Webster,	Deficiency in strength,	Mar. 4, 1913	Conviction.
Lilla, Michael A.,	Webster,	Deficiency in strength,	Mar. 4, 1913	Conviction.

SPIRIT OF CAMPHOR.

Farrell, Thos. H.,	Pittsfield,	Deficiency in strength,	Nov. 21, 1913	Conviction.

[1] Appealed to upper court; case pending.

For Sale of Adulterated Drugs — Concluded.

TINCTURE OF IODINE.

Name.	Place.	Adulterant.	Date.	Result.
Sorel, Honorious J.,	Easthampton,	Deficiency in strength,	Nov. 19, 1913	Conviction.
Burke Drug Co.,	Marlborough,	Deficiency in strength,	May 17, 1913	Conviction.
Lerche, Albert E.,	Springfield,	Deficiency in strength,	May 29, 1913	Conviction.

SPIRIT OF PEPPERMINT.

Name.	Place.	Adulterant.	Date.	Result.
Davies, Cyrus,	Boston,	Deficiency in strength,	Feb. 26, 1913	Conviction.
Burke Drug Co.,	Marlborough,	Deficiency in strength,	May 17, 1913	Conviction.
Traufaglia, Vincent,	Revere,	Deficiency in strength,	Oct. 15, 1913	Conviction.

SWEET SPIRIT OF NITRE.

Name.	Place.	Adulterant.	Date.	Result.
Waite, Dr. Clarence A.,	Pittsfield,	Deficiency in strength,	Nov. 21, 1913	Conviction.
Goddu, Joseph R.,	Salem,	Deficiency in strength,	Jan. 8, 1913	Conviction.
Hawthorne Pharmacy,	Salem,	Deficiency in strength,	Jan. 8, 1913	Conviction.
Upton, Jesse F.,	Salem,	Deficiency in strength,	Jan. 8, 1913	Conviction.
Middlesex Drug Co.,	Stoneham,	Deficiency in strength,	Nov. 19, 1913	Pending.

None of the cases reported as pending in the last preceding report have been settled.

The amount paid in fines was $2,922.75, as follows: —

Milk and milk products,	$2,257 75
Foods other than above,	325 00
Drugs,	340 00
	$2,922 75

The total number of samples of food, drugs, liquors and poisons examined during the year was as follows: —

Milk,	6,702
Food,	1,632
Drugs,	1,393
Liquors,	75
Poisons,	141
Articles held in cold storage,	83
	10,026

Expenditures under the Provisions of the Food and Drug Acts for the Year ended Nov. 30, 1913.

Appropriation,	$17,500 00
Credit by cash returned to treasury on account of money advanced to inspectors,	13 79
	$17,513 79

Salaries of analysts,	$6,900 00
Salaries of inspectors,	6,180 01
Salary of laboratory assistant,	214 00
Traveling expenses and purchase of samples,	3,383 18
Apparatus and chemicals,	390 24
Printing,	161 88
Services, cleaning laboratory,	50 75
Express,	4 04
Telephone messages and postage,	27 85
Sundry laboratory supplies,	55 51
Books, binding and stationery,	53 89
Extra services,	47 62
Advertising,	1 80
Miscellaneous,	19 40
Total,	$17,490 17

During the year 1913, two cases reported as pending in 1908 have been settled; one for obstruction of an inspector, and one for sale of adulterated cider, both of which were placed on file.

Of the cases reported as pending in 1911, three for the sale of adulterated milk have been settled; one was placed on file, and the other two cases resulted in conviction and fine; one case for the sale of adulterated maple sugar was placed on file; two cases for the sale of adulterated yeast and one for the sale of adulterated vinegar were *nol prossed,* and one case for the sale of adulterated alcohol was placed on file and fine imposed.

REPORT OF THE ANALYST.

By Hermann C. Lythgoe.

REPORT OF THE ANALYST.

By Hermann C. Lythgoe.

Dr. Mark W. Richardson, *Secretary of the Massachusetts State Board of Health.*

Dear Sir: — I herewith submit my report on the analysis of food and drugs for the year ending Nov. 30, 1913.

Milk and Milk Products.

During the year 6,702 samples of milk were collected, of which 1,682, or 25.1 per cent., were below the legal standard, 358 contained added water, 90 were skimmed and not so labeled, 26 were skimmed milk properly labeled and sold as such, and 1 sample contained formaldehyde. This is the second sample of preserved milk collected since 1908. The usual statistics of milk are as follows: —

Milk from Cities and Towns.

Locality.	Above Standard.	Below Standard.	Total Samples.	Total Solids in Lowest Sample (Per Cent.).	Skimmed Milk sold as Such.	Skimmed Milk sold as Pure Milk.	Watered Milk.	Milk containing Foreign Substances.
Abington,	20	-	20	12.26	-	-	-	-
Adams,	17	1	18	11.80	-	-	-	-
Andover,	22	3	25	10.96	-	-	-	-
Amesbury,	30	3	33	12.00	-	-	-	-
Arlington,	57	8	65	11.00	-	1	-	-
Athol,	23	4	27	9.00	1	-	2	-
Attleborough,	28	4	32	10.70	-	-	-	-
Ayer,	5	-	5	12.40	-	-	-	-
Belmont,	4	-	4	12.16	-	-	-	-
Beverly,	16	1	17	11.92	-	-	-	-
Boston,	2	1	3	9.26	-	2	-	-
Braintree,	73	11	84	10.67	-	-	1	-
Bridgewater,	29	3	32	11.80	-	-	-	-

Milk from Cities and Towns — Continued.

Locality.	Above Standard.	Below Standard.	Total Samples.	Total Solids in Lowest Sample (Per Cent.).	Skimmed Milk sold as Such.	Skimmed Milk sold as Pure Milk.	Watered Milk.	Milk containing Foreign Substances.
Brockton,	61	13	74	11.58	–	–	–	–
Brookfield,	11	2	13	11.90	–	–	–	–
Brookline,	93	12	105	11.80	–	–	–	–
Burlington,	19	10	29	10.40	–	–	2	–
Cambridge,	70	24	94	10.47	–	1	1	–
Canton,	22	3	25	11.30	–	–	–	–
Chelmsford,	7	2	9	12.06	–	–	–	–
Chelsea,	72	7	79	11.50	–	–	–	–
Chicopee,	48	22	70	10.44	–	–	1	–
Clinton,	25	7	32	11.32	–	–	–	–
Concord,	6	3	9	11.80	–	–	–	–
Dalton,	6	–	6	12.20	–	–	–	–
Danvers,	28	24	52	11.14	–	–	–	–
Dartmouth,	37	17	54	9.74	–	1	8	–
Dedham,	7	14	21	10.26	–	–	3	–
Easthampton,	22	9	31	9.54	–	2	1	–
Everett,	56	17	73	11.41	–	–	–	–
Fall River,	89	14	103	9.30	–	2	1	–
Fitchburg,	17	6	23	11.56	–	–	–	–
Foxborough,	13	–	13	12.36	–	–	–	–
Framingham,	64	12	76	9.64	–	1	1	–
Franklin,	47	6	53	10.76	–	1	–	–
Gardner,	15	1	16	11.67	–	–	–	–
Gloucester,	104	106	210	8.88	–	1	36	–
Greenfield,	39	12	51	10.40	–	–	11	–
Haverhill,	58	27	85	8.84	–	3	10	–
Hingham,	81	15	96	9.50	2	–	4	–
Holliston,	18	3	21	12.12	–	–	–	–
Holyoke,	54	7	61	12.10	–	–	–	–
Hopkinton,	11	3	14	11.56	–	–	–	–
Hudson,	24	3	27	8.24	–	1	3	–
Hull,	7	9	16	8.10	–	–	4	–
Lawrence,	63	22	85	9.22	–	8	2	–
Leicester,	12	6	18	11.80	–	–	–	–
Lenox,	14	1	15	12.06	–	–	–	–

Milk from Cities and Towns — Continued.

Locality.	Above Standard.	Below Standard.	Total Samples.	Total Solids in Lowest Sample (Per Cent.).	Skimmed Milk sold as Such.	Skimmed Milk sold as Pure Milk.	Watered Milk.	Milk containing Foreign Substances.
Lexington, . .	8	4	12	11.08	–	1	–	–
Lowell, . .	95	24	119	9.56	–	2	–	–
Ludlow, . .	10	20	30	11.06	–	–	13	–
Lynn, . . .	141	12	153	9.80	1	–	1	–
Malden, . .	93	13	106	10.82	–	1	3	–
Mansfield, . .	13	1	14	12.00	–	–	–	–
Marlborough, .	29	–	29	12.16	–	–	–	–
Maynard, . .	13	5	18	11.86	–	–	–	–
Medford, . .	63	24	87	10.66	–	1	–	–
Melrose, . .	30	5	35	11.86	–	–	–	–
Middleborough, .	13	3	16	11.26	–	–	–	–
Milford, . . .	79	11	90	9.73	2	–	6	–
Millbury, . .	10	5	15	9.47	1	–	–	–
Millis, . . .	8	5	13	9.80	–	3	–	–
Montague, . .	17	2	19	11.18	–	–	2	–
Nantucket, . .	79	8	87	10.46	–	5	2	–
Natick, . . .	60	14	74	9.50	2	3	1	–
Needham, . .	11	–	11	12.40	–	–	–	–
New Bedford, .	146	58	204	9.02	–	5	9	–
Newburyport, .	48	8	56	11.44	–	4	–	–
Newton, . .	88	14	102	11.20	–	2	–	–
Northampton, .	25	10	35	11.04	–	–	–	–
No. Attleborough, .	30	2	32	11.46	–	–	–	–
North Easton, .	13	5	18	11.98	–	–	–	–
North Reading, .	11	–	11	12.74	–	–	–	–
Norwood, . .	31	4	35	11.66	–	–	–	–
Oak Bluffs, . .	14	11	25	11.36	–	1	–	–
Palmer, . . .	12	1	13	11.90	–	–	–	–
Peabody, . .	26	2	28	10.28	–	1	–	–
Pittsfield, . .	262	91	353	10.00	1	1	24	–
Plymouth, . .	15	–	15	12.17	–	–	–	–
Quincy, . .	119	32	151	7.82	–	7	5	–
Randolph, . .	11	5	16	11.40	–	4	–	–
Reading, . .	25	3	28	10.82	–	–	–	–
Revere, . . .	50	29	79	10.70	–	4	4	–

Milk from Cities and Towns — Concluded.

LOCALITY.	Above Standard.	Below Standard.	Total Samples.	Total Solids in Lowest Sample (Per Cent.).	Skimmed Milk sold as Such.	Skimmed Milk sold as Pure Milk.	Watered Milk.	Milk containing Foreign Substances.
Richmond,	21	6	27	11.60	–	–	1	–
Rockland,	28	–	28	12.20	–	–	–	–
SALEM,	26	6	32	11.60	–	–	–	–
Saugus,	8	–	8	12.40	–	–	–	–
Sherborn,	10	1	11	11.58	–	–	–	–
SOMERVILLE,	87	10	97	9.50	2	–	–	–
Southbridge,	29	6	35	12.00	–	–	–	–
South Framingham,	26	3	29	12.00	–	–	–	–
Spencer,	36	9	45	10.30	–	–	2	–
SPRINGFIELD,	123	22	145	3.18	–	2	2	1[1]
Stoneham,	39	13	52	9.50	2	–	3	–
Stoughton,	24	6	30	10.70	–	3	–	–
Swampscott,	11	–	11	12.50	–	–	–	–
TAUNTON,	42	4	46	9.68	1	1	1	–
Templeton,	14	1	15	12.10	–	–	–	–
Uxbridge,	11	–	11	12.40	–	–	–	–
Wakefield,	13	2	15	11.90	–	–	–	–
Walpole,	8	6	14	11.36	–	–	–	–
WALTHAM,	68	25	93	5.14	4	–	9	–
Ware,	31	18	49	7.36	–	1	2	–
Wareham,	12	3	15	11.20	–	–	1	–
Watertown,	54	10	64	8.66	3	1	–	–
Webster,	22	–	22	12.20	–	–	–	–
Wellesley,	12	–	12	12.42	–	–	–	–
West Newbury,	2	2	4	11.50	–	–	–	–
West Springfield,	41	9	50	10.38	1	–	1	–
Whitman,	27	7	34	11.53	–	–	–	–
Williamstown,	13	3	16	11.92	–	–	–	–
Wilmington,	21	2	23	10.56	–	–	–	–
Winchester,	38	7	45	11.40	–	–	–	–
Winthrop,	15	4	19	10.80	–	1	–	–
WOBURN,	36	22	58	10.30	–	–	3	–
WORCESTER,	62	23	85	10.62	–	4	1	–
Totals,	4,354	1,139	5,493	3.18	23	80	187	1

[1] Formaldehyde.

Milk from Suspected Producers.

LOCALITY.	Above Standard.	Below Standard.	Total Samples.	Total Solids in Lowest Sample (Per Cent.).	Skimmed Milk not marked.	Watered Milk.
Arlington,	12	11	23	11.02	–	–
Ashby,	12	–	12	12.30	–	–
Bedford,	5	5	10	11.20	1	–
Billerica,	6	16	22	11.20	–	–
Bolton,	8	17	25	10.52	–	–
Carlisle,	2	2	4	11.13	2	–
Chelmsford,	10	11	21	11.32	–	1
Cheshire,	5	2	7	11.18	–	3
Dalton,	12	5	17	10.40	–	3
Danvers,	11	16	27	11.30	–	–
Dartmouth,	3	15	18	6.94	–	14
Dedham,	14	4	18	11.54	–	–
Dracut,	5	1	6	11.02	–	–
FITCHBURG,	4	15	19	10.44	–	–
GLOUCESTER,	9	16	25	10.60	–	–
Groton,	11	7	18	11.60	–	–
Hamilton,	28	14	42	11.00	–	–
HAVERHILL,	12	16	28	9.40	–	–
Hingham,	13	1	14	11.60	–	1
LAWRENCE,	3	14	17	10.76	2	–
Lexington,	–	20	20	10.30	–	18
Lincoln,	8	7	15	10.80	–	2
Littleton,	22	13	35	9.94	1	8
Maynard,	3	6	9	11.70	–	–
Medfield,	5	–	5	12.46	–	–
Mendon,	8	4	12	11.42	–	–
Methuen,	23	28	51	10.06	–	19
Millis,	13	47	60	10.56	3	–
North Andover,	11	19	30	10.52	–	6
Norwood,	23	25	48	10.20	–	5
Plaistow, N. H.,	4	14	18	10.36	2	6
Rutland,	2	–	2	13.08	–	–
Saugus,	7	11	18	8.40	–	8
Sherborn,	7	7	14	11.05	–	–
Somerset,	26	22	48	9.20	–	10
Southampton,	18	7	25	11.36	2	–

Milk from Suspected Producers — Concluded.

LOCALITY.	Above Standard.	Below Standard.	Total Samples.	Total Solids in Lowest Sample (Per Cent.).	Skimmed Milk not marked.	Watered Milk.
Stow,	35	11	46	11.24	-	-
Swansea,	5	8	13	9.66	1	7
Wayland,	3	2	5	12.00	-	-
Westborough,	-	5	5	9.78	-	4
Westford,	5	16	21	10.18	-	9
Westminster,	9	1	10	12.00	-	-
Weston,	-	12	12	10.26	-	12
Weymouth,	-	5	5	9.06	-	5
Wilmington,	20	13	33	8.36	-	10
WOBURN,	41	15	56	7.73	-	17
Totals,	483	506	989	6.94	14	168

Summary of Milk Statistics.

LOCALITY.	Above Standard.	Below Standard.	Total.	Total Solids in Lowest Sample (Per Cent.).	Skimmed Milk sold as Such.	Skimmed Milk not marked.	Watered Milk.	Milk containing Foreign Substances.
Milk from cities and towns.	4,354	1,139	5,493	3.18	23	80	187	1
Milk from suspected producers.	483	506	989	6.94	-	14	168	-
Miscellaneous milk samples.	183	47	220	11.37	3	-	3	-
Totals,	5,020	1,682	6,702	3.18	26	94	358	1

Summary of Milk Statistics by Months.

Month.	Number above Standard.	Number below Standard.	Total Samples collected.	Skimmed Samples marked.	Skimmed Samples not marked.	Watered Samples.	Pasteurized Sample.	Pasteurized Samples below Standard.	Per Cent. of Skimmed Samples not marked.	Per Cent. of Watered Samples.	Per Cent. of Pasteurized Samples.	Per Cent. of Pasteurized Samples below Standard.	Per Cent. of Total Samples below Standard.	Samples giving Precipitate with 68 Per Cent. Alcohol.	Pasteurized Samples giving Precipitate with 68 Per Cent. Alcohol.	Samples reducing Methylene Blue in Thirty Minutes to One Hour.	Samples reducing Methylene Blue in less than Thirty Minutes.	Per Cent. of Total Samples giving Precipitate with Alcohol.	Per Cent. of Pasteurized Samples giving Precipitate with Alcohol.	Per Cent. of Samples reducing Methylene Blue in Thirty Minutes to One Hour.	Per Cent. of Samples reducing Methylene Blue in less than Thirty Minutes.
1912.																					
December, .	365	34	399	2	5	3	85	6	1.5	0.9	21.3	7.1	8.5	2	–	–	2	0.5	–	–	0.5
1913.																					
January, .	276	120	396	1	5	42	50	7	1.3	10.6	12.6	14.0	30.6	20	–	1	9	5.3	–	0.3	2.3
February, .	250	70	320	–	8	25	39	5	2.5	7.8	12.2	12.8	21.9	10	2	3	2	3.0	5.1	0.1	0.1
March, .	354	68	422	1	7	6	48	3	1.7	1.4	11.4	6.3	16.1	25	1	9	14	5.9	2.4	1.9	3.3
April, . .	525	138	663	2	14	22	100	15	2.1	3.3	15.1	15.0	20.8	9	–	–	8	1.4	–	–	1.2
May, . .	643	167	810	2	14	21	105	28	1.7	2.6	13.0	26.3	20.6	37	–	13	62	4.6	–	1.6	7.7
June, . .	552	126	678	–	9	7	98	12	1.3	1.0	14.4	12.2	18.3	–	–	–	–	–	–	–	–
July, . .	502	408	910	2	18	84	56	22	2.0	9.2	6.2	39.4	44.8	–	–	–	–	–	–	–	–
August, .	248	183	431	1	3	36	48	16	0.6	8.3	11.1	33.0	42.3	–	–	–	–	–	–	–	–
September, .	381	151	532	3	8	44	93	15	1.5	8.3	17.5	16.1	28.4	–	–	–	–	–	–	–	–
October, .	549	104	653	1	1	29	107	23	0.2	4.4	16.4	21.7	15.9	70	8	24	86	10.7	7.5	3.7	13.2
November, .	375	113	488	11	2	39	33	3	0.4	8.0	6.8	11.0	23.2	10	–	1	27	2.0	–	0.2	5.6
Totals, .	5,020	1,682	6,702	26	94	358	862	155	1.4	5.3	12.8	18.0	25.1	183	11	51	210	4.4	1.9	1.2	5.0

Quality of Milk by Months.

Month.	Number of Samples with Solids varying between —										Average of all Samples.			Average of all Samples not declared Skimmed or Watered.				Average of Raw Samples not declared Skimmed or Watered.				Average of Pasteurized Samples not declared Skimmed or Watered.			
	15 Per Cent. and above.	14 and 15 Per Cent.	13 and 14 Per Cent.	12.15 and 13 Per Cent.	11 and 12.15 Per Cent.	10 and 11 Per Cent.	9 and 10 Per Cent.	8 and 9 Per Cent.	Below 8 Per Cent.	Total.	Solids (Per Cent.).	Fat (Per Cent.).	Solids not Fat (Per Cent.).	Number.	Solids (Per Cent.).	Fat (Per Cent.).	Solids not Fat (Per Cent.).	Number.	Solids (Per Cent.).	Fat (Per Cent.).	Solids not Fat (Per Cent.).	Number.	Solids (Per Cent.).	Fat (Per Cent.).	Solids not Fat (Per Cent.).
1912.																									
December,	11	23	124	207	29	4	1	–	–	399	12.94	3.94	9.00	389	12.99	3.99	9.00	304	13.05	4.01	9.04	85	12.75	3.90	8.85
1913.																									
January,	8	16	79	173	84	28	5	2	1	396	12.45	3.82	8.63	348	12.75	3.94	8.81	299	12.78	3.97	8.81	49	12.59	3.77	8.82
February,	9	77	164	51	15	3	1	–	–	320	12.57	3.80	8.77	287	12.76	3.89	8.87	250	12.77	3.91	8.87	37	12.67	3.80	8.87
March,	17	19	111	207	64	2	2	–	–	422	12.87	4.03	8.84	408	12.93	4.08	8.85	361	12.94	4.11	8.83	47	12.74	3.86	8.88
April,	7	19	131	367	109	23	4	1	2	663	12.56	3.75	8.81	625	12.69	3.81	8.88	529	12.75	3.86	8.89	96	12.44	3.61	8.83
May,	3	31	177	430	147	11	6	3	2	810	12.61	3.74	8.87	774	12.69	3.78	8.91	669	12.73	3.81	8.92	105	12.41	3.61	8.80
June,	8	34	177	333	122	4	–	–	–	678	12.42	3.76	8.66	663	12.44	3.76	8.68	565	12.36	3.72	8.64	98	12.83	3.98	8.85
July,	5	19	129	349	327	44	17	17	3	910	12.15	3.65	8.50	807	12.44	3.65	8.79	753	12.45	3.66	8.79	52	12.27	3.52	8.75
August,	–	14	71	163	159	23	1	–	–	431	12.27	3.72	8.55	392	12.39	3.77	8.62	344	12.40	3.77	8.63	48	12.35	3.70	8.65
September,	3	32	126	217	137	6	11	–	–	532	12.35	3.74	8.61	477	12.56	3.83	8.73	384	12.62	3.85	8.77	93	12.39	3.79	8.60
October,	10	29	220	289	82	20	3	–	–	653	12.79	3.91	8.88	558	12.91	3.95	8.96	466	12.92	3.94	8.98	92	12.81	4.03	8.78
November,	4	20	124	224	85	13	10	5	3	488	12.54	3.78	8.77	427	12.90	3.90	9.00	395	12.91	3.90	9.01	32	12.69	3.74	8.95
Totals,	85	333	1,633	3,010	1.360	181	61	28	11	6,702	12.55	3.78	8.77	6,154	12.69	3.84	8.85	5,319	12.69	3.84	8.85	834	12.58	3.79	8.79

The adulterated milk samples were in greater number than those in previous years, due to the large number of samples collected from suspected producers and the high ratio of adulteration in these samples. The majority of these suspected producers were selling milk to milk dealers in whose possession was found adulterated milk. Many times it was necessary to trace the samples through several people before reaching the man who was doing the actual adulteration; the adulterated samples, therefore, are much greater in number than would be shown by a systematic collection of milk from the retail dealers throughout the State. The tests for pasteurized milk and for old milk as described in the report of last year, were carried on during the year, and the figures obtained are given in the table of the summary of milk statistics by months. During the months of May, June, July and August, many of the samples come from such a long distance that they arrive in the laboratory too late to be examined that day. For this reason the figures obtained for old milk have been omitted from the table during these months, because such reports would manifestly be unfair to the milk supply. Three and three-tenths per cent. of the samples examined during the cold weather gave precipitate with 68 per cent. alcohol and 3.5 per cent. reduced methylene blue solution within one hour, showing that these samples were too old for use as food when examined. These figures, while undoubtedly high, owing to the fact that the samples were examined in some cases several hours after being taken, show that there is considerable old milk sold, and these conditions will continue to exist until there is some uniform and adequate inspection along sanitary lines as well as the present inspection for quality. The average quality of milk collected shows the same seasonal variation as in previous years. The milk for the month of July showed the lowest average solids of all samples that has been recorded for several years, owing to the large number of adulterated samples collected during this month. The quality of the pasteurized samples was slightly below that of the average raw samples, but not sufficiently so to show any form of systematic adulteration which might be carried on. During the month of July, however, a large number of samples were taken from restaurants, many of which proved to be both pasteurized and skimmed, and some of which were below standard by reason of their being skimmed to an extent too small for detection. The skimming in these cases had been practised in the restaurants, either deliberately by removal of cream for use with coffee and cereal, or accidentally by improper mixing when milk was sold by the glass. The actual figures for the pasteurized milk as put out by the dealers would therefore be slightly higher than the figures given.

Milk of Known Purity.

During the past six years nearly 500 samples of known purity milk have been examined in the laboratory, representing about 440 samples from individual cows and the balance from herd. These samples were obtained from Guernsey, Ayrshire, Dutch Belted and Holstein, as well as from cross-breed or grade cows. All the samples were examined for solids, fat, proteins, ash and lactose, and the serum was prepared by one or more methods from each sample. A summary of these analyses is given in the table. The variation in the composition of milk is due primarily to the breed of the cow, but it is more or less influenced by the period of lactation and the season of the year. In order to show the seasonal variation and variation according to the period of lactation 194 samples were chosen, representing the milk from grade Holstein, grade Durham, Ayrshire and grade Ayrshire cows whose period of lactation was known. This selection of cows eliminated to a great extent the influence of different breeds, as the abnormally high Jersey and Guernsey milk and the abnormally low milk from Holstein and Dutch Belted cows is not represented. These samples were then arranged according to months, but owing to the small number of samples obtained in some months it was impossible to get a representative average and the averages were accordingly made by seasons.

Summary of Analyses of Samples of Milk of Known Purity.

	Breed.											
	Jersey.	Guernsey.	Grade Jersey.	Grade Guernsey.	Grade Durham.	Grade Ayrshire.	Ayrshire.	Grade Holstein.	Dutch Belted.	Holstein.	All Samples.	Herd Milk.
Number of samples,	36	28	27	20	16	52	27	131	41	56	434	47
Total solids: —												
Samples between 16 and 17.17 per cent.,	5	2	–	–	–	–	–	–	–	–	7	–
Samples between 15 and 16 per cent.,	11	11	2	1	–	1	–	4	–	–	30	–
Samples between 14 and 15 per cent.,	11	6	8	4	1	7	2	14	2	–	55	8
Samples between 13 and 14 per cent.,	7	5	12	5	9	21	7	36	4	7	113	8
Samples between 12 and 13 per cent.,	2	4	4	8	3	19	11	40	14	11	116	27
Samples between 11 and 12 per cent.,	–	–	1	2	3	3	7	26	20	25	87	4
Samples between 10.2 and 11 per cent.,	–	–	–	–	–	1	–	11	1	13	26	–
Highest per cent.,	17.17	17.00	15.28	15.45	14.89	15.32	14.68	15.68	14.09	13.96	17.17	14.57
Lowest per cent.,	12.43	12.15	11.40	11.46	11.73	10.77	11.44	10.58	10.93	10.20	10.20	11.56
Average per cent.,	14.75	14.60	13.74	13.20	13.10	12.98	12.64	12.62	12.15	11.69	12.98	12.79
Fat: —												
Samples between 7 and 7.7 per cent.,	2	–	–	–	–	–	–	–	–	–	2	–
Samples between 6 and 7 per cent.,	14	5	–	–	–	2	–	1	–	–	22	–
Samples between 5 and 6 per cent.,	10	14	6	3	1	5	2	13	–	–	54	6
Samples between 4 and 5 per cent.,	10	8	19	12	10	27	10	44	4	6	150	16
Samples between 3 and 4 per cent.,	–	1	2	5	5	18	15	67	37	39	189	25
Samples between 2.45 and 3 per cent.,	–	–	–	–	–	–	–	6	–	11	17	–
Highest per cent.,	7.70	6.40	5.80	5.70	5.10	6.05	5.40	6.30	4.75	4.60	7.70	5.40
Lowest per cent.,	4.20	3.80	3.00	3.50	3.25	3.00	3.30	2.45	3.00	2.45	2.45	3.35
Average per cent.,	5.65	5.23	4.65	4.35	4.29	4.22	4.01	3.95	3.56	3.41	4.21	4.03
Proteins: —												
Samples between 4 and 5.01 per cent.,	3	8	2	–	3	–	–	6	–	1	23	1
Samples between 3 and 4 per cent.,	28	16	23	13	10	41	12	86	19	21	269	36
Samples between 2 and 3 per cent.,	5	4	2	7	3	11	15	39	22	34	142	10
Highest per cent.,	4.42	5.01	4.20	3.94	4.37	3.92	3.91	4.47	3.61	4.03	5.01	4.02
Lowest per cent.,	2.79	2.26	2.78	2.43	2.65	2.11	2.22	2.33	2.34	2.00	2.00	2.66
Average per cent.,	3.46	3.73	3.45	3.27	3.39	3.22	2.99	3.25	2.96	2.93	3.27	3.31
Ash: —												
Highest per cent.,	0.84	0.84	0.86	0.78	0.80	0.85	0.87	0.87	0.77	0.84	0.87	0.79
Lowest per cent.,	0.64	0.69	0.69	0.66	0.63	0.66	0.58	0.56	0.63	0.64	0.56	0.65
Average per cent.,	0.72	0.75	0.75	0.72	0.73	0.75	0.76	0.73	0.70	0.72	0.76	0.74

Summary of Analyses of Samples of Milk of Known Purity — Concluded.

	Breed.											
	Jersey.	Guernsey.	Grade Jersey.	Grade Guernsey.	Grade Durham.	Grade Ayrshire.	Ayrshire.	Grade Holstein.	Dutch Belted.	Holstein.	All Samples.	Herd Milk.
Solids not fat: —												
Samples between 10 and 10.65 per cent.,	–	3	–	–	–	–	–	3	–	–	6	–
Samples between 9 and 10 per cent.,	16	15	16	9	9	16	6	42	9	5	143	17
Samples between 8 and 9 per cent.,	20	10	11	10	7	34	20	68	29	39	248	29
Samples between 7.50 and 8 per cent.,	–	–	–	1	–	2	1	18	3	12	37	1
Highest per cent.,	9.80	10.65	9.76	9.75	9.74	9.80	9.46	10.24	9.43	9.61	10.65	9.48
Lowest per cent.,	8.13	8.00	8.40	7.96	8.47	7.77	7.89	7.50	7.63	7.55	7.50	7.63
Average per cent.,	9.10	9.37	9.09	8.85	8.81	8.76	8.63	8.67	8.59	8.28	8.77	8.76
Milk sugar: —												
Samples between 5 and 5.80 per cent.,	20	7	9	10	4	17	16	40	14	9	146	11
Samples between 4 and 5 per cent.,	16	21	18	10	12	35	11	90	27	47	287	36
Samples between 3.91 and 4 per cent.,	–	–	–	–	–	–	–	1	–	–	1	–
Highest per cent.,	5.80	5.22	5.46	5 34	5.29	5.75	5.30	5.58	5.35	5.20	5.80	5.25
Lowest per cent.,	4.10	4.46	4.35	4.50	4.36	4.20	4.05	3.91	4.20	4.08	3.91	4.35
Average per cent.,	4.94	4.84	4.87	4.94	4.86	4.85	4.88	4.65	4.93	4.70	4.78	4.83
Protein — fat ratio: —												
Highest per cent.,	0.80	0.82	0.86	0.90	0.91	0.98	0.92	0.99	0.97	0.99	0.99	0.95
Lowest per cent.,	0.46	0.55	0.58	0.60	0.62	0.56	0.59	0.55	0.71	0.62	0.46	0.66
Average per cent.,	0.61	0.71	0.74	0.75	0.79	0.76	0.75	0.82	0.83	0.86	0.78	0.82
Fat in total solids: —												
Highest per cent.,	47.4	38.6	38.8	35.9	35.4	40.4	36.3	40.0	31.8	33.5	47.4	37.1
Lowest per cent.,	33.1	31.0	30.1	30.6	27.7	27.9	27.2	25.0	26.3	25.0	25.0	28.2
Average per cent.,	38.3	35.9	33.9	33.0	32.7	32.8	31.8	31.3	30.9	29.2	32.5	31.6
Refraction of copper serum at 20° C.: —												
Samples between 40 and 40.4,	–	–	–	–	–	–	–	2	–	–	2	–
Samples between 39 and 40,	6	1	3	1	–	7	–	4	2	2	26	–
Samples between 38 and 39,	22	17	8	8	6	17	7	39	11	10	145	16
Samples between 37 and 38,	3	9	11	7	4	20	5	32	2	22	115	20
Samples between 36 and 37,	–	–	–	–	1	5	3	23	–	21	53	2
Total number of samples,	31	27	22	16	11	49	15	100	15	55	341	38
Highest scale reading,	39.5	39.0	39.3	39.0	38.8	39.7	38.8	40.4	39.0	39.3	40.4	38.8
Lowest scale reading,	37.1	37.0	37.2	36.6	36.6	36.0	36.0	36.0	37.3	36.0	36.0	36.7
Average scale reading,	38.1	38.2	38.0	38.0	38.0	37.9	37.7	37.6	38.3	37.2	37.9	37.8

Refraction of acetic serum at 20° C.: —												
Samples between 45 and 47.5,	3	4	–	2	–	–	–	2	3	–	14	–
Samples between 44 and 45,	7	11	2	4	–	4	3	4	5	3	43	3
Samples between 43 and 44,	5	8	10	10	7	6	5	12	12	4	79	6
Samples between 42 and 43,	1	3	7	1	3	5	10	12	14	8	64	12
Samples between 41 and 42,	–	2	1	1	1	6	2	12	6	5	36	3
Samples between 40 and 41,	–	–	–	–	1	2	–	4	–	14	21	–
Total number of samples,	16	28	20	18	12	23	20	46	40	34	257	24
Highest scale reading,	45.2	47.5	44.1	45.5	43.6	44.4	44.5	46.6	44.4	44.6	47.5	44.6
Lowest scale reading,	42.4	41.3	41.3	41.8	40.7	40.2	41.5	40 0	41.0	40.0	40.0	41.8
Average scale reading,	44.2	43.9	42.9	43.7	42.7	42.5	42.8	42.5	42.8	41.6	43.3	42.7
Refraction of sour milk serum at 20° C.: —												
Samples between 44 and 50.9,	1	–	–	–	–	1	–	12	–	–	14	–
Samples between 43 and 44,	5	–	2	–	2	7	–	13	–	1	30	3
Samples between 42 and 43,	6	–	3	1	1	5	1	11	–	4	32	7
Samples between 41 and 42,	2	–	–	–	1	5	3	13	–	8	32	5
Samples between 40 and 41,	1	–	2	1	1	4	–	3	–	3	15	–
Samples between 39 and 40,	–	–	–	–	–	2	2	10	–	3	17	–
Samples between 38.3 and 39,	–	–	–	–	–	–	1	3	–	3	7	–
Total number of samples,	15	–	7	2	5	24	7	65	–	22	147	15
Highest scale reading,	44.2	–	43.7	42 6	43.5	44.4	42.7	50 9	–	43.0	50.9	43.5
Lowest scale reading,	40.7	–	40.4	40.8	40.5	39.4	38.7	38.3	–	38.4	38.3	41.3
Average scale reading,	42.7	–	42.2	41.7	42.1	41.9	40.5	42.1	–	40.6	41.9	42.3
Ash of sour milk serum: —												
Samples between 0.9 and 0.932 grams per 100 c.c.,	–	–	–	–	–	–	1	2	–	–	3	–
Samples between 0.8 and 0.9 grams per 100 c.c.,	7	–	4	–	2	8	2	17	–	3	43	5
Samples between 0.730 and 0.8 grams per 100 c.c.,	8	–	2	2	1	10	1	35	–	9	68	8
Total number of samples,	15	–	6	2	3	18	4	54	–	12	114	13
Highest grams per 100 c.c.,	0.828	–	0.824	0.774	0.836	0.868	0.916	0.932	–	0.860	0.932	0.852
Lowest grams per 100 c.c.,	0.740	–	0.776	0.732	0.790	0.736	0.777	0.732	–	0.730	0.730	0 764
Average grams per 100 c.c.,	0.786	–	0.804	0.753	0.811	0.790	0.856	0.793	–	0.795	0.794	0.792

Known Purity Milk Samples according to Period of Lactation and Seasons.

	Number of Samples.	Total Solids (Per Cent.).	Fat (Per Cent.).	Proteins (Per Cent.).	Ash (Per Cent.).	Solids not Fat (Per Cent.).	Lactose (Per Cent.).	Refraction of —			Ash of Sour Serum.	Average Period of Lactation.
								Copper Serum.	Acetic Serum.	Sour Serum.		
Time since calving: —												
One month,	25	12.70	3.98	2.93	0.73	8.72	4.90	38.1	42.1	42.6	0.785	3 weeks
Two to five months,	82	12.76	3.97	3.19	0.74	8.79	4.86	37.7	42.6	41.8	0.779	3.4 months
Six to nine months,	58	13.03	4.14	3.43	0.75	8.89	4.71	37.7	42.3	42.0	0.817	7.5 months
Ten to fifteen months,	29	13.15	4.22	3.43	0.76	8.93	4.75	37.7	43.4	42.2	0.788	10.6 months
Highest,	-	15.86	6.30	4.08	0.89	9.81	5.58	39.7	44.5	44.5	0.900	-
Lowest,	-	10.64	2.80	2.33	0.65	7.50	4.20	36.0	38.3	40.0	0.731	-
Average,	194	12.89	4.06	3.29	0.75	8.83	4.81	37.7	42.6	42.1	0.793	5.4 months
Season of year: —												
Winter (December to February),	39	13.16	4.24	3.39	0.75	8.92	4.80	38.2	43.7	43.1	0.778	5.1 months
Spring (March to May),	70	12.65	3.92	3.19	0.75	8.73	4.78	37.7	42.5	42.0	0.811	5.6 months
Summer (June to August),	31	12.44	3.99	3.18	0.76	8.45	4.55	37.3	41.9	39.8	0.803	5.6 months
Fall (September to November),	54	12.84	4.00	3.27	0.76	8.84	4.87	37.9	42.4	40.4	0.801	4.7 months

These same analyses were then arranged by period of lactation, and for a reason similar to that stated above it was found necessary to make the averages according to periods of months instead of for single months. It so happens that the average period of lactation in the milk arranged by seasons was very uniform, so that these two tables are practically uninfluenced by each other, and the figures show that both these variations exist in milk; and according to these samples the variation according to season seems to be greater than that according to period of lactation. There is a relationship existing between the protein-fat ratio and the refractive index of the milk serum which is more noticeable in the case of the copper serum of the samples reported above, owing to the fact that a greater number of samples were examined by this method. In milk samples with a protein-fat ratio above 0.8 very few are found with a refractive index above 39.0, and with samples with a protein-fat ratio below 0.70 no samples were found with a refraction below 37.0, and a number of them were above 39.0. In the case of the acetic serum few of the samples with a protein-fat ratio below 0.70 gave serums which refracted less than 41.0, and of the sour serums obtained none refracted less than 40, with a protein-fat ratio of 0.70 or less. It is possible by using the protein-fat ratio as well as the refractive index of the serum, to detect samples of watered milk which would not be detected by depending upon the refractions of the serum alone. The use of the ash of the sour serum as well as the refractive index of the serum is a distinct advantage in detecting added water, as the mineral matter present has but little influence upon the refractive index of the serum, and if the sample is found watered by both methods the possibility of its being produced by a sick or otherwise abnormal cow is eliminated.

Cream.

Two hundred and nine samples were examined, of which 27 were found to be adulterated or below the standard; 7 of these samples were below the standard of 15 per cent. fat, and the balance contained added water. At first, it was impossible to reconcile the presence of added water with the high fat content of these samples, but subsequent investigation has shown the reason. There has been recently introduced a machine called the "homogenizer," which is capable of making thin cream thick by reason of the fact that it can break up the milk-fat globules into very small pieces. It is also possible to take unsalted butter and milk or skimmed milk, and by means of this machine produce an article which resembles cream. As butter usually contains from 12 to 16 per cent. of added water, introduced during the washing of the butter after churning, the resulting cream made from this butter will give reactions for added water if the fat is sufficiently high. The method used for examining the cream is to prepare a copper serum in the same manner as for milk, using, of course, a larger quantity of cream than of milk on account of the enormous volume of the precipitate. The examination of 97 samples of market cream by this method gave results varying from 37.0 to 39.0 on the scale of the Immersion Refractometer. Samples which fell below 36.5 were further examined by preparing an ash of the sour serum. A large quantity of cream is necessary for this purpose as the amount of serum is very small. After souring, the cream was shaken in a bottle until the fat had been turned into butter, then the serum was poured off and filtered, and the ash was determined on a 25 cubic centimeter portion of the serum. Experiments made on cream separated in the laboratory showed that the composition of the cream serum was identical with that obtained from milk from which the cream was made. All samples of cream which were reported adulterated gave copper serums refracting below 36.0 and sour serum with ash below .730 per cent., the refractions varying from 33.8 to 36.0 and the ash of the sour serum from .544 to .723 per cent. The following table shows the variation in refraction of serum found in 84 samples of commercial cream not declared adulterated: —

Number of Samples.	Fat (Per Cent.).	Average Fat (Per Cent.).	Average Copper Refraction (Per Cent.).
6,	6.6–15	10.1	38.2
12,	15–25	18.9	37.4
35,	25–35	30.1	37.8
31,	35–44	38.8	37.8
84,	6.6–44	30.6	37.8

Highest copper refraction, 39.0. Lowest copper refraction, 37.0.

There are two reasons why this product is on the market. In the first place it is an easy way to produce a large amount of cream at short notice when the demand for cream is high and the supply of milk is low. The storage butter is easily kept within reach, and there is sufficient skimmed milk in the creamery to emulsify with the butter. The second reason is that such cream is cheaper than pure cream. Butter fat is cheapest in the form of butter and most expensive in the form of milk. One pound of butter fat in the form of milk (4 per cent. fat) at 32 cents per 8½-quart can costs 47 cents per pound, and in the form of butter (80 per cent. fat) at 25 cents per pound costs 31 cents per pound. There is also a saving in the cost of transportation of butter over that of milk or cream.

This product cannot be shipped in interstate commerce as cream, and the frozen product made from it cannot be shipped under the name of ice cream according to the decision of the United States Department of Agriculture. Whether or not it can be sold in Massachusetts as cream has not as yet been passed upon by the courts (pleas of guilty having been made in all cases disposed of to date). It seems, however, that the sale of this product should be legalized, as it appears not to be unwholesome and no objections have been raised against its use other than those stated above. Cream being made from milk naturally contains all the constituents of milk but in different proportion, all the constituents except the fat becoming less as the fat increases, for if cream containing 100 per cent. fat could be prepared, the other constituents would be reduced to zero. The following table, showing the variation of the composition of cream, has been prepared upon the above assumption, and the figures agree within the limits of analytical error with analyses of samples of pure cream: —

Variation in Composition of Cream (Per Cent).

Fat.	Proteins.	Ash.	Sugar.
5,	2.83-3.49	0.70-0.75	4.78-4.96
10,	2.68-3.31	0.66-0.71	4.50-4.70
15,	2.53-3.12	0.63-0.68	4.26-4.44
20,	2.38-2.94	0.59-0.64	4.02-4.18
25,	2.23-2.75	0.55-0.60	3.75-3.92
30,	2.08-2.57	0.52-0.56	3.50-3.65
35,	1.94-2.39	0.48-0.51	3.26-3.39
40,	1.79-2.20	0.44-0.48	3.00-3.13
45,	1.65-2.02	0.41-0.45	2.73-2.87
50,	1.50-1.83	0.37-0.40	2.50-2.61
55,	1.34-1.65	0.33-0.38	2.26-2.35

Food exclusive of Milk.

There were 1,632 samples of food, exclusive of milk, examined during the year, of which 281 were found to be adulterated. The summary of statistics of food will be found on page 406. Under the several headings only such food as requires special mention will be discussed.

Baking Powder.

One sample was sold without the necessary label stating the name of each ingredient. This was the Pilgrim Baking Powder, and was an alum phosphate powder.

Butter.

Fifty-eight samples of butter were examined, of which 6 were adulterated. These consisted of 3 samples of oleomargarine, 1 sample of renovated butter and 2 samples of rancid butter. Fifteen samples of oleomargarine properly labeled and 7 of renovated butter properly labeled were obtained.

Canned Fish.

Five samples of smoked sardines and anchovies were examined, of which 4 were found to be decomposed. The methods of examination will be discussed in the report on the examination of cold-storage products.

Cider.

Fifty-one samples were examined, of which 34 were adulterated. These consisted of 2 samples containing salicylic acid, 1 of which also contained benzoic acid, and 32 samples which contained benzoic acid. Seven samples contained benzoic acid and were properly labeled, 1 sample contained sugar and was properly labeled, and 1 sample contained added water.

Cocoa.

Eighteen samples were examined, all of which were found pure. Determinations of moisture, fat, ash, fiber, pentosans and cocoa red were made upon all samples. The results of these analyses are shown in the following table: —

	Moisture (Per Cent.).	Fat (Per Cent.).	Fat-free Substance.			Cocoa Red (Per Cent.).
			Ash (Per Cent.).	Fiber (Per Cent.).	Pentosans (Per Cent.).	
Highest,	4.80	25.07	7.78	8.32	4.55	16.22
Lowest,	2.60	15.07	5.80	5.33	3.97	11.17
Average,	3.87	19.95	6.58	6.35	4.44	14.06
Dutch process, average,	4.76	24.37	9.87	6.24	4.47	13.47

Five samples of cocoa made by the so-called Dutch process, which consists in treating the cocoa with alkali, were examined, and the average results obtained are shown in the table. These samples were all labeled in a proper manner. This style of cocoa is easily distinguished from the other cocoa by the higher ash content.

Coffee.

Twenty-one samples were examined, 9 of which were adulterated with chicory, cereal, or both. Four samples containing chicory were correctly labeled. All samples were examined for fat, cold-water extract and reducing sugars, the results of which are shown in the following table: —

	Fat (Per Cent.).	Cold-water Extract (Per Cent.).	Reducing Sugars (Per Cent.).
Good samples: —			
Highest,	19.05	24.45	1.35
Lowest,	11.05	20.00	0.37
Average,	14.31	22.29	0.74
Bad samples: —			
Highest,	12.65	29.00	5.43
Lowest,	7.35	18.90	0.53

Confectionery.

Two samples of confectionery were reported adulterated, 1 of which was peanut taffy containing 1 per cent. of stones, each stone about the size of a peanut, and 1 sample of marshmallow kisses, which contained 2.5 per cent. of paraffin. Six samples of marshmallows were examined for sulphur dioxide, with negative results. A number of samples of Easter eggs were examined for talc, with negative results, the coating in all cases being starch and beeswax. Four samples of candy alleged to have caused sickness were sent in, and nothing injurious was found in any of them.

Eggs.

Eighty-nine samples of eggs were examined, of which 24 were decomposed; 2 of these decomposed samples were of eggs in the shell, the balance were broken-out eggs. The eggs were examined, as reported in the 1911 report, for ammonia and acidity, and the following table has been compiled from the results obtained during this and previous years: —

	Number of Samples.	Milligrams of Ammonia per 100 Grams.			Acidity Cubic Centimeters N/10 Alkali per 100 Grams.		
		Highest.	Lowest.	Average.	Highest.	Lowest.	Average.
Fresh eggs,	28	1.30	0.39	0.84	26	15	20.5
Storage eggs,	50	3.33	1.04	2.39	27	17	22.0
Broken-out rotten eggs,	122	18.40	6.20	–	60	21	–
Whole rotten eggs,	1	9.84	–	–	20	–	–
Frozen whole rotten eggs,	1	12.90	–	–	–	–	–

Flavoring Extracts.

Lemon Extract. — Ten samples were found adulterated and 52 were found pure. The polarization was determined upon all samples, and the citral was determined upon those samples polarizing zero. A number of citral determinations, however, were made upon samples running high in lemon oil, and the results of these analyses are given in the following table: —

Number of Samples.	Lemon Oil (Per Cent.).			Citral (Per Cent.).		
	Highest.	Lowest.	Average.	Highest.	Lowest.	Average.
15,	9.2	4.2	6.6	0.353	0.143	0.252
4,	1.2	0.4	0.67	0.170	0.075	0.145
8,	0.0	0.0	0.00	0.300	0.011	0.156

It will be noticed that the citral content of the samples containing the oil was much higher in the pure than in the so-called terpeneless extracts, yet there was more or less citral present in the latter, showing that this form of extract possesses some flavoring value.

Vanilla Extract. — Forty-one samples were examined, 5 of which were weak extracts reinforced with vanillin, or contained coumarin. In the majority of these extracts determinations of vanillin, coumarin and lead number were made. These results, including those obtained from the tinctures of vanilla obtained from drug stores and the analyses made by Winton, have been plotted. This plot shows that in pure extract as the lead number decreases the vanillin increases, therefore it is easy to distinguish by this means an extract reinforced with vanillin from an extract low in vanilla.

Wintergreen Extract. — The single sample of wintergreen extract found adulterated was labeled 3 per cent. wintergreen oil, and contained but 1.82 per cent. The balance of the extracts were either up to strength or were properly labeled.

Fruit Juices.

Fruit Juices. — Eighteen samples of grape juice, 1 of grape fruit juice and 19 of lime juice were examined and found to be pure. Two samples of lime juice were found adulterated, one, of J. P. W. von Laer & Co. of Boston, contained 50 per cent. water, without any statement to this effect being on the label. Another sample, put up by Delano, Potter & Co., was labeled 50 per cent. added water and contained 63 per cent. added water.

Ice Cream.

One hundred and thirty-two samples were examined, 123 of which contained more than the 7 per cent. of fat required by the statute. This fat standard is abnormally low. Most States which have ice-cream standards require from 12 to 15 per cent. fat, and the figures obtained from the samples examined warrant such a standard as being reasonable. Ninety-three and two-tenths per cent. of the total samples examined were above the fat standard, containing an average of 11.95 per cent. fat. Eighty-four samples, or 63.6 per cent. of the total samples, contained more than 10 per cent. fat, the average fat for these samples being 13.61 per cent. Sixty-four samples, or 48.50 per cent., contained more than 12 per cent. fat, with an average of 14.46 per cent. In view of these results it seems feasible that the minimum fat standard for ice cream should be raised from 7 per cent. to at least 10 per cent. and possibly 12 per cent. without any injustice to the dealer. The method used for the determination of fat was that described by H. F. Lichtenberg (Jour. Ind. and Eng. Chem., 1913, 786): weigh into a 10 per cent. Babcock milk bottle 9 grams of melted sample; add 20 cubic centimeters of glacial acetic acid, specific gravity, 1.049, mix well and add 10 cubic centimeters of sulphuric acid, specific gravity 1.83; mix again and proceed as in the regular Babcock test; multiply the reading of the fat column by 2 to get the per cent. of fat. This method is inclined to give results a trifle low; therefore, upon all samples showing less than 7 per cent. fat, the following method was performed to obtain the correct percentage of fat: weigh a 10-gram portion into a beaker, dilute with water containing a little asbestos, mix thoroughly, add some copper sulphate solution and filter; wash, dry and extract the precipitate with ether in a continuous extraction apparatus; evaporate the ether and weigh the fat.

Jams and Jellies.

Sixty samples of jams and jellies were examined, 1 of which contained preservative without being so labeled. Of the balance, 3 samples of fruit jams, 1 of jelly and 1 of maraschino cherries contained preservatives and were properly labeled; 4 samples of fruit jams contained apple and were properly labeled. No adulteration was detected in the balance of the samples.

Lard.

Sixty-eight samples of lard were examined, of which 48 were pure lard, 13 were compound lard correctly labeled, and 7 compound lard incorrectly labeled. The compounds were the usual mixtures of cottonseed oil with beef stearin, lard stearin or both; 1 sample, however, sold as lard consisted of hydrogenized oil.

Maple Sugar.

One hundred and five samples were examined, 41 of which contained more or less cane sugar. The amount of cane sugar was distributed about as follows: —

90 per cent. cane sugar, ...	6 samples.
80 per cent. cane sugar, ...	3 samples.
60 per cent. cane sugar, ...	2 samples.
50 per cent. cane sugar, ...	5 samples.
40 per cent. cane sugar, ...	9 samples.
30 per cent. cane sugar, ...	4 samples.
20 per cent. cane sugar, ...	12 samples.

Meat Products.

One hundred and sixty-six samples of meat products were examined, 32 of which were adulterated. One sample of canned meat was decomposed. Thirteen samples of hamburg steak contained preservatives and were properly labeled, 2 samples contained sodium benzoate and 6 sodium sulphite without the necessary label, 1 sample was decomposed, the other 30 samples were free from preservatives. One sample of mince meat contained sodium benzoate and was not so marked, 1 sample contained preservative and was properly labeled, and the balance of 8 contained no preservative. Fifty samples of sausages were found to be pure, 6 samples contained cereal and were properly marked, 21 samples contained cereal and were not marked, and 1 sample was decomposed.

Non-alcoholic Drinks.

Eighty-two samples of soft drinks were examined, none of which were reported as adulterated. Seventy-nine samples were examined for preservatives; all but 1, which was properly labeled, were found free from preservatives. Sixty samples were examined for glucose, with negative results, and the same samples were examined for saccharine, in 26 of which it was present. It was reported to us that carbonated water was being manufactured from flue gas, and that the gas used was not thoroughly purified before being introduced into the water. As a result of this complaint, 3 syphons of carbonated water were examined for carbon monoxide, with negative results.

Olive Oil.

Forty-three samples of olive oil were examined, 2 of which contained 65 and 100 per cent., respectively, of cottonseed oil; 1 sample contained cottonseed oil and was properly labeled; another sample gave the Halphen reaction for cottonseed oil, but a determination of other constants gave the same figures that would be expected from pure olive oil, showing that the adulterant was present to an extent less than 1 per cent.

Proprietary Foods.

One sample of Bracer Wild Cherry was examined and found to contain 8.72 per cent. alcohol.

Shrimp.

Eighteen samples were examined, 1 of which was preserved with sodium benzoate and was correctly labeled, 2 contained borax and were not so labeled, and 3 were decomposed.

Soda Water Syrups.

Sixty-five samples of soda water were obtained, 32 of which contained benzoic acid. At the same time 7 samples of college ices were obtained, in 1 of which benzoic acid was found. The dealers were all sent notices to place signs in their stores in order to notify their customers that the fruit syrups used there contained sodium benzoate.

Table Sauces.

One sample of Armour's tomato bouillon contained benzoic acid; 3 samples of catsup and pickles were examined and found to contain sodium benzoate, according to the statement upon the label; the other 10 samples were free from preservatives.

Vinegar.

Four samples were below the standard in acidity, 1 of which was a sample of hard cider containing 6.17 per cent. alcohol, 1.76 per cent. acid; another was a sample of wine vinegar containing 7.40 per cent. alcohol and 2.86 per cent. acid; 1 sample of molasses vinegar contained 4.42 per cent. acid, and 1 sample of cider vinegar contained 4.36 per cent. acid. Two samples of cider vinegar were slightly below the standard for solids, containing 1.75 and 1.76 per cent. solids; 1 sample of cider vinegar contained 1.34 per cent. solids; 2 samples of molasses vinegar were submitted as cider vinegar.

Summary of Statistics of Food exclusive of Milk.

	Genuine.	Adulterated.	Totals.		Genuine.	Adulterated.	Totals.
Baking powder,	5	1	6	Flavoring extracts — *Con.*			
Bread,	1	–	1	Lemon,	52	19	71
Breakfast foods,	1	–	1	Maple,	1	–	1
Buckwheat flour,	1	–	1	Orange,	1	–	1
Butter,	52	6	58	Peppermint,	7	–	7
Cake frosting,	1	–	1	Vanilla,	36	5	41
Canned fish,	1	4	5	Wintergreen,	9	1	10
Canned fruits and vegetables,	9	–	9	Fruit juice: —			
Canned soup,	3	–	3	Grape,	18	–	18
Cider,	17	34	51	Grape fruit,	1	–	1
Cocoa,	18	–	18	Lime,	19	2	21
Coffee,	12	9	21	Honey,	15	–	15
College ices,	6	1	7	Horse-radish,	2	–	2
Condensed milk,	8	–	8	Ice cream,	123	9	132
Confectionery,	46	2	48	Jams and jellies,	59	1	60
Cordials,	4	–	4	Lard,	61	7	68
Corn meal,	1	–	1	Maple sugar,	64	41	105
Cream,	182	27	209	Maple syrup,	14	2	16
Cream of tartar,	19	–	19	Maté,	1	–	1
Dried fruits,	3	1	4	Meat products: —			
Eggs,	65	24	89	Canned meats,	17	1	18
Flavoring extracts: —				Frogs' legs,	2	–	2
Ginger,	2	–	2	Hamburg steak,	44	8	52

Summary of Statistics of Food exclusive of Milk — Concluded.

	Genuine.	Adulterated.	Totals.		Genuine.	Adulterated.	Totals.
Meat products — *Con.*				Pickles, ...	16	2	18
Head cheese, . . .	2	–	2	Proprietary foods, . . .	–	1	1
Mince meat, . . .	8	1	9	Rice, ...	2	–	2
Pork chops, ...	2	–	2	Salad dressing, . . .	5	–	5
Pressed meat, . . .	1	–	1	Shrimp, ...	13	5	18
Sausages, ...	57	22	79	Soda water syrups, . .	33	32	65
Tripe, ...	1	–	1	Spices, ...	32	–	32
Molasses, ...	1	–	1	Syrup, ...	7	–	7
Non-alcoholic drinks, . .	82	–	82	Table sauce, ...	13	1	14
Nuts, ...	1	–	1	Tea, ...	2	–	2
Olive oil, ...	41	2	43	Vinegar, ...	13	10	23
Oysters, ...	8	–	8	Wine, ...	2	–	2
Peanut butter, . . .	6	–	6	Totals, ...	1,351	281	1,632

Drugs.

One thousand three hundred and ninety-three samples of drugs were examined, of which 204 were adulterated. Only such drugs as deserve special comment will be discussed.

Alcohol.

Eighty-six samples were collected, of which 14 were below the standard; 10 of these were approximately 70 per cent. and 1 each was approximately 30, 40, 50 and 80 per cent. alcohol.

Aspirin Tablets.

Five samples of 5-grain aspirin tablets were obtained and examined. They were found to contain from 4.16 to 5 grains per tablet. The melting point of the aspirin obtained was found to vary from 124.5° to 129.5° C.; the melting point of pure aspirin is 135. The low melting point obtained is due to a small amount of salicylic acid which is generally present as a decomposition product in commercial aspirin. The samples were examined for acetanilid and other similar substances with negative results.

Denatured Alcohol.

Four samples of denatured alcohol and 1 sample of wood alcohol were obtained, all of which were sold with the necessary poison label.

Elixir of Potassium Bromide.

Twenty samples were examined, 3 of which were below the National Formulary strength, containing, respectively, 71, 75 and 78 per cent. of the required amount of potassium bromide.

Olive Oil.

Twenty-eight samples were obtained from drug stores, all of which were pure olive oils. The value of the inspection work of the department can be seen by a study of the results of analyses of drug samples of olive oil during the past twelve years. In 1901, 27 per cent. of the total samples collected were adulterated; in 1902, 29 per cent.; in 1903, 31 per cent.; in 1904, 29 per cent.; in 1905, 7 per cent.; in 1906, 13 per cent.; in 1907, 0.80 per cent.; in 1908, 3.2 per cent.; 1909, 9.2 per cent.; and in 1910 to 1913, inclusive, all the samples were pure.

Proprietary Drugs.

Thirty-four samples were examined, 1 of which, a sample of Quinine-Whiskey put up by the Quinine-Whiskey Company, Louisville, Ky., contained 30.04 per cent. alcohol by volume, without bearing the necessary label stating this fact. The proprietary medicines containing acetanilid, phenacetine and morphine were all correctly labeled. There are upon the market at present certain proprietary medicines containing strychnine, over the sale of which the law has no control. A sample of olive tablets was found to contain strychnine, aloes and atropine. Some of these tablets are said to have killed a child in this State. Samples of Make-Man-Tablets were found to contain strychnine, and no doubt other proprietary drugs could be obtained in which strychnine could be found. Samples of unusual combinations were submitted in broken packages. One was an Obesity Powder, for external use only. Directions: use ½ to 1 teaspoonful with 3 volumes of water, and rub. This consisted largely of magnesium carbonate and perfume. Prolaxo tablets, made by the same person, contained magnesium carbonate, with a small amount of a bitter principal; no alkaloids or acetanilid, etc., were detected. Fermostop Tablets, made by the same person, were found to contain magnesium carbonate, and to be free from alkaloids, acetanilid, etc. A sample of catarrh powder, sold by a peddler in the city of Salem and submitted by the local board of health, was found to contain 48 per cent. cane sugar, 46 per cent. sodium bicarbonate and 6 per cent. of an herb resembling slippery elm bark.

Quinine Pills.

Thirty-six samples of 2-grain quinine pills were examined, 2 of which contained, respectively, 1.66 grains and 1.73 grains of quinine sulphate per pill; the balance contained about 2 grains per pill, according to the requirement of labels on the packages.

Spirits.

Seven hundred and forty-nine of the various forms of spirits were examined, of which 129 were adulterated. The single samples of whiskey and bay rum were of the quality required by the Pharmacopœia; all of the other varieties of spirits contained some adulterated samples.

Precipitated Sulphur.

Thirty-one samples were examined, 4 of which were adulterated, containing, respectively, 2, 12, 22 and 42 per cent. calcium sulphate. Calcium sulphate is present in these preparations as the result of improper manufacture. The Pharmacopœia directs that the sulphur be dissolved in lime, precipitated with hydrochloric acid and washed until free from lime salts. Sulphuric acid is sometimes used as a precipitant, which causes the separation of a large amount of insoluble calcium sulphate. The only reason for using sulphuric acid is for the purpose of filling the product with calcium sulphate as an adulterant.

Tinctures.

Three hundred and seventy-six samples of tinctures were examined. 53 of which were adulterated. No adulteration was detected in the samples of tinctures of capsicum, digitalis and sweet tincture of rhubarb. The single sample of tincture of ginger examined was either diluted with alcohol, or insufficient ginger or partly exhausted ginger was used in its preparation. Of the 58 samples of tincture of vanilla examined, 6 were the compound tincture of vanillin described in the National Formulary. The following table shows the variation from the United States Pharmacopœial requirements of the various spirits and tinctures found adulterated: —

Number of Samples.

	PER CENT. OF U. S. P. STRENGTH.										Totals.
	90	80	70	60	50	40	30	20	10	0	
Tinctures: —											
Ferric chloride,	–	1	–	–	–	–	–	–	–	–	1
Iodine,	11	10	8	4	4	2	–	1	1	–	41
Spirits: —											
Anise,	–	2	6	2	3	–	1	–	–	1	15
Camphor,	–	5	3	6	1	–	–	–	–	–	15
Nitrous ether,	–	7	10	13	10	1	1	1	2	1	46
Gaultheria,	–	2	1	–	3	–	–	–	–	–	6
Lemon,	–	–	–	–	–	–	–	–	–	4	4
Peppermint,	1	10	7	10	3	4	2	–	–	6	43

Mercurial Ointment.

The 2 samples reported adulterated were obtained from one dealer, and consisted of blue ointment below the required strength.

Summary of Drug Statistics.

CHARACTER OF SAMPLE.	Genuine.	Adulterated.	Totals.	CHARACTER OF SAMPLE.	Genuine.	Adulterated.	Totals.
Alcohol,	72	14	86	Potassii bitartras,	1	–	1
Aqua hamamelidis,	13	–	13	Proprietary drugs,	33	1	34
Aqua hydrogenii dioxidi,	3	–	3	Pulvis effervescens compositus,	1	–	1
Aqua rosæ,	1	–	1	Quinine pills,	34	2	36
Aspirin tablets,	5	–	5	Sodii boras,	4	–	4
Calx chlorinata,	1	–	1	Sodii phosphas,	2	–	2
Cera flava,	3	–	3	Spiritus ætheris nitrosi,	88	46	134
Denatured alcohol,	4	–	4	Spiritus anisi,	52	15	67
Elixir potassii bromidi,	17	3	20	Spiritus camphoræ,	180	15	195
Gin,	3	–	3	Spiritus frumenti,	1	–	1
Glycerinum,	1	–	1	Spiritus gaultheriæ,	57	6	63
Insecticide,	1	–	1	Spiritus limonis,	5	4	9
Oleum amygdalæ expressum,	18	–	18	Spiritus menthæ piperitæ,	236	43	279
Oleum olivæ,	28	–	28	Spiritus myrciæ,	1	–	1

Summary of Drug Statistics — Concluded.

Character of Sample.	Genuine.	Adulterated.	Totals.	Character of Sample.	Genuine.	Adulterated.	Totals.
Sulphur præcipitatum, . .	27	4	31	Tinctura vanillæ, ...	52	6	58
Tinctura capsici, . . .	6	–	6	Tinctura zingiberis, . .	–	1	1
Tinctura digitalis, . . .	2	–	2	Unguentum hydrargyri, .	4	2	6
Tinctura ferri chloridi, . .	4	1	5	Unguentum zinci oxidi, . .	1	–	1
Tinctura iodi, ...	226	41	267	Wood alcohol, ...	1	–	1
Tinctura rhei dulcis, . .	1	–	1	Totals, ...	1,189	204	1,393

Inspection of Liquors.

The police department of 16 cities and towns submitted 75 samples of liquors, of which 50 contained more than 1 per cent. and 25 less than 1 per cent. of alcohol. The table below gives the number and character of the samples obtained from the different localities. The attendance of the assistant analysts has been required in the lower courts of Attleborough, Barnstable, Lawrence, Lynn, Northampton and Quincy, and in the Superior Court of Hampshire County.

Summary of Liquor Statistics.

Locality.	Cider.	Beer.	Wine.	Whiskey.	Beef, Iron and Wine.	Jamaica Ginger.	Miscellaneous and Remarks.	Totals.
Attleborough, .	3	1	–	–	–	1	– –	5
Barnstable, . .	–	–	–	–	2	2	– –	4
Boston, . . .	–	1	1	–	–	–	4 (2, unknown; 2, malt extract),	6
Danvers, . .	1	–	–	–	–	–	– –	1
Dedham, . .	5	–	–	–	–	–	– –	5
Foxborough, . .	–	–	–	–	–	3	– –	3
Lawrence, . .	1	–	–	–	–	–	– –	1
Lee, . . .	–	–	1	–	–	–	– –	1
Lynnfield, . .	–	–	1	–	–	–	– –	1
Lynn, . . .	10	2	4	–	–	–	– –	16
Millis, . . .	–	–	–	1	–	–	– –	1
Quincy, . . .	–	–	–	–	–	–	3 (1, unknown; 1, preserved fruit; 1, jamaica ginger and cider).	3
Revere, . . .	–	23	–	–	–	–	– –	23
Rockport, . .	–	–	2	–	–	–	– –	2
Royalston, . .	–	1	–	–	–	–	– –	1
Waltham, . .	2	–	–	–	–	–	– –	2
Totals, . .	22	28	9	1	2	6	7 – –	75

Examination of Poisons.

One hundred and forty-one samples of poison were submitted during the year, 7 of which were declared legal and 134 illegal. One hundred and three of these samples were submitted by the Boston police, 31 by the Watch and Ward Society, 3 by the district police, and 1 each by the Plymouth and Cambridge police, Concord Reformatory, and Fish and Game Commission. The sample submitted by the Fish and Game Commission consisted of a small ball of grease found in the woods, apparently for the purpose of killing wild animals; this sample contained strychnine. The sample submitted by the police department of Plymouth consisted of a mixture of a powder with some oats and dirt in a bag; the powder was found to be arsenious oxide. A note accompanying the package stated that this powder was being used to poison horses. One sample obtained from the Boston police had the appearance of plant stems, etc., coarsely ground; morphine was found in this sample. Two of the samples submitted by the district police were wine and granulated sugar, of which both were found free from poison; the other samples submitted by the district police consisted of celery on which was a green deposit; this deposit was found to contain copper. The sample submitted by the Cambridge police was cocoa, all prepared for drinking, and was obtained from a man who suspected somebody was attempting to poison him; no poison was detected in the substance. A sample of milk was submitted by the Boston police department and was found to contain 13 per cent. of commercial wood alcohol. This was said to have been prepared for a woman by her husband. He was tried in the court of East Boston and held for the grand jury. The grand jury reported no bill.

Summary of Poison Statistics.

	Boston Police.	Cambridge Police.	Concord Reformatory.	District Police.	Fish and Game Commission.	Plymouth Police.	Watch and Ward Society.	Totals.
Morphine sulphate, ...	30	–	–	–	–	–	12	42
Morphine pills or tablets, ...	7	–	–	–	–	–	3	10
Substance containing morphine, . .	1	–	–	–	–	–	–	1
Heroin, ...	1	–	–	–	–	–	–	1
Heroin tablets, ...	19	–	–	–	–	–	2	21
Gum opium, ...	10	–	–	–	–	–	6	16
Opium ash, ...	8	–	–	–	–	–	–	8
Cocaine hydrochloride, ...	25	–	–	–	–	–	5	30
Proprietary medicines containing cocaine, .	–	–	–	–	–	–	3	3
Alleged poisons, ...	1	1	1	3	1	1	–	8
Blood, ...	1	–	–	–	–	–	–	1
Totals, ...	103	1	1	3	1	1	31	141

Examination of Articles in Cold Storage.

Eighty-three samples of articles held in cold storage were submitted, to see whether or not they could be destroyed, of which 45 were reported decomposed and 38 not decomposed. The character of these samples is shown in the accompanying table. The methods used in the examination of these samples were the determination of ammonia by the Folin method and the determination of total nitrogen. The samples were first passed through a meat chopper and a 5-gram sample weighed into a cylinder. Water, sodium, carbonate solution and potassium oxalate solution, together with a little oil, were added, and a current of ammonia free air was blown through the liquid, after which it was passed into a 100 cubic centimeter flask containing 2 cubic centimeters of tenth normal acid in 50 cubic centimeters of water. The blast was discontinued after two hours, the contents of the flask were treated with 5 cubic centimeters of Nessler's solution, previously diluted with 25 cubic centimeters of water, and made up to the mark. The ammonia was then determined in this solution by comparison in a Dubosque colorimeter, with a standard ammonia solution treated in the same way with the Nessler solution. The total nitrogen was determined by the Gunning method, using a 1 to 1½ gram sample. The ammonia was calculated first as milligram to 100 grams of sample, and second as per cent. of total nitrogen as ammonia. This latter figure is of course independent of all constituents except the nitrogen, and shows the relative deterioration of the protein substances. At present all samples containing less than 0.50 per cent. of the total nitrogen in the form of ammonia have been declared good. The average figure obtained from the samples declared good is about 0.35 per cent. The following table gives the summary of the examination of these samples, together with those examined in the course of the regular inspection of foods: —

Summary of Analyses of Meat and Fish for Decomposition.

	Ammonia Milligrams per 100 Grams.	Nitrogen (Per Cent.).	Total Nitrogen as Ammonia (Per Cent.).
Samples reported undecomposed.			
Canned fish: —			
Highest,	8.5	3.77	0.26
Lowest,	1.5	2.99	0.10
Average,	4.7	3.27	0.14
Chicken: —			
Highest,	20.1	4.86	0.50
Lowest,	7.3	3.23	0.26
Average,	16.0	4.26	0.38
Beef, moose and venison: —			
Highest,	16.8	4.23	0.50
Lowest,	6.3	2.77	0.23
Average,	11.0	3.46	0.33
Samples reported decomposed.			
Canned fish: —			
Highest,	91.0	4.11	2.60
Lowest,	18.3	2.99	0.56
Average,	31.8	3.53	0.90
Chicken: —			
Highest,	25.3	4.23	0.52
Lowest,	18.8	3.11	0.69
Average,	22.1	3.68	0.60
Poultry other than chicken: —			
Highest,	40.3	4.48	1.29
Lowest,	17.2	3.11	0.51
Average,	35.9	3.61	0.72
Beef, moose and venison: —			
Highest,	63.4	4.34	1.66
Lowest,	22.4	3.63	0.52
Average,	42.7	3.93	1.09

Summary of Cold-storage Statistics.

Character of Sample.	Good.	Decomposed.	Totals.	Character of Sample.	Good.	Decomposed.	Totals.
Beef,	1	–	1	Mutton chops,	3	–	3
Broilers,	1	2	3	Pigeons,	4	–	4
Butter,	1	–	1	Plover,	–	2	2
Chickens,	14	11	25	Pollock,	1	1	2
Ducks,	–	2	2	Sand peep,	2	–	2
Eggs,	1	15	16	Squab,	1	3	4
Fowl,	1	–	1	Squid,	1	–	1
Goose,	–	1	1	Turkeys,	2	1	3
Heart,	–	1	1	Venison,	4	4	8
Kidney,	–	1	1	Totals,	38	45	83
Liver,	1	1	2				

General Summary.

	Legal.	Illegal.	Totals.
Milk,	5,020	1,682	6,702
Foods exclusive of milk,	1,351	281	1,632
Drugs,	1,189	204	1,393
Totals,	7,560	2,167	9,727
Cold storage,	38	45	83
Poisons,	7	134	141
Liquor,	50	25	75
Totals,	7,655	2,371	10,026

Respectfully submitted,

HERMANN C. LYTHGOE.

REPORT UPON AN ACT

RELATIVE TO THE

COLD STORAGE OF CERTAIN FOOD PRODUCTS.

Report on the Business of Cold Storage.

The subject of the preservation of articles of food for future use, through the medium of refrigeration or cold storage, has been one to which we have given particular attention during the past year. One inspector has been stationed at the cold-storage warehouses every day, with instructions to note the effect of refrigeration on all articles of food. This necessitated a close physical examination of the goods when placed in cold storage and a chemical analysis of the same articles of food when taken out of storage within the statutory period of twelve calendar months. As a result of many such examinations we feel quite satisfied that only slight changes take place in their condition during storage, provided proper refrigeration has been maintained.

I am aware there is a more or less prevalent idea in the mind of the public that cold storage is for the purpose of providing a place to restore articles that, for some reason, have become unfit for food to a condition whereby they may be made edible, but our observations have convinced us that this idea is erroneous. We find that articles of food in the very best condition do not come out in exactly the same condition in which they were when placed in storage; that there is always a change from the original condition due to age, if nothing else. We also find that articles of food which, for some reason, have become decomposed, tainted, soiled, or otherwise unfit for food, when placed in storage will be even more unfit for food when taken out. Cold storage is not intended to redeem articles unfit for food but is for the purpose of preserving them as near as possible to their original condition when placed in storage. It is therefore obvious that the effect has been to make cold storage an indispensable factor in the present system of storing, preserving and distributing the food supply of the country.

It is established that cold storage is a practical means of successfully conveying perishable food products to the consumer without harmful exposure to heat or anything that might cause their deterioration, making it possible for articles of food to be delivered to the consumer in a wholesome condition.

The leading commodities subject to cold storage are perishable foodstuffs of seasonable production, including such articles as fresh meats, fresh meat products, fresh food fish, poultry, eggs and butter.

It is well known that the production of these commodities is confined to certain seasons of the year; for example, the heavy-producing season for eggs is in the months of April, May and June, whereas, the season for the heavy production of butter is in June, July and August. The season for poultry is not so confined as it is for eggs, and the same can be said of fish, although certain fish are caught in the largest volume during certain periods, sometimes within two weeks and often extending over two months. Were it not for cold storage, a large quantity of these articles would become so altered that they would be unfit for food and would, consequently, have to be destroyed, thereby causing an unnecessary destruction of good food, adding to the high cost of living. It is at this point that cold storage enters to save and distribute the output of these perishable foodstuffs by carrying the surplus of the fresh season over to meet the shortage of the later season.

The above is the function cold storage plays in the proper preservation of articles of food, and our observations have shown us that such a position is being met in a practical way through refrigeration or cold storage.

On the other hand, there is the possibility of cold storage being used by speculators for the purpose of buying large quantities of food in the flush of the season, depositing them in cold storage until such time as a shortage in such commodities occurs, and then placing them on the market when large profits can be realized. When this occurs, it is an abuse of cold storage, and should not be used to discount the practical good effect of cold storage in the preservation of foodstuffs.

Notwithstanding the above commercial advantages from a speculative point of view, the fact remains that cold storage is a practical and necessary method of preserving articles of food for future use.

During the fiscal year ending Nov. 30, 1913, the inspectors of cold storage under this Board visited every cold-storage plant within the Commonwealth a number of times. Most of the places are kept in good sanitary condition and appear to be well-conducted, and the proprietors and managers all show a disposition to coöperate with this Board in the enforcement of the law governing the business of cold storage.

During the year it became necessary to condemn and destroy a large amount of articles intended for food on account of decomposition, taint, decay and being soiled; also, accidents to the refrigerating machinery. These were condemned on physical examination or chemical analysis, and were disposed of by rendering, incinerating, burial, or loaded with garbage and taken to sea.

At the beginning of the year, Dec. 1, 1912, there were thirty-seven licensed cold-storage warehouse plants, while forty-seven were licensed Nov. 30, 1913.

It was also found necessary to prosecute some of the depositors of goods in cold storage for retaining such articles in cold storage over twelve calendar months; also, for removing goods that had been in cold storage over twelve calendar months, without permission from this Board.

Nineteen requests for an extension of time on goods in cold storage over twelve calendar months were made and granted by the Board for the reasons given on each request, as will be seen in the following table: —

Name.	Kind of Goods.	Amount (Pounds).	Deposited in	Request for Extension to	Extension granted to	Reason of Board for such Extension.
Waterhouse & Morrison,	Mackerel,	355	Sept. 14, 1912,	Jan. 1, 1914	Oct. 1, 1913	Considered in cold storage sufficiently long.
W. C. Hunneman,	Butter,	120	June 29, 1912,	Jan. 1, 1914	Oct. 1, 1913	Considered in cold storage sufficiently long.
W. C. Hunneman,	Butter,	40	July 15, 1912,	Jan. 1, 1914	Oct. 1, 1913	Considered in cold storage sufficiently long.
Dr. G. A. Leland, Jr.,	Butter,	85	July 17, 1912,	Mar. 1, 1914	Oct. 1, 1913	Considered in cold storage sufficiently long.
Thomas D. Borst,	Poultry,	333	Aug. 27, to Sept. 14, 1912,	Feb. 1, 1914	Oct. 1, 1913	Considered in cold storage sufficiently long.
Thomas D. Borst,	Poultry,	1,263	Dec. 30, 1911, to Sept. 16, 1912,	Feb. 1, 1914	Oct. 1, 1913	Considered in cold storage sufficiently long.
Eastern Cold Storage Company,	Beef,	325	June 10, 1911,	Jan. 1, 1914	Oct. 1, 1913	Considered in cold storage sufficiently long.
	Beef,	200	June 21, 1911,	Jan. 1, 1914	Oct. 1, 1913	Considered in cold storage sufficiently long.
	Beef,	456	June 30, 1911,	Jan. 1, 1914	Oct. 1, 1913	Considered in cold storage sufficiently long.
	Beef,	100	June 30, 1911,	Jan. 1, 1914	Oct. 1, 1913	Considered in cold storage sufficiently long.
French River Textile Company,	Butter,	11 tubs	July 27, 1912,	Apr. 1, 1914	Nov. 1, 1913	Considered in cold storage sufficiently long.
G. M. W. Legg Company,	Poultry,	701	Sept. 13, 1912,	Apr. 11, 1914	Nov. 1, 1913	Considered in cold storage sufficiently long.
	Poultry,	601	Oct. 11, 1912,	Apr. 11, 1914	Nov. 1, 1913	Considered in cold storage sufficiently long.
	Poultry,	335	Oct. 14, 1912,	Apr. 11, 1914	Nov. 1, 1913	Considered in cold storage sufficiently long.
	Poultry,	153	Oct. 25, 1912,	Apr. 11, 1914	Nov. 1, 1913	Considered in cold storage sufficiently long.
J. F. Kimball & Co.,	Rabbits,	15 cases	May 9, 1912,	Feb. 1, 1914	Nov. 1, 1913	Considered in cold storage sufficiently long.
F. H. Hosmer & Co.,	Poultry,	680	May 9, 1912,	Jan. 1, 1914	Oct. 15, 1913	Considered in cold storage sufficiently long.
	Game,	58 dozen	May 9, 1912,	Jan. 1, 1914	Oct. 15, 1913	Considered in cold storage sufficiently long.
Arthur E. Dorr, Inc.,	Beef livers,	3,183	Nov. 1, 1912,	Dec. 1, 1913	Dec. 1, 1913	Good condition; request granted.

Total, 8,930 pounds, 11 tubs, 15 cases, 58 dozen.

During the month of November, 1913, the following convictions were secured because goods were held in cold storage longer than twelve calendar months, without the consent of the State Board of Health: —

Name of Defendant.	Place.	Result.
Thomas Soracco,	Boston,	Fined $10.
Edwin E. Winkley,	Lynn,	Case filed.

Also, on account of secreting goods in a cold-storage warehouse to prevent inspection: —

Name of Defendant.	Place.	Result.
Charles E. Barrett,	Lynn,	Case filed.

Annual Report of Goods placed in Cold Storage for the Year 1913.

Article.	Cases.	Dozens.	Packages.	Pounds.
Eggs, case,	796,029	23,880,870	–	–
Eggs, broken,	23	13	1,259	1,020,403
Butter,	13	–	506,783[1]	28,271,831½
Poultry,	1,287	12¾	39,990	9,765,709
Game,	23	421⅓	2,027[2]	33,150¼
Meat, fresh,	1,545[3]	½	44,701[4]	12,010,842
Meat products, fresh (except in process of manufacture).	100[5]	–	9,640	2,198,229½
Fish, fresh food,	1,011	–	10,305[6]	17,818,558
Totals,	800,031	23,881,317 7/12	614,705	71,118,723¼

[1] Includes 36,085 tubs and 544 boxes.
[2] Includes 13 boxes and 14 crates.
[3] Includes 1,021 boxes and 129 barrels.
[4] Includes 1 barrel.
[5] Reported as boxes.
[6] Includes 6,314 barrels and 8 gallons.

Annual Report of Goods held in Cold Storage.

Article.	Cases.	Dozens.	Packages.	Pounds.
Eggs, case,	1,427,660½	42,826,045	–	–
Eggs, broken,	127	341	1,348½	53,489
Butter,	960	47,900	461,340[1]	47,229,395½[2]
Totals,	1,428,747½	42,874,286	462,688½	47,282,884½

[1] Includes 74 tubs.
[2] Includes 204 pounds print butter.

Chemical Examinations of Cold Storage Goods made by the State Board of Health.

Articles.	Number found to be of Good Quality.	Number found to be Unfit for Food.	Total Number of Samples examined.
Beef,	1	–	1
Broilers,	1	2	3
Butter,	1	–	1
Chickens,	14	11	25
Ducks,	–	2	2
Eggs,	1	15	16
Fowl,	1	–	1
Goose,	–	1	1
Heart,	–	1	1
Kidneys,	–	1	1
Liver,	1	1	2
Mutton chops,	3	–	3
Pigeons,	4	–	4
Plover,	–	2	2
Pollock,	1	1	2
Sandpeeps,	2	–	2
Squabs,	1	3	4
Squid,	1	–	1
Turkeys,	2	1	3
Venison,	4	4	8
Totals,	38	45	83

Articles in Cold Storage condemned upon Physical and Chemical Examinations as unfit for Food.

Date.	Articles.	Weight (Pounds).	Reasons.	Dispositions.
Dec. 6, 1912	Poultry,	–	Decomposed,	Buried.
Dec. 6, 1912	Pork loins,	–	Decomposed,	Buried.
Dec. 20, 1912	Mackerel,	119¼	Decomposed,	Rendered.
Dec. 26, 1912	Broilers,	58	Decomposed,	Rendered.
Jan. 1, 1913	Veal,	100	Decomposed,	Rendered.
Jan. 1, 1913	Beef,	30	Decomposed,	Rendered.
Jan. 1, 1913	Kidneys,	200	Decomposed,	Incinerated.
Jan. 8, 1913	Turkey,	19	Decomposed,	Rendered.
Jan. 9, 1913	Goose,	6	Decomposed,	Rendered.

Articles in Cold Storage condemned upon Physical and Chemical Examinations as unfit for Food — Continued.

Date.	Articles.	Weight (Pounds).	Reasons.	Dispositions.
Jan. 10, 1913	Venison, ...	20	Decomposed, . . .	Rendered.
Jan. 17, 1913	Beef, ...	1,010	Decomposed, . . .	Rendered.
Jan. 29, 1913	Turkey, ...	27	Decomposed, . . .	Incinerated.
Mar. 18, 1913	Chicken, ...	16	Decomposed, . . .	Incinerated,
Mar. 18, 1913	Goose, ...	24½	Decomposed, . . .	Incinerated.
Mar. 19, 1913	Squab, ...	6	Decomposed, . . .	Incinerated.
Mar. 19, 1913	Turkey, ...	14	Decomposed, . . .	Incinerated.
Mar. 19, 1913	Beef, ...	20	Decomposed, . . .	Incinerated.
Mar. 20, 1913	Eggs, ...	900	Decomposed, . . .	Buried.
Mar. 22, 1913	Shad, ...	1,000	Decomposed, . . .	Bait.
Mar. 26, 1913	Chicken, ...	9	Decomposed, . . .	Incinerated.
Mar. 31, 1913	Squid, ...	5,000	Decomposed, . . .	Fertilizer.
Apr. 26, 1913	Fowl, ...	24	Tainted, ...	Incinerated.
Apr. 28, 1913	Veal, ...	100	Decomposed, . . .	Rendered.
Apr. 30, 1913	Lamb fries, ...	16	Decomposed, . . .	Incinerated.
Apr. 30, 1913	Livers, ...	12	Decomposed, . . .	Incinerated.
Apr. 30, 1913	Ducks, ...	12	Decomposed, . . .	Incinerated.
Apr. 30, 1913	Lamb, ...	60	Decomposed, . . .	Incinerated.
Apr. 30, 1913	Fish, ...	150	Decomposed, . . .	Rendered.
Apr. 30, 1913	Partridge, ...	9	Decomposed, . . .	Incinerated.
Apr. 30, 1913	Bluefish, ...	7	Tainted, ...	Incinerated.
May 1, 1913	Goose, ...	5	Decomposed, . . .	Incinerated.
May 2, 1913	Guinea fowl, . . .	62	Decomposed, . . .	Incinerated.
May 6, 1913	Livers, ...	6	Decomposed, . . .	Rendered.
May 10, 1913	Miscellaneous meat, . .	40	Decomposed, . . .	Rendered.
May 12, 1913	Sweetbreads, . . .	6	Decomposed, . . .	Rendered.
May 17, 1913	Venison, ...	14	Decomposed, . . .	Rendered.
June 16, 1913	Squid (food), . . .	65,000	Surcharged with ammonia,	Fertilizer.
Aug. 5, 1913	Lamb, ...	96	Decomposed, . . .	Incinerated.
Aug. 6, 1913	Fowl, ...	18	Decomposed, . . .	Incinerated.
Aug. 6, 1913	Eggs, ...	300	Decomposed, . . .	Incinerated.
Aug. 10, 1913	Turkeys, ...	37¾	Decomposed, . . .	Incinerated.
Sept. 5, 1913	Pigeons, ...	10	Decomposed, . . .	Incinerated.
Sept. 6, 1913	Venison, ...	49	Decomposed, . . .	Incinerated.
Sept. 10, 1913	Lamb, ...	79	Decomposed, . . .	Incinerated.
Sept. 11, 1913	Eggs, ...	2,370	Decomposed, . . .	Rendered.

Articles in Cold Storage condemned upon Physical and Chemical Examinations as unfit for Food — Continued.

Date.	Articles.	Weight (Pounds).	Reasons.	Dispositions.
Sept. 12, 1913	Eggs,	64	Decomposed,	Buried.
Sept. 13, 1913	Squabs,	100	Decomposed,	Incinerated.
Sept. 13, 1913	Moose,	93	Decomposed,	Incinerated.
Sept. 13, 1913	Coons,	22	Decomposed,	Incinerated.
Sept. 15, 1913	Geese,	939	Decomposed,	Rendered.
Sept. 18, 1913	Venison,	115	Decomposed,	Incinerated.
Sept. 23, 1913	Mackerel,	600	Decomposed,	Rendered.
Sept. 24, 1913	Eggs,	1,560	Decomposed,	Buried at sea.
Sept. 25, 1913	Mackerel,	1,125	Decomposed,	Rendered.
Sept. 25, 1913	Halibut,	95	Decomposed,	Rendered.
Sept. 25, 1913	Salmon,	150	Decomposed,	Rendered.
Sept. 26, 1913	Eggs,	1,384	Decomposed,	Buried at sea.
Sept. 26, 1913	Livers,	226	Decomposed,	Buried at sea.
Sept. 26, 1913	Plover,	30	Decomposed,	Incinerated.
Sept. 26, 1913	Squabs,	30	Decomposed,	Incinerated.
Sept. 26, 1913	Broilers,	250	Decomposed,	Incinerated.
Sept. 26, 1913	Broilers,	92	Decomposed,	Buried at sea.
Sept. 26, 1913	Ducks,	84	Decomposed,	Incinerated.
Oct. 1, 1913	Venison,	9	Decomposed,	Rendered.
Oct. 1, 1913	Plux,	1,500	Decomposed,	Rendered.
Oct. 1, 1913	Lamb,	51	Decomposed,	Rendered.
Oct. 1, 1913	Livers,	300	Decomposed,	Rendered.
Oct. 3, 1913	Partridges,	8	Decomposed,	Incinerated.
Oct. 3, 1913	Chickens,	158	Decomposed,	Incinerated.
Oct. 3, 1913	Turkeys,	80	Decomposed,	Incinerated.
Oct. 6, 1913	Eggs,	1,662	Decomposed,	Rendered.
Oct. 7, 1913	Turkeys,	18	Soiled,	Incinerated.
Oct. 9, 1913	Fowl,	150	Decomposed,	Rendered.
Oct. 14, 1913	Chickens,	839	Decomposed,	Rendered.
Oct. 14, 1913	Chickens,	156	Soiled,	Rendered.
Oct. 16, 1913	Ducks,	411	Decomposed,	Rendered.
Oct. 16, 1913	Venison,	238	Decomposed,	Rendered.
Oct. 16, 1913	Turkeys,	843	Decomposed,	Rendered.
Oct. 16, 1913	Coons,	15	Decomposed,	Rendered.
Oct. 16, 1913	Chickens,	344	Decomposed,	Rendered.
Oct. 16, 1913	Beef loins,	157	Decomposed,	Rendered.

Articles in Cold Storage condemned upon Physical and Chemical Examinations as unfit for Food — Continued.

Date.	Articles.	Weight (Pounds).	Reasons.	Dispositions.
Oct. 16, 1913	Quail,	118	Decomposed,	Rendered.
Oct. 16, 1913	Miscellaneous birds,	40	Decomposed,	Rendered.
Oct. 16, 1913	Ducklings,	86	Decomposed,	Rendered.
Oct. 16, 1913	Guinea chickens,	110	Decomposed,	Rendered.
Oct. 16, 1913	Moose,	89	Decomposed,	Rendered.
Oct. 16, 1913	Grouse,	46	Decomposed,	Rendered.
Oct. 16, 1913	Goose,	20	Decomposed,	Rendered.
Oct. 16, 1913	Pork tenderloins,	40	Decomposed,	Rendered.
Oct. 16, 1913	Pork,	73	Decomposed,	Rendered.
Oct. 16, 1913	Pigeons,	40	Decomposed,	Rendered.
Oct. 16, 1913	Squabs,	66	Decomposed,	Rendered.
Oct. 16, 1913	Lamb fries,	201	Decomposed,	Rendered.
Oct. 16, 1913	Lamb fores,	90	Decomposed,	Rendered.
Oct. 16, 1913	Lamb chops,	70	Decomposed,	Rendered.
Oct. 16, 1913	Broilers,	306	Decomposed,	Rendered.
Oct. 16, 1913	Frogs' legs,	50	Decomposed,	Rendered.
Oct. 16, 1913	Plover,	48	Decomposed,	Rendered.
Oct. 16, 1913	Fowl,	332	Decomposed,	Rendered.
Oct. 16, 1913	Sweetbreads,	187	Decomposed,	Rendered.
Oct. 16, 1913	Beef rounds,	61	Decomposed,	Rendered.
Oct. 16, 1913	Grass birds,	30	Decomposed,	Rendered.
Oct. 16, 1913	Oxtails,	82	Decomposed,	Rendered.
Oct. 16, 1913	Livers,	50	Tainted,	Rendered.
Oct. 16, 1913	Scallops,	28	Tainted,	Rendered.
Oct. 16, 1913	Livers,	80	Sour,	Rendered.
Oct. 16, 1913	Pork tenderloins,	42	Soiled,	Rendered.
Oct. 16, 1913	Pork loins,	46	Soiled,	Rendered.
Oct. 16, 1913	Ducks,	49	Soiled,	Rendered.
Oct. 16, 1913	Bear meat,	50	Soiled,	Rendered.
Oct. 16, 1913	Lobster meat,	40	Soiled,	Rendered.
Oct. 16, 1913	Chickens,	432	Soiled,	Rendered.
Oct. 16, 1913	Livers,	40	Soiled,	Rendered.
Oct. 16, 1913	Broilers,	488	Soiled,	Rendered.
Oct. 16, 1913	Fowl,	213	Soiled,	Rendered.
Oct. 16, 1913	Crab meat,	18	Soiled,	Rendered.
Oct. 16, 1913	Pigeons,	18	Soiled,	Rendered.

Articles in Cold Storage condemned upon Physical and Chemical Examinations as unfit for Food — Concluded.

Date.	Articles.	Weight (Pounds).	Reasons.	Dispositions.
Oct. 16, 1913	Guinea hens, ...	70	Soiled, ...	Rendered.
Oct. 17, 1913	Squabs, ...	80	Decomposed, . . .	Rendered.
Oct. 17, 1913	Turkeys, ...	127	Decomposed, . . .	Rendered.
Oct. 17, 1913	Ducks, ...	108	Decomposed, . . .	Rendered.
Oct. 17, 1913	Fowl, ...	82	Decomposed, . . .	Rendered.
Nov. 19, 1913	Venison, ...	80	Decomposed, . . .	Rendered.
Nov. 26, 1913	Venison, ...	27	Decomposed, . . .	Rendered.
Total, .	. . . .	95,312½		

RELATIVE

TO THE

SALE OF EGGS TAKEN FROM COLD STORAGE.

Relative to the Sale of Eggs taken from Cold Storage.

Acts of 1913, Chapter 538.

An Act relative to the Sale of Eggs taken from Cold Storage.

Be it enacted, etc., as follows:

Section 1. Whenever eggs that have been in cold storage are sold at retail, or offered or exposed for sale, the basket, box or other container in which the eggs are placed shall be marked plainly and conspicuously with the words "cold storage eggs", or there shall be attached to such container a placard or sign having on it the said words. If eggs that have been in cold storage are sold at retail or offered or exposed for sale without a container, or placed upon a counter or elsewhere, a sign or placard, having the words "cold storage eggs" plainly and conspicuously marked upon it, shall be displayed in, upon or immediately above the said eggs; the intent of this act being that cold storage eggs sold at retail or offered or exposed for sale shall be designated in such a manner that the purchaser will know that they are cold storage eggs. The display of the words "cold storage eggs", as required by this act, shall be done in such a manner as is approved by the state board of health.

Section 2. Violation of any provision of this act shall be punished by a fine of not less than ten dollars nor more than five hundred dollars for each offence. [*Approved April 25, 1913.*

At a meeting of the State Board of Health held Aug. 7, 1913, it was voted to modify the regulation made June 5, 1913, to read as follows: —

The sign or placard required by section 1 of chapter 538 of the Acts of 1913, to be placed upon or immediately above cold-storage eggs, or upon the basket, box or other container in which cold-storage eggs are placed, shall consist of the words "Cold Storage Eggs" printed in uncondensed Gothic type, in letters not less than 1 inch in height, printed in black on a white background, no other lettering to appear on or to be attached to said sign or placard. (This sign or placard to be used only where eggs are offered or exposed for sale.)

On Oct. 10, 1913, the State Board of Health voted to make the following additional regulation concerning the proper marking of cold-storage eggs when sold to a purchaser: —

The marking required by section 1 of chapter 538 of the Acts of 1913, to be placed upon the bag, basket, box or other container in which cold-storage eggs are placed, after having been sold to a purchaser, shall consist of the words "Cold Storage Eggs" printed or stamped in uncondensed Gothic type, in letters not less than ½ inch in height, in black, purple or red ink, no other lettering to appear in connection with the words "Cold Storage Eggs." (This method of marking to appear on the bag, basket, box or other container in which eggs are delivered to the purchaser.)

The operation of this act being placed in the hands of this Board, in order that the provisions of the law be complied with by the retail dealers in eggs throughout the State, it was found necessary to summon a number of dealers into court for evading the law. Below will be found a list of such court cases together with the results: —

Number.	Date.	Name of Defendant.	Place.	Result.
1	Oct. 16, 1913	Mohican Company,	Pittsfield,	Case filed.
2	Oct. 16, 1913	New York Cash Grocery,	Pittsfield,	Case filed.
3	Oct. 16, 1913	Mason Egg and Butter Company.	Pittsfield,	Case filed.
4	Oct. 16, 1913	Albany Cash Market,	Pittsfield,	Case filed.
5	Oct. 21, 1913	Walter J. Munger,	Springfield,	Fined.
6	Oct. 21, 1913	Julius F. Carman,	Springfield,	Fined.
7	Oct. 21, 1913	Thomas Tillman,	Springfield,	Fined.
8	Oct. 21, 1913	George C. Hodges,	Springfield,	Fined.
9	Oct. 21, 1913	James Van Dyke Company,	Springfield,	Fined.
10	Oct. 21, 1913	Isidor Tillman,	Springfield,	Fined.
11	Oct. 22, 1913	Michael Smith,	Holyoke,	Fined.
12	Oct. 22, 1913	John Moskal,	Holyoke,	Fined.
13	Oct. 22, 1913	New York Butter House,	Holyoke,	Fined.
14	Oct. 27, 1913	J. Ashman Mansfield,	Worcester,	Fined.
15	Oct. 27, 1913	Sarkis Zarkarian,	Worcester,	Fined.
16	Oct. 27, 1913	William E. Meggett,	Worcester,	Case filed.
17	Oct. 28, 1913	Charles L. Thrasher,	Springfield,	Fined.
18	Oct. 28, 1913	Josiah R. Smith,	Holyoke,	Fined.
19	Oct. 30, 1913	Mae D. Gregory,	Malden,	Case filed.
20	Oct. 30, 1913	Edward W. Hughson, Frank T. Clark,	Malden,	Case filed.
21	Oct. 30, 1913	William H. Donn,	Malden,	Case filed.
22	Oct. 30, 1913	Arthur C. Phillips,	Malden,	Case filed.
23	Oct. 30, 1913	W. H. Pembrook, G. H. Feltrup,	Malden,	Case filed.

Number.	Date.	Name of Defendant.	Place.	Result.
24	Oct. 30, 1913	Nicholas Berlo, . . .	South Boston, .	Fined.
25	Oct. 30, 1913	William Scott, . . .	South Boston, .	Case filed.
26	Oct. 30, 1913	Stanley Welaish, . . .	South Boston, .	Case filed.
27	Oct. 30, 1913	Jacob Cohen, ...	South Boston, .	Case filed.
28	Oct. 30, 1913	James Dalzell, . . .	South Boston, .	Case filed.
29	Oct. 30, 1913	David Cooper, . . .	South Boston, .	Case filed.
30	Oct. 30, 1913	Leonard H. Stevenson, . .	South Boston, .	Case filed.
31	Oct. 30, 1913	Joseph S. Schuver, . .	South Boston, .	Case filed.
32	Oct. 30, 1913	Toni Mucci, ...	South Boston, .	Case filed.
33	Oct. 30, 1913	Abraham Cohen, . . .	South Boston, .	Case filed.
34	Oct. 30, 1913	Adam S. Amrhein, . .	South Boston, .	Case filed.
35	Nov. 6, 1913	L. M. Johnson, . . .	Boston, . .	Fined.
36	Nov. 6, 1913	James Simmons, . . .	Boston, . .	Fined.
37	Nov. 6, 1913	Lazarus K. Surabian, . .	Boston, . .	Fined.
38	Nov. 6, 1913	Joseph Sugarman, . . .	Boston, . .	Fined.
39	Nov. 6, 1913	C. I. Hutchinson, . . .	Boston, . .	Fined.
40	Nov. 11, 1913	Patrick J. McManus, . .	Boston, . .	Case filed.
41	Nov. 11, 1913	Lewis E. Rose, . . .	Boston, . .	Fined.
42	Nov. 14, 1913	H. T. Condon, . . .	Lynn, . .	Case filed.
43	Nov. 14, 1913	Blair Gautreau, . . .	Lynn, . .	Case filed.
44	Nov. 14, 1913	J. Frederick Hatton, . .	Lynn, . .	Case filed.
45	Nov. 14, 1913	James W. M. Harvey, . .	Lynn, . .	Case filed.
46	Nov. 14, 1913	Fred S. Langdon, . . .	Lynn, . .	Case filed.
47	Nov. 14, 1913	Charles McManus, . . .	Lynn, . .	Case filed.
48	Nov. 14, 1913	Silas G. Small, . . .	Lynn, . .	Case filed.
49	Nov. 19, 1913	M. N. Winters, . . .	Lowell, . .	Case filed.
50	Nov. 19, 1913	Samuel Rostler, . . .	Lowell, . .	Case filed.
51	Nov. 19, 1913	Samuel P. Pike, . . .	Lowell, . .	Case filed.
52	Nov. 19, 1913	William T. Patten, . .	Lowell, . .	Case filed.
53	Nov. 19, 1913	Francisco Pinto, . . .	Lowell, . .	Case filed.
54	Nov. 19, 1913	Arthur Boulais, . . .	Lowell, . .	Case filed.
55	Nov. 19, 1913	Antonio M. Bettencourt, .	Lowell, . .	Case filed.
56	Nov. 19, 1913	John Reynolds, . . .	Lowell, . .	Case filed.
57	Nov. 19, 1913	Murdock McKinnon, . .	Lowell, . .	Case filed.
58	Nov. 19, 1913	Michael McGlinchey, . .	Lowell, . .	Case filed.
59	Nov. 19, 1913	Gabriel Kahan, . . .	Lowell, . .	Case filed.
60	Nov. 19, 1913	Harry Novinsky, . . .	Lowell, . .	Case filed.
61	Nov. 19, 1913	Barnet Kaplan, . . .	Lowell, . .	Case filed.
62	Nov. 19, 1913	Charles H. Wing, . . .	Lowell, . .	Case filed.
63	Nov. 19, 1913	Edward Strauss, . . .	Lowell, . .	Case filed.

Number.	Date.	Name of Defendant.	Place.	Result.
64	Nov. 19, 1913	Charles P. Hopkins,	Lowell,	Case filed.
65	Nov. 19, 1913	Clement Bairstow,	Lowell,	Case filed.
66	Nov. 21, 1913	Max M. Warshaw,	Lawrence,	Continued for sentence.
67	Nov. 21, 1913	Charles H. Merrill,	Lawrence,	Continued for sentence.
68	Nov. 21, 1913	Boise Supernant,	Lawrence,	Continued for sentence.
69	Nov. 21, 1913	Frederick Greenleaf,	Lawrence,	Continued for sentence.
70	Nov. 25, 1913	Morris Lifschitz,	Boston,	Fined.
71	Nov. 25, 1913	George A. Vail,	Boston,	Case filed.
72	Nov. 28, 1913	Charles H. Bossé,	Lawrence,	Continued for sentence.

Total amount of fines imposed, $210.

REPORT OF THE BOARD

RELATIVE TO THE

BUSINESS OF SLAUGHTERING.

Report on the Business of Slaughtering for the Year 1913.

In transmitting the second annual report on the business of slaughtering, I am able to note some improvement in its operation throughout the Commonwealth of Massachusetts during the year 1913. While it is evident that some of the inspectors of slaughtering are becoming more interested in the work and are recognizing the importance of a thorough inspection of meats at the time of slaughter, there still remains an unreliability in their work owing to the fact that the majority of the inspectors are laymen who, perhaps, do as well as they know how but, being without any special education along these lines, are unable to perform the work satisfactorily.

Three hundred and sixty-two inspectors of slaughtering were approved by the State Board of Health in 1912, while 460 were approved for the cities and towns throughout the State in the year 1913, making an increase of 98 inspectors during the fiscal year. These inspectors are nominated by the local boards of health and are subject to the approval of the State Board of Health. Before being approved every effort is made by this Board to ascertain the character and qualifications of the nominees for the position. This has enabled us to secure men of experience and better qualifications than heretofore, the result of which is shown in the improvement in the work of inspecting meats which is receiving more attention than before, inspection taking place in towns where such work was unknown before.

When we consider the question of scientific and practical meat inspection, we are forced to the conclusion that the system now employed in this State does not meet the requirements of the work and, therefore, cannot be commended. The admirable system of meat inspection as now carried on in Germany, France, Australia and other countries, as well as the system in vogue at the abattoirs in this country, under the direction of the United States Bureau of Animal Industry, convinces us that the municipal abattoir or centralized slaughterhouse is the only effective remedy to control the sanitary conditions at slaughterhouses and to eliminate the meat of diseased animals. In view of the above, I respectfully present my reasons for advocating the establishment of municipal abattoirs or centralized slaughterhouses: —

1. Centralized slaughtering is necessary in order that proper equipment and sanitary methods be employed.

2. Centralized slaughtering enables a city or a number of contiguous towns, acting collectively, to maintain an adequate force of competent inspectors necessary for the proper inspection of meats. It has been demonstrated that this can be done more economically at one point than at a number of scattered plants.

3. The appropriation made to this department is not sufficient to assume all the expenses of the work. Centralized abattoirs in cities or localized districts can be made self-supporting and profitable and to pay the cost of inspection by commercializing the offal, thereby reducing the cost of killing, and the charging of a small fee for the inspection.

There is no question but that the inspection of meats is necessary in order that the health of the public be protected from meats affected with disease. It is equally necessary that the slaughterhouse be kept in a sanitary condition. I appreciate the fact that the capital now invested in undesirable, insanitary and unfit slaughterhouses is given as one of the problems against the centralized abattoir, and much of the opposition against the establishment of these abattoirs will come from this source, but when we consider the possible effect of meats from the insanitary slaughterhouse upon the health of the public, it seems to me that proper sanitary conditions should prevail at the slaughterhouse, even at the expense of the amount of capital invested in the unfit places.

In talking with many as to the necessity of establishing the municipal or centralized slaughterhouse, the majority of those opposing such a course will give one or all of the following reasons for their opposition: —

1. There is no doubt but that there is an apathy on the part of a large majority of the public and many city and town officials regarding the danger in uninspected and diseased meats; they do not, therefore, realize the necessity of a municipal or centralized slaughterhouse where proper inspection would protect the health of the people.

2. The butcher and meat dealer, having money invested in a slaughterhouse which would be done away with, if a municipal or centralized slaughterhouse were established, would certainly oppose this building.

3. The trade, being conscious of the loss occurring where a carcass of meat is condemned on account of disease and sent to be rendered, would also oppose their establishment.

4. The doing away with the nefarious dealer in meat of animals affected with disease or of animals killed otherwise than by slaughter.

5. Lack of information as to the necessary procedure to take in the building and operation of a municipal slaughterhouse and a general trade conservatism towards a new venture.

Why is the Inspection of Meat necessary?

As meat constitutes the principal foodstuff for the human body, it should receive the attention, from a hygienic standpoint, that its importance demands. This can only be done by a thorough examination of meat and the products of the same by men qualified by education and training for such work, appreciating the object and duties of meat inspection, which are the prevention of the dangers threatening human health from noxious meats. It becomes evident, then, that the inspection of meat is necessary and should be demanded. A visit to most of the country slaughterhouses (and some in the cities) where the methods of inspection are conducted under insanitary conditions will be sufficient to convince one of the necessity for a proper inspection of this important article of food. Space does not permit me to give in detail all the reasons why meat should be inspected. I must confine myself to the four principal purposes for such an inspection, as follows: —

1. To protect against the possible transmission of animal parasites (trichina and tapeworm).
2. To protect against infectious diseases, as tuberculosis, glanders, anthrax, rabies, septicæmia and pyæmia.
3. To protect against meat poisoning caused by ptomaines and other toxins which develop in spoiled meat.
4. To protect from fraud where inferior meat is sold at the price of preferred kinds and classes of meat.

Those giving the matter close attention have noted that the economic phases of meat inspection extend from the farm to the retail distributor. The subjoined statistics rendered by the inspectors of slaughtering throughout the State will show the number of carcasses condemned on account of diseased conditions found on post-mortem examination, so that the conclusion remains that a large part of the meat supply comes from animals diseased or worn out in breeding and dairying. That ailing and sick animals are neglected at the farm is a fact well known to all interested in such matters and, consequently, a large share of the responsibility of the farmer, dairyman and trader in the matter of diseased meats, immature calves, etc., as found at the slaughterhouse, cannot be overlooked. The nefarious dealer in meats avoids slaughterhouses where Federal and State inspection under veterinarians is carried on, and most of the diseased meats are taken to the slaughterhouses where inspection is known to be lax and there disposed of in various ways. The public are paying for meats to be properly inspected, and should have some assurance that the inspection is of such a character that they can be reasonably sure they are being supplied with a clean, safe food, free from disease or any other condition rendering it unfit for food.

The protection of the consumers of meat from animal diseases is recognized by all nations as one of the most important measures of preventive medicine, and this can only be assured by the proper inspection of meat at the time of slaughter.

In view of the above, I respectfully call your attention to the necessity of every effort being made by this Board to lend its approval to any means to be employed in bringing about the establishment of municipal abattoirs or centralized slaughterhouses, the same to be supported and maintained by the cities, or contiguous towns acting collectively, as heretofore described.

In the exercise of their duties the two veterinarians employed as inspectors of slaughtering have found it necessary to travel in many parts of the State. As there are but two inspectors, it is apparent that they cannot visit every city and town in the State within a year, which ought to be done. I, therefore, recommend that at least three more veterinarians be appointed inspectors of slaughtering; this would enable us to have every city and town throughout the State visited at least once a year, making their work more thorough. The two inspectors now employed report having found comparatively few of the slaughterhouses in a condition to permit of commendation, and some were in such a decidedly unfit condition for slaughtering purposes that it was found necessary to call the attention of the local board of health to them. These inspectors instruct the licensee of the slaughterhouse what to do in order to put his premises in fair sanitary condition, a report of which is sent to this office. The local inspectors of slaughtering are instructed as to their duties in inspection work, and the board of health of the city or town is made acquainted with all insanitary conditions found at the slaughterhouses by the inspector. This is done in order that there may be a coöperation of all parties concerned, with a view of remedying these conditions. As a result, there has been, perhaps, a little improvement at some of the places visited, but there still remains that unsightly, insanitary country slaughterhouse in many parts of the State. Every board of health and every inspector of slaughtering has been furnished with a copy of the laws of Massachusetts on the business of slaughtering, together with a copy of the rules and regulations pertaining to the law. Reference to these pamphlets will give them all the necessary information relative to their duties, as well as the diseases and conditions requiring the condemnation of meats as articles of food.

During the year 1913, 7,376½ pounds of meat were condemned on account of disease, immaturity, or being uninspected and unstamped, and the owners were prosecuted, with the results found in the table below. For a detailed report on the condemnation of meat during the fiscal year 1913, your attention is directed to the following: —

Date.	Articles.	Weight (Pounds).	Reasons.	Dispositions.
Mar. 5, 1913	Beef, . . .	930	Uninspected and unstamped,	Rendered.
Mar. 12, 1913	Veal, . . .	60	Uninspected and unstamped,	Incinerated.
Mar. 13, 1913	Veal, . . .	42½	Uninspected and unstamped,	Buried.
Mar. 13, 1913	Pork, . . .	500	Uninspected and unstamped,	Rendered.
Mar. 17, 1913	Beef, . . .	400	Uninspected and unstamped,	Rendered.
Mar. 17, 1913	Pork, . . .	360	Uninspected and unstamped,	Rendered.
Mar. 18, 1913	Veal, . . .	20	Uninspected and unstamped,	Rendered.
Mar. 19, 1913	Beef, . . .	250	Putrefaction, ...	Rendered.
Mar. 19, 1913	Veal, . . .	300	Uninspected and unstamped,	Buried.
Mar. 19, 1913	Veal, . . .	175	Uninspected and unstamped,	Buried.
Apr. 1, 1913	Veal, . . .	120	Uninspected and unstamped,	Buried.
Apr. 2, 1913	Pork, . . .	270	Tuberculosis, ...	Rendered.
Apr. 3, 1913	Veal, . . .	50	Uninspected and unstamped,	Rendered.
Apr. 3, 1913	Beef, . . .	365	Uninspected and unstamped,	Rendered.
Apr. 30, 1913	Veal, . . .	90	Uninspected and unstamped,	Destroyed with lime.
May 27, 1913	Veal, . . .	38	Immature, ...	Rendered.
June 10, 1913	Veal, . . .	34	Immature, ...	Fed to dogs.
June 10, 1913	Beef, . . .	822	Tuberculosis, ...	Rendered.
June 24, 1913	Veal, . . .	25	Immature, ...	Rendered.
June 25, 1913	Veal, . . .	31	Immature, ...	Rendered.
June 30, 1913	Beef, . . .	500	Tuberculosis, ...	Rendered.
Oct. 1, 1913	Pork, . . .	790	Uninspected and unstamped,	Rendered.
Oct. 2, 1913	Beef, . . .	302	Uninspected and unstamped,	Rendered.
Oct. 6, 1913	Veal, . . .	192	Uninspected and unstamped,	Rendered.
Oct. 8, 1913	Pork, . . .	169	Uninspected and unstamped,	Rendered.
Oct. 18, 1913	Beef, . . .	500	Uninspected and unstamped,	Rendered.
Nov. 3, 1913	Veal, . . .	41	Uninspected and unstamped,	Rendered.
Total, .	. . . . .	7,376½		

The following convictions were secured because the inspector was not present at the time of slaughter, and the meat was unstamped: —

Name of Defendant.	Place.	Result.
Max Steinberg,[1]	Methuen,	Fined.
Max Cohan,[1]	Methuen,	Fined.
Frederick Friederich,	Pittsfield,	Fined.
Max Otterburig,	Pittsfield,	Fined.
M. D. Petrell,	Quincy,	Fined.
Caesar Cavigioli,[1]	Milford,	Case filed.
Henry Shove,	Taunton,	Case filed.
H. A. Lincoln,	Taunton,	Case filed.
H. J. Fredette,	New Bedford,	Fined.

Total amount of fines imposed, $117.

[1] License revoked in accordance with paragraph 15 of the slaughtering laws of Massachusetts.

Nominations for inspectors of slaughtering were made in 325 cities and towns. Of the nominees approved by the State Board of Health 2 died and 10 resigned.

An outline of the work relating to the appointment of inspectors of slaughtering in the various cities and towns throughout the State is given in the following table; also, the number of licensed slaughterhouses as reported to this department by the local boards of health: —

Cities and Towns.	Number of Inspectors nominated by the Local Boards of Health.	Number of Nominees approved by the State Board of Health.	Number of Nominees disapproved by the State Board of Health.	Number of Licensed Slaughter-houses reported.
Abington,	1	1	-	-
Acton,	1	1	-	1
Acushnet,	1	1	-	-
Adams,	2	1	1	-
Agawam,	1	-	1	-
Alford,	1	1	-	1
Amesbury,	1	1	-	3
Amherst,	1	1	-	6
Andover,	1	1	-	-
Arlington,	1	1	-	-
Ashburnham,	1	1	-	2
Ashby,	1	1	-	1
Ashfield,	3	3	-	1
Ashland,	1	1	-	1

Cities and Towns.	Number of Inspectors nominated by the Local Boards of Health.	Number of Nominees approved by the State Board of Health.	Number of Nominees disapproved by the State Board of Health.	Number of Licensed Slaughter-houses reported.
Athol,	1	1	-	-
Attleborough,	1	1	-	3
Auburn,	2	2[1]	-	-
Avon,	1	1	-	-
Ayer,	-	-	-	-
Barnstable,	3	3	-	6
Barre,	2	2[1]	-	1
Becket,	1	1	-	2
Bedford,	1	1	-	1
Belchertown,	3	3	-	5
Bellingham,	1	1	-	1
Belmont,	1	1	-	-
Berkley,	1	1	-	1
Berlin,	-	-	-	-
Bernardston,	1	1	-	-
BEVERLY,	1	1	-	-
Billerica,	1	1	-	2
Blackstone,	1	1	-	2
Blandford,	3	3	-	-
Bolton,	-	-	-	-
Bourne,	3	3	-	-
Boxborough,	1	1	-	-
Boxford,	1	1	-	-
Boylston,	1	1	-	1
Braintree,	1	1	-	6
Brewster,	1	1	-	-
Bridgewater,	-	-	-	-
Brimfield,	1	1	-	-
BROCKTON,	1	1	-	-
Brookfield,	1	1	-	-
Brookline,	1	1	-	-
Buckland,	-	-	-	-
Burlington,	1	1	-	-
CAMBRIDGE,	3	3[2]	-	3
Canton,	1	1	-	2
Carlisle,	1	1	-	2
Carver,	1	1	-	1

[1] One resigned. [2] One deceased.

Cities and Towns.	Number of Inspectors nominated by the Local Boards of Health.	Number of Nominees approved by the State Board of Health.	Number of Nominees disapproved by the State Board of Health.	Number of Licensed Slaughter-houses reported.
Charlemont,	2	2	–	–
Charlton,	4	4	–	–
Chatham,	1	1	–	2
Chelmsford,	1	1	–	8
CHELSEA,	1	1	–	–
Cheshire,	1	1	–	–
Chester,	3	3	–	–
Chesterfield,	4	4	–	–
CHICOPEE,	2	2	–	1
Chilmark,	3	3	–	–
Clarksburg,	1	1	–	–
Clinton,	1	1	–	2
Cohasset,	1	1	–	–
Colrain,	1	1	–	–
Concord,	3	3[1, 2]	–	1
Conway,	–	–	–	–
Cummington,	1	1	–	1
Dalton,	1	1	–	–
Dana,	1	1	–	2
Danvers,	1	1	–	1
Dartmouth,	4	4	–	6
Dedham,	1	1	–	1
Deerfield,	1	1	–	–
Dennis,	2	2	–	–
Dighton,	1	1	–	2
Douglas,	1	1	–	–
Dover,	1	1	–	–
Dracut,	2	2	–	3
Dudley,	1	1	–	2
Dunstable,	1	1	–	–
Duxbury,	1	1	–	–
East Bridgewater,	1	1	–	2
East Longmeadow,	4	3	1	–
Eastham,	2	2	–	1
Easthampton,	2	2	–	–
Easton,	1	1	–	2
Edgartown,	1	1	–	–

[1] One deceased. [2] One temporary.

CITIES AND TOWNS.	Number of Inspectors nominated by the Local Boards of Health.	Number of Nominees approved by the State Board of Health.	Number of Nominees disapproved by the State Board of Health.	Number of Licensed Slaughter-houses reported.
Egremont,	3	1	2	1
Enfield,	1	1	-	-
Erving,	2	2	-	-
Essex,	1	1	-	-
EVERETT,	1	1	-	-
Fairhaven,	1	1	-	1
FALL RIVER,	1	1	-	-
Falmouth,	2	2	-	-
FITCHBURG,	1	1	-	-
Florida,	1	1	-	-
Foxborough,	1	1	-	1
Framingham,	1	1	-	1
Franklin,	1	1	-	4
Freetown,	2	2	-	1
Gardner,	-	-	-	-
Gay Head,	-	-	-	-
Georgetown,	1	1	-	-
Gill,	1	1	-	1
GLOUCESTER,	2	2	-	-
Goshen,	1	1	-	-
Gosnold,	2	2[1]	-	-
Grafton,	-	-	-	2
Granby,	3	3	-	3
Granville,	3	3	-	-
Great Barrington,	1	1	-	-
Greenfield,	1	1	-	6
Greenwich,	2	2	-	-
Groton,	1	1	-	3
Groveland,	1	1	-	1
Hadley,	1	-	1	-
Halifax,	1	1	-	-
Hamilton,	1	1	-	-
Hampden,	1	1	-	1
Hancock,	1	1	-	-
Hanover,	2	2	-	-
Hanson,	2	2	-	-
Hardwick,	2	2	-	-

[1] One resigned.

Cities and Towns.	Number of Inspectors nominated by the Local Boards of Health.	Number of Nominees approved by the State Board of Health.	Number of Nominees disapproved by the State Board of Health.	Number of Licensed Slaughter-houses reported.
Harvard,	1	1	–	3
Harwich,	1	1	–	3
Hatfield,	1	1	–	5
HAVERHILL,	1	1	–	3
Hawley,	2	2	–	1
Heath,	3	2	1	–
Hingham,	1	1	–	–
Hinsdale,	1	1	–	–
Holbrook,	1	1	–	1
Holden,	3	3	–	2
Holland,	1	1	–	–
Holliston,	1	1	–	–
HOLYOKE,	2	2	–	–
Hopedale,	1	1	–	–
Hopkinton,	1	1	–	2
Hubbardston,	1	1	–	2
Hudson,	1	1	–	1
Hull,	1	1	–	–
Huntington,	3	2	1	2
Ipswich,	4[1]	1	–	–
Kingston,	1	1	–	–
Lakeville,	1	1	–	1
Lancaster,	1	1	–	–
Lanesborough,	1	1	–	–
LAWRENCE,	2	2	–	2
Lee,	1	1	–	–
Leicester,	2	2	–	3
Lenox,	1	1	–	1
Leominster,	1	1	–	1
Leverett,	2	2	–	1
Lexington,	2	2	–	6
Leyden,	1	1	–	–
Lincoln,	–	–	–	–
Littleton,	–	–	–	–
Longmeadow,	1	1	–	–
LOWELL,	1	1	–	–
Ludlow,	1	1	–	3

[1] On three, no action taken.

Cities and Towns.	Number of Inspectors nominated by the Local Boards of Health.	Number of Nominees approved by the State Board of Health.	Number of Nominees disapproved by the State Board of Health.	Number of Licensed Slaughter-houses reported.
Lunenburg,	1	1	-	3
LYNN,	2	2	-	2
Lynnfield,	1	1	-	1
MALDEN,	1	1	-	-
Manchester,	1	1	-	-
Mansfield,	1	1	-	-
Marblehead,	1	1	-	-
Marion,	2	1	1	1
MARLBOROUGH,	2	2	-	2
Marshfield,	1	1	-	-
Mashpee,	-	-	-	-
Mattapoisett,	1	1	-	2
Maynard,	1	1	-	1
Medfield,	1	1	-	-
MEDFORD,	2	2	-	-
Medway,	1	1	-	3
MELROSE,	2	2	-	-
Mendon,	-	-	-	-
Merrimac,	-	-	-	-
Methuen,	1	-	1	6[3]
Middleborough,	1	1	-	4
Middlefield,	1	1	-	-
Middleton,	1	1	-	-
Milford,	1	1	-	4[2]
Millbury,	-	-	-	-
Millis,	2	2[1]	-	1
Milton,	1	1	-	1
Monroe,	-	-	-	-
Monson,	1	1	-	-
Montague,	3	3	-	2
Monterey,	3	3	-	2
Montgomery,	1	1	-	-
Mount Washington,	1	1	-	-
Nahant,	-	-	-	-
Nantucket,	1	1	-	1
Natick,	1	1	-	-
Needham,	1	1	-	-

[1] One resigned. [2] One revoked and later re-issued. [3] Two revoked.

Cities and Towns.	Number of Inspectors nominated by the Local Boards of Health.	Number of Nominees approved by the State Board of Health.	Number of Nominees disapproved by the State Board of Health.	Number of Licensed Slaughter-houses reported.
New Ashford,	2	2[1]	–	–
New Bedford,	1	1	–	1
New Braintree,	1	1	–	–
New Marlborough,	2	2	–	–
New Salem,	1	1	–	–
Newbury,	–	–	–	3
Newburyport,	2	2	–	4
Newton,	2	2	–	1
Norfolk,	1	1	–	1
North Adams,	2	2	–	1
North Andover,	1	1	–	–
North Attleborough,	1	1	–	3
North Brookfield,	1	1	–	–
North Reading,	1	1	–	2
Northampton,	1	1	–	2
Northborough,	1	1	–	–
Northbridge,	1	1	–	1
Northfield,	4	3	1	–
Norton,	1	1	–	1
Norwell,	3	3	–	–
Norwood,	1	1	–	1
Oak Bluffs,	1	1	–	–
Oakham,	1	1	–	2
Orange,	1	1	–	–
Orleans,	1	1	–	–
Otis,	1	1	–	1
Oxford,	4	4	–	–
Palmer,	4	4	–	2
Paxton,	1	1	–	1
Peabody,	1	1	–	3
Pelham,	3	3	–	–
Pembroke,	2	2	–	2
Pepperell,	1	1	–	–
Peru,	1	1	–	–
Petersham,	1	1	–	–
Phillipston,	3	3	–	1
Pittsfield,	–	–	–	–

[1] One resigned.

Cities and Towns.	Number of Inspectors nominated by the Local Boards of Health.	Number of Nominees approved by the State Board of Health.	Number of Nominees disapproved by the State Board of Health.	Number of Licensed Slaughter-houses reported.
Plainfield,	1	1	-	-
Plainville,	1	1	-	-
Plymouth,	1	1	-	2
Plympton,	1	1	-	-
Prescott,	1	1	-	-
Princeton,	1	1	-	1
Provincetown,	3	2[1]	1	2
Quincy,	2	2	-	-
Randolph,	1	1	-	-
Raynham,	3	3[1]	-	3
Reading,	1	1	-	1
Rehoboth,	1	1	-	4
Revere,	-	-	-	-
Richmond,	1	1	-	-
Rochester,	3	2	1	2
Rockland,	1	1	-	-
Rockport,	1	1	-	-
Rowe,	1	1	-	-
Rowley,	2	2	-	-
Royalston,	4	4	-	-
Russell,	1	1	-	1
Rutland,	1	1	-	2
Salem,	2	2	-	-
Salisbury,	-	-	-	-
Sandisfield,	2	2	-	2
Sandwich,	1	1	-	-
Saugus,	1	1	-	-
Savoy,	1	1	-	-
Scituate,	1	1	-	-
Seekonk,	1	1	-	1
Sharon,	1	1	-	-
Sheffield,	2	2	-	-
Shelburne,	4	4	-	3
Sherborn,	1	1	-	1
Shirley,	-	-	-	-
Shrewsbury,	1	1	-	4
Shutesbury,	1	1	-	-

[1] One resigned.

CITIES AND TOWNS.	Number of Inspectors nominated by the Local Boards of Health.	Number of Nominees approved by the State Board of Health.	Number of Nominees disapproved by the State Board of Health.	Number of Licensed Slaughter-houses reported.
Somerset,	1	1	-	-
SOMERVILLE,	1	1	-	-
South Hadley,	1	1	-	-
Southampton,	2	2	-	3
Southborough,	1	1	-	-
Southbridge,	1	1	-	4
Southwick,	3	3	-	-
Spencer,	1	1	-	5
SPRINGFIELD,	1	1	-	-
Sterling,	-	-	-	1
Stockbridge,	-	-	-	-
Stoneham,	1	1	-	-
Stoughton,	1	1	-	2
Stow,	1	1	-	-
Sturbridge,	3	3[1]	-	4
Sudbury,	1	1	-	-
Sunderland,	1	1	-	-
Sutton,	4	4	-	-
Swampscott,	1	1	-	-
Swansea,	2	2	-	-
TAUNTON,	3	3	-	6
Templeton,	2	2	-	1
Tewksbury,	1	1	-	1
Tisbury,	1	1	-	-
Tolland,	3	3	-	-
Topsfield,	1	1	-	-
Townsend,	1	1	-	1
Truro,	1	1	-	-
Tyngsborough,	1	1	-	1
Tyringham,	1	1	-	-
Upton,	2	2	-	-
Uxbridge,	1	1	-	-
Wakefield,	1	1	-	-
Wales,	1	1	-	-
Walpole,	2	2[1]	-	-
WALTHAM,	1	1	-	1
Ware,	2	2	-	-

[1] One resigned.

Cities and Towns.	Number of Inspectors nominated by the Local Boards of Health.	Number of Nominees approved by the State Board of Health.	Number of Nominees disapproved by the State Board of Health.	Number of Licensed Slaughter-houses reported.
Wareham,	2	1	1	3
Warren,	1	1	-	1
Warwick,	1	1	-	-
Washington,	2	2	-	-
Watertown,	1	1	-	1
Wayland,	1	1	-	1
Webster,	1	1	-	-
Wellesley,	1	1	-	-
Wellfleet,	1	1	-	-
Wendell,	2	2	-	-
Wenham,	-	-	-	2
West Boylston,	1	1	-	-
West Bridgewater,	1	1	-	3
West Brookfield,	1	1	-	-
West Newbury,	1	1	-	2
West Springfield,	1	1	-	-
West Stockbridge,	2	2	-	-
West Tisbury,	1	1	-	1
Westborough,	1	1	-	1
Westfield,	4	4	-	-
Westford,	1	1	-	-
Westhampton,	2	2	-	-
Westminster,	2	2	-	1
Weston,	1	1	-	3
Westport,	4	4	-	10
Westwood,	1	1	-	1
Weymouth,	-	-	-	-
Whately,	1	1	-	1
Whitman,	1	1	-	-
Wilbraham,	1	1	-	3
Williamsburg,	1	1	-	-
Williamstown,	1	1	-	-
Wilmington,	1	1	-	1
Winchendon,	1	1	-	2
Winchester,	1	1	-	-
Windsor,	2	2	-	-
Winthrop,	-	-	-	-

Cities and Towns.	Number of Inspectors nominated by the Local Boards of Health.	Number of Nominees approved by the State Board of Health.	Number of Nominees disapproved by the State Board of Health.	Number of Licensed Slaughter-houses reported.
Woburn,	1	1	-	2
Worcester,	3	3	-	6
Worthington,	1	1	-	-
Wrentham,	1	1	-	1
Yarmouth,	4	4[1]	-	2

[1] One resigned.

Summary.

Number of nominations made by local boards of health, ... 474
Number of nominees approved by State Board of Health, ... 460
Number of nominees disapproved by State Board of Health, ... 14
Total number of licensed slaughterhouses, ... 337
Number of licenses reissued, ... 159
Number of licenses refused, ... 5

Of the total number of inspectors of slaughtering approved, 127 were new nominations.

During the past year inspectors of slaughtering have found it necessary to condemn 770½ cattle, 1,329 calves, 346 hogs, 1 boar, 11 sheep and 2 lambs on account of disease, taint, uninspected and unstamped, and disposed of the same in such manner that it could not be used for food.

The following table gives in detail the results of inspection work performed in the cities and towns throughout the Commonwealth during the fiscal year ending Nov. 30, 1913: —

Report on the Work of Slaughtering Inspection from Dec. 1, 1912, to Nov. 30, 1913, inclusive.

Cities and Towns.	Number of Cattle.	Number of Calves.	Number of Hogs.	Number of Sheep.	Number of Condemnations.	Reasons for Condemnation.	Disposition of Carcasses.
Abington,	4	68	379	-	2 cattle, 2 hogs,	2 tuberculosis, 1 hog cholera, 1 dropsy,	4 rendered.
Acton,	1,966	812	84	6	94 cattle, 60 calves,	86 tuberculosis, 60 immature, 2 septicæmia, 1 milk fever, 2 bruised, 1 tumor, 2 pneumonia.	99 rendered, 21 fed to hogs, 34 fed to hogs and hens.
Acushnet,	35	262	322	-	2 cattle, 2 hogs,	4 tuberculosis,	4 rendered.
Adams,	26	98	-	-	- -	- -	- -
Agawam,	318	548	274	9	7 cattle, 6 calves, 2 hogs,	9 tuberculosis, 6 immature,	11 rendered, 4 fed to hogs.
Alford,	18	8	44	36	- -	- -	- -
Amesbury,	15	121	116	6	2 cattle,	2 tuberculosis,	2 rendered.
Amherst,	367	648	257	74	19 cattle, 31 calves, 4 hogs,	22 tuberculosis, 1 nephritis, 31 immature.	3 rendered, 51 buried.
Andover,	1	16	399	-	3 hogs,	2 tuberculosis, 1 paralysis,	3 rendered.
Arlington,	-	973	-	-	10 calves,	10 immature,	10 rendered.
Ashburnham,	22	61	102	4	1 cow,	1 tuberculosis,	1 burned.
Ashby,	79	267	140	1	10 cattle, 28 calves,	10 tuberculosis, 28 immature,	38 rendered.
Ashfield,	121	16	146	71	1 cow,	1 tuberculosis,	1 rendered.
Ashland,	40	73	374	-	6 cattle, 11 hogs,	15 tuberculosis, 2 hog cholera,	17 rendered.
Athol,	113	52	419	95	17 cattle, 1 hog,	17 tuberculosis, 1 paralysis,	18 rendered.
Attleborough,	203	232	265	-	5 cattle, 1 calf, 4 hogs,	8 tuberculosis, 1 anæmia, 1 immature,	2 rendered, 8 buried.
Auburn,	67	73	76	1	5 cattle,	4 tuberculosis, 1 pneumonia,	5 rendered.
Avon,	-	-	-	-	- -	- -	- -
Ayer,	-	-	-	-	- -	- -	- -
Barnstable,	19	63	290	-	- -	- -	- -
Barre,	6	10	32	15	- -	- -	- -

Report on the Work of Slaughtering Inspection from Dec. 1, 1912, to Nov. 30, 1913, inclusive — Continued.

Cities and Towns.	Number of Cattle.	Number of Calves.	Number of Hogs.	Number of Sheep.	Number of Condemnations.	Reasons for Condemnation.	Disposition of Carcasses.
Becket,	13	12	28	2	- -	- -	- -
Bedford,	-	-	4	-	- -	- -	- -
Belchertown,	36	501	244	7	1 cow, 4 calves,	1 tuberculosis, 4 immature,	5 buried.
Bellingham,	1	-	39	-	1 bull,	1 bruised,	1 buried.
Belmont,	-	-	856	-	- -	- -	- -
Berkley,	1	-	51	-	- -	- -	- -
Berlin,	3	5	79	-	- -	- -	- -
Bernardston,	9	4	27	10	- -	- -	- -
Beverly,	-	-	10	-	- -	- -	- -
Billerica,	103	229	66	-	2 cattle, 20 calves, 2 hogs,	4 tuberculosis, 20 immature,	24 rendered.
Blackstone,	-	-	-	-	- -	- -	- -
Blandford,	44	80	159	22	1 cow,	1 tuberculosis,	1 buried.
Bolton,	-	-	61	-	- -	- -	- -
Bourne,	3	12	102	-	- -	- -	- -
Boxborough,	-	-	-	-	- -	- -	- -
Boxford,	43	114	306	-	1 hog,	1 tuberculosis,	1 rendered.
Boylston,	44	185	152	3	- -	- -	- -
Braintree,	20	262	257	3	4 cattle,	4 tuberculosis,	4 rendered.
Brewster,	17	43	5	6	- -	- -	- -
Bridgewater,	13	2	130	-	- -	- -	- -
Brimfield,	-	21	36	-	- -	- -	- -
Brockton,	13	9	134	-	2 cattle, 2 calves, 2 hogs,	3 tuberculosis, 1 abscess, 1 septicæmia, 1 pleurisy.	6 rendered.

Brookfield,	6	47	159	4	1 hog,	1 tuberculosis,	1 buried.
Brookline,	-	-	-	-	-	-	-
Buckland,	-	-	-	-	-	-	-
Burlington,	-	-	-	-	-	-	-
CAMBRIDGE,	-	12,603	4	71	324 calves, 2 sheep,	257 immature, 22 weak condition, 13 omphalitis, 15 dead on arrival, 19 dysentery.	326 rendered.
Canton,	-	-	125	-	2 hogs,	2 pneumonia,	2 buried.
Carlisle,	38	95	17	-	1 calf,	1 immature,	1 fed to hens.
Carver,	3	21	16	-	-	-	-
Charlemont,	58	16	148	35	1 cow,	1 hernia,	1 rendered.
Charlton,	352	744	230	43	2 cattle, 9 hogs,	7 tuberculosis, 4 hog cholera,	11 buried.
Chatham,	4	-	108	-	-	-	-
Chelmsford,	1,477	1,149	850	156	40½ cattle, 26 calves, 12 hogs, 1 sheep.	43 tuberculosis, 26 immature, 7 hog cholera, 1 pneumonia, 2 died, ½ bruised.	79½ rendered.
CHELSEA,	-	-	-	-	-	-	-
Cheshire,	42	26	39	-	-	-	-
Chester,	9	24	16	17	1 cow,	1 tuberculosis,	1 buried.
Chesterfield,	33	82	186	-	1 cow,	1 tuberculosis,	1 buried.
CHICOPEE,	9	11	331	6	3 hogs,	3 tuberculosis,	3 buried.
Chilmark,	1	-	-	70	-	-	-
Clarksburg,	12	10	11	-	-	-	-
Clinton,	42	375	338	-	7 calves, 3 hogs,	7 immature, 3 hog cholera,	10 rendered.
Cohasset,	1	3	113	-	-	-	-
Colrain,	142	8	285	3	-	-	-
Concord,	1,280	646	6	35	81 cattle, 64 calves,	81 tuberculosis, 62 immature, 2 improperly prepared.	145 rendered.
Conway,	-	-	-	-	-	-	-

Report on the Work of Slaughtering Inspection from Dec. 1, 1912, to Nov. 30, 1913, inclusive—Continued.

Cities and Towns.	Number of Cattle.	Number of Calves.	Number of Hogs.	Number of Sheep.	Number of Condemnations.	Reasons for Condemnation.	Disposition of Carcasses.
Cummington,	63	64	276	109	2 cattle,	2 tuberculosis,	2 buried.
Dalton,	9	3	56	4	-	-	-
Dana,	13	6	53	8	-	-	-
Danvers,	-	432	57	-	2 calves, 2 hogs,	2 immature, 2 hog cholera,	2 fed to pigs, 2 rendered.
Dartmouth,	93	564	428	-	5 cattle, 3 calves, 5 hogs,	10 tuberculosis, 3 immature,	13 rendered.
Dedham,	21	735	438	14	6 cattle, 21 calves, 7 hogs,	7 tuberculosis, 1 pneumonia, 21 immature, 5 hog cholera.	34 rendered.
Deerfield,	51	66	315	20	2 cattle,	1 tuberculosis, 1 septicæmia,	1 rendered, 1 buried.
Dennis,	19	30	108	4	-	-	-
Dighton,	119	382	220	2	-	-	-
Douglas,	5	34	47	-	-	-	-
Dover,	-	-	-	-	-	-	-
Dracut,	986	618	1,093	4	23 cattle, 33 calves, 25 hogs,	26 tuberculosis, 14 immature, 3 hog cholera, 8 diarrhœa, 5 enteritis, 4 icterus, 9 jaundice, 3 injured, 5 dog bites, 4 inspector not present.	55 rendered, 26 buried.
Dudley,	125	272	226	3	4 cattle,	4 tuberculosis,	4 buried.
Dunstable,	3	5	37	12	-	-	-
Duxbury,	1	24	185	8	-	-	-
East Bridgewater,	4	176	177	-	1 hog,	1 tuberculosis,	1 buried.
East Longmeadow,	18	7	135	-	1 cow,	1 tuberculosis,	1 buried.
Eastham,	9	33	69	-	-	-	-
Easthampton,	34	738	113	-	1 hog,	1 tuberculosis,	1 burned.
Easton,	96	257	196	1	2 calves, 1 hog,	2 peritonitis, 1 contusions,	3 rendered.
Edgartown,	19	62	222	92	-	-	-

Egremont,	123	19	156	147	–	–	–
Enfield,	12	627	89	7	1 hog,	1 tuberculosis,	1 rendered.
Erving,	11	12	28	–	–	–	–
Essex,	–	7	20	–	–	–	–
Everett,	–	–	–	–	–	–	–
Fairhaven,	966	1,038	91	52	16 cattle, 49 calves, 2 hogs, 2 sheep.	16 tuberculosis, 1 hydræmia, 1 pneumonia, 49 immature, 2 caseous lymphadenitis.	69 rendered.
Fall River,	–	–	32	–	–	–	–
Falmouth,	1	–	90	–	–	–	–
Fitchburg,	768	906	267	–	11 cattle, 7 calves,	10 tuberculosis, 1 pericarditis, 6 immature, 1 injured.	18 rendered.
Florida,	3	–	11	4	–	–	–
Foxborough,	7	21	69	–	–	–	–
Framingham,	300	439	8	13	6 cattle, 15 calves,	5 tuberculosis, 1 anæmia, 1 nephritis, 14 immature.	21 rendered.
Franklin,	7	75	424	2	1 cow, 12 hogs,	11 tuberculosis, 1 uræmia, 1 septicæmia,	2 rendered, 11 buried.
Freetown,	5	21	42	–	1 cow,	1 tuberculosis,	1 buried.
Gardner,	–	–	–	–	–	–	–
Gay Head,	–	–	–	–	–	–	–
Georgetown,	–	–	–	–	–	–	–
Gill,	41	63	154	34	–	–	–
Gloucester,	16	222	140	–	4 cattle, 27 calves,	3 tuberculosis, 1 pericarditis, 27 immature.	30 rendered, 1 destroyed by owner.
Goshen,	–	9	3	–	–	–	–
Gosnold,	3	–	10	31	3 cattle,	3 tuberculosis,	3 buried.
Grafton,	1	64	148	–	–	–	–
Granby,	532	762	192	4	15 cattle, 11 calves, 3 hogs,	8 tuberculosis, 10 immature, 2 hog cholera, 1 internal hemorrhage, 2 emaciation, 2 bruised, 1 old age, 1 parturient fever, 1 anæmia, 1 dropsy.	9 rendered, 18 buried, 2 fed to hens.
Granville,	–	31	38	7	–	–	–

Report on the Work of Slaughtering Inspection from Dec. 1, 1912, to Nov. 30, 1913, inclusive — Continued.

Cities and Towns.	Number of Cattle.	Number of Calves.	Number of Hogs.	Number of Sheep.	Number of Condemnations.	Reasons for Condemnation.	Disposition of Carcasses.
Great Barrington,	14	80	37	92	– –	– –	– –
Greenfield,	76	235	145	704	1 cow, 5 calves, 1 hog, 1 sheep.	1 tuberculosis, 4 immature, 2 anæmia, 1 trichinosis.	7 rendered, 1 buried.
Greenwich,	15	68	62	16	– –	– –	– –
Groton,	20	98	201	–	2 hogs,	2 tuberculosis,	2 rendered.
Groveland,	–	9	61	2	– –	– –	– –
Hadley,	5	5	87	2	– –	– –	– –
Halifax,	1	–	4	–	– –	– –	– –
Hamilton,	–	–	–	–	– –	– –	– –
Hampden,	6	237	54	–	1 hog,	1 peritonitis,	1 buried.
Hancock,	2	17	3	117	– –	– –	– –
Hanover,	38	48	87	19	4 hogs,	4 hepatitis,	3 buried, 1 burned.
Hanson,	–	5	118	–	1 hog,	1 decomposed,	1 buried.
Hardwick,	22	18	133	8	– –	– –	– –
Harvard,	27	715	162	5	1 cow, 13 calves,	1 tuberculosis, 13 immature,	2 rendered, 2 buried, 9 fed to hens, 1 consumed by owner.
Harwich,	8	1	21	–	– –	– –	– –
Hatfield,	45	269	352	–	4 cattle,	4 tuberculosis,	4 rendered.
Haverhill,	13	86	23	–	– –	– –	– –
Hawley,	55	3	56	–	– –	– –	– –
Heath,	30	1	94	–	1 cow,	1 tuberculosis,	1 rendered.
Hingham,	1	1	221	–	3 hogs,	3 tuberculosis,	3 rendered.
Hinsdale,	3	5	7	–	– –	– –	– –

Holbrook,	-	-	-	-	-	-	-
Holden,	31	119	134	6	-	-	-
Holland,	3	2	3	-	-	-	-
Holliston,	24	22	11	-	-	-	-
HOLYOKE,	18	38	88	-	4 cattle, 1 hog,	5 tuberculosis,	5 rendered.
Hopedale,	-	-	-	-	-	-	-
Hopkinton,	1	13	81	-	-	-	-
Hubbardston,	21	134	121	7	-	-	-
Hudson,	5	33	132	-	-	-	-
Hull,	-	1	8	-	-	-	-
Huntington,	33	43	68	105	-	-	-
Ipswich,	9	16	152	-	2 cattle, 5 hogs,	2 tuberculosis, 5 hog cholera,	6 rendered, 1 buried.
Kingston,	3	18	46	-	1 cow, 2 hogs,	2 tuberculosis, 1 emaciation,	2 rendered, 1 buried.
Lakeville,	1	3	50	-	-	-	-
Lancaster,	3	14	116	2	-	-	-
Lanesborough,	-	-	-	-	-	-	-
LAWRENCE,	184	47	580	-	7 cattle, 1 calf, 11 hogs,	6 tuberculosis, 1 immature, 2 hog cholera, 1 hernia, 2 blood poison, 1 uræmia, 1 milk fever, 2 emaciation, 2 bruised, 1 inspector not present.	19 rendered.
Lee,	51	23	106	-	5 cattle,	5 tuberculosis,	5 buried.
Leicester,	35	370	134	2	2 cattle, 1 hog,	2 tuberculosis, 1 hog cholera,	3 rendered.
Lenox,	292	9	132	137	1 calf,	1 parturient fever,	1 buried.
Leominster,	134	489	371	4	12 cattle, 20 calves, 11 hogs,	23 tuberculosis, 20 immature,	43 rendered.
Leverett,	21	16	44	-	-	-	-
Lexington,	137	3,953	1,927	82	109 calves,	69 immature, 39 bruised, 1 injured,	74 rendered, 20 buried, 15 fed to hens.
Leyden,	22	16	62	26	-	-	-

Report on the Work of Slaughtering Inspection from Dec. 1, 1912, to Nov. 30, 1913, inclusive — Continued.

Cities and Towns.	Number of Cattle.	Number of Calves.	Number of Hogs.	Number of Sheep.	Number of Condemnations.	Reasons for Condemnation.	Disposition of Carcasses.
Lincoln,	12	37	158	21	2 calves,	2 immature,	2 buried.
Littleton,	–	–	73	–	–	–	–
Longmeadow,	–	1	11	–	–	–	–
Lowell,	–	1	314	–	2 hogs, 1 calf,	2 tuberculosis, 1 immature,	2 rendered, 1 consumed by owner.
Ludlow,	5	930	132	8	1 hog,	1 tuberculosis,	1 buried.
Lunenburg,	246	714	602	12	10 cattle, 3 calves,	10 tuberculosis, 1 strangulation, 2 immature.	13 rendered.
Lynn,	528	370	146	1	5 cattle, 11 calves, 2 hogs,	6 tuberculosis, 11 immature, 1 pneumonia.	18 rendered.
Lynnfield,	810	630	10	–	20 cattle, 29 calves,	20 tuberculosis, 29 immature,	49 rendered.
Malden,	–	–	–	–	–	–	–
Manchester,	–	–	–	–	–	–	–
Mansfield,	31	37	507	11	2 calves, 2 hogs,	4 tuberculosis,	4 rendered.
Marblehead,	–	–	108	–	–	–	–
Marion,	–	–	158	–	–	–	–
Marlborough,	12	133	328	14	1 cow, 1 hog,	1 tuberculosis, 1 emaciation,	2 rendered.
Marshfield,	1	8	2	–	1 cow,	1 suffocation,	1 buried.
Mashpee,	–	–	–	–	–	–	–
Mattapoisett,	2	20	105	3	1 cow, 1 calf, 1 hog,	1 tuberculosis, 1 immature, 1 pneumonia.	3 buried.
Maynard,	39	346	195	14	4 hogs,	2 tuberculosis, 2 hog cholera,	1 rendered, 3 buried.
Medfield,	1	7	89	2	–	–	–
Medford,	–	–	–	–	–	–	–
Medway,	200	571	89	8	1 cow, 4 calves, 1 hog,	1 tuberculosis, 4 immature, 1 paralysis,	5 rendered, 1 buried.
Melrose,	–	–	184	–	6 hogs,	2 tuberculosis, 3 hog cholera, 1 jaundice.	5 rendered, 1 buried.

Mendon,	-	-	-	-	-	-	-
Merrimac,	-	6	64	-	-	-	-
Methuen,	187	94	176	-	5 cattle, 3 calves, 2 hogs,	7 tuberculosis, 3 immature,	10 rendered.
Middleborough,	109	119	205	-	1 cow, 1 hog,	1 tuberculosis, 1 bronchitis,	1 rendered, 1 buried.
Middlefield,	-		-	-	-	-	-
Middleton,	-	-	58	-	-	-	-
Milford,	308	535	390	9	7 cattle, 22 calves, 1 hog,	6 tuberculosis, 1 bruised, 22 immature, 1 hog cholera.	7 rendered, 23 buried.
Millbury,	-	-	-	-	-	-	-
Millis,	82	91	7	-	1 cow,	1 tuberculosis,	1 buried.
Milton,	2	-	66	49	1 cow,	1 tuberculosis,	1 rendered.
Monroe,	-	-	-	-	-	-	-
Monson,	1	45	36	-	-	-	-
Montague,	91	110	140	5	1 boar,	1 tainted,	1 owner took back.
Monterey,	1	27	47	-	1 cow,	1 tuberculosis,	1 buried.
Montgomery,	10	34	16	-	-	-	-
Mount Washington,	-	-	-	-	-	-	-
Nahant,	-	-	-	-	-	-	-
Nantucket,	5	156	160	8	-	-	-
Natick,	-	4	11	-	-	-	-
Needham,	-	-	-	-	-	-	-
New Ashford,	1	1	8	2	-	-	-
New Bedford,	253	585	542	3	11 cattle, 10 calves, 1 hog,	11 tuberculosis, 10 immature, 1 peritonitis.	22 rendered.
New Braintree,	67	211	34	-	-	-	-
New Marlborough,	21	15	7	51	-	-	-
New Salem,	15	62	152	-	-	-	-

Report on the Work of Slaughtering Inspection from Dec. 1, 1912, to Nov. 30, 1913, inclusive — Continued.

Cities and Towns.	Number of Cattle.	Number of Calves.	Number of Hogs.	Number of Sheep.	Number of Condemnations.	Reasons for Condemnation.	Disposition of Carcasses.
Newbury,	16	105	29	5	1 cow, 4 calves,	1 tuberculosis, 4 immature,	4 rendered, 1 buried.
NEWBURYPORT,	387	494	327	16	1 cow, 8 calves, 1 hog,	2 tuberculosis, 8 immature,	10 rendered.
NEWTON,	-	-	3	-	-	-	-
Norfolk,	6	2	65	-	-	-	-
NORTH ADAMS,	641	501	204	73	15 cattle, 6 calves,	14 tuberculosis, 1 paralysis, 6 immature.	20 rendered, 1 buried.
North Andover,	1	-	37	-	-	-	-
North Attleborough,	151	257	276	1	1 cow, 4 calves, 1 hog,	2 tuberculosis, 4 immature,	6 buried.
North Brookfield,	10	40	84	-	-	-	-
North Reading,	-	-	41	-	-	-	-
NORTHAMPTON,	184	404	280	4	6 cattle, 3 hogs,	6 tuberculosis, 3 hog cholera,	9 rendered.
Northborough,	5	17	89	15	-	-	-
Northbridge,	12	9	80	10	2 cows,	2 tuberculosis,	1 rendered, 1 buried.
Northfield,	19	18	142	25	4 hogs,	4 tuberculosis,	3 rendered, 1 buried.
Norton,	-	16	69	-	-	-	-
Norwell,	2	7	226	1	1 hog,	1 nephritis,	1 buried.
Norwood,	2	205	165	18	-	-	-
Oak Bluffs,	-	-	-	-	-	-	-
Oakham,	3	122	4	-	-	-	-
Orange,	86	159	90	5	13 cattle, 15 hogs,	14 tuberculosis, 1 septicæmia, 13 hog cholera.	1 rendered, 27 buried.
Orleans,	13	27	84	-	1 hog,	1 inspector not present,	1 rendered.
Otis,	46	46	59	25	2 cattle, 1 hog,	3 tuberculosis,	3 buried.
Oxford,	19	13	173	2	1 hog,	1 tuberculosis,	1 buried.

Palmer,	343	190	178	10	4 cattle, 6 calves, 4 hogs,	7 tuberculosis, 6 immature, 1 liver flukes.	8 rendered, 2 buried, 2 compost, 2 owner took back.
Paxton,	21	140	25	-	-	-	-
Peabody,	479	759	1,095	43	3 cattle, 17 calves, 8 hogs, 2 sheep.	5 tuberculosis, 16 immature, 7 hog cholera, 2 killed by dogs.	28 rendered, 2 owner took back.
Pelham,	-	5	12	-	-	-	-
Pembroke,	4	43	75	2	1 cow,	1 tuberculosis,	1 buried.
Pepperell,	12	118	20	1	2 cattle, 4 calves,	2 tuberculosis, 4 immature,	6 buried.
Peru,	-	-	-	-	-	-	-
Petersham,	15	39	130	51	1 hog,	1 pneumonia,	1 buried.
Phillipston,	25	43	85	-	-	-	-
PITTSFIELD,	122	53	47	-	10 cattle,	9 tuberculosis, 1 jaundice,	10 rendered.
Plainfield,	13	78	111	17	-	-	-
Plainville,	-	-	3	-	-	-	-
Plymouth,	131	92	246	5	3 cattle, 4 calves, 1 hog,	2 tuberculosis, 4 immature, 1 hog cholera, 1 septic poison.	5 rendered, 3 buried.
Plympton,	1	-	13	-	-	-	-
Prescott,	6	-	13	-	-	-	-
Princeton,	14	205	212	5	1 calf,	1 immature,	1 fed to hens.
Provincetown,	-	5	88	-	1 hog,	1 paralysis,	1 buried.
QUINCY,	-	-	1	-	1 hog,	1 suffocation,	1 rendered.
Randolph,	-	1	2	-	-	-	-
Raynham,	14	95	53	9	1 cow,	1 tuberculosis,	1 buried.
Reading,	631	130	227	-	7 cattle, 2 calves, 6 hogs,	7 tuberculosis, 2 immature, 6 improperly prepared.	15 rendered.
Rehoboth,	261	941	275	5	2 cattle, 1 calf,	2 tuberculosis, 1 immature,	3 rendered.
Revere,	-	-	-	-	-	-	-
Richmond,	8	1	13	29	-	-	-
Rochester,	5	50	63	-	-	-	-

Report on the Work of Slaughtering Inspection from Dec. 1, 1912, to Nov. 30, 1913, inclusive — Continued.

Cities and Towns.	Number of Cattle.	Number of Calves.	Number of Hogs.	Number of Sheep.	Number of Condemnations.	Reasons for Condemnation.	Disposition of Carcasses.
Rockland,	-	-	-	-	-	-	-
Rockport,	6	17	4	-	1 cow,	1 tuberculosis,	1 buried.
Rowe,	27	3	54	11	-	-	-
Rowley,	50	335	203	-	1 cow, 1 hog,	1 tuberculosis, 1 cirrhosis,	1 rendered, 1 buried.
Royalston,	11	18	61	18	-	-	-
Russell,	5	10	74	-	-	-	-
Rutland,	39	186	40	-	-	-	-
Salem,	-	1	193	-	-	-	-
Salisbury,	1	1	55	-	-	-	-
Sandisfield,	52	87	20	27	-	-	-
Sandwich,	4	2	61	-	-	-	-
Saugus,	-	9	59	-	-	-	-
Savoy,	-	-	-	-	-	-	-
Scituate,	1	15	3	-	-	-	-
Seekonk,	21	4	190	-	1 hog,	1 hog cholera,	1 rendered.
Sharon,	-	7	5	-	-	-	-
Sheffield,	50	50	73	248	1 cow,	1 tuberculosis,	1 buried.
Shelburne,	162	97	265	322	5 cattle, 1 hog,	4 tuberculosis, 1 parturient fever, 1 dropsy.	5 rendered, 1 buried.
Sherborn,	20	75	45	-	2 cattle,	2 inspector not present,	2 rendered.
Shirley,	-	-	-	-	-	-	-
Shrewsbury,	55	845	440	23	3 cattle,	3 tuberculosis,	2 rendered, 1 buried.
Shutesbury,	3	8	14	-	-	-	-

Somerset,	19	-	176	1	-	-	-
SOMERVILLE,	-	-	422	-	5 hogs,	5 hog cholera,	5 rendered.
South Hadley,	32	340	369	3	1 cow,	1 paralysis,	1 buried.
Southampton,	146	194	164	-	4 cattle, 3 calves,	4 tuberculosis, 3 immature,	2 rendered, 5 buried.
Southborough,	-	-	-	-	-	-	-
Southbridge,	90	125	189	-	2 cattle, 3 calves, 1 hog,	2 tuberculosis, 3 immature, 1 hog cholera.	5 rendered, 1 buried.
Southwick,	22	150	305	68	2 hogs,	1 tuberculosis, 1 bruised,	1 rendered, 1 buried.
Spencer,	47	195	152	1	1 cow,	1 tuberculosis,	1 buried.
SPRINGFIELD,	-	471	109	35	4 calves, 1 hog,	2 immature, 2 decomposed, 1 suffocation.	4 rendered, 1 buried.
Sterling,	5	58	34	-	-	-	-
Stockbridge,	-	-	-	-	-	-	-
Stoneham,	-	-	141	-	-	-	-
Stoughton,	21	147	73	-	-	-	-
Stow,	2	1	3	-	-	-	-
Sturbridge,	437	832	243	26	3 cattle, 16 calves,	3 tuberculosis, 16 immature,	3 rendered, 16 buried.
Sudbury,	1	3	22	-	-	-	-
Sunderland,	6	63	100	-	-	-	-
Sutton,	25	294	117	-	-	-	-
Swampscott,	-	-	-	-	-	-	-
Swansea,	507	498	398	27	11 cattle, 1 calf, 1 hog,	12 tuberculosis, 1 immature,	13 rendered.
TAUNTON,	388	129	823	1	3 hogs,	3 tuberculosis,	3 rendered.
Templeton,	13	38	84	-	-	-	-
Tewksbury,	581	419	214	1	18 cattle, 16 calves, 1 hog,	15 tuberculosis, 2 pneumonia, 2 died, 16 immature.	23 rendered, 9 buried, 3 fed to hogs.
Tisbury,	-	-	14	-	-	-	-
Tolland,	3	7	16	-	-	-	-

Report on the Work of Slaughtering Inspection from Dec. 1, 1912, to Nov. 30, 1913, inclusive — Continued.

Cities and Towns.	Number of Cattle.	Number of Calves.	Number of Hogs.	Number of Sheep.	Number of Condemnations.	Reasons for Condemnation.	Disposition of Carcasses.
Topsfield,	2	148	167	3,936	12 calves, 1 sheep, 2 lambs,	14 immature, 1 injured,	15 rendered.
Townsend,	34	27	45	-	4 cattle, 1 calf,	4 tuberculosis, 1 immature,	4 rendered, 1 buried.
Truro,	6	-	44	-	1 cow,	1 tuberculosis,	1 buried.
Tyngsborough,	-	1	45	-	-	-	-
Tyringham,	13	6	71	-	-	-	-
Upton,	7	22	43	-	1 cow,	1 injured,	1 buried.
Uxbridge,	47	45	181	5	6 cattle, 3 hogs,	9 tuberculosis,	3 rendered, 6 buried.
Wakefield,	-	-	286	-	3 hogs,	1 tuberculosis, 1 tumor, 1 erysipelas,	3 rendered.
Wales,	-	-	-	-	-	-	-
Walpole,	2	10	285	6	-	-	-
Waltham,	-	-	84	-	-	-	-
Ware,	14	41	89	-	-	-	-
Wareham,	-	2	53	6	-	-	-
Warren,	58	111	211	15	4 cattle,	2 tuberculosis, 2 injured,	1 rendered, 3 buried.
Warwick,	2	4	23	1	-	-	-
Washington,	13	112	50	12	1 cow,	1 tuberculosis,	1 buried.
Watertown,	235	285	162	-	3 cattle, 2 hogs,	4 tuberculosis, 1 jaundice,	5 rendered.
Wayland,	3	12	213	5	1 hog,	1 hog cholera,	1 rendered.
Webster,	4	57	204	-	-	-	-
Wellesley,	-	-	-	-	-	-	-
Wellfleet,	9	5	42	-	1 calf,	1 immature,	1 consumed by owner.
Wendell,	18	21	48	28	-	-	-

Wenham,	58	63	203	-	3 cattle, 2 calves, 2 hogs,	5 tuberculosis, 1 immature, 1 pneumonia.	7 rendered.
West Boylston,	1	2	48	-	- -	- -	- -
West Bridgewater,	10	570	501	4	2 cattle, 44 calves, 4 hogs,	7 tuberculosis, 43 immature,	31 rendered, 11 buried, 8 fed to hogs.
West Brookfield,	15	58	84	3	1 cow, 1 hog,	1 tuberculosis, 1 hog cholera,	2 buried.
West Newbury,	-	-	-	-	- -	- -	- -
West Springfield,	-	1	23	-	- -	- -	- -
West Stockbridge,	2	76	18	5	- -	- -	- -
West Tisbury,	18	8	7	393	- -	- -	- -
Westborough,	7	36	78	-	1 cow, 2 hogs,	3 tuberculosis,	3 rendered.
Westfield,	35	9	125	-	4 cattle,	2 tuberculosis, 1 decomposed, 1 improperly prepared.	1 rendered, 3 buried.
Westford,	37	698	345	10	3 cattle, 13 calves, 2 hogs,	5 tuberculosis, 12 immature, 1 hog cholera.	18 rendered.
Westhampton,	5	44	40	-	- -	- -	- -
Westminster,	6	15	99	13	1 hog,	1 tuberculosis,	1 buried.
Weston,	48	783	142	2	7 cattle, 90 calves, 9 hogs,	4 tuberculosis, 1 septicæmia, 1 pneumonia, 1 abscess, 90 immature, 5 measles, 1 cancer, 3 inspector not present.	71 rendered, 35 buried.
Westport,	567	668	1,048	88	12 cattle, 6 calves, 9 hogs,	19 tuberculosis, 1 hog cholera, 6 immature, 1 abuse and exhaustion.	21 rendered, 4 burned, 2 destroyed by acid.
Westwood,	-	2	91	-	- -	- -	- -
Weymouth,	-	-	-	-	- -	- -	- -
Whately,	-	-	-	-	- -	- -	- -
Whitman,	3	-	2	-	3 cattle,	3 tuberculosis,	3 rendered.
Wilbraham,	38	35	134	-	1 hog,	1 tuberculosis,	1 rendered.
Williamsburg,	6	17	46	-	2 hogs,	2 tainted,	2 buried.
Williamstown,	136	508	488	1,605	4 cattle, 2 hogs,	4 tuberculosis, 2 hog cholera,	2 rendered, 4 buried.
Wilmington,	46	470	960	-	10 calves, 12 hogs,	10 immature, 12 hog cholera,	22 rendered.
Winchendon,	10	35	84	1	1 cow, 1 calf, 2 hogs,	1 advanced pregnancy, 3 septicæmia,	3 rendered, 1 buried.

Report on the Work of Slaughtering Inspection from Dec. 1, 1912, to Nov. 30, 1913, inclusive — Concluded.

Cities and Towns.	Number of Cattle.	Number of Calves.	Number of Hogs.	Number of Sheep.	Number of Condemnations.	Reasons for Condemnation.	Disposition of Carcasses.
Winchester,	-	-	-	-	-	-	-
Windsor,	5	25	40	14	2 sheep,	2 tuberculosis,	2 buried.
Winthrop,	-	-	-	-	-	-	-
Woburn,	-	88	3,094	-	2 calves, 13 hogs,	2 immature, 13 tuberculosis,	15 rendered.
Worcester,	2,789	2,250	1,970	28	68 cattle, 56 calves, 16 hogs,	72 tuberculosis, 55 immature, 2 hog cholera, 10 pneumonia, 1 jaundice.	130 rendered, 10 buried.
Worthington,	14	65	165	19	-	-	-
Wrentham,	-	9	41	-	-	-	-
Yarmouth,	1	2	42	-	-	-	-

In addition to the above, 1 goat was inspected in Chelmsford, 1 boar in Montague, and 2 lambs in Topsfield.

Summary.

Total number of carcasses inspected,		151,349
(a) Cattle,	27,115	
(b) Calves,	62,517	
(c) Hogs,	51,372	
(d) Sheep,	10,341	
(e) Lambs,	2	
(f) Goat,	1	
(g) Boar,	1	
Total number of carcasses passed,		148,889½
Total number of carcasses condemned,		2,459½
(a) Cattle,	770½	
(b) Calves,	1,329	

Reasons for condemnation — *Continued.*		
(10) Icterus,		4
Hogs,	4	
(11) Omphalitis,		13
Calves,	13	
(12) Bronchitis,		1
Hog,	1	
(13) Pericarditis,		2
Cattle,	2	
(14) Peritonitis,		4
Calves,	2	
Hogs,	2	

(c) Hogs,		346
(d) Sheep,		11
(e) Lambs,		2
(f) Boar,		1
Reasons for condemnation: —		
(1) Tuberculosis,		880
Cattle,	717	
Calves,	8	
Hogs,	153	
Sheep,	2	
(2) Immature,		1,183
Calves,	1,181	
Lambs,	2	
(3) Cholera,		94
Hogs,	94	
(4) Septicæmia,		10
Cattle,	5	
Calf,	1	
Hogs,	4	
(5) Pneumonia,		25
Cattle,	8	
Calf,	1	
Hogs,	16	
(6) Anæmia,		5
Cow,	1	
Calves,	2	
Hog,	1	
Sheep,	1	
(7) Nephritis,		3
Calf,	1	
Hogs,	2	
(8) Hepatitis,		4
Hogs,	4	
(9) Enteritis,		5
Calves,	4	
Hog,	1	
(15) Uræmia,		2
Hogs,	2	
(16) Hydræmia,		1
Cow,	1	
(17) Paralysis,		6
Cattle,	2	
Hogs,	4	
(18) Pleurisy,		1
Hog,	1	
(19) Diarrhœa,		8
Calves,	8	
(20) Dysentery,		19
Calves,	17	
Sheep,	2	
(21) Jaundice,		13
Cow,	1	
Hogs,	12	
(22) Hernia,		2
Cow,	1	
Hog,	1	
(23) Caseous lymphadenitis,		2
Sheep,	2	
(24) Dropsy,		3
Hogs,	3	
(25) Cirrhosis,		1
Hog,	1	
(26) Trichinosis,		1
Hog,	1	
(27) Erysipelas,		1
Hog,	1	
(28) Measles,		5
Hogs,	5	
(29) Tumor,		2
Cow,	1	
Hog,	1	

Summary — Concluded.

Reasons for condemnation — *Continued.*			
(30) Cancer,		1	
Hog,	1		
(31) Abscess,		2	
Cattle,	2		
(32) Milk fever,		2	
Cow,	1		
Hog,	1		
(33) Parturient fever,		3	
Cattle,	2		
Calf,	1		
(34) Contusions,		1	
Hog,	1		
(35) Internal hemorrhage,		1	
Cow,	1		
(36) Emaciation,		6	
Cattle,	3		
Hogs,	3		
(37) Injured,		9	
Cattle,	3		
Calves,	5		
Sheep,	1		
(38) Bruised,		48½	
Cattle,	6½		
Calves,	39		
Hogs,	3		
(39) Decomposed,		4	
Cow,	1		
Calves,	2		
Hog,	1		
(40) Tainted,		3	
Hogs,	2		
Boar,	1		
Reasons for condemnation — *Concluded.*			
(51) Died,		4	
Cattle,	2		
Hog,	1		
Sheep,	1		
(52) Dog bites,		5	
Hogs,	5		
(53) Killed by dogs,		2	
Sheep,	2		
(54) Improperly prepared,		9	
Cow,	1		
Calves,	2		
Hogs,	6		
(55) Inspector not present,		11	
Cattle,	3		
Calves,	4		
Hogs,	4		
Total number of reasons for condemnation,			55
Disposition of condemned carcasses. —			
(*a*) Rendered,		1,931½	
Cattle,	653½		
Calves,	1,053		
Hogs,	216		
Sheep,	7		
Lambs,	2		
(*b*) Buried,		408	
Cattle,	113		
Calves,	166		
Hogs,	127		
Sheep,	2		
(*c*) Fed to hogs,		38	
Calves,	38		

(41) Liver flukes,		1
Hog,	1	
(42) Blood poison,		2
Cow,	1	
Hog,	1	
(43) Septic poison,		1
Cow,	1	
(44) Advanced pregnancy,		1
Cow,	1	
(45) Strangulation,		1
Calf,	1	
(46) Suffocation,		3
Cow,	1	
Hogs,	2	
(47) Old age,		1
Cow,	1	
(48) Abuse and exhaustion,		1
Cow,	1	
(49) Weak condition,		22
Calves,	22	
(50) Dead on arrival.		15
Calves,	15	
(*d*) Fed to hens,		28
Calves,	27	
Hog,	1	
(*e*) Fed to hogs and hens,		34
Calves,	34	
(*f*) Burned,		7
Cattle,	3	
Calves,	2	
Hogs,	2	
(*g*) Compost,		2
Calves,	2	
(*h*) Destroyed by acid,		2
Calves,	2	
(*i*) Destroyed by owner,		1
Cow,	1	
(*j*) Consumed by owner,		3
Calves,	3	
(*k*) Owner took back,		5
Calves,	2	
Sheep,	2	
Bear,	1	
Total number of dispositions of carcasses,		11

In addition to the State Board of Health supervising the inspection of slaughtering within the State, a law was enacted governing the inspection of neat cattle, sheep or swine slaughtered without the State and offered for sale in this Commonwealth, the enforcement of which was placed in our hands.

We have found it necessary to bring the provisions of this law to the attention of the board of health in every city and town in the State, and have endeavored, with more or less success, to have them coöperate with the State Board of Health in bringing about its enforcement.

Acts of 1912, Chapter 248.

An Act relative to the stamping or branding of Carcasses of Neat Cattle, Sheep or Swine sold or offered for Sale.

Section 1. Carcasses of neat cattle, sheep or swine slaughtered without the commonwealth shall be deemed unfit for human food and shall not be sold or offered for sale unless they have been inspected at the time of slaughter by an official inspector, and unless, if not condemned, they have been stamped or branded by said inspector in like manner as those inspected by the United States Bureau of Animal Industry for interstate trade. By "official inspector" is meant one appointed or approved either (*a*) by the Bureau of Animal Industry of the United States Department of Agriculture; or (*b*) by the state board of health of the state in which the animals are slaughtered; or (*c*) by the local board of health of the city or town in which the animals are slaughtered. The stamp used by inspectors other than those of the Bureau of Animal Industry of the United States Department of Agriculture shall indicate in letters not less than one fourth of an inch high the name of the city or town in which the animals are slaughtered. Whoever sells or offers for sale, or has in his possession with intent to sell, a carcass, or any part thereof, required by the provisions of this section to be stamped or branded which has not been stamped or branded as herein provided, shall be punished by a fine of not more than one hundred dollars or by imprisonment for not more than sixty days, or by both such fine and imprisonment.

Section 2. Section one hundred and five of chapter seventy-five of the Revised Laws, as amended by section two of chapter three hundred and twelve of the acts of the year nineteen hundred and two, and by section two of chapter two hundred and twenty of the acts of the year nineteen hundred and three and by section six of chapter three hundred and twenty-nine of the acts of the year nineteen hundred and eight, is hereby further amended by striking out at the end thereof the words "unless said animal is less than six months old", — and by inserting after the word "inspected", in the sixth line, the words: — and, unless condemned, shall be stamped or branded according to the provisions of section one hundred and three of chapter seventy-five of the Revised Laws, as set forth in chapter two hundred and twenty of the acts of the year nineteen hundred and three, and as amended by chapter four hundred and seventy-one of the acts of the year nineteen hundred and nine and by section five of chapter two hundred and ninety-seven of the acts of the year nineteen hundred and eleven, — so as to read as follows: — *Section 105.* The provisions of the six preceding sections shall not apply to a person not engaged in such business, who, upon his own premises, and not in a slaughterhouse, slaughters his own neat cattle, sheep or swine, but the carcass of any such animals shall be inspected, and, unless condemned, shall be stamped or branded according to the provisions of section one hundred and three of chapter seventy-five of the Revised Laws as set forth in chapter two hundred and twenty of the acts of the year nineteen hundred and three, and as amended by chapter four hundred and seventy-one of the acts of the year nineteen hundred and nine and by section five of chapter two hundred and ninety-seven of the acts of the year nineteen hundred and eleven, by an inspector at the time of slaughter. [*Approved March 14, 1912.*

Note. — Amended by chapter 603 of the Acts of the year 1912 to go into effect Sept. 1, 1912; still further amended by chapter 570 of the Acts of 1913 to go into effect July 1, 1913.

INSPECTION OF DAIRIES.

INSPECTION OF DAIRIES.

In the work of the inspection of dairies in Massachusetts, this report shows the extent of the inspection during the year ended Nov. 30, 1913. Four thousand four hundred and ninety-three milk-producing dairies, whose product was being sold within the State, were inspected by the veterinarian of the Board and his assistants. In the cities and towns visited by the inspectors of this Board, it was noticed that there continues to be a gradual improvement in the condition of the dairies. This shows a disposition on the part of the producers to coöperate with this Board in its endeavor to obtain a more sanitary condition at the dairies, in order that the public may have some assurance that they are receiving a clean, wholesome milk supply. It became necessary to call the attention of 1,543 proprietors of dairies and the boards of health of the cities and towns where the dairies were situated, as well as where the milk is disposed of, to 5,071 objectionable conditions. The inspectors of this Board are directed to make suggestions to the producers of milk how to improve conditions at their dairies. This has resulted in a noticeable improvement in the sanitary conditions, as well as in the methods employed in handling, cooling and storing milk. We find, too, that conditions are such that fewer letters have been sent to the owners on account of objectionable conditions at their dairies than in any year since the inspection of dairies has been conducted by this Board.

Of the total number of dairies examined, 4,492 were situated in Massachusetts and 1 in a neighboring State. This extra-State dairy was visited because of its proximity to the Massachusetts State line and its product being marketed in this Commonwealth. A general inspection of extra-State dairies was not made this year because our inspectors did not complete the work of inspection within this State. As soon as this has been accomplished, it is our intention to take up the inspection of dairies without the State, whose product is consumed in Massachusetts.

The following table shows the number of dairies examined in the cities and towns visited, and the percentage found in each place to be commendable: —

Inspection of Dairies, 1913.

Cities and Towns.	Total Number of Dairies examined.	Number of Dairies where One or More Objectionable Features were observed.	Number of Dairies found to be without Objectionable Features.	Per Cent. Clean Dairies.
Acton,	12	1	11	91.67
Second inspection,	3	-	3	100.00
Third inspection,	38	4	34	89.47
Fourth inspection,	1	-	1	100.00
Fifth inspection,	2	-	2	100.00
Amherst,	6	6	-	-
Second inspection,	24	16	8	33 33
Third inspection,	5	3	2	40.00
Fourth inspection,	6	5	1	16.67
Arlington,	15	5	10	66.67
Second inspection,	1	-	1	100.00
Third inspection,	6	3	3	50.00
Ashburnham,	7	5	2	28.57
Second inspection,	2	2	-	-
Third inspection,	3	2	1	33.33
Ashby,	8	7	1	12.50
Second inspection,	12	6	6	50.00
Ashland,	11	4	7	63.64
Second inspection,	5	1	4	80.00
Third inspection,	4	1	3	75.00
Fourth inspection,	1	-	1	100.00
Athol,	7	4	3	42.86
Second inspection,	3	2	1	33.33
Third inspection,	5	1	4	80.00
Attleborough,	8	4	4	50.00
Second inspection,	5	3	2	40.00
Third inspection,	31	13	18	58.06
Avon,	1	-	1	100.00
Third inspection,	10	3	7	70.00
Ayer,	-	-	-	-
Second inspection,	2	1	1	50.00
Third inspection,	2	1	1	50.00
Fourth inspection,	2	1	1	50.00
Barnstable,	7	2	5	71.43
Second inspection,	19	11	8	42.11
Third inspection,	4	1	3	75.00

Inspection of Dairies, 1913 — Continued.

Cities and Towns.	Total Number of Dairies examined.	Number of Dairies where One or More Objectionable Features were observed.	Number of Dairies found to be without Objectionable Features.	Per Cent. Clean Dairies.
Barre,	11	6	5	45.45
Second inspection,	38	19	19	50.00
Bedford,	7	5	2	28.57
Second inspection,	4	2	2	50.00
Third inspection,	31	19	12	38.71
Bellingham,	6	4	2	33.33
Second inspection,	21	5	16	76.19
Third inspection,	6	-	6	100.00
Berkley,	4	1	3	75.00
Second inspection,	3	1	2	66.67
Third inspection,	9	3	6	66.67
Berlin,	12	5	7	58.33
Second inspection,	4	-	4	100.00
Third inspection,	15	5	10	66.67
Fourth inspection,	2	1	1	50.00
Bernardston,	26	15	11	42.31
Billerica,	31	5	26	83.87
Second inspection,	1	-	1	100.00
Third inspection,	17	5	12	70.59
Blackstone,	10	6	4	40.00
Second inspection,	15	4	11	73.33
Third inspection,	13	-	13	100.00
Bolton,	1	1	-	-
Second inspection,	5	3	2	40.00
Third inspection,	22	11	11	50.00
Bourne,	6	4	2	33.33
Boxborough,	9	2	7	77.78
Third inspection,	16	4	12	75.00
Boylston,	3	1	2	66.67
Third inspection,	15	5	10	66.67
Fourth inspection,	1	-	1	100.00
Braintree,	9	5	4	44.44
Second inspection,	4	3	1	25.00
Third inspection,	10	5	5	50.00
Bridgewater,	4	2	2	50.00
Third inspection,	16	3	13	81.25

Inspection of Dairies, 1913 — Continued.

Cities and Towns.	Total Number of Dairies examined.	Number of Dairies where One or More Objectionable Features were observed.	Number of Dairies found to be without Objectionable Features.	Per Cent. Clean Dairies.
Burlington,	3	1	2	66.67
Second inspection,	10	1	9	90.00
Third inspection,	15	2	13	86.67
Canton,	8	1	7	87.50
Second inspection,	2	-	2	100.00
Third inspection,	11	2	9	81.82
Fourth inspection,	4	2	2	50.00
Carlisle,	9	3	6	66.67
Second inspection,	6	2	4	66.67
Third inspection,	29	8	21	72.41
Fourth inspection,	1	-	1	100.00
Chelmsford,	28	5	23	82.14
Third inspection,	23	6	17	73.91
Clarksburg,	5	2	3	60.00
Second inspection,	6	3	3	50.00
Third inspection,	4	2	2	50.00
Clinton,	2	1	1	50.00
Third inspection,	1	-	1	100.00
Colrain,	13	11	2	15.38
Second inspection,	19	10	9	47.37
Dana,	4	2	2	50.00
Danvers,	12	6	6	50.00
Second inspection,	9	4	5	55.56
Third inspection,	26	11	15	57.69
Dedham,	-	-	-	-
Second inspection,	3	-	3	100.00
Third inspection,	22	6	16	72.73
Dighton,	11	3	8	72.73
Second inspection,	3	-	3	100.00
Third inspection,	3	-	3	100.00
Fourth inspection,	1	1	-	-
Douglas,	3	2	1	33.33
Second inspection,	3	-	3	100.00
Dover,	3	1	2	66.67
Second inspection,	1	1	-	-

Inspection of Dairies, 1913 — Continued.

Cities and Towns.	Total Number of Dairies examined.	Number of Dairies where One or More Objectionable Features were observed.	Number of Dairies found to be without Objectionable Features.	Per Cent. Clean Dairies.
Dover — *Con.*				
Third inspection,	16	9	7	43.75
Fourth inspection,	1	–	1	100.00
Dracut,	30	8	22	73.33
Second inspection,	2	–	2	100.00
Third inspection,	18	3	15	83.33
Fourth inspection,	2	–	2	100.00
Easthampton,	29	24	5	17.24
Second inspection,	1	1	–	–
Easton,	12	3	9	75.00
Second inspection,	11	3	8	72.73
Third inspection,	21	4	17	80.95
Erving,	3	3	–	–
Essex,	13	2	11	84.62
Second inspection,	27	3	24	88.89
Third inspection,	5	1	4	80.00
Fitchburg,	4	1	3	75.00
Second inspection,	10	2	8	80.00
Third inspection,	21	2	19	90.48
Fourth inspection,	2	1	1	50.00
Foxborough,	9	4	5	55.56
Second inspection,	5	4	1	20.00
Third inspection,	5	1	4	80.00
Framingham,	16	3	13	81.25
Second inspection,	15	2	13	86.67
Third inspection,	14	1	13	92.86
Fourth inspection,	6	–	6	100.00
Franklin,	9	4	5	55.56
Second inspection,	6	1	5	83.33
Third inspection,	6	2	4	66.67
Gardner,	4	3	1	25.00
Second inspection,	4	2	2	50.00
Third inspection,	16	6	10	62.50
Gill,	6	5	1	16.67
Second inspection,	5	3	2	40.00

Inspection of Dairies, 1913 — Continued.

Cities and Towns.	Total Number of Dairies examined.	Number of Dairies where One or More Objectionable Features were observed.	Number of Dairies found to be without Objectionable Features.	Per Cent. Clean Dairies.
Grafton,	15	8	7	46.67
Second inspection,	4	1	3	75.00
Third inspection,	21	9	12	57.14
Fourth inspection,	3	2	1	33.33
Greenfield,	18	13	5	27.78
Second inspection,	27	16	11	40.74
Groton,	13	3	10	76.92
Second inspection,	2	–	2	100.00
Third inspection,	13	6	7	53.85
Hardwick,	13	5	8	61.54
Second inspection,	41	8	33	80.49
Third inspection,	1	–	1	100.00
Harvard,	27	5	22	81.48
Second inspection,	9	2	7	77.78
Third inspection,	30	9	21	70.00
Heath,	3	3	–	–
Second inspection,	4	2	2	50.00
Hingham,	9	2	7	77.78
Second inspection,	7	1	6	85.71
Fourth inspection,	3	–	3	100.00
Holbrook,	3	–	3	100.00
Third inspection,	2	–	2	100.00
Holden,	15	5	10	66.67
Second inspection,	5	2	3	60.00
Third inspection,	22	7	15	68.18
Holliston,	10	3	7	70.00
Second inspection,	4	1	3	75.00
Third inspection,	14	5	9	64.29
Fourth inspection,	3	1	2	66.67
Hopedale,	2	–	2	100.00
Hopkinton,	17	4	13	76.47
Second inspection,	4	–	4	100.00
Third inspection,	24	9	15	62.50
Hubbardston,	7	5	2	28.57
Second inspection,	7	3	4	57.14
Third inspection,	12	2	10	83.33

Inspection of Dairies, 1913 — Continued.

Cities and Towns.	Total Number of Dairies examined.	Number of Dairies where One or More Objectionable Features were observed.	Number of Dairies found to be without Objectionable Features.	Per Cent. Clean Dairies.
Hudson,	11	–	11	100.00
Second inspection,	7	3	4	57.14
Third inspection,	2	–	2	100.00
Fourth inspection,	1	1	–	–
Ipswich,	19	11	8	42.11
Second inspection,	1	–	1	100.00
Third inspection,	22	10	12	54.55
Lancaster,	12	2	10	83.33
Third inspection,	10	2	8	80.00
Lenox,	3	1	2	66.67
Second inspection,	5	3	2	40.00
Third inspection,	2	–	2	100.00
Leominster,	19	9	10	52.63
Third inspection,	38	16	22	57.89
Lexington,	10	5	5	50.00
Second inspection,	5	4	1	20.00
Third inspection,	5	2	3	60.00
Fourth inspection,	9	3	6	66.67
Fifth inspection,	1	1	–	–
Leyden,	26	20	6	23.08
Lincoln,	11	4	7	63.64
Second inspection,	2	–	2	100.00
Third inspection,	24	11	13	54.17
Littleton,	13	2	11	84.62
Second inspection,	3	1	2	66.67
Third inspection,	2	–	2	100.00
Fourth inspection,	39	7	32	82.05
Fifth inspection,	2	1	1	50.00
Lunenberg,	–	–	–	–
Second inspection,	3	1	2	66.67
Third inspection,	32	6	26	81.25
Lynn,	1	1	–	–
Second inspection,	7	3	4	57.14
Third inspection,	3	1	2	66.67
Fourth inspection,	5	3	2	40.00

Inspection of Dairies, 1913 — Continued.

Cities and Towns.	Total Number of Dairies examined.	Number of Dairies where One or More Objectionable Features were observed.	Number of Dairies found to be without Objectionable Features.	Per Cent. Clean Dairies.
Lynnfield,	3	2	1	33.33
Third inspection,	13	10	3	23.08
Mansfield,	5	–	5	100.00
Third inspection,	12	–	12	100.00
Marion,	3	1	2	66.67
Third inspection,	2	–	2	100.00
Marlborough,	9	4	5	55.56
Second inspection,	14	6	8	57.14
Third inspection,	22	11	11	50.00
Fourth inspection,	5	–	5	100.00
Mattapoisett,	3	1	2	66.67
Second inspection,	15	11	4	26.67
Third inspection,	7	5	2	28.57
Maynard,	8	1	7	87.50
Second inspection,	1	–	1	100.00
Third inspection,	5	3	2	40.00
Medfield,	–	–	–	–
Second inspection,	21	10	11	52.38
Medford,	9	–	9	100.00
Second inspection,	4	–	4	100.00
Third inspection,	5	1	4	80.00
Fourth inspection,	1	–	1	100.00
Medway,	5	1	4	80.00
Third inspection,	11	1	10	90.91
Melrose,	13	8	5	38.46
Second inspection,	8	6	2	25.00
Third inspection,	1	1	–	–
Fifth inspection,	1	–	1	100.00
Mendon,	22	8	14	63.64
Second inspection,	1	–	1	100.00
Third inspection,	7	–	7	100.00
Middleton,	–	–	–	–
Third inspection,	9	7	2	22.22
Milford,	13	10	3	23.08
Second inspection,	8	5	3	37.50
Third inspection,	7	4	3	42.86

Inspection of Dairies, 1913 — Continued.

Cities and Towns.	Total Number of Dairies examined.	Number of Dairies where One or More Objectionable Features were observed.	Number of Dairies found to be without Objectionable Features.	Per Cent. Clean Dairies.
Millis,	5	–	5	100.00
Second inspection,	7	2	5	71.43
Third inspection,	14	1	13	92.86
Milton,	16	7	9	56.25
Third inspection,	7	2	5	71.43
Fourth inspection,	9	2	7	77.78
Montague,	16	8	8	50.00
Second inspection,	2	2	–	–
Natick,	7	2	5	71.43
Second inspection,	5	2	3	60.00
Third inspection,	14	3	11	78.57
Needham,	3	2	1	33.33
Second inspection,	6	2	4	66.67
Third inspection,	6	–	6	100.00
Fourth inspection,	1	–	1	100.00
Newburyport,	9	5	4	44.44
Second inspection,	3	3	–	–
Third inspection,	10	6	4	40.00
New Salem,	3	2	1	33.33
Second inspection,	1	1	–	–
Newton,	13	4	9	69.23
Second inspection,	6	1	5	83.33
Third inspection,	38	15	23	60.53
Norfolk,	4	1	3	75.00
Second inspection,	6	1	5	83.33
Third inspection,	1	–	1	100.00
North Andover,	10	4	6	60.00
Second inspection,	4	1	3	75.00
Third inspection,	20	1	19	95.00
North Attleborough,	7	4	3	42.86
Second inspection,	6	4	2	33.33
Third inspection,	15	4	11	73.33
North Reading,	7	2	5	71.43
Second inspection,	1	1	–	–
Third inspection,	16	5	11	68.75
Fourth inspection,	2	2	–	–

Inspection of Dairies, 1913 — Continued.

Cities and Towns.	Total Number of Dairies examined.	Number of Dairies where One or More Objectionable Features were observed.	Number of Dairies found to be without Objectionable Features.	Per Cent. Clean Dairies.
Northborough,	4	1	3	75.00
Second inspection,	2	2	-	-
Third inspection,	25	5	20	80.00
Fourth inspection,	1	1	-	-
Northfield,	16	9	7	43.75
Second inspection,	10	2	8	80.00
Third inspection,	1	1	-	-
Norton,	7	2	5	71.43
Second inspection,	5	1	4	80.00
Third inspection,	11	2	9	81.82
Norwood,	19	6	13	68.42
Second inspection,	18	8	10	55.56
Orange,	17	8	9	52.94
Second inspection,	8	4	4	50.00
Orleans,	2	-	2	100.00
Third inspection,	1	1	-	-
Paxton,	7	4	3	42.86
Second inspection,	18	12	6	33.33
Peabody,	12	10	2	16.67
Second inspection,	10	2	8	80.00
Third inspection,	8	5	3	37.50
Pepperell,	4	-	4	100.00
Second inspection,	3	-	3	100.00
Third inspection,	15	1	14	93.33
Petersham,	-	-	-	-
Second inspection,	13	6	7	53.85
Phillipston,	-	-	-	-
Second inspection,	2	1	1	50.00
Plainville,	2	-	2	100.00
Second inspection,	3	1	2	66.67
Third inspection,	8	4	4	50.00
Princeton,	15	5	10	66.67
Second inspection,	1	-	1	100.00
Third inspection,	12	2	10	83.33
Quincy,	30	6	24	80.00
Second inspection,	8	1	7	87.50

Inspection of Dairies, 1913 — Continued.

Cities and Towns.	Total Number of Dairies examined.	Number of Dairies where One or More Objectionable Features were observed.	Number of Dairies found to be without Objectionable Features.	Per Cent. Clean Dairies.
Quincy — *Con.*				
Third inspection,	7	3	4	57.14
Fourth inspection,	19	3	16	84.21
Randolph,	20	2	18	90.00
Second inspection,	1	1	–	–
Third inspection,	7	–	7	100.00
Reading,	3	3	–	–
Second inspection,	1	1	–	–
Third inspection,	11	5	6	54.55
Revere,	–	–	–	–
Second inspection,	2	1	1	50.00
Third inspection,	1	1	–	–
Fourth inspection,	4	3	1	25.00
Rowe,	1	1	–	–
Royalston,	–	–	–	–
Second inspection,	1	1	–	–
Third inspection,	2	–	2	100.00
Rutland,	8	–	8	100.00
Second inspection,	7	1	6	85.71
Third inspection,	16	4	12	75.00
Salem,	–	–	–	–
Third inspection,	3	–	3	100.00
Saugus,	5	3	2	40.00
Second inspection,	10	1	9	90.00
Third inspection,	1	–	1	100.00
Fourth inspection,	17	9	8	47.06
Seventh inspection,	1	1	–	–
Sharon,	7	–	7	100.00
Second inspection,	2	–	2	100.00
Third inspection,	6	1	5	83.33
Sherborn,	22	4	18	81.82
Second inspection,	5	2	3	60.00
Third inspection,	19	5	14	73.68
Fourth inspection,	1	–	1	100.00
Shirley,	1	–	1	100.00
Second inspection,	5	–	5	100.00

Inspection of Dairies, 1913 — Continued.

Cities and Towns.	Total Number of Dairies examined.	Number of Dairies where One or More Objectionable Features were observed.	Number of Dairies found to be without Objectionable Features.	Per Cent. Clean Dairies.
Shirley — *Con.*				
Third inspection,	8	–	8	100.00
Somerville,	3	–	3	100.00
Third inspection,	2	–	2	100.00
Southborough,	1	–	1	100.00
Second inspection,	4	–	4	100.00
Third inspection,	6	–	6	100.00
Fourth inspection,	23	1	22	95.65
Sixth inspection,	1	1	–	–
Sterling,	22	5	17	77.27
Second inspection,	8	1	7	87.50
Third inspection,	66	24	42	63.64
Fourth inspection,	3	1	2	66.67
Stoneham,	14	5	9	64.29
Second inspection,	15	2	13	86.67
Third inspection,	9	1	8	88.89
Fourth inspection,	2	–	2	100.00
Stoughton,	15	10	5	33.33
Second inspection,	12	10	2	16.67
Third inspection,	9	8	1	11.11
Stow,	31	5	26	83.87
Second inspection,	4	–	4	100.00
Third inspection,	19	3	16	84.21
Sudbury,	22	4	18	81.82
Second inspection,	2	–	2	100.00
Third inspection,	30	4	26	86.67
Fourth inspection,	4	–	4	100.00
Fifth inspection,	5	–	5	100.00
Sunderland,	20	15	5	25.00
Second inspection,	17	8	9	52.94
Third inspection,	1	–	1	100.00
Taunton,	12	2	10	83.33
Second inspection,	15	6	9	60.00
Third inspection,	16	2	14	87.50
Templeton,	5	3	2	40.00
Second inspection,	1	1	–	–

Inspection of Dairies, 1913 — Continued.

Cities and Towns.	Total Number of Dairies examined.	Number of Dairies where One or More Objectionable Features were observed.	Number of Dairies found to be without Objectionable Features.	Per Cent. Clean Dairies.
Templeton — *Con.*				
Third inspection,	12	6	6	50.00
Tewksbury,	19	7	12	63.16
Second inspection,	1	–	1	100.00
Third inspection,	19	4	15	78.95
Topsfield,	4	2	2	50.00
Third inspection,	16	5	11	68.75
Townsend,	3	2	1	33.33
Second inspection,	2	2	–	–
Third inspection,	4	1	3	75.00
Upton,	8	5	3	37.50
Second inspection,	6	–	6	100.00
Uxbridge,	9	2	7	77.78
Second inspection,	18	6	12	66.67
Third inspection,	19	1	18	94.74
Wakefield,	3	1	2	66.67
Second inspection,	2	2	–	–
Third inspection,	8	6	2	25.00
Fourth inspection,	1	–	1	100.00
Walpole,	8	4	4	50.00
Second inspection,	28	5	23	82.14
Third inspection,	2	–	2	100.00
Waltham,	3	1	2	66.67
Second inspection,	5	–	5	100.00
Third inspection,	12	4	8	66.67
Fourth inspection,	20	9	11	55.00
Ware,	20	2	18	90.00
Second inspection,	42	8	34	80.95
Warwick,	3	1	2	66.67
Watertown,	8	4	4	50.00
Second inspection,	1	1	–	–
Third inspection,	5	2	3	60.00
Fourth inspection,	3	1	2	66.67
Wayland,	12	4	8	66.67
Second inspection,	1	1	–	–
Third inspection,	25	10	15	60.00

Inspection of Dairies, 1913 — Continued.

Cities and Towns.	Total Number of Dairies examined.	Number of Dairies where One or More Objectionable Features were observed.	Number of Dairies found to be without Objectionable Features.	Per Cent. Clean Dairies.
Webster,	4	4	-	-
Second inspection,	4	-	4	100 00
Wellesley,	2	1	1	50.00
Second inspection,	7	1	6	85.71
West Boylston,	11	5	6	54.55
Second inspection,	15	5	10	66.67
Third inspection,	23	5	18	78.26
Fourth inspection,	1	-	1	100.00
West Bridgewater,	13	4	9	69.23
Second inspection,	3	2	1	33.33
Third inspection,	27	9	18	66.67
Westborough,	7	3	4	57.14
Second inspection,	9	4	5	55.56
Third inspection,	30	7	23	76 67
Fourth inspection,	16	1	15	93.75
Westford,	19	2	17	89.47
Second inspection,	4	1	3	75.00
Third inspection,	21	5	16	76.19
Fourth inspection,	1	-	1	100.00
Westhampton,	28	10	18	64 29
Westminster,	5	1	4	80.00
Second inspection,	14	4	10	71.43
Third inspection,	4	1	3	75.00
Weston,	10	1	9	90.00
Second inspection,	3	-	3	100.00
Third inspection,	27	7	20	74.07
Fourth inspection,	1	-	1	100.00
Westwood,	15	12	3	20 00
Second inspection,	3	3	-	-
Third inspection,	7	1	6	85.71
Weymouth,	27	8	19	70.37
Second inspection,	2	2	-	-
Third inspection,	13	6	7	53.85
Williamstown,	2	1	1	50.00
Second inspection,	5	2	3	60.00
Third inspection,	3	1	2	66.67

Inspection of Dairies, 1913 — Concluded.

Cities and Towns.	Total Number of Dairies examined.	Number of Dairies where One or More Objectionable Features were observed.	Number of Dairies found to be without Objectionable Features.	Per Cent. Clean Dairies.
Wilmington,	7	3	4	57.14
Second inspection,	1	–	1	100.00
Third inspection,	9	7	2	22.22
Winchendon,	7	2	5	71.43
Second inspection,	2	–	2	100.00
Third inspection,	7	–	7	100.00
Winchester,	2	–	2	100.00
Second inspection,	1	1	–	–
Third inspection,	7	–	7	100.00
Woburn,	34	15	19	55.88
Second inspection,	4	1	3	75.00
Third inspection,	4	2	2	50.00
Fourth inspection,	1	–	1	100.00
Wrentham,	4	3	1	25.00
Second inspection,	4	2	2	50.00
Third inspection,	3	1	2	66.67
Miscellaneous,	12	5	7	58.33
Halifax, Vt.,	–	–	–	–
Third inspection,	1	–	1	100.00
Extra-State dairy,	1	–	1	100.00
Total Massachusetts dairies,	4,492	1,543	2,949	65 65
Total dairies,	4,493	1,543	2,950	65.66

Under "Miscellaneous" are included dairies situated in the following places, in no one of which was more than 1 inspected, the examinations having been made for some special reason and not as a part of the general investigation: —

Duxbury,
Granby,
Hull,
Milton,
Newton,
Plymouth,
Quincy,
South Hadley,
Southborough,
Stoughton,
Wayland,
Wellesley.

Included in the total number of dairies examined are 9 dairies in Canton, a special examination of which was made in May, during the outbreak of septic tonsillitis in that town.

Of the dairies examined in the towns of Leyden and Montague, 19 were reported as making butter and 1 making cheese.

The towns of New Marlborough, Otis and Sandisfield were also visited, and it was found that the supply was used in the production of butter.

Included in the total number of Massachusetts dairies were 1,574 which had recently started in the milk-producing business and were inspected for the first time.

In addition to the foregoing, 1,271 dairies were visited at which the sale of milk had been discontinued; also, 179 dairies were reported as producing less than 20 quarts of milk a day.

Nature of the Defects to which Attention was called.

Below is presented an analysis of the 5,071 objectionable conditions to which the attention of the boards of health was called: —

	Defects.	
Condition of Cows.		
Unclean herds,	365	
Moldy food fed to cows,	1	
		366
Condition of Barns.		
Tie-up ceiling in need of repair,	199	
Tie-up floor in need of repair,	85	
Tie-up wall in need of repair,	5	
		289
Light.		
Insufficient number of windows,	90	
Windows inadequate in size,	41	
		131
Ventilation.		
Barn overcrowded,	172	
		172
General Cleanliness.		
General uncleanliness of premises,	273	
Tie-up in need of cleaning and whitewashing,	1,371	
Pigs kept near cows,	258	
Swill kept near cows,	22	
Accumulated manure,	88	
Manure pit near cows,	3	
Horse manure used as bedding for cows,	17	
Horse manure used in vicinity of cows,	166	
Donkeys not separated from cows,	1	
Horses not separated from cows,	456	
Brewers' grains in cow tie-up,	4	
Tie-up used for general storage,	6	

	Defects.	
Unclean cellar,	14	
Lack of proper drainage,	65	
Privy in barn,	68	
Tie-up floor used as privy,	2	
Trough behind cows used as privy,	2	
Poultry in cow tie-up,	17	
Poultry slaughtered in cow tie-up,	5	
Decaying bedding in cow tie-up,	13	
Slaughtering in cow barn,	2	
Hay stored in cow tie-up,	15	
Sand used as an absorbent,	3	
No bedding used,	8	
Cows kept in unclean cellar,	3	
		2,882

Condition of Cow Yards.

General uncleanliness,	15	
Yard in need of proper drainage,	8	
Pool of stagnant water in yard,	1	
		24

Water Supplies.

Well exposed to surface drainage,	28	
Spring exposed to barn drainage,	1	
		29

Milk Rooms.

Milk room needed,	634	
Unclean milk room,	89	
Milk room unused,	40	
Milk room used for general storage,	35	
Milk room in house,	4	
Milk room in barn,	13	
Poultry allowed in milk room,	2	
Poultry slaughtered in milk room,	1	
Milk room used for laundry and household purposes,	1	
Lack of proper drainage,	2	
Milk room floor in need of repair,	30	
Change location of milk room,	8	
Milk room in vicinity of henhouse,	1	
Milk room in need of screening,	8	
Milk room in need of whitewashing,	8	
		876

Care of Milk and Milk Utensils.

Milk cooled: —		
(*a*) In barn,	4	
(*b*) In barn cellar,	2	
(*c*) In house,	3	
(*d*) In trough where animals drink,	7	

	Defects.	
Milk cooled — *Continued.*		
(*e*) In insanitary duck pool,	1	
(*f*) Between two hencoops,	1	
		18
Milk handled: —		
(*a*) In barn,	77	
(*b*) In barn cellar,	5	
(*c*) Back of cows,	11	
(*d*) In house,	65	
(*e*) In shed,	9	
(*f*) In yard,	10	
(*g*) In front of cows,	3	
(*h*) In carriage shed,	5	
(*i*) In grain room,	2	
(*j*) In tool room,	1	
(*k*) Near hogs,	2	
(*l*) Near horses,	2	
(*m*) Near manure pile,	2	
(*n*) Near privy,	1	
		195
Milk stored: —		
(*a*) In trough where animals drink,	3	
(*b*) In barn,	3	
(*c*) In house,	3	
(*d*) In shed,	1	
(*e*) In grain room,	1	
(*f*) In yard,	1	
		12
Cans kept in barn,		37
Cans kept in harness room,		2
Cans kept in shed,		1
Cans kept in grain room,		1
Cans inverted over rubbish pile,		1
Unclean water in cooling tank,		2
Unclean milk utensils,		25
Milk utensils washed in dwelling,		2
Milk utensils aired near place where hens are kept,		1
Mixer kept in barn,		4
Rubbish kept on top of chest where milk is stored,		1
Total number of objectionable conditions,		5.071

REPORT OF THE BOARD

OF THE

STATE EXAMINERS OF PLUMBERS.

Report of the Board of the State Examiners of Plumbers.

State Board of Health, Commonwealth of Massachusetts, Boston, Mass.

Gentlemen: — The State Examiners of Plumbers respectfully submit the following report of their affairs for the year ending November, 1913: —

Examinations.	Examined.	Passed.	Refused.
Boston, Dec. 7, 1912,	53	16	37
Lowell, Dec. 21, 1912,	27	8	19
Boston, Jan. 4, 1913,	56	19	37
Pittsfield, Jan. 18, 1913,	28	8	20
Boston, Feb. 1, 1913,	77	24	53
Springfield, Feb. 15, 1913,	67	24	43
Boston, March 1, 1913,	76	18	58
Fall River, March 15, 1913,	38	9	29
Boston, April 5, 1913,	80	23	57
Worcester, April 12, 1913,	33	12	21
Boston, May 3, 1913,	100	30	70
Lowell, May 17, 1913,	24	7	17
Boston, June 7, 1913,	95	30	65
Pittsfield, June 21, 1913,	43	11	32
Boston, July 2, 1913,	93	32	61
Boston, Sept. 6, 1913,	75	22	53
Springfield, Sept. 20, 1913,	60	16	44
Boston, Oct, 4, 1913,	77	25	52
Fall River, Oct. 18, 1913,	34	9	25
Boston, Nov. 1, 1913,	67	12	55
Worcester, Nov. 15, 1913,	12	6	6
	1,215	361	854

	Masters.	Journeymen.	Total.
Licenses granted on account of examination, December, 1912, to December, 1913.	57	304	361
Probationary licenses issued during the year,	-	-	5

Registrations.	Masters.	Journeymen.
December, 1912,	1	27
January, 1913,	5	25
February, 1913,	10	29
March, 1913,	7	36
April, 1913,	7	27
May, 1913,	6	52
June, 1913,	13	19
July, 1913,	6	35
August, 1913,	6	23
September, 1913,	8	24
October, 1913,	8	29
November, 1913,	3	22
Totals,	80	348

Meetings,	72	Examinations,	21
Hearings,	5		

Fees received.	Paid to the Treasurer of the Commonwealth.
1,215 examination fees, at $0.50,	$607 50
80 master plumber licenses issued, at $2,	160 00
348 journeyman plumber licenses issued, at $0.50,	174 00
1,596 master plumber renewals, at $0.50,	798 00
3,505 journeyman plumber renewals, at $0.50,	1,752 50
56 renewal fees for years 1911–12, at $0.50,	28 00
	$3,520 00

For carrying out the Provisions of the Acts relative to the Supervision of the Business of Plumbing (Chapter 536 of the Acts of 1909).

Appropriation for the year ended Nov. 30, 1913, ... $5,200 00

Salary, clerk,	$2,000 00
Wages, second and third examiners,	545 00
Traveling expenses,	488 71
Express charges,	29 05
Printing,	367 50
Postage,	356 74
Books and stationery,	91 83
Office supplies,	108 55
Plumbers' materials,	110 67
Cleaning,	21 00
Extra services,	920 78
Miscellaneous,	4 15
	$5,043 98

Summary of Registrations.

	Masters.	Journeymen.
Certificate holders,	517	500
Licensed for year ending May 1, 1914,	1,676	2,501
Total,	2,193	3,001

Licenses suspended upon request of authorities having supervision of plumbing, after hearing, ... 3

Suspended for thirty days, ... 2
Suspended for twenty-four days, ... 1

Deceased Plumbers (reported to Examiners).

Masters, ... 24 | Journeymen, ... 9

Rules formulated by the State Examiners of Plumbers have been accepted by the following towns during the year: Weymouth and Whitman.

JAMES C. COFFEY.
CHAS. R. FELTON.
EDWARD C. KELLY.

REPORT

UPON THE

Production and Distribution of Diphtheria Antitoxin and Vaccine Virus

FOR THE

Year ended Nov. 30, 1913.

Report upon the Production and Distribution of Diphtheria Antitoxin and Vaccine Virus for the Year ended Nov. 30, 1913.

The production of diphtheria antitoxin and vaccine has continued, under the direction of Dr. Theobald Smith, at the laboratory of the State Board of Health at Forest Hills. The distribution has been conducted, as before, at the office of the Board.

The total number of packages issued by the Board during the eighteen years and eight months ended Nov. 30, 1913, was as follows: —

	Bottles.
In 1895–96 (year ended March 31),	1,724
In 1896–97 (year ended March 31),	3.219
In 1897–98 (year ended March 31),	4,668
In 1898–99 (year ended March 31),	12,491
In 1899–1900 (year ended March 31),	31,997
In 1900–01 (year ended March 31),	53,389
In 1901–02 (year ended March 31),	40,211
In 1902–03 (year ended March 31),	33,475
In 1903–04 (year ended March 31),	41,133
During six months ended Sept. 30, 1904,	22.255
In 1904–05 (year ended Sept. 30, 1905),	47,387
During fourteen months ended Nov. 30, 1906,	70,424
In 1906–07 (year ended Nov. 30, 1907),	64,807
In 1907–08 (year ended Nov. 30, 1908),	94,645
In 1908–09 (year ended Nov. 30, 1909),	90,131
In 1909–10 (year ended Nov. 30, 1910),	92.623
In 1910–11 (year ended Nov. 30, 1911),	96,522
In 1911–12 (year ended Nov. 30, 1912),	82,085
In 1912–13 (year ended Nov. 30, 1913),	96,891
Total,	980,077

The serum was distributed to local boards of health, to hospitals and to practitioners in 207 cities and towns, 76 of which used more than 100 bottles each. The following table shows the distribution: —

Number of Bottles of Diphtheria Antitoxin distributed from Dec. 1, 1912, to Nov. 30, 1913.

City or Town.	Number of Bottles.	City or Town.	Number of Bottles.
Abington,	24	Cambridge,	941
Acton,	24	Diphtheria Hospital,	625
Adams,	174	Hospital,	24
Amherst,	12	Stillman Infirmary,	48
Andover,	74	Canton,	12
Arlington,	72	Massachusetts Hospital School,	24
Ashburnham,	24	Carver,	6
Athol,	12	Chatham,	24
Attleborough,	172	Chelsea,	610
Auburn,	6	Cheshire,	6
Avon,	132	Chester,	6
Ayer,	72	Chesterfield,	3
Barnstable,	157	Chicopee,	166
Barre,	44	Clinton,	232
Bedford,	18	Cohasset,	205
Belmont,	52	Colrain,	18
Massachusetts School for the Feeble-minded.	62	Concord,	62
Beverly,	124	Conway,	12
Billerica,	24	Cummington,	18
Blackstone,	120	Dalton,	74
Bourne,	15	Danvers,	166
Braintree,	49	Dedham,	134
Bridgewater,	12	Deerfield,	137
Brimfield,	6	Dennis,	12
Brockton,	1,479	Dighton,	6
Brookfield,	24	Douglas,	12
Brookline,	340	Dudley,	36
Boston: —		East Bridgewater,	9
Children's Hospital,	1,425	Easthampton,	135
City Hospital,	34,064	Easton,	240
General Supply,	11,940	Edgartown,	46
Infants' Hospital,	98	Essex,	6
Massachusetts General Hospital,	154	Everett,	490
Massachusetts Homœopathic Hospital.	2,996	Fairhaven,	207
St. Elizabeth's Hospital,	3	Fall River,	2,448

Number of Bottles of Diphtheria Antitoxin distributed from Dec. 1, 1912, to Nov. 30, 1913 — Continued.

City or Town.	Number of Bottles.	City or Town.	Number of Bottles.
Falmouth,	36	Lenox,	16
Fitchburg,	463	Lexington,	24
Foxborough,	48	Lincoln,	7
Framingham,	60	Lowell,	1,423
Franklin,	24	Corporation Hospital,	174
Gardner,	53	Lynn,	1,163
Georgetown,	48	Hospital for Contagious Diseases,	2,600
Gloucester,	222	Malden,	1,637
Grafton,	22	Manchester,	36
Greenfield,	123	Mansfield,	24
Groton,	150	Marblehead,	24
Groveland,	36	Children's Island Sanatorium,	28
Hadley,	96	Marion,	42
Hamilton,	188	Marlborough,	12
Hanson,	24	Marshfield,	6
Hanover,	24	Mashpee,	36
Hardwick,	30	Mattapoisett,	12
Harvard,	6	Maynard,	67
Harwich,	133	Medfield,	36
Hatfield,	12	Medford,	262
Haverhill,	775	Medway,	149
Hingham,	69	Melrose,	54
Holbrook,	12	Merrimac,	6
Holliston,	12	Methuen,	33
Holyoke,	486	Middleborough,	57
Hopedale,	36	Milford,	112
Hubbardston,	12	Millbury,	114
Hudson,	39	Millis,	12
Hull,	24	Milton,	12
Huntington,	6	Monson,	36
Ipswich,	21	State Hospital,	36
Kingston,	6	Montague,	210
Lawrence,	1,098	Nantucket,	48
Lee,	12	Natick,	49
Leominster,	664	Needham,	75

Number of Bottles of Diphtheria Antitoxin distributed from Dec. 1, 1912, to Nov. 30, 1913 — Continued.

City or Town.	Number of Bottles.	City or Town.	Number of Bottles.
New Bedford,	1,942	Shirley,	12
Newburyport,	174	Industrial School for Boys,	12
Newton,	250	Somerville,	1,850
Hospital,	850	Hospital for Contagious Diseases,	2,174
North Adams,	175	Southbridge,	24
North Andover,	36	Southwick,	18
North Attleborough,	96	Springfield,	1,291
North Brookfield,	12	Stoneham,	36
Northampton,	100	Stoughton,	260
Northborough,	6	Stow,	12
Northbridge,	33	Sturbridge,	6
Northfield,	24	Sudbury,	6
Norwell,	6	Sunderland,	12
Norwood,	76	Sutton,	32
Oak Bluffs,	33	Swampscott,	12
Orange,	18	Taunton,	448
Palmer,	60	Tewksbury: —	
Peabody,	246	State Infirmary,	55
Petersham,	141	Tisbury,	204
Pittsfield,	1,600	Topsfield,	24
Plymouth,	62	Townsend,	104
Provincetown,	99	Uxbridge,	114
Quincy,	1,044	Wakefield,	112
Randolph,	206	Walpole,	18
Reading,	48	Waltham,	300
Revere,	254	Hospital,	1,300
Rockland,	12	Ware,	304
Rockport,	12	Wareham,	60
Salem,	624	Warren,	36
Salisbury,	7	Watertown,	53
Sandwich,	12	Wayland,	18
Saugus,	138	Webster,	78
Scituate,	24	Wellesley,	129
Sharon,	12	Academy of the Assumption,	50
Shelburne,	12	Wellfleet,	25

Number of Bottles of Diphtheria Antitoxin distributed from Dec. 1, 1912, to Nov. 30, 1913 — Concluded.

City or Town.	Number of Bottles.	City or Town.	Number of Bottles.
West Brookfield,	30	Williamstown,	87
West Springfield,	36	Wilmington,	36
Westborough,	54	Winchendon,	51
Westfield,	138	Winchester,	82
Westford,	60	Winthrop,	98
Westminster,	36	Woburn,	97
Weston,	27	Worcester,	3,250
Westport,	69	State Hospital,	20
Weymouth,	78	Wrentham: —	
Whitman,	48	State School,	25
Wilbraham,	30	Total,	96,891

The total number of tubes of vaccine virus issued by the Board during the nine years and two months ended Nov. 30, 1913, was as follows: —

	Tubes.
In 1904–05 (year ended Sept. 30, 1905),	23,970
During fourteen months ended Nov. 30, 1906,	31,805
In 1906–07 (year ended Nov. 30, 1907),	45,265
In 1907–08 (year ended Nov. 30, 1908),	48,768
In 1908–09 (year ended Nov. 30, 1909),	47,961
In 1909–10 (year ended Nov. 30, 1910),	76,690
In 1910–11 (year ended Nov. 30, 1911),	65,251
In 1911–12 (year ended Nov. 30, 1912),	109,668
In 1912–13 (year ended Nov. 30, 1913),	112,039
Total,	561,417

The vaccine virus was distributed as shown in the following table: —

Number of Tubes of Vaccine distributed from Dec. 1, 1912, to Nov. 30, 1913.

City or Town.	Number of Tubes.	City or Town.	Number of Tubes.
Abington,	553	Amesbury,	514
Acton,	88	Amherst,	505
Acushnet,	150	Andover,	126

Number of Tubes of Vaccine distributed from Dec. 1, 1912, to Nov. 30, 1913 — Continued.

City or Town.	Number of Tubes.	City or Town.	Number of Tubes.
Arlington,	350	Clinton,	471
Ashby,	12	Cohasset,	153
Attleborough,	624	Colrain,	70
Auburn,	24	Concord,	186
Avon,	37	Massachusetts Reformatory,	750
Ayer,	86	Cummington,	115
Barnstable,	60	Dana,	250
Barre,	18	Danvers,	225
Bedford,	43	Dedham,	538
Belmont,	213	Dudley,	1,030
Massachusetts School for the Feeble-minded.	150	Duxbury,	40
McLean Hospital,	35	East Bridgewater,	85
Beverly,	170	East Longmeadow,	30
Corporation Hospital,	10	Easton,	152
Blackstone,	825	Enfield,	50
Boston: —		Everett,	679
City Hospital,	1,345	Fairhaven,	166
General Supply,	22,810	Fall River,	6,085
Infants' Hospital,	210	Falmouth,	6
Massachusetts General Hospital,	355	Fitchburg,	1,950
Massachusetts Homœopathic Hospital.	650	Foxborough,	151
Penal Institutions,	975	Framingham,	378
Bourne,	15	Freetown,	40
Braintree,	228	Gardner,	69
Bridgewater,	193	Georgetown,	40
Brimfield,	20	Gloucester,	451
Brockton,	1,189	Grafton,	96
Brookline,	733	Greenwich,	6
Cambridge,	795	Groton,	25
Canton,	177	Hamilton,	85
Chatham,	20	Hanover,	15
Chelmsford,	151	Hanson,	53
Chelsea,	1,495	Harvard,	5
Chester,	5	Haverhill,	45
Chesterfield,	19	Heath,	3
Chicopee,	1,219	Hingham,	200

Number of Tubes of Vaccine distributed from Dec. 1, 1912, to Nov. 30, 1913 — Continued.

City or Town.	Number of Tubes.	City or Town.	Number of Tubes.
Holbrook,	72	Nantucket,	85
Holden,	84	Natick,	177
Hopkinton,	48	Needham,	206
Hudson,	45	New Bedford,	278
Hull,	63	New Marlborough,	24
Huntington,	695	New Salem,	50
Ipswich,	62	Newburyport,	188
Kingston,	15	Newton,	896
Lancaster,	50	North Adams,	465
Lawrence,	3,530	North Andover,	221
Lee,	201	North Attleborough,	264
Leominster,	1,096	North Reading,	20
Lexington,	174	Northampton,	785
Lincoln,	18	State Hospital,	225
Littleton,	10	Northbridge,	420
Lowell,	12,816	Northfield,	245
Ludlow,	556	Norwell,	3
Lynn,	3,715	Norwood,	424
Malden,	1,183	Oak Bluffs,	6
Manchester,	12	Orange,	120
Mansfield,	150	Orleans,	45
Marblehead,	297	Otis,	3
Marshfield,	59	Oxford,	235
Mattapoisett,	25	Palmer,	401
Medfield,	53	Petersham,	170
Medford,	508	Pittsfield,	671
Medway,	8	Plymouth,	134
Melrose,	420	Provincetown,	127
Merrimac,	40	Quincy,	1,162
Methuen,	295	Randolph,	57
Milford,	250	Reading,	48
Millbury,	430	Revere,	540
Millis,	24	Rockland,	217
Milton,	38	Rockport,	103
Monson: —		Russell,	330
State Hospital,	258	Salem,	737

Number of Tubes of Vaccine distributed from Dec. 1, 1912, to Nov. 30, 1913 — Concluded.

City or Town.	Number of Tubes.	City or Town.	Number of Tubes.
Salisbury,	12	Wareham,	91
Sandwich,	3	Warren,	13
Scituate,	36	Watertown,	220
Seekonk,	100	Wayland,	15
Sharon,	17	Webster,	5,620
Sherborn: —		Wellesley,	521
Reformatory for Women,	31	Wellfleet,	18
Somerville,	1,291	West Bridgewater,	30
South Hadley,	100	West Brookfield,	50
Southbridge,	130	West Newbury,	44
Southwick,	15	West Springfield,	100
Springfield,	2,980	West Stockbridge,	32
Stoneham,	249	Westfield,	418
Stoughton,	249	Westford,	85
Sturbridge,	6	Westminster,	49
Swampscott,	183	Weston,	75
Sutton,	15	Westport,	126
Taunton,	1,645	Weymouth,	301
State Hospital,	275	Whitman,	76
Templeton,	50	Williamsburg,	34
Tewksbury: —		Williamstown,	99
State Infirmary,	1,715	Wilmington,	74
Tisbury,	13	Winchester,	159
Topsfield,	88	Winthrop,	321
Townsend,	52	Woburn,	301
Upton,	25	Worcester,	3,153
Uxbridge,	12	Wrentham: —	
Wakefield,	386	State School,	250
Walpole,	164	Total,	112,039
Waltham,	650		

Typhoid Vaccine.

City or Town.	Number of Ampoules.	City or Town.	Number of Ampoules.
Abington,	15	Fall River,	369
Acton,	24	Union Hospital,	90
Amherst,	21	Falmouth,	19
Andover,	61	Fitchburg,	39
Arlington,	180	Framingham,	93
Ashland,	3	Gardner,	48
Attleborough,	3	Gloucester,	18
Auburn,	9	Hamilton,	9
Ayer,	9	Hanson,	27
Barnstable,	12	Haverhill,	48
Belmont,	57	Hingham,	24
Beverly,	110	Holbrook,	18
Boston: —		Holden,	21
Children's Hospital,	76	Holyoke,	39
General Supply,	2,443	Hopkinton,	9
Massachusetts Institute of Technology,	369	Hull,	24
Massachusetts General Hospital,	9	Ipswich,	12
Massachusetts Militia,	10,526	Lawrence,	99
U. S. S. "Ranger",	15	General Hospital,	225
Braintree,	15	Lexington,	227
Brockton,	60	Lincoln,	77
Hospital,	78	Lowell,	21
Brookline,	223	Corporation Hospital,	41
Cambridge,	390	Lynn,	162
Hospital,	66	Hospital,	153
Canton,	9	Malden,	54
Chelsea,	342	Manchester,	9
Chicopee,	45	Marlborough,	9
Clinton,	64	Marshfield,	6
Cohasset,	147	Melrose,	6
Concord,	36	Milton,	69
Reformatory,	36	Monson: —	
Danvers,	9	State Hospital,	428
Dedham,	54	Nahant,	6
Easton,	18	Needham,	87
Edgartown,	9	New Bedford,	11
Everett,	45	Newburyport,	87

Typhoid Vaccine — Concluded.

City or Town.	Number of Ampoules.	City or Town.	Number of Ampoules.
Newton,	183	Sterling,	21
Hospital,	12	Stoneham,	3
North Adams,	60	Stoughton,	42
North Andover,	6	Swampscott,	21
Northampton,	24	Templeton,	12
North Attleborough,	6	Tewksbury: —	
Norwood,	42	State Infirmary,	60
Oak Bluffs,	9	Tisbury,	6
Palmer,	63	Wakefield,	27
Peabody,	21	Walpole,	3
Petersham,	12	Waltham,	19
Pittsfield: —		Hospital,	45
House of Mercy,	108	Warren,	27
Plymouth,	27	Wayland,	42
Quincy,	165	Wellesley,	324
Randolph,	21	Westfield,	22
Reading,	15	Weston,	24
Revere,	36	Weymouth,	6
Rockport,	12	Winchendon,	15
Salem,	50	Winchester,	15
Saugus,	84	Winthrop,	120
Shelburne,	150	Woburn,	36
Somerville,	51	Worcester,	186
Southborough,	27	City Hospital,	168
Southbridge,	6	State Asylum,	90
Springfield,	218	Total,	21,014

REPORT

UPON THE

WORK OF THE BACTERIOLOGICAL LABORATORY

FOR THE

YEAR ENDED NOV. 30, 1913.

Report upon the Diphtheria Cultures examined during the Year ended Nov. 30, 1913.

From Dec. 1, 1912, to Nov. 30, 1913, 5,332 cultures were received from 203 cities and towns in the State. Of these cultures, 3,898 were for the purpose of diagnosis and 1,434 were for release from quarantine.

The following table gives the number of cultures received from the different cities and towns and the results of the examinations: —

City or Town.	Whole Number of Cultures examined.	Cultures examined for Diagnosis.		Cultures examined for Release from Quarantine.
		Positive.	Negative.	
Abington,	2	–	2	–
Acton,	6	1	4	1
Adams,	4	1	3	–
Amesbury,	1	–	1	–
Amherst,	3	–	2	1
Andover,	10	4	6	–
Arlington,	4	–	3	1
Ashburnham,	5	–	3	2
Ashland,	7	1	4	2
Athol,	4	1	3	–
Attleborough,	120	19	56	45
Avon,	34	4	8	22
Ayer,	1	–	1	–
Barnstable,	131	24	43	64
Barre,	31	5	14	12
Bedford,	3	–	3	–
Belchertown,	1	–	1	–
Bellingham,	1	–	1	–
Belmont,	13	1	9	3
Beverly,	66	11	28	27
Boston,	11	–	11	–
Bourne,	9	1	6	2
Boylston,	1	–	1	–
Braintree,	7	–	5	2

City or Town.	Whole Number of Cultures examined.	Cultures examined for Diagnosis.		Cultures examined for Release from Quarantine.
		Positive.	Negative.	
Brewster,	1	-	1	-
Bridgewater,	2	-	2	-
Brimfield,	2	-	2	-
Brookfield,	12	2	3	7
Brookline,	1	-	1	-
Burlington,	2	-	2	-
Cambridge,	1	-	1	-
Canton,	11	1	6	4
Carlisle,	1	-	1	-
Carver,	4	2	-	2
Chatham,	11	4	3	4
Chelmsford,	1	-	1	-
Chelsea,	259	43	63	153
Cheshire,	3	-	2	1
Clarksburg,	5	-	-	5
Cohasset,	91	14	41	36
Concord,	44	8	14	22
Conway,	2	-	1	1
Cummington,	3	-	2	1
Dalton,	7	1	1	5
Danvers,	36	4	23	9
Dartmouth,	1	-	1	-
Deerfield,	8	2	2	4
Dennis,	4	-	4	-
Dighton,	3	2	1	-
Douglas,	3	-	3	-
Dover,	1	-	1	-
Dudley,	13	1	4	8
Duxbury,	1	-	1	-
East Bridgewater,	3	-	3	-
Eastham,	4	-	3	1
Easton,	29	3	8	18
Edgartown,	187	13	171	3
Egremont,	1	-	1	-
Erving,	5	1	3	1
Essex,	3	-	1	2
Everett,	113	15	67	31
Fairhaven,	10	1	2	7

City or Town.	Whole Number of Cultures examined.	Cultures examined for Diagnosis.		Cultures examined for Release from Quarantine.
		Positive.	Negative.	
Falmouth,	24	5	8	11
Foxborough,	57	10	38	9
Framingham,	10	1	8	1
Franklin,	21	7	3	11
Georgetown,	4	–	4	–
Gill,	3	–	3	–
Grafton,	2	–	2	–
Great Barrington,	3	–	2	1
Greenfield,	6	–	6	–
Groton,	28	1	27	–
Hamilton,	25	6	8	11
Hanover,	10	–	10	–
Hanson,	7	–	5	2
Hardwick,	1	–	1	–
Harvard,	25	4	15	6
Harwich,	744	11	695	38
Haverhill,	1	–	1	–
Hingham,	49	5	29	15
Holbrook,	10	–	10	–
Holliston,	6	–	5	1
Hopkinton,	3	–	3	–
Hubbardston,	3	–	–	3
Hudson,	4	1	3	–
Hull,	7	–	7	–
Ipswich,	15	1	5	9
Kingston,	5	–	5	–
Lakeville,	23	4	12	7
Lenox,	1	–	1	–
Lincoln,	16	2	6	8
Littleton,	6	1	–	5
Lowell,	1	–	1	–
Malden,	4	1	3	–
Manchester,	3	1	1	1
Mansfield,	28	2	20	6
Marblehead,	39	1	29	9
Marion,	9	1	2	6
Marlborough,	49	11	21	17
Marshfield,	6	–	6	–

City or Town.	Whole Number of Cultures examined.	Cultures examined for Diagnosis.		Cultures examined for Release from Quarantine.
		Positive.	Negative.	
Mashpee,	40	3	24	13
Mattapoisett,	4	–	4	–
Maynard,	23	6	11	6
Medfield,	8	2	4	2
Medford,	112	23	52	37
Medway,	15	5	8	2
Melrose,	64	10	38	16
Merrimac,	2	–	2	–
Methuen,	2	1	1	–
Middleborough,	24	2	8	14
Milford,	1	–	1	–
Millis,	3	1	–	2
Milton,	25	4	20	1
Monson,	76	4	61	11
Montague,	27	–	5	22
Natick,	30	2	27	1
Needham,	4	–	4	–
New Salem,	4	1	–	3
Newton,	3	1	2	–
Norfolk,	8	3	–	5
North Andover,	1	–	1	–
North Attleborough,	41	6	27	8
North Brookfield,	7	2	5	–
Northampton,	2	1	–	1
Northbridge,	28	2	5	21
Northfield,	5	1	2	2
Norton,	19	2	15	2
Norwell,	3	–	3	–
Norwood,	31	6	18	7
Oak Bluffs,	220	2	218	–
Oakham,	2	–	2	–
Orleans,	1	–	1	–
Oxford,	2	1	1	–
Palmer,	15	3	7	5
Peabody,	61	16	12	33
Pelham,	2	–	2	–
Pepperell,	2	–	–	2
Petersham,	13	3	2	8

City or Town.	Whole Number of Cultures examined.	Cultures examined for Diagnosis.		Cultures examined for Release from Quarantine.
		Positive.	Negative.	
Plainville,	9	4	2	3
Plymouth,	11	1	4	6
Provincetown,	28	5	14	9
Quincy,	133	23	66	44
Randolph,	33	7	6	20
Reading,	9	–	9	–
Rehoboth,	1	–	1	–
Revere,	143	20	96	27
Rochester,	10	3	2	5
Rockland,	8	1	4	3
Rockport,	12	–	12	–
Salem,	124	19	45	60
Sandwich,	3	–	3	–
Saugus,	84	6	50	28
Scituate,	17	2	11	4
Sharon,	12	1	9	2
Sheffield,	1	–	1	–
Shelburne,	3	–	3	–
Sherborn,	9	2	4	3
Shirley,	1	–	1	–
Somerville,	2	1	1	–
South Hadley,	4	–	–	4
Southborough,	1	–	1	–
Southbridge,	11	–	2	9
Stockbridge,	1	–	1	–
Stoneham,	25	4	13	8
Stoughton,	34	8	16	10
Stow,	3	1	1	1
Sudbury,	3	2	–	1
Sutton,	5	1	2	2
Taunton,	69	20	36	13
Tisbury,	323	28	256	39
Topsfield,	7	1	3	3
Townsend,	15	1	6	8
Truro,	1	1	–	–
Uxbridge,	51	5	16	30
Wakefield,	41	8	20	13
Walpole,	38	5	26	7

City or Town.	Whole Number of Cultures examined.	Cultures examined for Diagnosis.		Cultures examined for Release from Quarantine.
		Positive.	Negative.	
Ware,	1	–	–	1
Wareham,	16	2	4	10
Warren,	9	3	4	2
Washington,	1	–	1	–
Watertown,	40	7	15	18
Wayland,	11	1	6	4
Webster,	14	5	3	6
Wellesley,	2	1	1	–
Wellfleet,	1	1	–	–
Wendell,	1	–	1	–
Wenham,	9	2	–	7
West Boylston,	1	–	1	–
West Newbury,	11	2	5	4
Westborough,	97	5	75	17
Westfield,	4	1	2	1
Westford,	18	4	5	9
Westport,	3	–	2	1
Weymouth,	57	6	41	10
Whitman,	14	3	2	9
Williamstown,	23	7	9	7
Wilmington,	8	–	8	–
Winchendon,	20	–	10	10
Winchester,	46	12	20	14
Windsor,	1	–	1	–
Winthrop,	27	4	13	10
Woburn,	48	1	25	22
Wrentham,	13	2	11	–
Totals,	5,332	628	3,270	1,434

Report upon the Examination of Sputum and Other Material suspected of containing the Bacilli of Tuberculosis.

From Dec. 1, 1912, to Nov. 30, 1913, microscopical examination has been made of 2,525 lots of sputum and other material suspected of containing the bacilli of tuberculosis. This material has been received from 203 cities and towns in the State. The following table gives the places from which the material has been received and the results of the microscopical examination: —

City or Town.	Whole Number of Examinations.	Positive.	Negative.	City or Town.	Whole Number of Examinations.	Positive.	Negative.
Abington,	17	3	14	Beverly,	16	5	11
Acton,	9	3	6	Blackstone,	20	3	17
Adams,	18	6	12	Bolton,	1	–	1
Amesbury,	33	8	25	Boston,	19	7	12
Amherst,	27	7	20	Bourne,	15	3	12
Andover,	11	4	7	Braintree,	17	1	16
Arlington,	16	6	10	Bridgewater,	9	4	5
Ashby,	1	–	1	Brookfield,	2	–	2
Ashfield,	1	–	1	Brookline,	1	–	1
Ashland,	5	–	5	Cambridge,	2	1	1
Athol,	21	4	17	Canton,	12	5	7
Attleborough,	89	24	65	Carver,	2	–	2
Ayer,	3	2	1	Chatham,	1	–	1
Barnstable,	6	–	6	Chelmsford,	7	1	6
Becket,	2	–	2	Chelsea,	120	17	103
Belchertown,	2	1	1	Chesterfield,	2	1	1
Bellingham,	1	–	1	Clinton,	1	–	1
Belmont,	9	2	7	Cohasset,	20	6	14
Berlin,	1	–	1	Colrain,	7	2	5

City or Town.	Whole Number of Examinations.	Positive.	Negative.	City or Town.	Whole Number of Examinations.	Positive.	Negative.
Concord, ...	13	5	8	Holden, ...	7	–	7
Conway, ...	1	1	–	Hopedale, ...	6	–	6
Dalton, ...	2	–	2	Hopkinton, ...	7	2	5
Dana, ...	1	1	–	Hudson, ...	13	3	10
Danvers, ...	26	4	22	Hull, ...	8	2	6
Dedham, ...	1	–	1	Ipswich, ...	30	6	24
Dennis, ...	6	1	5	Kingston, ...	1	1	–
Dighton, ...	3	1	2	Lakeville, ...	2	–	2
Douglas, ...	2	–	2	Lancaster, ...	10	–	10
Dover, ...	4	1	3	Lawrence, ...	2	1	1
Dudley, ...	2	–	2	Lee, ...	4	1	3
Duxbury, ...	2	–	2	Lenox, ...	7	5	2
East Bridgewater, ...	10	3	7	Leominster, ...	1	1	–
East Longmeadow, ...	1	1	–	Lexington, ...	13	4	9
Easthampton, ...	1	–	1	Littleton, ...	4	2	2
Easton, ...	1	–	1	Lunenburg, ...	6	4	2
Edgartown, ...	1	–	1	Lynn, ...	2	1	1
Everett, ...	90	19	71	Lynnfield, ...	2	–	2
Fall River, ...	21	4	17	Malden, ...	3	–	3
Falmouth, ...	8	3	5	Manchester, ...	5	2	3
Foxborough, ...	15	3	12	Mansfield, ...	18	3	15
Framingham, ...	34	2	32	Marblehead, ...	3	–	3
Franklin, ...	4	1	3	Marion, ...	1	–	1
Gill, ...	1	–	1	Marlborough, ...	20	8	12
Gloucester, ...	42	13	29	Marshfield, ...	2	1	1
Great Barrington, ...	15	2	13	Mashpee, ...	1	–	1
Greenfield, ...	5	2	3	Maynard, ...	22	5	17
Hadley, ...	3	1	2	Medfield, ...	1	–	1
Hamilton, ...	4	1	3	Medford, ...	47	11	36
Hanover, ...	7	1	6	Medway, ...	7	–	7
Hanson, ...	1	–	1	Melrose, ...	66	13	53
Hardwick, ...	2	–	2	Mendon, ...	3	1	2
Harvard, ...	3	–	3	Merrimac, ...	4	1	3
Harwich, ...	15	2	13	Methuen, ...	6	1	5
Hingham, ...	31	4	27	Middleborough, ...	3	1	2
Holbrook, ...	3	–	3	Middleton, ...	3	1	2

City or Town.	Whole Number of Examinations.	Positive.	Negative.	City or Town.	Whole Number of Examinations.	Positive.	Negative.
Milford,	56	14	42	Salem,	120	34	86
Milton,	6	1	5	Salisbury,	1	–	1
Monterey,	1	–	1	Sandisfield,	1	–	1
Natick,	20	2	18	Sandwich,	3	1	2
Needham,	11	2	9	Saugus,	20	3	17
New Bedford,	4	1	3	Scituate,	5	–	5
New Marlborough,	1	–	1	Sheffield,	2	–	2
Newburyport,	2	–	2	Shelburne,	7	1	6
Newton,	2	–	2	Sherborn,	6	2	4
Norfolk,	1	1	–	Shirley,	5	1	4
North Adams,	1	–	1	Somerville,	4	1	3
North Andover,	1	1	–	South Hadley,	5	1	4
North Attleborough,	56	4	52	Spencer,	5	1	4
North Brookfield,	7	1	6	Springfield,	1	–	1
North Reading,	2	–	2	Stoneham,	18	1	17
Northbridge,	4	–	4	Stoughton,	10	3	7
Northfield,	10	4	6	Sturbridge,	1	–	1
Norton,	4	3	1	Sudbury,	1	–	1
Norwood,	8	3	5	Swampscott,	1	1	–
Oak Bluffs,	5	–	5	Swansea,	1	–	1
Orleans,	3	2	1	Taunton,	83	38	45
Oxford,	4	1	3	Tisbury,	1	–	1
Peabody,	49	16	33	Townsend,	2	–	2
Petersham,	3	–	3	Upton,	1	–	1
Pittsfield,	91	42	49	Wakefield,	40	8	32
Plainville,	4	–	4	Walpole,	9	6	3
Plymouth,	6	–	6	Waltham,	2	–	2
Provincetown,	20	7	13	Ware,	19	5	14
Quincy,	109	36	73	Wareham,	11	3	8
Randolph,	11	2	9	Warren,	12	2	10
Reading,	13	2	11	Washington,	1	1	–
Rehoboth,	1	–	1	Watertown,	17	3	14
Revere,	57	16	41	Wayland,	1	–	1
Rochester,	2	–	2	Webster,	21	5	16
Rockland,	13	–	13	Wellesley,	2	1	1
Rockport,	10	3	7	Wenham,	1	–	1

City or Town.	Whole Number of Examinations.	Positive.	Negative.	City or Town.	Whole Number of Examinations.	Positive.	Negative.
West Bridgewater,	2	1	1	Williamsburg,	1	–	1
West Brookfield,	3	1	2	Williamstown,	10	2	8
West Newbury,	3	–	3	Wilmington,	17	2	15
West Tisbury,	1	–	1	Winchendon,	8	1	7
Westborough,	3	–	3	Winchester,	26	5	21
Westfield,	25	5	20	Windsor,	1	–	1
Westford,	7	1	6	Winthrop,	25	6	19
Westport,	2	1	1	Woburn,	26	4	22
Westwood,	2	–	2	Wrentham,	5	–	5
Weymouth,	36	9	27	Yarmouth,	2	1	1
Whitman,	15	2	13	Totals,	2,525	610	1,915

Report upon the Examinations for Typhoid Fever.

During the year ended Nov. 30, 1913, the Widal test was carried out with 1,502 specimens of blood. Of these specimens, 348, or 23.16 per cent., gave a positive reaction. Specimens were sent from 165 cities and towns. These facts are shown in detail in Table I. In a second table (Table II.) the specimens, positive and negative, are classified according to the day of the disease on which they were collected. A moderate number of second and third specimens from the same case were examined, so that the total number of tests made is somewhat over the number of cases of disease concerned. The outfit provided for the collection of the blood now consists of an aluminum plate in place of the paper slips formerly used. This change obviates all possibility of fallacies which might result from the use of paper of unknown composition, and enables the desired dilution to be made more conveniently and quickly.

Cultural tests designed to demonstrate the presence of typhoid bacilli in the blood, feces and urine of patients, particularly in the excreta of convalescents, were performed with 337 specimens.

The method of isolating the specific organism is briefly as follows: bile, or a medium of which it is the chief constituent, is inoculated with whatever material from the patient seems most likely to contain the typhoid bacilli. Bile media are devised to permit the growth of the typhoid bacillus while inhibiting the growth of the non-pathogenic organisms that may accompany it. After incubation the bile is "plated out" on lactose agar, to which is added a suitable amount of alcoholic solution of fuchsin and sodium sulfite. The sulfite serves two purposes, — it inhibits more or less successfully the growth of many organisms while permitting the typhoid-colon group to grow, and it decolorizes the fuchsin. Lactic acid reacts with the fuchsin-sulfite solution, and the color is restored. Hence, the colonies of those organisms that ferment the lactose redden the agar about them, while the colonies of the typhoid bacillus do not color the medium.

There are very many methods and modifications of methods proposed for the purpose of isolating the typhoid organisms from mixed cultures, and those at present in use are very likely to be superseded by newer methods in the near future.

Two points regarding this method of diagnosis seem to need particular emphasis: first, a negative result should be given much less weight than a negative from any other sort of bacteriological examination; second, the method should never be used merely as a substitute for the Widal test, but rather in those cases where for any reason a Widal may be impracticable or unreliable, especially for diagnosis very early in the acute attack for the purpose of determining carriers and the presence of the bacilli in the excreta of convalescents.

TABLE I. — *Widal Test, Dec. 1, 1912, to Nov. 30, 1913, inclusive, classified according to the City or Town from which the Specimen was sent.*

CITY OR TOWN.	Whole Number of Examinations.	Positive.	Negative.	CITY OR TOWN.	Whole Number of Examinations.	Positive.	Negative.
Abington,	5	–	5	Brookline,	2	–	2
Acton,	3	–	3	Burlington,	2	–	2
Adams,	9	5	4	Cambridge,	3	–	3
Agawam,	3	–	3	Canton,	5	2	3
Amesbury,	8	–	8	Chelsea,	105	39	66
Amherst,	10	1	9	Chesterfield,	3	–	3
Andover,	1	1	–	Cohasset,	22	4	18
Arlington,	6	3	3	Concord,	5	–	5
Ashland,	3	–	3	Danvers,	11	3	8
Athol,	3	3	–	Dedham,	4	–	4
Attleborough,	37	1	36	Deerfield,	1	1	–
Avon,	5	5	–	Dennis,	5	1	4
Ayer,	1	–	1	Dighton,	1	–	1
Barre,	1	–	1	Dover,	1	–	1
Becket,	1	–	1	Duxbury,	2	–	2
Bedford,	2	–	2	Eastham,	1	1	–
Belchertown,	4	2	2	Easthampton,	2	1	1
Belmont,	4	1	3	Easton,	1	–	1
Beverly,	43	8	35	Edgartown,	1	1	–
Blackstone,	18	2	16	Everett,	29	8	21
Blandford,	5	–	5	Florida,	1	–	1
Boston,	14	2	12	Framingham,	1	–	1
Braintree,	4	–	4	Franklin,	4	–	4
Bridgewater,	4	–	4	Freetown,	2	2	–
Brimfield,	1	–	1	Gardner,	3	–	3

TABLE I. — *Widal Test, etc.* — Continued.

City or Town.	Whole Number of Examinations.	Positive.	Negative.	City or Town.	Whole Number of Examinations.	Positive.	Negative.
Georgetown,	1	-	1	Middleton,	1	-	1
Gloucester,	22	4	18	Milford,	18	3	15
Grafton,	4	-	4	Milton,	11	2	9
Greenfield,	7	2	5	Monson,	11	1	10
Hadley,	1	-	1	Nantucket,	1	1	-
Halifax,	1	1	-	Natick,	27	5	22
Hamilton,	3	-	3	New Marlborough,	2	-	2
Hampden,	2	-	2	Newton,	43	8	35
Hanover,	1	-	1	Norfolk,	1	1	-
Hardwick,	3	-	3	North Adams,	14	4	10
Harwich,	2	-	2	North Andover,	3	1	2
Haverhill,	1	-	1	North Attleborough,	22	5	17
Hingham,	8	-	8	North Brookfield,	6	-	6
Holden,	9	1	8	North Reading,	1	1	-
Holliston,	2	-	2	Northampton,	16	2	14
Hopkinton,	6	2	4	Northbridge,	1	1	-
Hudson,	3	1	2	Northfield,	3	-	3
Hull,	13	2	11	Norton,	2	2	-
Ipswich,	12	3	9	Norwell,	1	-	1
Lawrence,	2	1	1	Norwood,	19	2	17
Lee,	1	-	1	Oak Bluffs,	4	-	4
Lenox,	3	-	3	Orange,	7	4	3
Lexington,	40	11	29	Orleans,	1	-	1
Lincoln,	1	-	1	Palmer,	37	14	23
Lynn,	101	30	71	Peabody,	3	-	3
Malden,	3	-	3	Pembroke,	1	-	1
Mansfield,	2	-	2	Pepperell,	1	-	1
Marblehead,	5	1	4	Pittsfield,	25	4	21
Marlborough,	19	7	12	Plymouth,	2	-	2
Marshfield,	4	2	2	Princeton,	8	-	8
Maynard,	16	2	14	Quincy,	63	22	41
Medford,	31	8	23	Randolph,	2	1	1
Melrose,	17	2	15	Raynham,	1	-	1
Middleborough,	1	-	1	Reading,	2	-	2

TABLE I. — *Widal Test, etc.* — Concluded.

City or Town.	Whole Number of Examinations.	Positive.	Negative.	City or Town.	Whole Number of Examinations.	Positive.	Negative.
Revere,	29	10	19	Walpole,	2	1	1
Rockport,	8	3	5	Waltham,	2	–	2
Rowley,	2	–	2	Ware,	2	–	2
Salem,	15	1	14	Wareham,	1	–	1
Saugus,	17	3	14	Warren,	5	2	3
Savoy,	1	–	1	Watertown,	7	1	6
Scituate,	15	6	9	Wayland,	10	1	9
Sharon,	1	–	1	Wellesley,	3	1	2
Seekonk,	1	–	1	West Bridgewater,	1	–	1
Shelburne,	7	–	7	Westfield,	7	1	6
Shrewsbury,	3	–	3	Weston,	1	–	1
Somerville,	10	2	8	Westport,	15	2	13
Southborough,	1	–	1	Weymouth,	14	1	13
Southbridge,	2	1	1	Whitman,	2	–	2
Spencer,	11	9	2	Williamsburg,	3	–	3
Sterling,	2	1	1	Williamstown,	1	–	1
Stoneham,	11	1	10	Wilmington,	1	–	1
Stoughton,	24	17	7	Winchendon,	3	1	2
Stow,	2	–	2	Winchester,	8	1	7
Sturbridge,	4	1	3	Winthrop,	36	11	25
Swampscott,	6	1	5	Woburn,	20	3	17
Taunton,	18	3	15	Wrentham,	2	–	2
Templeton,	4	–	4	Doubtful cases,[1]	26	–	–
Tisbury,	3	–	3		1,502	348	1,128
Wakefield,	14	2	12				

[1] Twenty-six reactions were reported as incomplete or doubtful, and second specimens were requested. In 6 cases these were received and 2 proved positive. It is believed that in nearly all these cases the incompleteness of the reaction was due to the early stage of the disease at the time the blood was taken.

TABLE II. — *Widal Test, according to Stage of Disease, Dec. 1, 1912, to Nov. 30, 1913, inclusive.*

Approximate Number of Days from Beginning of Disease to Collection of Blood.	Number of Cases.		Approximate Number of Days from Beginning of Disease to Collection of Blood.	Number of Cases.	
	Positive.	Negative.		Positive.	Negative.
1,	3	8	32,	–	1
2,	8	23	33,	–	1
3,	10	37	34,	–	1
4,	16	55	35,	–	4
5,	15	59	36,	1	–
6,	20	63	38,	–	1
7,	28	86	41,	–	1
8,	20	81	42,	1	–
9,	20	56	43,	–	1
10,	35	81	44,	–	1
11,	14	50	46,	–	2
12,	14	39	49,	–	1
13,	10	20	62,	–	1
14,	9	32	79,	–	1
15,	14	29	84,	–	1
16,	8	28	92,	1	–
17,	6	15	10–12,	–	1
18,	10	19	1 week,	5	23
19,	4	5	1 to 2 weeks,	–	1
20,	6	12	2 weeks,	4	26
21,	5	4	2½ weeks,	–	1
22,	4	7	3 weeks,	2	6
23,	2	4	4 weeks,	1	1
24,	1	4	4 to 5 weeks,	–	1
25,	–	5	7 weeks,	–	1
26,	1	2	1 month,	–	1
27,	1	–	5 months,	–	1
28,	2	3	7 months,	–	7
29,	–	5	9 months,	–	1
30,	3	2	Not stated,	43	203
31,	1	3	Totals,	348	1,128

Cultural Tests for Typhoid Fever, Dec. 1, 1912, to Nov. 30, 1913, inclusive.

City or Town.	Whole Number of Examinations.	Positive.	Negative.	City or Town.	Whole Number of Examinations.	Positive.	Negative.
Adams,	1	–	1	Lexington,	6	1	5
Avon,	5	–	5	Lowell,	9	–	9
Barnstable,	1	–	1	Lynn,	10	–	10
Becket,	8	–	8	Malden,	3	–	3
Belchertown,	2	–	2	Marblehead,	2	–	2
Blackstone,	2	–	2	Melrose,	6	–	6
Boston,	49	1	48	Milford,	1	–	1
Brookline,	4	–	4	North Adams,	4	–	4
Burlington,	2	–	2	North Andover,	1	–	1
Cambridge,	9	–	9	Norwood,	1	–	1
Canton,	3	–	3	Orleans,	1	–	1
Chelsea,	21	3	18	Peabody,	1	–	1
Clinton,	2	–	2	Pittsfield,	2	–	2
Cohasset,	6	–	6	Princeton,	10	–	10
Colrain,	1	–	1	Quincy,	3	–	3
Danvers,	4	–	4	Rutland,	1	–	1
Dedham,	12	–	12	Salem,	3	–	3
Dennis,	1	–	1	Scituate,	11	–	11
Easton,	1	–	1	Sharon,	2	–	2
Everett,	14	1	13	Shelburne,	2	–	2
Framingham,	2	–	2	Somerville,	8	–	8
Gardner,	29	1	28	Southwick,	1	–	1
Hanover,	1	–	1	Sterling,	3	–	3
Hanson,	1	–	1	Stoughton,	22	2	20
Holden,	1	–	1	Tisbury,	1	–	1
Holliston,	1	–	1	Wakefield,	4	–	4
Hubbardston,	1	–	1	Webster,	2	–	2
Hull,	3	–	3	Westport,	16	–	16
Ipswich,	3	–	3	Winchester,	5	–	5
Lawrence,	2	–	2	Woburn,	1	–	1
Lee,	1	–	1	Totals,	337	9	328
Lenox,	2	–	2				

Of the total of 337 examinations made, 190 were inoculated from feces, 40 from blood, 50 from urine and 44 were inoculated with material from 2 or more sources.

Of the positive cases 3 were inoculated with feces, 2 with blood, 1 with urine and 3 with material from 2 or more sources.

MALARIA.

From Dec. 1, 1912, to Nov. 30, 1913, 55 blood specimens were received, to be examined for the presence or absence of malarial parasites. The percentage of positive cases was 9.09.

The following table shows the city or town from which the specimens, positive and negative, were derived: —

City or Town.	Whole Number of Examinations.	Positive.	Negative.	City or Town.	Whole Number of Examinations.	Positive.	Negative.
Boston,	1	-	1	North Attleborough,	4	-	4
Cohasset,	3	-	3	Norwood,	2	-	2
Dedham,	4	1	3	Quincy,	4	1	3
Dover,	1	-	1	Saugus,	2	-	2
Hopkinton,	1	-	1	Watertown,	1	-	1
Hull,	3	-	3	Westwood,	1	-	1
Melrose,	2	-	2	Winchester,	5	1	4
Milton,	4	-	4	Winthrop,	2	1	1
Natick,	14	1	13	Totals,	55	5	50
Newton,	1	-	1				

REPORT

UPON THE

WORK OF THE STATE BOARD OF HEALTH

RELATIVE TO THE

CONTROL OF INFECTIOUS DISEASE.

Report upon the Work of the State Board of Health relative to the Control of Infectious Disease.

Accounts of outbreaks of infective diseases which have been investigated by State Inspectors of Health are recorded in another portion of the annual report under the heading "Seventh Annual Report on the Work of the State Inspectors of Health."

FURTHER EXPERIMENTS IN POLIOMYELITIS.[1]

Experiments with the Stable Fly. — During the fall of 1912 attempts were made to obtain further information concerning the transmission of the virus of poliomyelitis through the stable fly. A large number of experiments were conducted with a modified technique. The flies, a few in number, were kept in battery jars and applied to the monkeys from time to time. Frequently, only one fly was made the subject of experiment, with the hope that something might be learned concerning the period of incubation and other factors. All these experiments, however, resulted negatively.

Another series of experiments were started in July, 1913, and consisted in exposing infected monkeys on alternate days to the bites of numerous stable flies kept in large cages and under conditions similar to those of the summer of 1912. Four separate cages were used. Flies caught in nature were placed in three of the cages. The remaining cage, No. 4, was used to hold flies bred by Professor Brues at the Bussey Institution. These experiments also resulted negatively.

The details of the experiments are plainly seen in the tables: —

[1] By M. J. Rosenau, M.D., Department of Preventive Medicine and Hygiene, Harvard University Medical School, Boston. Reprinted from "Infantile Paralysis in Massachusetts, 1907-1912," Massachusetts State Board of Health, 1914.

Fly Cage No. 1.

[The number of flies is approximate. + = monkey exposed to fly bites; I = incubation period; S = symptoms; P = paralysis.]

	1913.																
	July 30.	July 31.	Aug. 1.	Aug. 2.	Aug. 3.	Aug. 4.	Aug. 5.	Aug. 6.	Aug. 7.	Aug. 8.	Aug. 9.	Aug. 10.	Aug. 11.	Aug. 12.	Aug. 13.	Aug. 14.	Aug. 15.
Infected rhesus No. 85,	+ I	+ I	+ I	+ I	+ P	+ P	+ P	+ P	+ P	+ P		+ P				+ P	
Infected rhesus No. 162,								+ I	+ I		+ S	+ P					
Infected rhesus No. 47,														+ I		+ I	
Infected rhesus No. 83,																	
Infected rhesus No. 19,																	
Infected rhesus No. 168,																	
Normal rhesus No. 86,						+	+	+	+	+	+		+		+		+
Normal rhesus No. 87,							+	+	+	+	+		+		+		+
Normal rhesus No. 88,										+	+		+		+		+
Number of flies added to cage,	200	25	200	410	200	300	400	400	800	800	800	-	-	-	-	-	-
Number of flies that fed,	25	75	150	300	400	700	700	600	800	800	600	800	900	800	500	500	few

Fly Cage No. 1 — Concluded.

	1913.																
	Aug 16.	Aug. 17.	Aug. 18.	Aug. 19.	Aug. 20.	Aug. 21.	Aug. 22.	Aug. 23.	Aug. 24.	Aug. 25.	Aug. 26.	Aug. 27.	Aug. 28.	Aug. 29.	Aug. 30.	Aug. 31.	Sept. 1.
Infected rhesus No. 85,																	
Infected rhesus No. 162,																	
Infected rhesus No. 47,	+ P		+ P														
Infected rhesus No. 83,	+ P																
Infected rhesus No. 19,					+ I		+ P										
Infected rhesus No. 168,									+ P								
Normal rhesus No. 86,		+		+		+					+			+			+
Normal rhesus No. 87,		+		+				+				+			+		
Normal rhesus No. 88,		+		+						+			+			+	
Number of flies added to cage,	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Number of flies that fed,	few	few	150	60	60	60	40	40	30	10	6	4	2	5	4	4	1

Fly Cage No. 2.

[The number of flies is approximate. +=monkey exposed to fly bites; I=incubation period; S=symptoms; P=paralysis.]

	1913.																		
	Aug. 11.	Aug. 12.	Aug. 13.	Aug. 14.	Aug. 15.	Aug. 16.	Aug. 17.	Aug. 18.	Aug. 19.	Aug. 20.	Aug. 21.	Aug. 22.	Aug. 23.	Aug. 24.	Aug. 25.	Aug. 26.	Aug. 27.	Aug. 28.	Aug. 29.
Infected rhesus No. 85,	+ P	+ P			+ P														
Infected rhesus No. 162,	+ P																		
Infected rhesus No. 47,					+ S				+ P										
Infected rhesus No. 83,							+ P												
Infected rhesus No. 19,											+ P								
Infected rhesus No. 36,											+ S								
Infected rhesus No. 76,													+ I				+ P		
Infected rhesus No. 65,													+ I		+ P		+ P		

Infected rhesus No. 168,															+ P		+ P		
Infected rhesus No. 67,																			
Infected rhesus No. 32,																			
Infected rhesus No. 84,																			
Infected rhesus No. 107,																			
Normal rhesus No. 90,			+	+		+		+	Diarrhœa; died August 29; autopsy showed death due to infection of intestinal tract.										
Normal rhesus No. 91,			+	+		+		+		+		+		+		+		+	
Normal rhesus No. 97,										+		+		+		+		+	
Number of flies added to cage,	800	300	1,000	630	200	300	-	-	200	-	-	1,000	-	-	600	1,500	-	-	-
Number of flies that fed,	100	500	800	900	1,000	800	-	500	500	400	-	1,200	800	900	800	900	800	600	800

Fly Cage No. 2 — Continued.

	1913.																	
	Aug. 30.	Aug. 31.	Sept. 1.	Sept. 2.	Sept. 3.	Sept. 4.	Sept. 5.	Sept. 6.	Sept. 7.	Sept. 8.	Sept. 9.	Sept. 10.	Sept. 11.	Sept. 12.	Sept. 13.	Sept. 14.	Sept. 15.	Sept. 16.
Infected rhesus No. 85,																		
Infected rhesus No. 162,																		
Infected rhesus No. 47,																		
Infected rhesus No. 83,																		
Infected rhesus No. 19,																		
Infected rhesus No. 36,																		
Infected rhesus No. 76,																		
Infected rhesus No. 65,																		

Infected rhesus No. 168,																		
Infected rhesus No. 67,		+ S		+ P		+ P												
Infected rhesus No. 32,				+ S		+ P												
Infected rhesus No. 84,								+ S		+ P								
Infected rhesus No. 107,																		
Normal rhesus No. 90,																		
Normal rhesus No. 91,	+		+		+		+		+		+		+		+		+	
Normal rhesus No. 97,	+		+		+		+		+			+		+		+		+
Number of flies added to cage,	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Number of flies that fed,	–	–	–	–	500	400	300	200	–	100	75	50	–	40	30	20	10	10

Fly Cage No. 2 — Concluded.

	1913.																	
	Sept. 17.	Sept. 18.	Sept. 19.	Sept. 20.	Sept. 21.	Sept. 22.	Sept. 23.	Sept. 24.	Sept. 25.	Sept. 26.	Sept. 27.	Sept. 28.	Sept. 29.	Sept. 30.	Oct. 1.	Oct. 2.	Oct. 3.	Oct. 4.
Infected rhesus No. 85, ...																		
Infected rhesus No. 162, ...																		
Infected rhesus No. 47, ...																		
Infected rhesus No. 83, ...																		
Infected rhesus No. 19, ...																		
Infected rhesus No. 36, ...																		
Infected rhesus No. 76, ...																		
Infected rhesus No. 65, ...																		

Infected rhesus No. 168,																		
Infected rhesus No. 67,																		
Infected rhesus No. 32,																		
Infected rhesus No. 84,																		
Infected rhesus No. 107,												+ I		+ P				
Normal rhesus No. 90,																		
Normal rhesus No. 91,	+		+		+		+		+		+		+		+		+	
Normal rhesus No. 97,		+		+		+		+		+						+		+
Number of flies added to cage,	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Number of flies that fed,	10	10	8	8	6	6	8	8	6	6	6	6	6	4	5	5	4	4

Fly Cage No. 3 — Flies Bred.

[The number of flies is approximate. + = monkey exposed to fly bites; I = incubation period; S = symptoms; P = paralysis.]

	1913.																		
	Aug. 15.	Aug. 16.	Aug. 17.	Aug. 18.	Aug. 19.	Aug. 20.	Aug. 21.	Aug. 22.	Aug. 23.	Aug. 24.	Aug. 25.	Aug. 26.	Aug. 27.	Aug. 28.	Aug. 29.	Aug. 30.	Aug. 31.	Sept. 1.	Sept. 2.
Infected rhesus No. 83,	+ S																		
Infected rhesus No. 47,			+ P			+ P													
Infected rhesus No. 73,			+ P	+ P															
Infected rhesus No. 36,						+ I		+ S											
Infected rhesus No. 65,								+ I		+ I		+ P							
Infected rhesus No. 67,																+ S		+ P	
Infected rhesus No. 76,								+ I		+ I		+ P		+ P		+ P			
Infected rhesus No. 32,																		+ I	

Infected rhesus No. 56,																			
Infected rhesus No. 168,						+ I		+ I				+ P							
Infected rhesus No. 64,																			
Infected rhesus No. 63,																			
Infected rhesus No. 106,																			
Infected rhesus No. 107,																			
Normal rhesus No. 92,		+			+	+	+	Died; tuberculosis.											
Normal rhesus No. 94,					+	Diarrhœa.					+		+		+	Diarrhœa.			
Normal rhesus No. 95,					+		+		+	+	+		+	+	+	+	+		+
Normal rhesus No. 96,					+		+		+	+	+	+	+	+	+		+	+	+
Normal rhesus No. 98,									+		+		+		+	+	+		+
Number of flies added to cage,	600	600	-	1,000	400	400	-	-	-	-	-	-	-	-	-	-	-	-	-
Number of flies that fed,	500	900	-	1,200	1,500	2,000	1,800	-	1,800	1,800	1,600	1,600	1,500	1,000	1,000	1,000	-	800	800

Fly Cage No. 3 — Flies Bred — Continued.

	1913.																		
	Sept. 3.	Sept. 4.	Sept. 5.	Sept. 6.	Sept. 7.	Sept. 8.	Sept. 9.	Sept. 10.	Sept. 11.	Sept. 12.	Sept. 13.	Sept. 14.	Sept. 15.	Sept. 16.	Sept. 17.	Sept. 18.	Sept. 19.	Sept. 20.	Sept. 21.
Infected rhesus No. 83,																			
Infected rhesus No. 47,																			
Infected rhesus No. 73,																			
Infected rhesus No. 36,																			
Infected rhesus No. 65,																			
Infected rhesus No. 67,	+ P		+ P																
Infected rhesus No. 76,																			
Infected rhesus No. 32,	+ P		+ P																

Infected rhesus No. 56,	+ P																		
Infected rhesus No. 168,																			
Infected rhesus No. 64,					+ I														
Infected rhesus No. 63,					+ I		+ S												
Infected rhesus No. 106,																			
Infected rhesus No. 107,																			
Normal rhesus No. 92,																			
Normal rhesus No. 94,																			
Normal rhesus No. 95,																			
Normal rhesus No. 96,		+		+		+		+		+		+		+		+		+	
Normal rhesus No. 98,		+		+		+			+		+		+		+		+		+
Number of flies added to cage,	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Number of flies that fed,	800	400	300	400	-	300	250	150	75	60	70	40	20	20	20	20	10	10	5

Fly Cage No. 3 — Flies Bred — Concluded.

	1913.																		
	Sept. 22.	Sept. 23.	Sept. 24.	Sept. 25.	Sept. 26.	Sept. 27.	Sept. 28.	Sept. 29.	Sept. 30.	Oct. 1.	Oct. 2.	Oct. 3.	Oct. 4.	Oct. 5.	Oct. 6.	Oct. 7.	Oct. 8.	Oct. 9.	Oct. 10.
Infected rhesus No. 83,																			
Infected rhesus No. 47,																			
Infected rhesus No. 73,																			
Infected rhesus No. 36,																			
Infected rhesus No. 65,																			
Infected rhesus No. 67,																			
Infected rhesus No. 76,																			
Infected rhesus No. 32,																			

Infected rhesus No. 56,																			
Infected rhesus No. 168,																			
Infected rhesus No. 64,																			
Infected rhesus No. 63,																			
Infected rhesus No. 106,					+ I														
Infected rhesus No. 107,									+ P										
Normal rhesus No. 92,																			
Normal rhesus No. 94,																			
Normal rhesus No. 95,																			
Normal rhesus No. 96,	+		+			+		+		+		+			+		+		+
Normal rhesus No. 98,		+		+			+				+		+			+		+	
Number of flies added to cage,	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Number of flies that fed,	5	8	8	8	8	8	8	6	2	5	5	5	4	-	2	2	2	2	1

Fly Cage No. 4 — Flies caught in Nature.

[The number of flies is approximate. + = monkey exposed to fly bites; I = incubation period; S = symptoms; P = paralysis.]

	1913.																					
	Aug. 27.	Aug. 28.	Aug. 29.	Aug. 30.	Aug. 31.	Sept. 1.	Sept. 2.	Sept. 3.	Sept. 4.	Sept. 5.	Sept. 6.	Sept. 7.	Sept. 8.	Sept. 9.	Sept. 10.	Sept. 11.	Sept. 12.	Sept. 13.	Sept. 14.	Sept. 15.	Sept. 16.	Sept. 17.
Infected rhesus No. 67, .	+ I	+ I																				
Infected rhesus No. 99, .		+ I		+ P																		
Infected rhesus No. 168, .		+ P		+ P																		
Infected rhesus No. 56, .						+ I																
Infected rhesus No. 84, .								+ I		+ I		+ P										
Infected rhesus No. 164, .								+ I		+ I		+ I		+ I		+		+		+		+
Infected rhesus No. 63, .																+ I						
Infected rhesus No. 40, .																+ S						
Infected rhesus No. 106, .																						

Infected rhesus No. 107, .																						
Infected rhesus No. 112, .																						
Infected rhesus No. 68, .																+ I		+ S				
Infected rhesus No. 105, .																						
Normal rhesus No. 100, .			+		+		+		+		+		+		+		+		+		+	
Normal rhesus No. 101, .			+	+	+		+		+		+		+		+		+		+		+	
Normal rhesus No. 102, .			+		+	+	+		+		+		+				+		+		+	
Normal rhesus No. 103, .			+	+	+		+		+		+		+				+		+		+	
Normal rhesus No. 108, .																						
Normal rhesus No. 109, .																						
Normal rhesus No. 110, .																						
Normal rhesus No. 111, .																						
Number of flies added to cage.	1,700	600	-	-	-	-	800	-	-	-	-	-	-	400	800	-	-	-	-	-	-	200
Number of flies that fed, .	200	500	800	800	-	500	900	900	700	600	700	-	700	800	900	-	1,000	900	800	200	200	150

Fly Cage No. 4 — Flies caught in Nature — Continued.

	1913.																					
	Sept. 18.	Sept. 19.	Sept. 20.	Sept. 21.	Sept. 22.	Sept. 23.	Sept. 24.	Sept. 25.	Sept. 26.	Sept. 27.	Sept. 28.	Sept. 29.	Sept. 30.	Oct. 1.	Oct. 2.	Oct. 3.	Oct. 4.	Oct. 5.	Oct. 6.	Oct. 7.	Oct. 8.	Oct. 9.
Infected rhesus No. 67, .																						
Infected rhesus No. 99, .																						
Infected rhesus No. 168, .																						
Infected rhesus No. 56, .																						
Infected rhesus No. 84, .																						
Infected rhesus No. 164, .		+		+		+		+		+												
Infected rhesus No. 63, .																						
Infected rhesus No. 40, .																						
Infected rhesus No. 106, .								+ I		+ S												

Infected rhesus No. 107, .										+ I		+ S										
Infected rhesus No. 112, .													+ S									
Infected rhesus No. 68, .																						
Infected rhesus No. 105, .		+ S		+ P		+ P																
Normal rhesus No. 100, .	+		+		+		+															
Normal rhesus No. 101, .	+		+		+		+															
Normal rhesus No. 102, .	+		+		+		+															
Normal rhesus No. 103, .	+		+		+		+															
Normal rhesus No. 108, .									+		+		+		+	+		+		+		+
Normal rhesus No. 109, .									+		+		+		+		+		+		+	
Normal rhesus No. 110, .									+		+		+		+		+		+		+	
Normal rhesus No. 111, .									+		+		+		+			+		+		+
Number of flies added to cage.	1,000	-	-	-	-	600	600	600	-	1,000	-	-	-	-	-	-	-	-	-	-	-	-
Number of flies that fed, .	200	250	600	-	200	200	800	1,200	800	800	800	400	400	400	300	300	300	400	450	400	400	300

Fly Cage No. 4 — Flies caught in Nature — Concluded.

	1913.																					
	Oct. 10.	Oct. 11.	Oct. 12.	Oct. 13.	Oct. 14.	Oct. 15.	Oct. 16.	Oct. 17.	Oct. 18.	Oct. 19.	Oct. 20.	Oct. 21.	Oct. 22.	Oct. 23.	Oct. 24.	Oct. 25.	Oct. 26.	Oct. 27.	Oct. 28.	Oct. 29.	Oct. 30.	Oct. 31.
Infected rhesus No. 67, .																						
Infected rhesus No. 99, .																						
Infected rhesus No. 168, .																						
Infected rhesus No. 56, .																						
Infected rhesus No. 84, .																						
Infected rhesus No. 164, .																						
Infected rhesus No. 63, .																						
Infected rhesus No. 40, .																						
Infected rhesus No. 106, .																						

Infected rhesus No. 107, .																						
Infected rhesus No. 112, .																						
Infected rhesus No. 68, .																						
Infected rhesus No. 105, .																						
Normal rhesus No. 100, .																						
Normal rhesus No. 101, .																						
Normal rhesus No. 102, .																						
Normal rhesus No. 103, .																						
Normal rhesus No. 108, .		+		+		+		+		+				+				+				
Normal rhesus No. 109, .	+		+		+		+		+		+				+				+			
Normal rhesus No. 110, .	+		+		+		+		+			+				+				+		
Normal rhesus No. 111, .		+		+		+		+					+				+				+	
Number of flies added to cage.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Number of flies that fed, .	300	200	200	100	100	75	50	50	20	20	20	15	15	10	10	10	10	10	8	5	1	

Feeding Experiments. — A number of experiments were made in order to infect monkeys by the mouth. The animals were fed with the virus in various foods and drink, such as banana and milk. The virus was usually given on an empty stomach, and was given to both normal monkeys and monkeys with diarrhœa. As soon as one of the stock monkeys showed symptoms of diarrhœa he was at once isolated and fed with the virus, with the expectation that perhaps the digestive disturbance would prompt the virus to penetrate the intestinal mucosa. All the feeding experiments resulted negatively.

Infection through the Nasal Mucosa. — Several attempts were made to infect monkeys through the uninjured nasal mucosa, with only one positive result, as follows: —

Rhesus No. 91. Previously exposed to Flies, with Negative Results.

Dec. 2. About 1 cubic centimeter of a very rich emulsion of the virus (brain and spinal cord of rhesus No. 107) was placed in the nostrils while the animal was under ether. The monkey did not cough or sputter, and probably swallowed most of the virus.

Dec. 10. Trembling; poor appetite.

Dec. 11. Trembling more evident, especially on right side; poor appetite; no paralysis.

Dec. 12. Paresis, right side, which soon became more marked with definite paralysis of right arm and right leg; recovered with residual paralysis.

Quinine in Poliomyelitis. — In view of the favorable results reported by the use of quinine in rabies, a few attempts were made to determine the influence of this drug upon poliomyelitis. Although nothing encouraging developed from the few experiments in which quinine bihydrochlorid was used, both as a prophylactic and therapeutic agent, nevertheless, it must be remembered that the monkeys were given an overpowering amount of the virus directly into the brain tissue. It is possible that with less overwhelming amounts of infection, and with more normal channels of entrance, different results may be obtained.

It is interesting to note that a normal monkey was able to withstand 0.1 of a gram of quinine bihydrochlorid intravenously, whereas monkeys just beginning to show symptoms of poliomyelitis died at once with this same amount. The following protocols are given: —

Rhesus No. 102. Previously exposed to Flies, with Negative Results.

Nov. 10. At 11.55 A.M. 0.2 cubic centimeter emulsion of virus No. 107 intracranially; 0.1 gram quinine bihydrochlorid intravenously at same time. At 4.25 P.M. 0.1 gram of quinine bihydrochlorid subcutaneously.

Nov. 11. At 9.15 A.M. 0.1 gram of quinine bihydrochlorid subcutaneously. At 12.45 P.M. 0.1 gram of quinine bihydrochlorid subcutaneously. At 4.45 P.M. 0.1 gram of quinine bihydrochlorid subcutaneously.

Nov. 12. At 9.05 A.M. 0.1 gram of quinine bihydrochlorid subcutaneously. At 12.45 P.M. 0.1 gram of quinine bihydrochlorid subcutaneously. At 4.45 P.M. 0.1 gram of quinine bihydrochlorid subcutaneously.

Nov. 13. At 9 A.M. 0.1 gram of quinine bihydrochlorid subcutaneously. At 12.30 P.M. 0.1 gram of quinine bihydrochlorid subcutaneously. At 5.45 P.M. 0.2 gram of quinine bihydrochlorid subcutaneously.

Nov. 14. Well marked tremor; weakness of left wrist and legs.

Nov. 15. Complete paralysis; died at 8.45 P.M.

Rhesus No. 88. Previously exposed to Flies, with Negative Results.

Nov. 10. 0.2 cubic centimeter emulsion of virus No. 107 intracranially.

Nov. 14. Somewhat more quiet than usual.

Nov. 15. Very quiet; very slight tremor; some difficulty in walking. At 9.45 A.M. 0.3 gram quinine bihydrochlorid intravenously; died at once.

Rhesus No. 96. Previously exposed to Flies, with Negative Results.

Nov. 10. 0.2 cubic centimeter emulsion of virus No. 107 intracranially.

Nov. 14. Unusually quiet; poor appetite.

Nov. 15. Marked trembling; 0.1 gram of quinine bihydrochlorid intravenously; died at once.

Rhesus No. 95. Previously exposed to Flies, with Negative Results.

Nov. 10. 0.2 cubic centimeter emulsion of virus No. 107 intracranially.

Nov. 12. Marked trembling; rather quiet; 0.1 gram quinine bihydrochlorid intravenously; died at once.

EXPERIMENTS TO DETERMINE IF PARALYZED DOMESTIC ANIMALS AND THOSE ASSOCIATED WITH CASES OF INFANTILE PARALYSIS MAY TRANSMIT THIS DISEASE.[1]

Introduction.

The sporadic occurrence of poliomyelitis in numerous, apparently unrelated foci, and the tendency of the disease to appear in rural districts which have only slight intercourse with large centers of population, have led to the hypothesis of some animal reservoir for the virus. The incidence of epidemics in summer, when all animal life is most active, favors this hypothesis. On the other hand, poliomyelitis is inoculable only into monkeys and possibly into rabbits. Other species have shown themselves refractory. Even monkeys are not easily infected, and rabbits are as a rule so difficult to infect that their susceptibility is a matter of debate.

There still remains the hypothesis that certain animals may be carriers of the infection without becoming diseased. The infection may vegetate on mucous membranes without invading the central nervous system.

Hypotheses of this sort do not, as a rule, lead anywhere unless as guides to actual experiments which serve to test their validity. The material available for experimentation under the above hypotheses is so abundant that in planning some investigations to trace the virus of poliomyelitis into the lower animals we thought it best to begin with cases of paralysis not explainable as the result of injury, poisons or well-known infectious agents. Before detailing these experiments a brief survey of what is known of animal diseases simulating infantile paralysis will be in order.

There are several spontaneous diseases of animals associated with paralysis that have strong resemblances to infantile paralysis. P. H. Römer[2] discovered a disease among guinea-pigs which causes paralysis and death. It is due to a filterable agent and may be transmitted from guinea-pig to guinea-pig by the intracerebral method of inoculation. It is a meningo-myelo-encephalitis with lymphocytic infiltration.

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[1] By Carl Ten Broeck, M.D., with an introductory note by Prof. Theobald Smith, M.D. (From the Department of Comparative Pathology, Harvard University Medical School, Boston.) The cost of this investigation was met by a fund generously contributed by the following gentlemen: Messrs. Frederick S. Converse, William H. Hill, Charles C. Jackson, Charles H. W. Foster, Moses Williams, Moses Williams, Jr., Charles Jackson, Robert Treat Paine, 2d, Frederick P. Royce, Francis R. Bangs, and "A Friend." Reprinted from "Infantile Paralysis in Massachusetts, 1907–1912," Massachusetts State Board of Health, 1914; also published in Monthly Bulletin of Massachusetts State Board of Health, July, 1914.

[2] Deutsche Med. Wochenschr., XXXVII., 1911, p. 1209.

M'Gowan and Rettie[1] describe a poliomyelitis in sheep known as "loupin ill," trembling, etc. This disease begins with fever, restlessness, excitability, trembling and muscular twitching, followed by coma and death or by paralysis producing various deformities and often complete loss of the use of the hind quarters.

The lesions of the central nervous system vary according as the animal suffered from the acute or the chronic type of the disease. In the latter, the pia, nerve roots, the gray and white matter and the perivascular sheaths are infiltrated with small round cells. The nerve cells, especially of the anterior horns of the cord, are in various stages of disintegration. Cultures were negative. Intracerebral inoculations of two sheep with brain tissue from acute cases produced no effect.

In the spinal cord and ganglia of a dog affected with paralysis, Flexner and Clark[2] found lesions closely resembling, but not identical with, poliomyelitis lesions as they are found in man and in inoculated monkeys. The lesions, most pronounced in the cervical and lumbar enlargements, consisted of perivascular infiltrations, hæmorrhage, œdema, infiltration and necrosis of the ground substance and necrosis of ganglion cells, which become at times replaced by small round cells.

Inoculation of two dogs and two monkeys (*Macacus rhesus*) led to no positive result. The animals were under observation for several months.

An infectious disease of horses affecting the central nervous system, which may appear both in sporadic and epidemic form and which has been investigated in Saxony, where it has been prevalent for some twenty years, has recently been studied histologically by E. Joest.[3] This author finds much resemblance between the lesions of poliomyelitis and of this horse disease. The disease is at its height in the spring of the year, and its infectiousness is very slight. The affected animal becomes dull and listless, but the paralyses are incomplete.

Joest finds that the pathological changes are chiefly in the brain. There is a marked lymphocytic infiltration of the perivascular lymph spaces, with a tendency to invasion of the nervous tissue. The spinal cord is much less involved.

Although a diplo-streptococcus has been described by several investigators as associated with the lesions, the etiology is not cleared up. Joest describes intranuclear bodies, and is inclined to regard them as belong-

[1] Jour. Pathol. and Bacteriol., XVIII., 1913, p. 47.

[2] Jour. Exper. Med., XVII., 1913, p. 577.

[3] Handbuch d. path. Mikroorganismen, 2d edition, Vol. VI., p. 251.

ing to the chlamydozoa of von Prowazek and to contain the virus of the disease.

Attention has been called to the occurrence of paralysis among domestic animals during epidemics or to individual paralyzed animals that have come in contact with cases in families.

Ed. Müller [1] calls attention to the statements which have appeared in medical writings concerning the possible relation between animals and infantile paralysis (Wickman, Krause, Wilke) and adds one case of his own. A child two years old had carried about and played with a paralyzed fowl. No occurrence pointing to contact either direct or indirect with another case could be discovered.

Bruno [2] gives details of two cases occurring in two children of the same family aged two and three years, respectively. The children had not come in contact with other children, but were restricted to a large garden containing poultry and a few sheep. About six weeks before the disease appeared in the children, the father had purchased a number of ducks from an establishment handling many thousands yearly. Five of the ducks became paralyzed, one died, one was killed and three recovered. Bruno does not hesitate to bring this disease of ducks into etiological relation with the cases of infantile paralysis.

Lust and Rosenberg [3] in studying an epidemic in and around Heidelberg fixed their attention upon paralysis in domestic fowls, which was quite common. They inoculated fowls with a suspension of brain and cord of a paralyzed fowl without success. Four young chickens were placed in a hospital ward with cases of poliomyelitis and fed with nasal secretion of such cases for nine days. This experiment also proved negative. Finally, they injected a strain of poliomyelitis virus into nine chickens, either into the brain or into the peritoneal cavity. This experiment likewise failed to produce the disease.

Neustaedter [4] states that two guinea-pigs contracted poliomyelitis by being kept in proximity to a severe case of inoculation poliomyelitis in a monkey. He also found that in one case swabbing the nasal mucosa with filtered virus from the cord of a monkey caused poliomyelitis in a guinea-pig. No subsequent confirmatory experiments have been reported.

The inoculability of the human virus into the lower animals has received considerable attention. Thus far, the tailed monkeys present the most reliable reaction to this virus after intracerebral inoculation. Rabbits have been tried by various experimenters with uncertain and equivocal

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[1] Die spinale Kinderlähmung, Berlin, 1910.
[2] Münch. Med. Wochenschr., 60, 1913, p. 1995.
[3] Münch. Med. Wochenschr., LXI., 1914, p. 120.
[4] Jour. A.M.A., LX., 1913, p. 982.

results. H. K. Marks[1] has more recently gone over this problem again. He found that by using young rabbits, the virus at times may be transmitted through a short series of rabbits and be detected in the last of the series by the use of monkeys. In the experimental work described below, only monkeys were employed, because no other species could be relied upon to yield trustworthy results.

Experimental Part.

Method. — After having been kept under observation for some days the animals were killed, at first, by chloroform, later, as we did not know the effect of chloroform on the virus of poliomyelitis if such should be present on the mucous membranes, by a blow on the head followed by bleeding. A careful autopsy was made and portions of the cord and nasal mucosa removed for inoculation material. In the majority of cases the nasal mucosa was used for inoculation, as it has been shown that in the monkey, at least, the virus persists here long after it can be demonstrated in the cord.[2] We assumed that if the animals were to transmit the disease, they would be more apt to do so through the nose than in any other way that we know of at present. In some cases, however, both nasal mucosa and cord were used for inoculation.

The tissue was ground with sterile sand in a sterile mortar and suspended in salt solution. After standing in the refrigerator over night this suspension was passed through a sterile Berkefeld filter and one or two monkeys inoculated with the filtrate.

Using aseptic precautions and having the monkey under ether anæsthesia, we injected 4 to 6 cubic centimeters into the lateral ventricle. In a few cases we partially sterilized the suspension to be injected, by means of 0.5 per cent. phenol instead of passing it through a filter. The monkeys were kept under observation for at least two months and then, if they remained well, inoculated with tissue from another case, care being taken that it was from a different species than that of the first inoculation, to prevent anaphylactic reaction. In no case was a monkey used more than twice. We lost several monkeys from various causes, as will be seen in the notes, but in all except one case, one of the pair, inoculated from any one animal, lived throughout the incubation period of poliomyelitis. The monkeys used were *Macacus rhesus,* except Nos. 16, 17 and 19, which agreed most nearly with the species description of *Cereocebus galeritus.* The latter were susceptible to poliomyelitis, as we proved by inoculation.

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[1] Jour. Exper. Med., XIV., 1911, p. 116.

[2] Flexner and Clark, Jour. Amer. Med. Assoc., 1911, Vol. LVI., p. 585.

In order to show that by our methods we could produce the disease, we made the two following experiments as controls: —

R. L. — Boy, age 4, had a rise in temperature, pulse and respiration, with vomiting. The next day there was a complete paralysis of the left leg, and the knee jerks were absent. On the fifth day he died, showing at this time complete flaccid paralysis of both legs, left arm and partial paralysis of the right arm, marked difficulty in swallowing. Coarse bubbling rales throughout front and back of both lungs. Cord removed and sent to the State Board of Health, July 21, 1911.

The membranes of the cord showed an intense congestion in the lumbar region, and the vessels of the white matter are well marked. Near the cauda equina there is an intense congestion of the anterior horns and of the white matter. Microscopic examination shows the gray matter infiltrated with lymphocytes and red blood corpuscles, the normal tissue being almost entirely destroyed. Clinical and pathological diagnosis: acute poliomyelitis.

Cord suspended in salt solution, filtered and injected into the lateral ventricles of monkeys Nos. 5 and 6, July 22, 1911. Seventeen days later monkey No. 5 became paralyzed in the right leg, and the next day it had a flaccid paralysis of both hind legs. Nine days after monkey No. 6 was inoculated it became very nervous, lost its appetite, and two days later had a paresis of the left arm and both legs. Gradually, it recovered the use of its limbs, and two months after the inoculation was practically normal. Killed at this time, the autopsy showed lumbar cord slightly congested, the superficial vessels slightly prominent and the anterior horns somewhat reddened. No abnormality noted in the remainder of the cord or in the brain. Pleural and peritoneal cavities with contents normal. Microscopical examination shows a marked perivascular infiltration with lymphocytes in the lumbar cord and a degeneration of the anterior horn cells. A piece of muscle removed from the axilla showed marked atrophy.

Monkeys Nos. 18 and 24. — Inoculated Dec. 28, 1912, with 1 cubic centimeter of a 5 per cent. suspension of the cord of a monkey that had died from the effects of an inoculation with a strain of poliomyelitis virus received from the Hygienic Laboratory of the United States Public Health Service at Washington, D. C. Twelve days later these monkeys were found totally paralyzed, and died the next day. Microscopic examination of their central nervous systems showed the typical lesions of poliomyelitis.

Dogs.

Dog No. 57.[1] — Springfield, Aug. 19, 1911. Dog struck by an automobile two weeks ago. Spastic paralysis of hind legs with retention of feces. Autopsy showed a marked lateral curvature of the spine in the upper thoracic

[1] These numbers are running laboratory numbers and have no bearing on the number of cases of paralysis examined.

region with an enlargement of the bodies of the vertebræ. No inoculations made.

Dog No. 58. — From Dr. G., Boston, Sept. 11, 1911. History of paralysis. Dead when received. Slight indication of injections of minute vessels of pia. Post-mortem: putrefaction well under way.

Filtered suspension of cord injected into lateral ventricle of monkey No. 21. Death in a month from a colitis. No evidence of paralysis. Filtered suspension of nasal mucosa injected into lateral ventricle of monkey No. 22. No effects from inoculation after two months.

Dog No. 59. — North Andover, Sept. 22, 1911. Dog had been sick for about a month. Did not use left fore foot. There seemed to be a hyperæsthesia of all limbs. Chloroformed. Autopsy. Walls of stomach and small intestine thickened and congested. Cord apparently normal except in the lower cervical and thoracic regions, where the gray matter appears to be softer than normal. Inoculations not made as there was no apparent connection between this animal and any cases of poliomyelitis.

Dog No. 60. — West Harwich, Feb. 7, 1912. Spastic paralysis of hind legs with retention of urine and feces. First noticed ten days ago. Autopsy. About 10 centimeters above the lumbar enlargement of the cord for a space of about 3 centimeters the cord was found to be slightly larger, firmer and of a more pearly color than the adjacent tissue. On section a grayish white, pearly mass of tissue was seen replacing the gray matter and most of the white matter of the cord, leaving only a ring of the latter around the periphery. Microscopical examination showed that this tumor was probably a fibroma. No inoculations made as the paralysis was most probably due to the tumor.

Cattle.

Cattle No. 237. — Fairhaven, Nov. 8, 1911. Cow, six years old. Raised on the farm and was a great pet of the children. No cases of poliomyelitis for some years in Fairhaven. Two weeks ago it was noticed that there was a slight incoördination in the cow's movements. This increased until there was a complete paralysis of the hind quarters. Killed and autopsied by M. J. Curran, M.D.V., New Bedford, who reports ascites of the abdominal cavity, organs normal, and no signs of tuberculosis. Cord removed and sent to the State Board of Health.

Cord shows slight congestion. Suspended in salt solution, filtered and injected into the lateral ventricles of monkeys Nos. 18 and 22. Monkey No. 22 became blind and was killed a month and a half after the inoculation. Autopsy showed an internal hydrocephalus. Monkey No. 18 remained well for over two months following the inoculation.

Cattle No. 241. — Sharon. Case obtained by kindness of Dr. Mulvehill, March 1, 1912. Heifer, one year old. Complete motor paralysis of the hind quarters beginning four days ago. No known injury and no evidences of external injury. Autopsy. Distal 15 centimeters of lumbar cord bluish, swollen, with an irregular cavity following the lines of the gray matter and having a hæmorrhagic border. Microscopical examination of the cord shows no evidences of an inflammatory condition, but does show a diffuse hæmorrhage which has probably softened and produced the cavity. No evidence of injury to spine, but Dr. E. E. Southard, who was consulted, regarded the condition as probably due to trauma. No inoculations made.

Cattle No. 253. — Jan. 8, 1913, from Dr. Langdon Frothingham, three pieces of the fore brain weighing about 20 grams, the medulla and the first portion of the cord.

The brain had been sent in by Dr. Playdon of Reading, Mass., who states that before death the cow had a paralysis of its hind legs and that its head was twisted around as in milk fever. Negri bodies were not found by Dr. Frothingham.

The material was received in a putrid condition, so that microscopic examination was not attempted. The portions of brain and cord were ground in a mortar with sterile sand and suspended in 100 cubic centimeters of salt solution. The suspension was shaken for one hour in a machine, frozen and thawed three times, then centrifuged and the supernatant fluid passed through a Berkefeld filter.

Monkey No. 46 received 4 cubic centimeters of the filtrate into its right lateral ventricle and 42 cubic centimeters into its peritoneal cavity.

Monkey No. 58 received 5 cubic centimeters of the filtrate into its right lateral ventricle.

Monkey No. 46 was under observation for six months following the injection and remained perfectly well during this period. One month after monkey No. 58 had been inoculated, it developed a marked diarrhœa. This disappeared for a time, but reappeared about a month later, and three months after the inoculation the monkey died apparently from this chronic diarrhœa. Microscopical examination of the cord showed normal nerve cells and no perivascular infiltration.

Swine.

Swine, No. 101. — Woburn, Aug. 18, 1911. This pig comes from a neighborhood where there is a case of acute poliomyelitis. Along with four others, this pig was taken sick last winter. The nature of the sickness was not determined, but it was stated that during July there was a similar illness among the pigs, from which over a hundred died. Examination shows that the fore legs are used normally while the hind legs are totally paralyzed. Chloroformed and autopsied. Pig about 100 centimeters long and weighing about 80 to 100 pounds. Viscera in general normal, with the exception of the stomach mucosa, of which the fundus is marked by congestion and is pigmented. Slight erosions around margins of cardiac expansion. No parasites. A portion of the ileum near valve congested. Rectum for a distance of 15 centimeters uniformly distended with dry feces into a cylindrical mass about 3 centimeters in diameter. Urinary bladder well distended into a globular mass equal to two fists put together. Spinal cord at level of lumbar enlargement has a distended vein running along its dorsal aspect; several similar veins on ventral aspect. No other abnormalities noticed. The vertebræ in this region sawn through, but nothing unusual found. Microscopical examination negative.

Injected the filtered suspension of the nasal mucosa into the lateral ventricles of monkeys Nos. 1 and 2. Monkey No. 1 developed an internal hydrocephalus and died in about a month from the time of the inoculation without showing any signs of paralysis. Monkey No. 2 showed no effects from the inoculation after three months.

Swine No. 105. — North Dana, Feb. 20, 1912. One of five pigs that were taken sick last spring, the others dying. Examination shows a paralysis of the extensor muscles of the hind legs. Given morphine and bled to death. Autopsy showed the cord in the lower lumbar region to be possibly a trifle more moist and softer than normal. Microscopical examination negative.

The suspension of the nasal mucosa partially sterilized by means of 0.5 per cent. phenol, injected into the lateral ventricles of monkeys Nos. 32 and 33. No effect from the inoculation during the following two months.

Swine No. 106. — Westwood, Feb. 8, 1912. This pig came originally from a family where there was a case of acute poliomyelitis. Pig taken with an acute illness and died in twenty-four hours. Unable to use legs, which were hyperæsthetic and somewhat œdematous. Autopsy: white female pig weighing about 75 pounds. Post-mortem: decomposition advanced. Bloody around snout. The membranes of the spinal cord were of a purplish red color, but the individual vessels were not very prominent. In the lumbar region the cord was very soft, and the gray matter could not be distinguished from the white. In the dorsal region the cord was soft, yet the markings were distinct. At no place in the cord was there any apparent congestion. The vessels of the membranes covering the brain were markedly enlarged, but the diffuse reddening of the cord was not present. Peritoneal cavity distended with gas; contains considerable blood-stained fluid. Intestine purplish red in color and distended with gas. Not opened. Spleen not enlarged. Right lung crepitant but firm, not collapsed and dark red in color. Section shows a deeply congested tissue with dark clots in the vessels. Left lung less firm than the right, crepitant and on section of a bright red color.

Frozen sections of the cord showed an exudate of fibrin and polymorphonuclear leucocytes in the meninges, but no perivascular infiltration.

We were not successful in getting the suspension of the nasal mucosa sterile by means of 0.5 per cent. phenol, so that no inoculations were made.

Swine No. 107. — This pig was received May 27, 1912, from Westwood. Three months before a paralyzed pig (No. 106) had been received from the same neighborhood. There was a rather close association with a case of poliomyelitis.

On May 19, 1912, this pig became weak in its fore legs and its hind legs were paralyzed. When received at the laboratory, it was found that the hind legs were in a spastic condition and that the animal could move but could not stand on them. The fore legs were weak. The animal had a rectal temperature of 107.4 degrees. The pig was killed by a blow on the head. The autopsy showed a rather soft, moist cord, the markings of which were indistinct. The brain was apparently normal except for the congestion due to the blow. The liver, spleen, kidneys and adrenal appeared normal on macroscopic examination. The bladder was distended and the rectum was filled with hard feces. The small intestine was normal. The pancreas was firm and on section numerous bands of a firm, yellowish, soap-like substance were visible. The glands in the groin, under the sternum, at the angles of the jaw and in the mesentery were enlarged. Their cortex was hæmorrhagic, and on section they were light gray in color. The heart and lungs were apparently normal.

Microscopic examination of the tissues of this pig showed an early lymph-node tuberculosis, fat necrosis of the pancreas, together with many focal cell accumulations of lymphocytes under the capsule of the adrenal and around the perilobular veins of the liver. There were numerous, relatively large, focal cell collections in the cortex of the kidneys which crowded upon and compressed the tubules. The cells were of the endothelial type. A few mitoses were seen. Necrosis absent. Most remarkable of all, a very evident perivascular lymphocytic infiltration of the vessels of the lumbar cord. There was no destruction of the nerve cells nor accumulation of lymphocytes in the anterior horns of the gray matter.

Portions of the cord of this pig were placed in 0.5 per cent. phenol and kept in the refrigerator until Nov. 8, 1912 (five and one-third months), when they were washed, suspended in salt solution, and the suspension passed through a Berkefeld filter.[1] Five cubic centimeters of this filtrate were injected into the lateral ventricle of the brain of monkey No. 43 and 50 cubic centimeters into the peritoneal cavity of monkey No. 44. Both animals remained perfectly well throughout the following four months.

Swine No. 114. — This pig was received Oct. 25, 1913, from Framingham. White male pig weighing about 50 pounds. Owner had previously killed one paralyzed pig. This one eats normally. Limbs so weak that animal lies down, but is able to walk to reach his food. Reflexes present. Killed after a week's observation, by cutting vessels of neck after stunning with a blow. All the viscera were normal. There were some fresh small hæmorrhages in muscles of back, probably result of death struggle. Some were found in psoas and muscles of diaphragm. Slight hæmorrhagic infiltration of lymph sinus, lymph nodes of neck, mediastinum, aorta and pelvis. Microscopic examination of muscular tissue fixed and sectioned shows hæmorrhages in the septa between bundles of fibers. Red corpuscles well preserved. No cellular infiltration or other signs of inflammation. The cord of this animal was ground up with sand, suspended in five parts of salt solution by weight, shaken and refrigerated for one day; filtered through

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[1] Flexner, Clark and Amoss found that the cord of a child which had died of infantile paralysis, kept for fifteen months in 0.5 per cent. phenol, produced typical paralysis when injected into monkeys (Jour. Exper. Med. XIX., 1914, p. 205).

Berkefeld filter. Filtrate in refrigerator for two days, then injected into monkey No. 63, 2.3 cubic centimeters intracerebral, and 20 cubic centimeters into abdominal cavity. Monkey well after four months.

Fowls.

Fowl No. 25. — Lexington, Aug. 10, 1911. This fowl was received from a family where there is a case of acute poliomyelitis. The only sick chicken in the flock. Stands erect with its sternum pushed out and sways from side to side. Falls over when touched, probably from weakness. No paralysis. Feathers around anus soiled. August 12, dead. Autopsy shows brain and cord normal. Anterior nares plugged with a light yellow fibrinous exudate. Eyes moist but without exudate. Nothing abnormal found in the pleural or peritoneal cavities. Diagnosis: avian diphtheria.

Filtered suspension of nasal mucosa injected into the lateral ventricles of monkeys Nos. 9 and 10. No effect from the inoculations in the following two months.

Fowl No. 26. — Woburn, Aug. 25, 1911. This fowl comes from a flock where two or three chickens are said to have died in a mysterious manner, and where the man who cared for them had an attack of acute poliomyelitis that caused his death. Chicken walks with a limp, as though its foot had been injured. No evident paralysis. Killed by a blow on the head. Autopsy showed fatty degeneration of the liver but no other abnormality.

The filtered suspension of the nasal mucosa was injected into the lateral ventricles of monkeys Nos. 19 and 20, and the filtered suspension of the cord into a lateral ventricle of monkey No. 18. All monkeys remained well during the following two months.

Fowls Nos. 27, 28 and 29. — These three fowls were received Sept. 1, 1911, from Boxford. The principal trouble, as far as their walking went, was an apparent loss of equilibrium. When first received, they would stagger when they walked, but later any movement would cause them to fall forward on their heads. After falling they would lie for some time. There was no evident paralysis. For three years chickens on this farm have had some difficulty in walking which appeared when they were about three months old and which progressed until they died. They have evidently had good care and the owner cannot account for their condition.

Fowl No. 27 was chloroformed September 11, when it was nearly dead. Filtered suspension of nasal mucosa was injected into the lateral ventricle of monkey No. 24; filtered suspension of cord injected into the lateral ventricle of monkey No. 23. Both monkeys remained well during the following three months.

Fowls Nos. 28 and 29 were, on Oct. 24, 1911, bled to death, and the nasal mucosæ of both suspended in salt solution, filtered and injected into the lateral ventricle of monkey No. 17. The brains and cervical cords of the two fowls were suspended in salt solution, filtered and injected into the lateral ventricle of monkey No. 16. The monkey showed no effects from the inoculation during the following two months. Immediately after monkey No. 17 had been inoculated, it was totally paralyzed. A little later it had some convulsions, and the next day it had a left-sided hemiplegia. Two days later it died, evidently from some accident during the operation, the nature of which could not be determined at autopsy.

Fowl No. 30. — Leominster, Sept. 23, 1911. This fowl comes from a flock where there have been several cases of paralysis among the chickens, and where the boy who was intimately associated with them has an acute attack of poliomyelitis. The chicken showed a complete paralysis of the legs, which by October 3 had somewhat improved, but which still prevented it from walking. Bled to death and autopsied. Nothing abnormal found.

Filtered suspension of nasal mucosa injected into the lateral ventricle of monkey No. 26. Well for the following two months. Filtered suspension of cord injected into the lateral ventricle of monkey No. 25. Eight days later the monkey succumbed to an attack of colitis and nephritis.

Fowl No. 40. — Ipswich, March 17, 1914. A very fat adult Plymouth Rock hen. The fowl is unable to stand on its feet apparently on account of a paralysis of the muscles of the back. No atrophy of the muscles can be demonstrated. The toes are flaccid, but are moved by the hen. Both legs seem equally involved. The knee jerks are present and equal. The crossed knee jerks are marked. There is no wing drop and the head is held normally. The comb and feathers are in good condition and no ectoparasites can be demonstrated.

This fowl has not been associated with a case of poliomyelitis and there are no other cases of paralysis among the chickens of this flock, though they have occurred in the flock of the breeder from whom this chicken originally came.

On March 21 the fowl was chloroformed and bled to death. There is no atrophy of the muscles of the back or legs and no evidence of an injury to the spine. The abdominal and thoracic viscera and the central nervous system appear to be normal.

Histological examination of the cord at different levels showed a marked perivascular cell infiltration in the gray matter of the lumbar cord in the pia and, to a slight extent, in the white matter. The same condition was found in sections of the dorsal region, but not so pronounced. None was seen in a section of the cervical region and of the midbrain. The infiltrating cells were of lymphoid type. There was no evidence of neuronophagia, but a small number of the nerve cells were swollen, the Nissl bodies absent, and the cytoplasm very attenuated, almost free from stain. Sections from the cords of fowls Nos. 26 and 27, and one other not referred to above, showed no such changes.

The cord, brain and nasal mucosa were ground with sterile sand and suspended in 75 cubic centimeters of salt solution. The suspension was shaken for one hour and placed in the refrigerator for forty-eight hours. It was then centrifugalized and the supernatant fluid passed through a Berkefeld filter.

On March 24 monkeys Nos. 63 and 64 were each given an intracerebral (intraventricular) injection of 5 cubic centimeters of the filtrate and an intra-abdominal injection of 20 cubic centimeters of the same.

Four days after the inoculation both monkeys were very excitable and had some difficulty in climbing. This lasted for a few days and then gradually passed away, leaving the monkeys apparently normal. At no time was there a definite paralysis. Monkey No. 63 is still normal two months after the inoculation, but monkey No. 64 died suddenly six weeks after the inoculation without showing any paralysis or any other symptoms of note. A very careful autopsy failed to reveal any abnormalities, except slightly congested lungs and a very soft, slightly enlarged spleen. From this last organ a bacterium was obtained which has not been classified, but which is not pathogenic for guinea-pigs. Sections of the cord of this monkey show normal nerve cells and no perivascular infiltration.

Horses.

Horse No. 183. — Aug. 4, 1911. Diphtheria-antitoxin horse has had a drooping of the left eyelid and left side of the lip along with a paralysis of the left fore leg for the last month. Chloroformed. Autopsy showed a blood clot in the Sylvian aqueduct ¼ by 1 inch in size.

The filtered suspension of the nasal mucosa was injected into the lateral ventricles of monkeys Nos. 7 and 8. Both monkeys remained well during the following two months.

Horses Nos. 205, 206 and 208. — These three horses in the same stable in Medford were taken sick in March, 1912, at about the same time with fever, difficulty in swallowing, and a paresis of the legs which made it necessary to suspend them in slings. In Wakefield there was a similar disease among the horses belonging to a man who, along with the owner of the Medford horses, had bought some frozen potatoes, which had been fed in both stables. This was the only known connection between the two places and there was no known association with poliomyelitis. Dr. Playdon of Reading reports that some frostbitten potatoes fed to his rabbits caused similar symptoms, with death in four out of the five animals affected. The disease in the horse was also very fatal, as four of the Wakefield and three of the Medford horses died.

Horse No. 205. — This horse died during the night of March 22–23. Autopsy, March 23, 1912, several hours post-mortem. In the mucosa of the small intestine were found a few hæmorrhagic spots 0.5 centimeter in diameter. The lungs showed a marked pneumonic process on the right side. Nothing else of note was found in the peritoneal or pleural cavities. On opening the skull, considerable cloudy yellow fluid escaped. The vessels of the brain were prominent, and in the region of the left Rolandic fissure over an area 5 centimeters in diameter the cortex was of a decided pinkish hue. Similar areas of less extent were present in other places on the surface of the cerebrum. Nothing abnormal was found in the brain on section. The cord in the region of the fourth, fifth and sixth cervical vertebræ was apparently normal. Microscopic examination showed a slight hæmorrhagic exudate in the meninges of the brain and cord.

The nasal mucosa was treated with 0.5 per cent. phenol, suspended in salt solution, and injected into the lateral ventricles of monkeys Nos. 36 and 37. Both monkeys remained well during the following two months.

Horse No. 206. — Autopsy, March 26, 1912, eighteen hours post-mortem. Marked pneumonia of both lungs. Other viscera normal. Considerable blood-stained fluid surrounded the brain and the surface of the latter was congested, but nothing abnormal was found on section. The cord in the region of the fifth cervical vertebra showed nothing more than a congestion of the membranes. Cultures made from the fluid surrounding the brain showed a variety of organisms which were not pathogenic to mice. Microscopic examination of the central nervous system showed a congestion of the vessels of the cerebral cortex but no signs of an inflammatory reaction. No inoculations were made as the disease was regarded as identical with that of horse No. 205.

Horse No. 208. — This horse died April 9; autopsy, April 10, 1912. Cord and brain packed in ice and sent to the laboratory. The brain showed a marked surface congestion, but was otherwise apparently normal. One portion of the cord was apparently normal, while continuous with it was a region where the membranes were markedly congested and the substance of the cord softened. Microscopic examination of the tissues was unsatisfactory on account of the decomposition that had taken place before fixation. There was a marked hæmorrhage into the membranes but no signs of inflammation. In some portions of the cord there was a loss of tissue which involved the gray matter, but this was probably due to the poor fixation.

The cord was treated with 0.5 per cent. phenol, suspended in salt solution, and injected into the lateral ventricles of monkeys Nos. 38 and 39. Both monkeys remained well during the following two months.

Cats.

Cat No. 28. — Boston, May 26, 1911. Cat was picked up on the street. Flaccid paralysis of both hind legs with retention of urine and feces. Chloroformed June 3. Autopsy showed two small hæmorrhagic spots in the dorsal region of the cord. No apparent injury to the spine. Microscopical examination negative.

Filtered suspension of nasal mucosa injected into lateral ventricle of monkey No. 1. Filtered suspension of cord and medulla injected into lateral ventricle of monkey No. 2. Both monkeys appeared perfectly well during the following two and a half months.

Cat No. 29. — Fitchburg. On June 12, 1911. the cat was noticed to favor the left fore leg, and some heat and tenderness were found below the elbow. On June 16 he had a fit and on examination it was found that he could not use either fore leg.

Received at the laboratory Aug. 12, 1911. Examination showed a paralysis of the extensor muscles of both fore legs so that they were sharply flexed at the elbow. Cat ate and felt well during the time it was under observation. August 23, no change in its condition. Killed by a blow on the head. The autopsy showed gray matter of cord hæmorrhagic in the cervical region. (This may have been due to the blow on the head.) Elbow joints freely movable and apparently normal. No visible atrophy of muscles.

Filtered suspension of nasal mucosa injected into the lateral ventricles of monkeys Nos. 16 and 17. Neither monkey showed any effects from the inoculation during the following two months.

Cat No. 31. — Oct. 16, 1911, from Dr. M. F. Hoar of Fall River. Cat was well but had been associated with a case of acute poliomyelitis in a child. Killed by a blow on the head.

Filtered suspension of the nasal mucosa injected into the lateral ventricles of monkeys Nos. 7 and 8. Monkey No. 8 remained well for over two months following the inoculation. A month after monkey No. 7 was inoculated it became blind, but showed no paralysis. Autopsy showed a marked internal hydrocephalus.

Cats Nos. 32 and 33. — Oct. 16, 1911, from Dr. M. F. Hoar of Fall River. These healthy cats came from a family where there was a case of acute poliomyelitis in a child. Killed by a blow on the head. Filtered suspension of the nasal mucosa injected into the lateral ventricles of monkeys Nos. 9 and 10. Monkey No. 9 remained well for over two months following the inoculation. Nearly a month after monkey No. 10 was inoculated, he stopped eating and in another two weeks was very weak, but showed no signs of any paralysis. Autopsy showed a thickening of the walls of the colon with an enlargement of the mesenteric glands. Central nervous system normal.

Cat No. 34. — Chelmsford, March 28, 1912. Cat has been the pet of a child who is affected with acute poliomyelitis. Shows no signs of disease. Killed by a blow on the head. Suspension of nasal mucosa treated with 0.5 per cent. phenol, injected into the lateral ventricles of monkeys Nos. 34 and 35. Monkey No. 34 was well for over a month and then died from an attack of colitis. Monkey No. 35 was well during the following two months.

Cat No. 35. — Amherst, Oct. 5, 1912. This animal was sent to the laboratory with the history that it had had a bad cough and that it had been intimately associated with two children who were suffering from acute poliomyelitis. As the cat had been introduced into the family about three weeks before the onset of the disease in the children there seemed to be a possibility that it might have brought the infection to them.

The cat was under observation in this laboratory for a month and showed no symptoms of paralysis, cough or loss of appetite. It was killed by a blow on the head and the organs appeared normal on gross and microscopical examination.

The nasal mucosa was placed in 0.5 per cent. phenol for twenty-four hours, washed, ground with sand, and suspended in sterile salt solution. After standing over night in the refrigerator, the suspension was passed through a sterile Berkefeld filter.

Five cubic centimeters of this filtrate were injected into the lateral ventricle of monkey No. 47. The monkey was under observation for ten months and remained perfectly well throughout this period.

Forty-five cubic centimeters of the filtrate were injected into the peritoneal cavity of monkey No. 48. This animal remained well for two months and then developed a diarrhœa and died seventy days after the inoculation from an acute colitis.

Cat No. 36. — Amherst, Nov. 6, 1912. This animal comes from a house about one-quarter mile away from the one where cat No. 35 lived and where there were two cases of poliomyelitis.

This cat was not a pet and spent most of its time around the barn. For the past few months the animal has appeared ill, but has been around the place as usual. One week before it was shipped to the laboratory, a paralysis of the hind legs was noticed.

The animal was received late in the evening and the next morning was found dead, so that no clinical observations were made on it in this laboratory.

Autopsy shows an extensive pneumonia accompanied by a purulent exudate from the nose. The abdominal viscera are apparently normal. The brain and cord on gross examination are normal except in the thoracic region, where the cord appears to be softer and more moist than normal.

Microscopical examination shows an acute bronchopneumonia and an infiltration of lymphocytes in the meninges surrounding the cord.[1]

Portions of the brain and cord of this cat were placed in 50 per cent. glycerine over night, washed, ground up with sand, and suspended in salt solution. This suspension was kept in the refrigerator for three days and then passed through a sterile Berkefeld filter.

Five cubic centimeters of this filtrate were injected into the lateral ventricle of monkey No. 45 and 50 cubic centimeters into the peritoneal cavity of monkey No. 46.

Eight days after the inoculation monkey No. 45 died from an acute colitis, but monkey No. 46 was under observation for a year and failed to show any signs of paralysis or other disturbances.

Cat No. 37. — This cat was brought to the laboratory Dec. 9, 1912, by Dr. S. of Cambridge, who stated that about three weeks ago one of three cats belonging to his family became listless and refused to eat. A few days later it lost the use of its hind legs, dragging them behind it as it walked. This lasted for about three days, after which time it gradually recovered the use of its legs and is now apparently well. The fore legs were not affected and there were no gastro-intestinal disturbances. About eight days from the onset of the disturbance in the first cat, the second cat began to be listless and showed the same symptoms of paralysis as the first one. The cat brought to the laboratory is the third one belonging to the family, and it is supposed to be in the first stages of the disease.

Examination shows an adult yellow and white castrated cat in good con-

[1] From later studies made on cats it seems probable that this animal was suffering from an infection with bacillus bronchisepticus. In dogs an infection with this organism may be followed by a paralysis, but we have not observed this in cats.

dition. The animal eats very little and remains quiet in its cage. When placed on the floor, it runs and leaps in an apparently normal manner.

On December 12 the cat appears to be stupefied and refuses to eat. When placed on the floor, it moves in a normal manner. Jan. 4, 1913, the cat is perfectly well again. On this date it was killed by a blow and autopsied. Nothing abnormal found beyond a moderate impaction of the rectum with dry feces and a slight distension of the urinary bladder.

The nasal mucosa of cat No. 37 was removed, ground with sterile sand and suspended in sterile salt solution. After standing in the refrigerator for three days, this suspension was filtered and 5 cubic centimeters of the filtrate injected into the lateral ventricle of monkeys Nos. 55 and 56. Monkey No. 55 received in addition 28 cubic centimeters of the filtrate into its peritoneal cavity. Both monkeys made a good recovery from the ether, but monkey No. 55 died twenty-three days and monkey No. 56 sixteen days after the inoculation. Both showed a generalized tuberculosis and neither showed signs of a paralysis between the time of inoculation and the time of death.

As the symptoms shown by cat No. 37 seemed to be of some significance, another cat was placed with it in the same cage. This second animal was under observation forty days and remained well during this period.

Rats.

Two rats were trapped in a house in Waltham in which a case of poliomyelitis had occurred. One of them died and was in a state of decomposition when received at the laboratory. The other was well.

The nasal mucosa, tongue, brain and cord, heart, spleen, kidney, bladder and portions of the liver, lung and rectum with contents from both rats were ground with sand, suspended in salt solution, shaken for two hours, and placed in the refrigerator. After standing for seven days the suspension was filtered through a Berkefeld filter, tested for sterility, and 6 cubic centimeters injected into the lateral ventricles of monkeys Nos. 61 and 62. The latter also received 30 cubic centimeters into the peritoneal cavity. Both monkeys made a good recovery from the ether and beyond a slight attack of diarrhœa remained well during the following five months that they were under observation.

On Nov. 8, 1913, two barn rats were brought to the laboratory with the message that they had been caught in a house in Worcester where there was a case of poliomyelitis. One rat was dead and on autopsy appeared normal.

The second rat sat "hunched" up in the corner of the cage and was evidently very sick. Chloroformed and autopsied. All four feet were very much swollen as a result of œdema. The viscera appeared normal.

Portions of the central nervous system, nasal mucosa, tongue, heart, lungs, spleen, liver, kidney, large intestine with contents and the urinary bladder of both rats were ground with sterile sand, suspended in 100 cubic centimeters of salt solution, shaken for three hours, and allowed to stand in the refrigerator for six days. The suspension was filtered through a Berkefeld filter, tested for sterility and 2½ cubic centimeters injected into the lateral ventricles of monkeys Nos. 65 and 66. Monkey No. 66 received in addition 22 cubic centimeters of the filtrate into the peritoneal cavity.

Both monkeys showed a good ether recovery, but three hours after the inoculation were very sick, lying on the floor of their cage completely prostrated. For the next three days the monkeys refused to eat and were very sick, but after this time, they gradually improved. During the following three and a half months that they were under observation, they appeared perfectly well.

Flies.

Nineteen specimens of *Stomoxys calcitrans* were caught Nov. 23, 1912, in the antitoxin horse stables of the State Board of Health at Forest Hills. They were ground up with sterile sand and suspended in 40 cubic centimeters of salt solution, placed in refrigerator for twelve days, filtered through a Berkefeld filter and 4 cubic centimeters injected into one lateral ventricle of each of two monkeys (Nos. 51 and 52). No. 52 received also 33 cubic centimeters into the peritoneal cavity. Both monkeys were under observation for four months and remained well.

On Dec. 7, 1912, this experiment was repeated with twenty-two *Stomoxys* obtained from the same stable. The filtrate was prepared as above, with the exception that the suspension remained in the refrigerator but five days. Monkey No. 53 received 5 cubic centimeters of the filtrate into a lateral ventricle and 14 cubic centimeters into the peritoneal cavity. The monkey died in forty-three days as a result of caseous (tubercular) pneumonia and miliary tuberculosis.

SUMMARY.

Besides the animals noted above we have received and autopsied eight fowls, two cats and two cows. Some of these showed evidence of injury to account for their paralysis, some were in a marked state of decomposition, or else were not paralyzed and had not been associated with cases of poliomyelitis, so that they were not used for inoculation.

We have received in all forty-eight animals, and material from thirty of these has been injected into monkeys. Of these thirty animals there were four rats, seven fowls, nine cats, three horses, four swine, one dog and two cows. Fifteen were paralyzed, four had a questionable paralysis, and eleven were free from paralysis. Thirteen of these animals had been more or less closely associated with human cases of poliomyelitis, and in the other seventeen no such association was known. *In no case did the monkeys inoculated from any of these animals show any signs of a paralysis or symptoms which would indicate that they were infected with poliomyelitis.* In the cords of those that died no perivascular infiltration with lymphocytes was found nor was there a degeneration of the cells of the anterior horns.

A summary of the inoculations made and the source of the material used is given in the following table: —

Animals furnishing Material to be injected.			Material used (Suspensions).	Site of Injection.	Amount injected (Cubic Centimeters).	Monkey injected (Number).	Result.
Species and Number.	Condition.	Exposed to Infantile Paralysis.					
Dog No. 58.	Paralyzed.	Not known.	Filtered cord.	Lateral ventricle.	5	21	Death; acute colitis.
				Lateral ventricle.	5	22	No effect.
Cattle No. 237.	Paralyzed.	No.	Filtered cord.	Lateral ventricle.	4	18	No effect.
				Lateral ventricle.	4.5	22	Killed; internal hydrocephalus.
Cattle No. 253.	Paralyzed.	Not known.	Filtered brain and cord.	Lateral ventricle. Peritoneal cavity.	4 42	46	No effect.
				Lateral ventricle.	5	58	Death in three months; chronic colitis.
Swine No. 101.	Paralyzed.	In neighborhood.	Filtered nasal mucosa.	Lateral ventricle.	4	1	Death; internal hydrocephalus
				Lateral ventricle.	4	2	No effect.
Swine No. 105.	Paralyzed.	Not known.	Nasal mucosa treated with 0.5 per cent. of phenol.	Lateral ventricle.	4	32	No effect.
				Lateral ventricle.	2	33	No effect.
Swine No. 107.	Paralyzed.	Yes.	Cord treated with 0.5 per cent. of phenol for five and one half months, then suspended and filtered.	Lateral ventricle.	5	43	No effect.
				Peritoneal cavity.	50	44	No effect.
Swine No. 114.	Paralyzed(?).	No.	Cord filtered.	Lateral ventricle. Peritoneal cavity.	2.3 20	63	No effect.
Fowl No. 25.	Avian diphtheria.	Yes.	Filtered nasal mucosa.	Lateral ventricle.	1.5	9	No effect.
				Lateral ventricle.	3	10	No effect.
Fowl No. 26.	Limps but is not paralyzed.	Yes.	Filtered nasal mucosa.	Lateral ventricle.	5	19	No effect.
			Filtered nasal mucosa.	Lateral ventricle.	5	20	No effect.
			Filtered cord.	Lateral ventricle.	4	18	No effect.

Animals furnishing Material to be injected.			Materials used (Suspensions).	Site of Injection.	Amount injected (Cubic Centimeters).	Monkey injected (Number).	Result.
Species and Number.	Condition.	Exposed to Infantile Paralysis.					
Fowl No. 27.	No evident paralysis.	Not known.	Filtered nasal mucosa.	Lateral ventricle.	5	24	No effect.
			Filtered cord.	Lateral ventricle.	5	23	No effect.
Fowls Nos. 28 and 29.	No evident paralysis.	Not known.	Filtered nasal mucosa.	Lateral ventricle.	4	17	Death two days after inoculation.
			Filtered brain and cord.	Lateral ventricle.	4	16	No effect.
Fowl No. 30.	Paralyzed.	Yes.	Filtered cord.	Lateral ventricle.	4	25	Death; acute colitis and nephritis.
			Filtered nasal mucosa.	Lateral ventricle.	4	26	No effect.
Fowl No. 40.	Paralyzed.	No.	Filtered suspension of brain cord and nasal mucosa.	Lateral ventricle. Peritoneal cavity.	5 20	63	Excitable four days after inoculation; recovered.
				Lateral ventricle. Peritoneal cavity.	5 20	64	Excitable four days after and death six weeks after inoculation.
Horse No. 183.	Paralyzed.	No.	Filtered nasal mucosa.	Lateral ventricle.	3	7	No effect.
				Lateral ventricle.	4	8	No effect.
Horse No. 205.	Paralyzed.	Not known.	Nasal mucosa treated with 0.5 per cent. of phenol.	Lateral ventricle.	4	36	No effect.
				Lateral ventricle.	4	37	No effect.
Horse No. 208.	Paralyzed.	Not known.	Cord treated with 0.5 per cent. of phenol.	Lateral ventricle.	4	38	No effect.
				Lateral ventricle.	4	39	No effect.
Cat No. 28.	Paralyzed.	Not known.	Filtered nasal mucosa.	Lateral ventricle.	4	1	No effect.
			Filtered cord and medulla.	Lateral ventricle.	4	2	No effect.
Cat No. 29.	Paralyzed.	Not known.	Filtered nasal mucosa.	Lateral ventricle.	4	16	No effect.
				Lateral ventricle.	4	17	No effect.
Cat No. 31.	Healthy.	Yes.	Filtered nasal mucosa.	Lateral ventricle.	4	7	Death; internal hydrocephalus.
				Lateral ventricle.	4	8	No effect.

Animals furnishing Material to be injected.			Material used (Suspensions).	Site of Injection.	Amount injected (Cubic Centimeters).	Monkey injected (Number).	Result.
Species and Number.	Condition.	Exposed to Infantile Paralysis.					
Cats Nos. 32 and 33.	Healthy.	Yes.	Filtered nasal mucosa.	Lateral ventricle. Lateral ventricle.	4 4	9 10	No effect. Death; chronic colitis.
Cat No. 34.	Healthy.	Yes.	Nasal mucosa treated with 0.5 per cent. of phenol.	Lateral ventricle. Lateral ventricle.	4 4	34 35	Death; acute colitis. No effect.
Cat No. 35.	Apparently healthy.	Yes.	Nasal mucosa treated with 0.5 per cent. of phenol, then filtered.	Lateral ventricle. Peritoneal cavity.	5 45	47 48	No effect. Death seventy days after inoculation; acute colitis.
Cat No. 36.	Paralyzed.	Indirectly.	Filtered brain and cord.	Lateral ventricle. Peritoneal cavity.	5 50	45 46	Death; acute colitis. No effect.
Cat No. 37.	No paralysis.	No.	Filtered nasal mucosa.	Lateral ventricle. Peritoneal cavity. Lateral ventricle.	5 } 28 } 5	55 56	Death; tuberculosis. Death; tuberculosis.
Rats (Waltham).	No paralysis.	Yes.	Portions of various organs suspended in salt solution and filtered.	Lateral ventricle. Lateral ventricle. Peritoneal cavity.	6 6 } 30 }	61 62	No effect. No effect.
Rats (Worcester).	No paralysis.	Yes.	Portions of various organs suspended in salt solution and filtered.	Lateral ventricle. Lateral ventricle. Peritoneal cavity.	2.5 2.5 } 22 }	65 66	No effect. No effect.
Flies (Stomoxys calcitrans).	Normal.	No.	Bodies suspended and filtered.	Lateral ventricle. Lateral ventricle. Peritoneal cavity.	4 4 } 33 }	51 52	No effect. No effect.
Flies (Stomoxys calcitrans).	Normal.	No.	Bodies suspended and filtered.	Lateral ventricle. Peritoneal cavity.	5 } 14 }	53	Death in forty-three days; generalized tuberculosis.

A STUDY OF AN EPIDEMIC OF INFANTILE PARALYSIS (ACUTE EPIDEMIC POLIOMYELITIS) OCCURRING IN THE SOUTHERN CONNECTICUT VALLEY DISTRICT DURING THE YEAR 1912 (NOV. 1, 1911, TO NOV. 1, 1912).[1]

Before taking up in detail the discussion of anterior poliomyelitis as it occurred in Springfield in 1912, it will be well to call attention to one or two facts which have come out as a result of a comparative study of the cases as they occurred in 1911, 1912 and 1913. In the first place, a study of the 1910 map shows that cases occurred well along into the winter; in fact, as late as December. In 1911, however, the curious fact was noted that the few cases that occurred took place in the latter months of the year; that is to say, in September, October and November. Indeed, the impression becomes strong that these late fall cases of 1911 constituted really the beginning of the 1912 epidemic, interrupted as is usually the case by the cold season.

If we are to believe, as many do, that anterior poliomyelitis is spread largely through the presence of the virus in the secretions of the mouths and noses of convalescents and also of healthy carriers, how is the fact to be explained that in the early months of 1911, when such carriers must theoretically have been numerous as the result of the 1910 epidemic, no cases of poliomyelitis occurred until late in the fall of 1911? It would appear, most probably, that during this period of immunity, the virus was undergoing a cycle of development, either in the bodies of human beings or in some animal or insect host. It is certainly not to be believed that the material for human infection was not present in the city of Springfield during the spring of 1911 as well as in the fall.

The tendency to a two-year periodicity in Springfield was certainly marked, as shown by the number of cases reported in 1910, 1911, 1912 and 1913.

In 1912, 73 cases were investigated in the following cities and towns: Springfield, Holyoke, Chicopee, Ware, Westfield, West Springfield, Agawam, Southwick, Three Rivers (Palmer), Longmeadow.

In Springfield the epidemic seemed to start in the Italian quarter. Numerous peddlers live in this district, and it was ascertained that some of these peddlers had illness among their horses. This fact was investigated but, as will be seen later, the information obtained was not very conclusive.

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[1] By James V. W. Boyd, M.D., State Inspector of Health, Springfield, Mass. Reprinted from "Infantile Paralysis in Massachusetts, 1907-1912," Massachusetts State Board of Health, 1914.

INFANTILE PARALYSIS
IN THE CITY OF SPRINGFIELD IN 1912

There were few cases among the colored race, a fact noted also in the 1910 epidemic. Furthermore, there were no cases among the Swedish people, whereas, in 1910, that race was considerably afflicted.

In the 1910 epidemic there were cases in three physicians' families. In 1912, only one such case was noted.

The cases occurring in near-by towns seemed to have little connection with the Springfield epidemic directly or indirectly.

From a careful study of all the facts no definite conclusions can be drawn as to the cause and the spread of the epidemic. As in previous epidemics the abortive cases may have been an important factor in the spread of the disease. Recognizing the fact, moreover, that the infection may enter the body through the nose and throat, the fact is unquestioned that insect life has been unusually abundant in the Connecticut valley during the past few years, so that it is not unreasonable to suppose that some insect may have been a factor in the spread of the disease.

Epidemic of Paralysis among the Birds at the State Hatchery in Wilbraham, Mass.

This hatchery is situated in the town of Wilbraham bounded by Sixteen Acres (Springfield) on the north and west, East Longmeadow on the south and west, and the village of Wilbraham on the east. A large number of pheasants, quail, prairie chickens and wild turkeys are raised on this place. The birds are hatched out by common hens, and, when old enough to leave the hen, are placed in large wire coops. When about six weeks old one wing is cut and the birds are then turned loose on the reservation, which is quite extensive.

From July 1 to Sept. 1, 1912, an epidemic of paralysis affected the young pheasants and some of the quail. These young birds seemed to do well until about six weeks old and while they were in their coops. After they had had a wing cut, however, and had been liberated, it was noticed that in a short time they began to sicken, and within a few days died. During this sickness they all became paralyzed and showed some cerebral disturbances. For instance, some would turn somersaults and do other queer antics.

Upon inquiry it was found that they were fed on maggots, which were grown especially for their use. The flies used were of the blue bottle variety and also the biting stable fly. This kind of food was given to them both before they were liberated and afterwards.

At the time the birds were liberated, to be sure, the berries on a large number of blackberry vines were just turning from red to black, and it was at first thought that perhaps these berries had something to do with the sickness of the birds. The last batch of birds, however, that became ill were kept near the house where there were none of these vines.

At the time these younger birds were dying it was also noticed that quite a number of the pheasants seemed to be in poor condition. Of these older birds about 50 died. These birds acted as if doped, were thin and were manifestly not well. They came from Darien, Conn.

Approximately 500 young birds died, and about 50 older birds. Two of the paralyzed birds sent to the Harvard Medical School died, but nothing positive was found in them to account for the paralysis. Two of the older pheasants were also sent, and with them a dead bird that had been killed by a wild turkey. A report received from Prof. Theobald Smith on these birds states that two of them had avian tuberculosis; as to the other, nothing definite was found in the organs, but presumably it was in the early stages of the same disease.

Contemporary Animal Sickness among the Horses.

Toward the last of May and the early part of June 9 horses owned by ice and vegetable peddlers, also one owned by a butcher, became ill. The horses were kept in an unsanitary barn situated in the rear of a butcher store, in that section of the city, furthermore, in which the epidemic started (Italian quarter).

One of the first horses to become ill was that of the butcher. This horse developed gastrointestinal symptoms of a subacute nature. On some days the horse would appear to be fairly well and would be driven for awhile. It would then become ill and would be unfit for use for several days. Finally, one night it became much worse, was unable to get up, and a few days afterwards died. There was no autopsy. A few days afterwards several of the peddlers' horses had similar symptoms, the most prominent of which was a sort of a general weakness. There was no paralysis and none of the remaining horses died. There was a distinct interval between the times of onset in the various cases.

One peddler's horse was in such poor shape that the owner himself became ashamed to drive it, and let a friend take it to his farm in the country.

These horses were attended by William J. Glasgow, D.V.S., who states that he treated, during the summer, other horses which presented similar symptoms. The information was obtained after the epidemic had ceased, however, so that it was impossible to investigate further the illness among these animals.

The cases in Springfield are located approximately in the same districts as those investigated by Sheppard during the epidemic of 1910. A few of them, however, situated in the Forest Park District, show that the disease had invaded to a certain extent territory which had escaped the previous epidemic. As before stated, the epidemic seemed to start in the Italian quarter.

Although the epidemic did not become active until May, there were two cases in November, 1911, one each in December, 1911, and March, 1912. These cases are shown on the map, numbered 46, 47, 48 and 1, and will be described later.

The incidence of the cases as they occurred, by months, in Springfield during 1910 and 1912 is seen in the following tables: —

Cases in Springfield, 1910.

Month.	Number of Cases.	Deaths.
May,	1	–
June,	15	2
July,	67	15
August,	30	3
September,	6	3
October,	5	1
November,	2	1
	126	25[1]

[1] Or 19.8+ per cent.

Cases in Springfield, 1912.

Month.	Number of Cases.	Deaths.
November (1911),	2	1
December (1911),	1	–
March (1912),	1	–
April,	–	–
May,	5	1
June,	3	–
July,	21	8
August,	10	2
September,	4	–
November,	1	1
	48	13[1]

[1] Or 27.08+ per cent.

Although in 1910 there were 126 cases in Springfield, as compared with 48 in 1912, the mortality was greater in the latter year, being 27 per cent. for 1912 and 19 per cent. for 1910.

The height of the 1910 epidemic occurred in July, as was the case in 1912.

Insect Life.

Insect life has markedly increased during 1910, 1911 and especially in 1912, according to the experience of Prof. George Dimmock, who has made a study of the local conditions, and who states that owing to the heavy spring rains (especially during 1912) many hollows have retained their moisture long enough to become breeding places for mosquitoes.

Many children, of course, have given histories of having been bitten by some insect, in most cases by mosquitoes. A number of adults also complained of being bitten by mosquitoes. The common house fly was very numerous, and at different times during the epidemic *stomoxys calcitrans* was found in or near the affected house.

Contemporary Illness.

As in the 1910 epidemic enterocolitis cases were somewhat more numerous than in other years in Springfield.

The following tables show that in 1910 there were more deaths from la grippe than in 1911 and 1912, but in 1912 cerebro-spinal meningitis was a trifle more fatal: —

	La Grippe.	Cerebro-spinal Meningitis.	Enterocolitis.
1910, ...	12	3	106
1911, ...	9	1	86
1912, ...	3	4	96

Some cases that were undoubtedly poliomyelitis were called meningitis, gastroenteritis, la grippe, etc. There were also a large number of abortive cases, which never came to the attention of the authorities.

Poliomyelitis, Outside of Springfield.

Cases developed in near-by cities and towns, but were not so numerous as in the 1910 epidemic. In fact, some places that were afflicted in 1910 escaped entirely the 1912 epidemic. It is also of interest to note that several of the smaller towns, where the disease was not noted in 1910, also appeared to be free from it in 1912.

The following cases, showing human and animal contact, also insect bites and other interesting data from an etiological point of view, are described below in some detail: —

Group 1.

Other Cases in the Family.

Case No. 14 (Springfield). — G. T., male, two years. French. Onset. July 11, 1912; paralysis, July 14, 1912. Father, a teamster. Other children, 11, 9, 8, 6, 4, and (2) years old.

When his brother, age six years, was one year old he had paralysis of both legs. He now has one leg paralyzed (left).

Case No. 44 (Springfield). — A. B., male, twenty-eight years. American. Onset, July 1, 1912; paralysis, July 5, 1912. Clerk in bank. This case proved fatal, and death certificate was signed "meningitis." Upon investigation it was found to be poliomyelitis. His five-weeks-old baby came in direct contact with him for several days and died a short time after with the gastrointestinal type of the disease, preceded by respiratory paralysis. (Case No. 45.)

Case No. 46 (Springfield). — E. B., female, two years, two months. Hebrew. Onset, Nov. 9, 1911; paralysis, Nov. 10, 1911. Father, a printer. Other children, 3 years, and (2 years, 2 months) old.

During the 1910 epidemic the sister, now three years old, had a facial paralysis. It is possible that this sister was a carrier.

Case No. 59 (Agawam). — F. P., female, three years. French. Onset, Aug. 6, 1912; paralysis, Aug. 9, 1912. Father, a molder in brass foundry. Other children (3), and 1 year old.

Her baby sister was ill the last of July with gastrointestinal symptoms, and gives a history of having died with respiratory paralysis. The father had "cholera morbus" a few weeks before, which left him too weak to work, so that he had to go out in the country to recuperate (a possibly abortive case).

Cases Nos. 60 and 61 (Agawam). — R. B., female, nine years. Negro. Onset, July 25, 1912; paralysis, July 29, 1912. Father, a chauffeur. Other children, (12), and (9) years old. Live on a small farm, had been picking strawberries almost daily with her sister, who had an onset July 28, 1912, and developed paralysis July 29, 1912. (Case No. 61.) It is possible that they became infected at the same time. Both of these cases made complete recoveries.

Case No. 70 (Westfield). — J. S., female, two years. American. Onset, Sept. 30, 1912; paralysis, Oct. 6, 1912. Father, a carpenter. Other children, 10, 8, and (2) years old.

A brother had the disease in 1910, both legs being paralyzed. He has since made a complete recovery. The patient was not born at that time.

Cases Nos. 72 and 73 (Longmeadow). — E. H., female, two years. American. Onset, May 17, 1912; paralysis, May 21, 1912. Father, register of deeds. Other children, (2), and (4) years old.

The brother, age four years, became sick May 23, 1912, but the case was an abortive one.

Group 2.

Cases occurring in a House where there was a Case in 1910.

Case No. 4 (Springfield). — A. G., male, twenty-two months. Italian. Onset, May 8, 1912; paralysis, May 9, 1912. Father, a chauffeur. Other children, (22 months), 10 days. A boy downstairs had the disease in 1910 and still resides there.

Case No. 10 (Springfield). — I. B., female, two and one-half years. American. Onset, July 4, 1912; paralysis, July 7, 1912. Father, a train despatcher. Only child.

A baby downstairs had the disease in 1910, but no history of contact with the case.

Case No. 34 (Springfield). — C. S., female, seven years. German. Onset, Aug. 2, 1912; paralysis, Aug. 7, 1912. Father, a bookkeeper. Other children, 11, 9, 7, (7), 5 years, and 11 months old.

A girl upstairs had the disease in 1910, and still shows partial paralysis in one extremity. These two children were quite intimate.

Group 3.

Cases which had Abrasions, Sores, Punctured Wounds, whereby Infection could enter, Other than through Mucous Membranes or Insect Bites.

Case No. 11 (Springfield). — C. S. C., male, eighteen years. American. Onset, July 9, 1912; paralysis, July 10, 1912. Father, a physician. Other children, (18), 15, 3, and 3 years old.

Some time in June he ran a rusty nail into his foot while tearing down an old church. The wound healed in a short time.

Case No. 43 (Springfield). — G. P., male, fifty-six years. American. Onset, Oct. 17, 1912; paralysis, Oct. 24, 1912. Occupation, machinist. He had a sore on left malar bone; scab came off about a week before he became ill and had not healed over. Gives no history of insect bites.

Case No. 53 (West Springfield). — E. L., male, two years. American. Onset, May 17, 1912; paralysis, May 19, 1912. Father, a laborer on the railroad. Other children, (2), and 12 years old.

This child had a ringworm on his scalp for several weeks before his onset, also a sore on his nose which had been there for several months.

Case No. 64 (Holyoke). — C. T., female, one year, eight months. American. Onset, Aug. 13, 1912; paralysis, Sept. 4, 1912. Father, a patrolman. Other children, 2½ years, and (1 year 8 months) old.

This child was found to be suffering with impetigo contagiosa for a month past; location, face and scalp.

Group 4.

Cases which came in Close Contact with Sick or Suspiciously Sick Animals.

Case No. 15 (Springfield). — M. W., male, one and a half years. French. Onset, July 15, 1912; paralysis, July 17, 1912. Father, a teamster. Other children, 4, and (1½) years old. This child was known to fondle a sick cat owned by a family downstairs. The cat mysteriously disappeared before it could be obtained for investigation.

Case No. 26 (Springfield). — E. A. F., male, one year and four months. American. Father, a chauffeur. Other children, 13, 8, 4 years, and (1 year 4 months) old. This child played with a sick cat owned by a family upstairs. This cat was ill two weeks before the child had his onset. Unfortunately the people killed the cat before it could be obtained for investigation.

Case No. 28 (Springfield). — R. E. B., male, seventeen years. French. Onset, July 27, 1912; paralysis, July 30, 1912. Stock clerk. He was very fond of animals, and is known to have petted a kitten next door. This kitten was suspected of being ill.

Case No. 31 (Indian Orchard, Springfield). — B. K., male, thirty-four years. Scotch. Onset, June 10, 1912; paralysis, July 23, 1912. Occupation, valve tester. This man had a cat which became ill about a week before. The animal was obtained and sent to Harvard Medical School for observation. Nothing positive was found to exist.

Case No. 34 (Springfield). — C. T., female, seven years. German. Onset, Aug. 2, 1912; paralysis, Aug. 7, 1912. Father, a bookkeeper. Other children, 11, 9, 7, (7), 5 years, and 11 months old.

This child played with a kitten which had come from a family where they had a case of poliomyelitis in 1910. The animal was sent to the Harvard Medical School for observation, but nothing positive was found.

Case No. 49 (Ware). — J. G. G., male, thirteen months. American. Onset, Sept. 27, 1912; paralysis, Sept. 28, 1912. Father, a farmer. Other children, 6, 3 years, and (13 months) old. On this farm there were two paralyzed chickens in 1911. Within the last few months a cat had several litters of kittens all of which died with some cerebral symptoms, rigidity of neck and impaired locomotion. The mother cat suddenly disappeared. A horse had tetanus some months previous.

Cases Nos. 72 and 73 (Longmeadow). — Described above under Group 1, these cases came in contact with a sick cat in the family. This animal had been killed, so it was impossible to obtain it for investigation.

Group 5.

Cases which are of Interest for Other Reasons.

Case No. 1 (Springfield). — M. M. G.. male, thirty years. Irish. Onset, Feb. 25, 1912; paralysis, Feb. 26, 1912. This man worked in a brewery, washing bottles. He was exposed to a continual dampness. It was first thought that he had rheumatism, and was so treated by several physicians.

Case No. 3 (Springfield). — A. F., male, thirteen months. Italian. Onset, May 8, 1912; paralysis, May 9, 1912. Father, a laborer. Other children, 9, 8, 7, 3 years, and (13 months) old. This child developed herpes zoster on the chest and the left shoulder and neck.

Case No. 13 (Springfield). — M. F. S., female, seventeen months. American. Onset, July 13, 1912; paralysis, July 14, 1912. Father, an iceman. This child's father is a driver for a large ice company. There was an epidemic of so-called pink eye in the barn where he kept the horses, and one of his horses was ill. It is possible that the father may have transported *stomoxys calcitrans.* This case was investigated by Mr. C. T. Brues, entomologist, but nothing definite was obtained.

Case No. 17 (Springfield). — A. W., female, seven years. American. Onset, July 15, 1912; abortive case. Father, an artist. Other children 9, and (7) years old. This was a very interesting case from the fact that it was next door to where there were two fatal cases. If there was any contact between these it was very indirect. The patient had her tonsils removed some ten days before by a specialist, whose son was afflicted with the disease on the 9th of July. This child was very ill and had the typical symptoms of poliomyelitis without the paralysis.

Case No. 18 (Springfield). — E. B., female, eighteen years. American. Onset, July 15, 1912; paralysis, July 22, 1912. Father, an attorney-at-law. During the week of July 7 she was on a farm in Worthington, where there were all sorts of domestic animals. There was no history of any illness among them. She also waded in a mountain brook, the water of which was very cold, and came in contact with the grandmother of a child who had the disease in another part of the town. It is not known whether this grandmother came in actual contact with the case.

Case No. 19 (Springfield). — M. C. D., female, eight months. French. Onset, July 9, 1912; paralysis, July 16, 1912. Father, a teamster. Other children, 13 years, and (8 months) old. This child came in intimate contact with two cases, which proved fatal. The two fatal cases were cousins of the patient, and the fathers of each of these were teamsters.

Case No. 22 (Springfield). — D. B. L., male, one year. American. Onset, July 22, 1912; paralysis, July 26, 1912. Father, a lumberman. The father of this child had been suffering with herpes zoster for the past three weeks. Several weeks before onset the child had been for a long automobile ride in Vermont, and was known to have stopped at Stratton and West Townsend. Living near this child was another case who had the disease in 1910, and who came in contact with him.

Case No. 23 (Springfield). — D. D. A., male, four years. American. Onset, July 1, 1912; paralysis, July 27, 1912. Father, a clerk in a railroad office. Other children, 19, 16, and (4) years old. This boy had a herpes of the face and mouth. His four sisters. 16, 19, 21, and 24 years old, also the mother and father, together with a visiting aunt, all had symptoms of mild grippe. This boy afterwards developed the same symptoms and became paralyzed. It is reasonable to suppose that the rest of the family were abortive cases of the disease.

Case No. 25 (*Springfield*). — G. W., male, nineteen years. American. Onset, July 20, 1912; paralysis, July 23, 1912. Occupation, clerk and bookkeeper. This young man was very sluggish mentally for several days during his attack, and suddenly developed acute mental excitement, sleeplessness, loss of memory, and at times became violent and had to be restrained.

Case No. 39 (*Springfield*). — I. O'C., male, two years. Irish. Onset, Aug. 2, 1912; paralysis, Sept. 2, 1912. Father, a laborer for the city. Other children, 12, 10, 5, and (2) years old. This child came in daily contact with another child who developed the disease previously. The other child died.

Case No. 47 (*Springfield*). — T. J. B., male, nineteen years. Assyrian. Onset, Nov. 7, 1911; paralysis, Nov. 7, 1911. Occupation, barber. He was found to be covered with pediculi, and may have received the infection from the bites of these parasites.

Case No. 48 (*Springfield*). — L. W., female, four years. American. Onset, Dec. 27, 1911; paralysis, Dec. 29, 1911. Father, a print builder. Other children, 21, 18, 14, 11, and (4) years old. A week before this child's onset her sisters, 14 and 11, had what was thought to be grippe colds. (Possible abortive cases.) This family used only canned milk.

Case No. 51 (*West Springfield*). — C. J. J., male, six months. American. Onset, July 20, 1912; paralysis, Aug. 3, 1912. Father, a mechanic. Other children, 5, 3 years, and (6 months) old. He was taken ill in West Springfield, but was later taken to Blandford where he died. The child had been in poor health since it was born and had very little resistance.

Case No. 52 (*West Springfield*). — A. R. B., female, three months. French. Onset, Aug. 4, 1912; paralysis, Aug. 11, 1912. Father, a shipping clerk. Other children, 4, 2 years, and (3 months) old. A week following the death of this child the other two children became ill with fever, vomiting and diarrhœa. The boy, age four years, had convulsions, probably abortive poliomyelitis.

Case No. 58 (*Agawam*). — H. D. C., male, three years. French. Onset, July 3, 1912; paralysis, July 6, 1912. Father, a harness maker. Other children, 10, 9, 7, 5, and (3) years old.

This child came in immediate contact with another case near his home. The other case had not been diagnosed correctly for several days and exposed quite a number of other people.

Case No. 63 (*Three Rivers*). — P. M., female, three years. American. Onset, Aug. 7, 1912; paralysis, Aug. 16, 1912. Father, a carpenter. Other children, 9, 5, (3) years, and 10 months old. Child gives a history of being on a train several days before her onset. Across the aisle in the car was a sick child who was constantly vomiting (a possible poliomyelitis case).

Case No. 66 (*Southwick*). — A. F. W., male, sixteen years. American. Onset, Sept. 19, 1912; paralysis, Sept. 26, 1912. Father, a farmer. Other children, (16), 6 years. and 16 months old. He worked on a farm after he left high school in Westfield (June). In his class at school he came in contact with a young girl who died with the disease July 26, 1912. He had been visiting in Springfield during the last week in August, but there was no illness in the family at the time. He was first taken ill in Westfield, but immediately removed to his home in Southwick. Although exposed to the *Stomoxys calcitrans L.*, he gives no history of being bitten by them; neither was there any illness of the animals on the farm.

Case No. 69 (*Westfield*). — M. L. S., female, thirty-three years. American. Onset, Sept. 22, 1912; paralysis, Sept. 23, 1912. Occupation, school-teacher. One child in family, 11 years. She taught school in Springfield, and while on a week-end visit to her sister in Westfield was taken ill. Gives a history of an insect bite on her arm about Sept. 13, 1912. No active case of poliomyelitis known among the school children where she taught.

Case No. 71 (*Westfield*). — F. R., female, sixteen years. American. Onset, July 23, 1912; paralysis, July 26, 1912. Father, a farmer in Blandford. She was in Blandford when first taken ill, but went to Westfield and became worse. She gives a history of being bitten by some insect on her left cheek several days before her onset. On the farm where she lived there were numerous stable flies and mosquitoes. No history of any sick animals however.

Detailed Analysis of Cases.

Of the 73 cases investigated, the following is a detailed analysis. The ages varied from under one year to fifty-six years, as shown in the following table: —

	Cases.
Under one year,	7
From one to two years,	16
From two to three years,	14
From three to four years,	8
From four to five years,	7
From five to ten years,	6
From ten to fifteen years,	2
From fifteen to twenty years,	6
From twenty to twenty-five years,	–
From twenty-five to thirty years,	2
From thirty to thirty-five years,	3
From thirty-five to forty years,	–
From forty to forty-five years,	1
From forty-five to fifty years,	–
From fifty to fifty-five years,	–
From fifty-five to sixty years,	1

There were 39 males and 34 females afflicted with the disease, the youngest five weeks, and the oldest fifty-six years.

The cases occurred among the following nationalities, as shown in the table following: —

	Cases.
American,	37
Irish,	5
French,	11
Italian,	6
German,	1
Scotch,	1
English,	1
Hebrew,	4
Polish,	2
Assyrian,	2
Negro,	3

The number of cases in the different cities and towns are as follows: —

	Cases.
Springfield,	48
Holyoke,	1
Chicopee,	1
Westfield,	5
Ware,	2
West Springfield,	6
Longmeadow,	2
Agawam,	5
Three Rivers (Palmer),	2
Southwick,	1

The sanitary conditions are given in the following table: —

Sanitary Conditions.	Cases.
Excellent,	23
Good,	27
Fair,	9
Bad,	14

Families with one positive case,	63
Families with two positive cases,	7

Cases among acquaintances or neighbors,	10
Cases in which there was illness in the family at the time.	3

Prevalent disease in the cities and towns at the time was not of sufficient importance to be noticed, except that gastrointestinal disturbances were more common.

	Cases.
House pets or domestic animals ill in the vicinity,	3

Diet.

	Cases.
General (including meat, fish, fruit, berries, cereals, bread, milk and eggs),	55
General with strawberries,	1
General with nursing,	1
Nursing baby,	5
Crackers and milk,	1
Bread and milk,	1
Cereals and milk,	1
Milk,	7
Nestlés Food,	1
Raw cows' milk used in	60
No specific article of diet,	65
Cereals,	1
General, in small amount of each,	3
General, without fish, small amounts,	1
Fruits,	1
Crackers and potatoes,	1
Bread and crackers,	1

Unusual Article of Diet within Two Weeks of Attack.

Strawberries,	5
Raw rhubarb and strawberries,	1
Cherries and strawberries,	1
Blackberries,	1
Bananas,	1
Bananas and oranges,	1
Bananas and apples,	1
Raw pears,	1
Clam chowder,	1
Little neck clams,	1
Welch rarebit,	1
Green grapes,	1
Ice cream,	3
Apples,	1
Tomatoes,	1
Crackers,	1
As to exposure to heat,	–
As to exposure to cold,	–
As to exposure to dampness,	7
Acute illness within four weeks of onset of disease,	7
Overexertion preceding attack,	4
Accident preceding attack,	4
Fall preceding attack,	7

Condition of Patient previous to Onset of Disease.	Cases.
Good health,	25
Headache,	1
Sickly,	3
Fretful and teething,	8
Laryngitis,	1
Backache,	2
Drowsy, tired, hard to raise feet,	1
Symptoms of grippe,	1
Mentally dull,	5
Toothache,	1
Fretful and irritable,	3
Herpes of face and mouth,	1
Fretful,	15
Nervous,	1
Quieter than usual,	1
Worried account of pain in chest,	1
Irritable,	2
Nightmare,	2

Appearance of Paralysis after Onset of Fever.

Same day,	4
One day,	17
Two days,	11
Three days,	8
Four days,	10
Five days,	2
Six days,	4
Seven days,	8
Nine days,	1
Ten days,	1
Eleven days,	1
Twelve days,	1
Fourteen days,	1
Three to four weeks,	1
Six to seven weeks,	1
Abortive cases,	2

General Features of Acute Attack.

1. Sixty cases gave a history of fever, as follows: —

100° F.,	31
101° F.,	10
102° F.,	11
103° F.,	5
104° F.,	3

2. Thirty-nine cases showed brain symptoms, as follows: —

	Cases.
Insomnia,	5
Delirium,	11
Headache,	13
Drowsiness.	2
Twitching, crying in sleep,	1
Convulsions,	3
Stupor and dulness,	4

3. Thirty-nine cases showed retraction of the head.
4. Sixty-five cases showed pain or tenderness.
5. The following cases showed unusual symptoms: —

Sore throat,	2
Dulness followed by acute mental excitement, resembling mania,	1
Cough,	1

There were 64 persons affected with digestive disturbances, — (*a*) those accompanying the attack, (*b*) those preceding the attack, and (*c*) those following the attack, as follows: —

	Preceding Attack.	Accompanying Attack.	Following Attack.
Constipation,	7	28	–
Vomiting,	17	29	1
Diarrhœa,	3	9	–
Colic,	2	–	–

Nine cases had no digestive disturbances.

Distribution of Paralysis at its Worst.

The first table shows the totals of these paralyses according to the members of the body affected, and the second table shows the combination of paralyses affecting each individual.

(1) *Distribution of Paralysis.*

	Cases.
Paralysis of right thigh,	38
Paralysis of left thigh,	33
Paralysis of right leg,	39
Paralysis of left leg,	34
Paralysis of right forearm,	17
Paralysis of left forearm,	18
Paralysis of right arm,	18
Paralysis of left arm,	20

	Cases.
Paralysis of back,	22
Paralysis of abdomen,	9
Paralysis of the right face,	1
Paralysis of the left face,	3
Disturbances of the bladder during the attack,	9
Disturbances of the rectum during the attack,	6

(2) *Paralysis, as last seen.*

Right back,	1
Right leg,	2
Left leg,	1
Left leg, both arms,	1
Both legs, left arm and back,	1
Right leg, left face,	1
General except in face,	2
Mostly right deltoid, slight in right biceps and triceps,	1
Right thigh and leg,	5
Both legs,	7
Respiratory,	4
Left thigh and leg,	4
Left arm and forearm,	2
Both legs and back,	3
Abortive,	2
Left leg and back,	1
Deltoid and back,	1
Left leg, arm and back,	1
Both legs and left arm,	1
Left leg and both hands,	1
Back,	2
Legs and hands,	1
Arms,	2
Neck, back, arms and right leg,	1
Right arm, both legs,	2
Right glutial,	1
Legs, back and arms,	2
Deglutition,	1
Legs, arms, back and bladder,	1
Both thighs and legs,	2
Legs, arms, back and abdomen,	1
Abdomen and back,	1
Right arm,	1
Right deltoid,	1
Left leg and throat,	1

	Cases.
Left face and respiratory,	1
Laryngeal,	1
Left face,	1
Left arm, leg and right face,	1
Legs and arms,	4

The duration of the pain or tenderness in the paralyzed cases is as follows: —

	Cases.
A few days,	47
Two weeks to ten days.	3
One week,	3
One month,	1
Three days,	2

The paralysis entirely disappeared in but 3 cases.

Line and effectiveness of treatment show nothing important.

	Cases.
Urotropin,	36
Urotropin and ergot,	1
Phenacetin and salicylates,	1
Palliative,	13
Bromide,	1
Ergot,	1
Strychnine,	1

Of the 19 fatal cases of this disease the symptoms were respiratory paralysis (preceding death).

Approximate Date of Recovery.

	Cases.
Not stated,	45
One week,	2
Few weeks,	5
Few days,	1
Six months,	1
Fatal,	19

There were no autopsies performed.

There was but one case of lumbar puncture in the 73 cases. This showed a clear cerebro-spinal fluid.

There were no blood examinations made.

There was one urine examination made, which proved to be negative.

Occupations of Adults in the Family.

Carpenters,	5
Laborer (washing bottles),	1
Laborer (forge shop),	1
Foundry helpers,	2
Laborer (waste company),	1
Laborer (metal body worker),	1
Laborers,	2
Bridgemen,	2
Chauffeurs,	3
Mason,	1
Stationary firemen,	3
Barbers,	2
Stock-room clerk (auto company),	1
Skate hardener,	1
Train despatcher,	1
Physician,	1
Salesman, soda water,	1
Ice man,	1
Teamsters,	4
Shipping clerk, also ruler of paper,	1
Artist,	1
Lumberman,	1
Clerks, railroad office,	2
School-teachers,	2
Tailor,	1
Attorney,	1
Servant girl,	1
Traveling salesman,	1
Steam fitters,	2
Valve tester,	1
Peddler,	1
Manager rubber company,	1
Bookkeeper,	1
Bartender,	1
Truckman on street railway,	1
Expressman,	1
Assembler autos,	1
Pattern maker,	1
Machinists,	3
Clerks,	2
Printer,	1
Farmers,	3
Boarding-house keeper,	1

Cement worker,	1
Tar roofer,	1
Harness maker,	1
Molder,	1
Patrolman,	1
Preacher,	1
Register of deeds,	1

Among the 73 cases there were 14 with lodgers in the family.

Occupations of the Lodgers.

Hod carriers,	2
Tar-paper roofer,	1
Laborers,	11
Schoolboy,	1
Teamsters,	2
Clerk, paper manufacturing company,	1
Ice men,	2
Chauffeur,	1
Peddler,	1
Housekeeper,	1
Instructors (Y. M. C. A.),	2
Upholsterer,	1
Lithographer,	1
Farm hand,	1
Railroad man,	1
Baker,	1
Machinist,	1

The following table shows the number of children in the 73 cases, according to family: —

	Cases.
Not any children in the family,	8
One child in the family,	14
Two children in the family,	20
Three children in the family,	13
Four children in the family,	8
Five children in the family,	3
Six children in the family,	4
Seven children in the family,	2

There were 179 children in 70 families, their ages being as follows: —

Children under one year,	18
Children from one to five years,	74

Children from five to ten years,	41
Children from ten to fifteen years,	31
Children from fifteen to twenty years,	12
Children from twenty to twenty-five years,	3

Of the 179 children, 83 were males and 96 females.

Number of Other Children who played with the Patient.

Contact with 2 children,	2
Contact with 3 children,	3
Contact with 4 children,	6
Contact with 6 children,	7
Contact with 10 children,	1
Contact with 12 children,	9
Contact with 15 children,	1

Of the remaining cases it might be stated that anywhere from 1 to 25 persons may have come in contact with the patient.

House, Old or New.	Cases.
House, old,	54
House, new,	19

Length of Time living in House.

A few days,	2
Less than one year,	27
From one to two years,	16
From two to three years,	7
From three to four years.	2
From four to five years,	7
From five to six years,	1
From six to seven years,	3
From seven to eight years,	3
Nine years,	1
Eleven years,	1
All their lives.	3

House situated on High or Low Ground.

On high ground,	33
On low ground,	40

House situated on Dry or Damp Ground.

On dry ground,	42
On damp ground,	31

Relation to Dust.	Cases.
With dust,	40
Without dust,	33

Road watered or oiled.	
Watered and oiled,	12
Watered,	15
Oiled,	23
No treatment,	23

Location of House.	
Nearness to railroad: —	
Within a block of the railroad,	22
Within one-half mile of the railroad,	34
Within one mile of the railroad,	13
Over one mile from the railroad,	4
Nearness to streams, ponds, etc.: —	
Within a block of the water,	18
Within one-half mile of the water,	34
Within one mile of the water,	19
Over a mile from the water,	2
Nearness to the highroad: —	
Within a block of the highroad,	18
Within one-half a mile of the highroad,	34
Within one mile of the highroad,	17
Over a mile from the highroad,	4
Nearness to the car line: —	
Within a block of the car line,	10
Within a half-mile of the car line,	34
Within a mile of the car line,	25
Over a mile from the car line,	4

Out of the 73 cases there had been recent illness in 20 families.

Paralysis in family, friends or relatives before or since attack, as shown in the following table: —

	Cases.
Paralysis in sister,	5
Paralysis in brother,	2
Paralysis in cousin,	1
Paralysis in boy, same house, downstairs,	1
Paralysis in neighbor's baby, next street,	1
Paralysis in neighbors,	2
Paralysis in father,	1

Movements of Patient and Family previous to Illness.	Cases.
At home,	36
Trolley rides, Riverside Grove,	17
Trolley rides, public parks,	9
Trolley rides,	7
Railroad,	7
Automobiling in country,	2
Bicycle riding,	1

In 4 cases out of the 73 there had been members of the family visiting.

There was no illness in the places visited.

There were no letters or other articles received from the houses in which sickness existed.

School Attendance.

Schools attended by patients,	3

There were no paralyzed children in the schools.

Habits and Amusements of the Patient.	Cases.
Baby in arms,	17
Baby in carriage,	2
Playing in the house,	1
Playing in the yard,	5
Sickly,	1
Working man,	2
Active,	45

Wading, Swimming or Paddling.

At Forest Park, Watershop Pond, Mountain Park and Worthington,	10
Fell into the water,	1

In 5 of the above cases the water was clean, and in 6 of these cases it was not clean.

In 3 cases out of the 73 there had been digging or excavating in their neighborhood.

Water Supply and Sewage.	Cases.
Good,	61
City water supply and bad water-closet,	2
Well water and privy,	1
Fair,	2
Good water and filthy privy.	1
Privy,	2
Bad privy,	1
Well and privy,	2

Animals or Birds in the House.

	Cases.
Cats,	16
Cat and dog,	6
Dog,	3
Chickens,	2
Birds,	2
Dog next door,	1
Cat next door,	1
Horses and cows,	1
Kittens, cows and horse,	1

How recently acquired.

Several months,	3
Few months,	5
Four weeks,	2
Three weeks,	2
One year,	5
One to two years,	2
Two years,	1
Six years,	4
Four years,	1
Ten years,	1
Three years,	2

In 7 of the cases there was disease among the animals, of which 2 of them (cats) were sent to Boston.

Animals found Dead in the Neighborhood of the Cases.

Several kittens in the street,	1
Dead cat at the corner,	1
Chickens,	4
Mice in well,	1
Rats,	1

Presence of Vermin, Insects, Rodents, etc.

	Cases.
Rats and roaches,	1
Flies,	48
Bedbugs and flies,	4
Pediculi,	1
Flies and rats,	3
Roaches,	1
Rats, flies and bedbugs,	1
Bedbugs, roaches and flies,	1
Stable flies,	1

	Cases.
Ants,	1
Flies and mosquitoes,	2
Mice and flies,	1
Mice,	1
Number of children paralyzed,	61
Number of children aborted,	2
Number of adults paralyzed,	10
Number of fatal cases of children,	12
Number of fatal cases of adults,	7

Child mortality,	16.43+ per cent.
Adult mortality,	9.59+ per cent.
Total mortality for the epidemic,	26.02+ per cent.

I am greatly indebted to the physicians and the members of the local boards of health throughout my district where these cases occurred for their numerous courtesies and assistance in obtaining this information.

STATISTICAL SUMMARIES

OF

DISEASE AND MORTALITY.

A General Review of the Vital Statistics of the State.

1913.

The number of deaths in the State in 1913 was 53,402, which was equivalent to a death-rate of 14.81 per 1,000 upon an estimated population of 3,604,759.

The mean death-rate of the five years, 1909, 1910, 1911, 1912 and 1913, was 15.46, as compared with 16.66 for the previous five years.

The following figures are presented for the ten years ended with 1913: —

Massachusetts.

Years.	Population.[1]	Deaths.	Death-rates.	Years.	Population.[1]	Deaths.	Death-rates.
1904,	3,076,083	48,482	15.76	1909,	3,172,395	51,236	16.16
1905,	3,003,680	50,486	16.81	1910,	3,366,416	54,407	16.16
1906,	3,044,998	50,624	16.63	1911,	3,444,059	53,062	15.42
1907,	3,086,885	54,234	17.57	1912,	3,523,493	52,400	14.87
1908,	3,129,348	51,788	16.55	1913,	3,604,759	53,402	14.81

[1] Population estimated for intercensal years.

Infective Diseases.

The death-rate from the principal infective diseases in 1913 was somewhat higher than that of 1912. There was an increase in the number of deaths from diphtheria and croup, scarlet fever, typhoid fever, measles, dysentery, whooping cough, pneumonia, cancer and cerebro-spinal meningitis, and a decrease in the deaths from cholera infantum and consumption. There were no deaths from smallpox.

The deaths and death-rates from each of the foregoing diseases in the past five years are shown in the following table: —

Deaths and Death-rates from Certain Diseases in Massachusetts, 1909–1913.

	1909.		1910.		1911.		1912.		1913.	
	Deaths.	Death-rates per 10,000.	Deaths.	Death-rates per 10,000.	Deaths.	Death-rates per 10,000.	Deaths.	Death-rates per 10,000.	Deaths.	Death-rates per 10,000.
Smallpox,	1	.003	–	–	2	.006	1	.003	–	–
Diphtheria,	694	2 19	679	2.02	563	1.63	473	1.34	628	1.74
Scarlet fever,	259	.82	254	.75	184	.53	118	.33	293	.81
Typhoid fever,	390	1.23	411	1.22	302	.88	269	.76	280	.78
Measles,	157	.49	240	.71	158	.46	286	.81	315	.87
Cholera infantum,	2,855	9.00	3,744	11.12	3,275	9.51	3,180	9.02	2,958	8.21
Consumption,	4,393	13.85	4,503	13.38	4,418	12.83	4,212	11.95	4,180	11.59
Dysentery,	215	.68	210	.62	148	.43	111	.32	137	.38
Whooping cough,	250	79	183	.54	292	.85	225	.64	239	.66
Pneumonia,	5,635	17.76	6,678	19.84	5,991	17.39	5,965	16.93	6,112	16.96
Cancer,	2,871	9.05	3,028	8.99	3,199	9 29	3,282	9.31	3,526	9.78
Cerebro-spinal meningitis,	124	.39	153	.45	143	.42	140	.40	147	.41

In the following table a balance is presented between the deaths from the principal infective diseases in the two years 1912 and 1913, by which it appears that the sum of the deaths from these twelve causes in 1913 was higher by 553 than those of 1912 from the same causes: —

Deaths from Certain Infective Diseases in 1912 and 1913.

	1912.	1913.	Increase.	Decrease.
Smallpox,	1	–	–	1
Diphtheria and croup,	473	628	155	–
Scarlet fever,	118	293	175	–
Typhoid fever,	269	280	11	–
Measles,	286	315	29	–
Cholera infantum,	3,180	2,958	–	222
Consumption,	4,212	4,180	–	32
Dysentery,	111	137	26	–
Whooping cough,	225	239	14	–
Pneumonia,	5,965	6,112	147	–
Cancer,	3,282	3,526	244	–
Cerebro-spinal meningitis,	140	147	7	–
Totals,	18,262	18,815	808	255

Infant Mortality.

The rate of infant mortality during the year 1913 was the lowest for the 10-year period 1904–1913, as shown by the following table.

The total number of births which occurred during the year ended June 30, 1913, was 91,155, and the total deaths under one year during the year ended Dec. 31, 1913, were 10,086.

For the sake of accuracy the death-rate of infants under one year old is obtained by comparing the deaths of such infants occurring in a year with the mean number of infants under one living throughout a year, and this number must "lie between the annual number of births and that number diminished by the deaths under one. It would be nearer the latter than the former number on account of the excess of deaths in the first months of life" (Dr. Farr). In the following table the births in the first line are those which occurred between July 1, 1903, and June 30, 1904, inclusive, and so on through the table, the births in the last line being those for the year ended June 30, 1913.

The deaths under one in the same table are those of the calendar years ended Dec. 31, 1904, 1905, etc. The births during these ten years were 833,499, and the deaths under one year were 107,809, which is equivalent to an infant mortality-rate of 129.3 per 1,000 births for the decade. The last half of the period shows a gain over the first half, since the infantile death-rate in the last five years was 121.9 per 1,000 births, as compared with 137.6 in the first five years.

Infant Mortality, Massachusetts, 1904–1913, Ten Years.

Years.	Births in Year ending June 30.	Deaths under One Year.	Death-rate under One Year per 1,000 Births.	Years.	Births in Year ending June 30.	Deaths under One Year.	Death-rate under One Year per 1,000 Births.
1904, . .	74,791	9,992	133.6	1909, . .	84,352	10,693	126.8
1905, . .	74,387	10,519	141.4	1910, . .	85,655	11,499	134.2
1906, . .	76,730	11,106	144.7	1911, . .	87,221	10,543	120.9
1907, . .	83,230	11,293	135.7	1912, . .	88,866	10,472	117.8
1908, . .	87,112	11,606	133.2	1913, . .	91,155	10,086	110.6

Total births in ten years ended June 30, 1913, 833,499.
Total deaths under one in ten years ended Dec. 31, 1913, 107,809.
Mean infantile death-rate, 129.3 per 1,000 births.

Consumption.

The total number of deaths from this cause registered in 1913 was 4,180, a decrease of 32 in the number of deaths occurring from this disease in 1912. The death-rate from consumption was less in 1913 than that of any year of record.

The following figures present the deaths and death-rates, by ten-year periods, during the past sixty years 1851–1910, and for the years 1911, 1912 and 1913.

Deaths and Death-rates from Consumption in Massachusetts, 1851–1913.

Periods.	Deaths.	Death-rates per 10,000.	Periods.	Deaths.	Death-rates per 10,000.
1851–60, ...	45,252	39.9	1901–10, ...	46,545	15.2
1861–70, . . .	45,913	34.9	1911, ...	4,418	12.8
1871–80, ...	54.039	32.7	1912, ...	4,212	12.0
1881–90, ...	58,303	29.2	1913, ...	4,180	11.6
1891–1900, . . .	54,374	21.4			

Typhoid Fever.

The following table presents the deaths and death-rates of these cities from this cause during the year 1913: —

Deaths and Death-rates from Typhoid Fever in the Cities of Massachusetts, 1913.

Cities.	Deaths from Typhoid Fever.	Death-rates per 10,000.	Cities.	Deaths from Typhoid Fever.	Death-rates per 10,000.
Newburyport, . .	4	2.6	Quincy, ...	3	.83
North Adams, . .	5	2.3	Boston, ...	61	.83
Marlborough, . . .	3	2.0	Gloucester, . . .	2	.82
Springfield, . . .	20	2.0	Somerville, . . .	6	.72
Salem, ...	7	1.5	Holyoke, ...	4	.64
Beverly, ...	3	1.4	Woburn, ...	1	.63
Lawrence, ...	12	1.4	Haverhill, ...	3	.62
Lynn, ...	13	1.3	Worcester, ...	9	.57
Chelsea, ...	5	1.3	Fitchburg, . . .	2	.49
Pittsfield, ...	5	1.3	Malden, ...	2	.41
Melrose, ...	2	1.2	Medford, ...	1	.39
Taunton, ...	4	1.1	Everett, ...	1	.27
Chicopee, ...	3	1.0	Newton, ...	1	.2
New Bedford, . . .	11	.97	Brockton, ...	1	.15
Lowell, ...	11	.97	Northampton, . . .	–	–
Cambridge, . . .	10	.91	Waltham, ...	–	–
Fall River, . . .	11	.85			

Death-rate for the above 33 cities, 1913, 1.

Following is a condensed summary from the report of 1900, from which it can be seen that a decided and continuous improvement in the death-rate from typhoid fever is taking place: —

Death-rates from Typhoid Fever per 10,000, 1871–1913, Massachusetts.

1871–75,	8.2	1901–05,	1.9
1876–80,	4.2	1906–10,	1.4
1881–85,	4.1	1911,	.9
1886–90,	4.6	1912,	.8
1891–95,	3.4	1913,	.8
1896–1900,	2.6		

For the entire State the death-rates from this cause in 1901, 1902, 1903, 1904, 1905, 1906, 1907, 1908, 1909, 1910, 1911, 1912 and 1913 were, respectively, 1.95, 1.83, 1.75, 1.75, 1.73, 1.57, 1.26, 1.65, 1.23, 1.22, .88, .76, and .78 per 10,000 inhabitants.

The highest death-rates from this cause among the cities appear to have occurred in Newburyport (2.6), North Adams (2.3), Marlborough (2.0) and Springfield (2.0); and the lowest occurred in Brockton (0.2) and Newton (0.2). Waltham reported 17 cases of typhoid fever and Northampton 4 cases, with no deaths.

Diphtheria.

The following table shows the deaths and death-rates from diphtheria by five-year periods from 1876 to 1910, and for the years 1911, 1912 and 1913.

Deaths and Death-rates from Diphtheria per 10,000, 1876–1913, Massachusetts.

Years.	Deaths.	Death-rates.	Years.	Deaths.	Death-rates.
1876–80,	13,676	15.8	1901–05,	4,259	2.9
1881–85,	8,944	9.5	1906–10,	3,615	2.3
1886–90,	8,857	8.4	1911,	563	1.6
1891–95,	7,652	6.4	1912,	473	1.3
1896–1900,	6,331	4.7	1913,	628	1.7

Further and more definite information relative to diphtheria may be found in that portion of the report which relates to the production and distribution of antitoxin.

Other Preventable Diseases.

The following table presents the deaths and death-rates from measles, scarlet fever, dysentery, cholera infantum, and whooping cough for the period of forty-eight years, 1866–1913: —

Deaths and Death-rates in Massachusetts per 10,000 Living from Certain Infective Diseases by Five-year Periods, 1866–1910, and for the Years 1911, 1912 and 1913.

	Measles.		Scarlet Fever.		Dysentery.		Cholera Infantum.		Whooping Cough.	
	Deaths.	Death-rates.	Deaths.	Death-rates.	Deaths.	Death-rates.	Deaths.	Death-rates.	Deaths.	Death-rates.
1866–70,	1,081	1.6	4,670	6.8	3,244	4.7	6,943	10.1	1,481	2.1
1871–75,	1,133	1.4	6,782	8.6	2,191	2.8	12,453	15.8	1,561	2.0
1876–80,	742	.9	3,517	4.1	2,366	2.7	9,054	10.5	1,493	1.7
1881–85,	1,007	1.1	2,504	2.7	1,601	1.7	9,894	10.5	1,213	1.3
1886–90,	1,089	1.0	1,810	1.7	1,276	1.2	10,904	10.3	1,421	1.3
1891–95,	815	.7	2,857	2.4	1,083	.9	13,426	11.2	1,445	1.2
1896–1900,	948	.7	1,358	1.0	1,434	1.1	11,865	8.9	1,465	1.1
1901–1905,	1,090	.7	1,463	1.0	970	.7	13,245	9.1	1,401	1.0
1906–1910,	1,099	.7	1,302	.8	995	.6	14,511	9.2	1,473	.9
1911,	158	.5	184	.5	148	.4	3,275	9.5	292	.9
1912,	286	.8	118	.3	111	.3	3,180	9.0	225	.6
1913,	315	.9	293	.8	137	.4	2,958	8.2	239	.7

The deaths from cerebro-spinal meningitis were 147, a slight increase in the number of deaths recorded in 1912, and represented a death-rate of .41 per 10,000 living. In 1912 the death-rate was .40.

There were 33 deaths from tetanus during the year, 2 from mycosis, 3 from malignant pustule or charbon (anthrax), 11 from pellagra, 1 from leprosy, 2 from rabies, 2 from glanders and 1 from typhus.

Returns of Disease and Mortality.

The statistical information relating to disease and mortality which has been received by the Board during each year, either through the medium of voluntary returns or in consequence of legal requirements, has, in the recent reports of the Board, been presented under four different heads or groups. Since 1902, this series of statistics has been condensed as much as can be done consistently with a clear and intelligent method of presentation.

These summaries are defined as follows: —

I. *The Weekly Mortality Returns.* — These consist of the reports of deaths, which are made up weekly and are sent to the office of the State Board by the registration officials of cities and towns. They serve principally to show the seasonal prevalence of each of the chief infective diseases, in weekly periods. Beginning with the year 1875, this series of statistics has been annually reported (see page 475 of report for that year), and was first published as a summary in the report of 1883.

II. *The Reports of Certain Infective Diseases, — Diphtheria, Scarlet Fever, Typhoid Fever and Measles.* — These are obtained from the reports of local boards of health forwarded during 1913 to the State Board as cases arose. By comparing the numbers of reported cases with the reported deaths, the mean fatality of each disease in the places from which the reports are made is obtained with a reasonable degree of accuracy.

III. *Reports of Cities and Towns, made under the Provisions of Chapter 75, Section 52, of the Revised Laws.* — By this act each local board of health is required to report to the State Board every case of "disease dangerous to the public health" which is reported to the local board. A digest of these reports is presented in Summary No. III. This summary was first published in the report of 1893, page 639.

IV. *Annual Reports made under the Provisions of Chapter 75, Section 12, of the Revised Laws.* — The full reports of deaths occurring in each city and town having over 5,000 inhabitants comprise another series of returns, which are summarized in No. IV. The population of these cities and towns, as estimated in 1913, constituted about 89 per cent. of the total population of the State. These reports are made under the requirements of the following statute: —

In each city and town having a population of more than five thousand inhabitants, as determined by the last census, at least one member of said board shall be a physician, and the board shall send an annual report of the deaths in such town to the state board of health. The form of such reports shall be prescribed and furnished by the state board of health. (Revised Laws, chapter 75, section 12.)

These summaries were first presented in the report of 1894.

Note. — Postal cards are sent to all boards of health in the State, for the purpose of aiding them to comply with the provisions of chapter 75, section 52, of the Revised Laws, relative to the reporting of diseases dangerous to the public health to the State Department of Health immediately after reports of the same are received by the local board.

Annual blank forms are also sent to each local board of health in cities and towns having over 5,000 inhabitants, for the return of such information as is called for by the provisions of chapter 75, section 12, of the Revised Laws.

I.

The Weekly Mortality Returns.

In the following summary, the voluntary reports of deaths received at the close of each week from the city registrars, town clerks and boards of health of the cities and towns are epitomized for the year ended Dec. 31, 1913. The chief value of this abstract consists in the fact that it presents a continuous history of the mortality from certain specified diseases from week to week throughout the year.

This weekly report has been published in the Boston Medical and Surgical Journal every week for a period of twenty-five years or more, and also in a publication of the Board, a weekly bulletin, since and including 1883.[1]

These returns are necessarily incomplete, since they are voluntary and consequently embrace the statistics of only a portion of the population, the reporting places being chiefly the cities and large towns.

The following items are embraced in this summary: —

Total deaths reported for each week.
Deaths from tuberculosis, pulmonary.
Deaths from tuberculosis other than pulmonary.
Deaths from diphtheria.
Deaths from typhoid fever.
Deaths from measles.
Deaths from cerebro-spinal meningitis.
Deaths from tubercular meningitis.
Deaths from whooping cough.

[1] The bulletin was changed from a weekly to a monthly publication in January, 1906.

Deaths from scarlet fever.
Deaths from anterior poliomyelitis.
Deaths from tetanus.
Deaths from ophthalmia neonatorum.
Deaths from chicken pox.
Deaths from trachoma.
Deaths from glanders.
Deaths from trichinosis.
Deaths from typhus.
Deaths from malignant pustule.
Deaths from actinomycosis.

NOTE. — Up to the passage in February, 1913, of the act (chapter 210 of the Acts of 1913) making compulsory the reporting of deaths in cities and all towns, the weekly mortality returns had been voluntary on the part of the local boards of health, and were received, for the most part, from cities and towns above 10,000 population. By the enactment of the new law the following table must of necessity be somewhat incomplete, and no attempt has been made to present the weekly averages of the different diseases nor their death-rates: —

Summary, Jan. 1 to March 29, 1913. Cities and Towns in Massachusetts over 10,000 Population.

1913.	Tuberculosis, Pulmonary.	Tuberculosis other than Pulmonary.	Diphtheria.	Typhoid Fever.	Scarlet Fever.	Measles.	Whooping Cough.	Cerebro-spinal Meningitis.	Tubercular Meningitis.	Erysipelas.	Influenza.	Anterior Poliomyelitis.	Tetanus.	Acute Lung Diseases.	Diarrhoeal Diseases.	Puerperal Fever.	Total Deaths reported for Each Week.
January 4, . . .	63	18	11	1	4	10	1	3	1	2	3	-	-	174	17	1	309
11, . . .	69	8	7	-	5	9	6	5	-	1	5	-	-	156	20	2	293
18, . . .	55	15	12	3	5	5	1	2	-	2	6	-	-	145	19	1	271
25, . . .	63	10	12	6	8	2	1	1	1	3	4	-	-	121	16	2	250
February 1, . . .	63	14	14	1	5	6	7	4	1	4	4	-	-	160	18	3	304
8, . . .	43	4	11	5	4	6	5	2	-	1	2	-	-	142	16	1	242
15, . . .	52	15	8	5	6	6	8	1	-	5	1	-	-	141	21	2	271
22, . . .	71	8	14	4	7	8	9	3	-	2	2	-	-	180	19	1	328
March 1, . . .	63	7	12	3	4	5	7	4	1	4	1	1	-	157	11	1	281
8, . . .	59	15	12	5	2	5	6	4	-	5	8	-	-	187	13	1	322
15, . . .	60	9	14	2	2	4	6	6	1	1	6	-	-	156	19	2	288
22, . . .	56	16	17	1	7	9	5	2	-	7	1	1	-	139	16	2	279
29, . . .	57	19	8	-	2	8	7	6	-	2	3	2	-	140	10	3	267
Totals, . . .	774	158	152	36	61	83	69	43	5	39	46	4	-	1,998	215	22	3,705

Summary, April 1 to Dec. 31, 1913. Cities and Towns in Massachusetts.

1913.		Tuberculosis, Pulmonary.	Tuberculosis other than Pulmonary.	Diphtheria.	Typhoid Fever.	Scarlet Fever.	Measles.	Whooping Cough.	Cerebro-spinal Meningitis.	Tubercular Meningitis.	Anterior Poliomyelitis.	Tetanus.	Ophthalmia Neonatorum.	Chicken Pox.	Malignant Pustule.	Trachoma.	Glanders.	Trichinosis.	Typhus.	Actinomycosis.	Total Deaths reported for Each Week.
April	5,	51	17	8	–	7	8	4	3	3	–	–	–	–	–	–	–	–	–	–	101
	12,	58	10	12	–	8	10	5	4	2	–	–	–	–	–	–	–	–	–	–	109
	19,	50	11	10	1	12	10	1	6	6	–	–	–	–	–	–	–	–	–	–	107
	26,	61	13	6	–	15	15	9	3	9	–	–	1	–	–	–	–	–	–	–	132
May	3,	72	6	12	3	7	12	7	2	11	–	2	–	–	–	–	–	–	–	–	134
	10,	85	4	7	5	6	9	5	6	7	1	–	–	–	–	–	–	–	–	–	136
	17,	77	10	9	1	9	21	3	4	3	–	1	–	–	–	–	–	–	–	–	138
	24,	65	3	15	4	3	19	6	2	5	–	–	–	–	–	–	–	–	–	–	122
	31,	68	7	16	4	5	12	9	2	13	1	–	–	–	–	–	–	–	–	–	137
June	7,	79	4	11	2	7	10	1	4	6	–	–	–	–	–	–	–	–	–	–	124
	14,	63	11	10	4	4	10	2	6	9	–	1	–	–	–	–	–	–	–	–	120
	21,	59	12	14	3	3	6	3	1	8	–	–	–	–	–	–	–	–	–	–	109
	28,	52	6	11	1	5	4	3	–	13	–	2	–	–	–	–	–	–	–	–	97
July	5,	50	3	5	2	5	6	2	2	5	–	–	–	–	–	–	–	–	–	–	80
	12,	74	6	8	4	2	7	6	1	7	1	–	–	–	–	–	–	–	–	–	116
	19,	52	6	8	4	3	4	1	4	4	–	2	–	1	–	–	–	–	–	–	89
	26,	43	13	10	9	3	7	5	–	10	–	1	–	–	1	–	–	–	–	–	102

Summary, April 1 to Dec. 31, 1913. Cities and Towns in Massachusetts — Concluded.

1913.	Tuberculosis, Pulmonary.	Tuberculosis other than Pulmonary.	Diphtheria.	Typhoid Fever.	Scarlet Fever.	Measles.	Whooping Cough.	Cerebro-spinal Meningitis.	Tubercular Meningitis.	Anterior Poliomyelitis.	Tetanus.	Ophthalmia Neonatorum.	Chicken Pox.	Malignant Pustule.	Trachoma.	Glanders.	Trichinosis.	Typhus.	Actinomycosis.	Total Deaths reported for Each Week.
August 2,	53	5	4	8	2	2	6	4	9	1	-	-	-	-	-	-	-	-	-	94
9,	47	9	9	9	5	3	4	5	11	2	1	-	-	-	-	-	-	-	-	105
16,	49	4	5	5	4	2	5	2	6	2	1	-	-	-	-	-	-	-	-	85
23,	44	1	6	7	4	3	5	4	8	2	-	-	-	-	1	-	-	-	-	85
30,	68	6	6	6	1	2	8	1	10	1	1	-	-	-	-	-	-	-	-	110
September 6,	35	4	8	11	-	1	4	1	7	1	1	-	-	-	-	-	-	-	-	73
13,	62	2	6	9	1	-	3	3	6	1	-	-	-	-	-	1	-	-	-	94
20,	52	6	6	7	-	3	5	3	3	1	-	-	-	-	-	-	-	-	-	86
27,	43	5	12	13	2	-	5	1	3	4	-	-	-	-	-	-	-	-	-	88
October 4,	38	7	9	7	4	1	9	2	4	2	-	1	-	-	-	-	-	-	-	84
11,	39	7	7	8	2	1	5	1	5	3	1	-	-	-	-	-	-	-	-	79
18,	47	6	7	8	4	-	2	-	3	2	2	-	-	-	-	-	1	-	-	82
25,	60	4	4	10	1	-	1	3	1	-	1	-	-	-	-	-	-	-	-	85
November 1,	67	6	3	8	1	-	2	2	8	2	-	-	-	-	-	-	-	-	-	99
8,	51	6	12	4	1	1	1	2	9	3	-	-	-	1	-	-	-	-	-	91
15,	54	2	14	5	3	1	2	2	3	-	2	-	-	-	-	-	-	1	-	89

22, ...	43	7	14	3	5	1	1	3	5	1	-	1	1	-	-	-	-	-	-	85
29, ...	51	7	13	4	2	2	4	3	2	2	-	2	-	2	-	-	-	-	-	94
December 6, ...	44	4	9	7	4	-	2	1	7	-	-	-	-	-	-	-	-	-	-	78
13, ...	53	6	10	3	2	-	3	2	2	-	-	-	-	-	-	-	-	-	-	81
20, ...	61	4	9	3	6	2	2	5	6	1	-	-	-	1	-	-	-	-	-	100
27, ...	57	3	15	4	2	3	2	1	9	3	-	-	-	-	-	-	-	-	1	100
Totals, ...	2,177	253	360	196	160	198	153	101	248	37	19	5	2	5	1	1	1	1	1	3,920

II.

Fatality of Certain Infective Diseases.

Since the year 1891 the following statistics relative to the fatality of certain diseases have been gathered from the published reports of local boards of health. Until the passage of the law in 1893 this was the only source from which figures could be obtained on which to base the fatality of diseases as compared with cases. When the law (chapter 302, Acts of 1893) requiring local boards of health to report all cases of contagious diseases to the State Board of Health first went into effect, very few returns were made, and it was not until after public notice had been given by the State Board to every board of health throughout the State that these returns came in with any regularity. The practice by the local boards of health of reporting cases of contagious diseases is now so well established, and the returns are so complete, it is no longer deemed necessary to continue the former method of basing the fatality of certain contagious diseases on the figures obtained through the annual reports of local boards, but, instead, to make use of the more complete returns as received from day to day at this office.

The diseases embraced in this summary in 1913 are diphtheria, scarlet fever, typhoid fever and measles.

The summary of the figures for 1913 is as follows: —

Reported cases of diphtheria for the State,	6,741
Registered deaths from diphtheria,	628
Fatality (per cent.),	9.3
Reported cases of scarlet fever for the State,	8,062
Registered deaths from scarlet fever,	293
Fatality (per cent.),	3.6
Reported cases of typhoid fever for the State,	2,398
Registered deaths from typhoid fever,	280
Fatality (per cent.),	11.7
Reported cases of measles for the State,	29,192
Registered deaths from measles,	315
Fatality (per cent.),	1.1

The following table presents the summary of these statistics for the twenty-three years 1891–1913: —

Reported Cases of Infective Diseases in Massachusetts.

Diphtheria.

[Pre-Antitoxin Period.]

	1891.	1892.	1893.	1894.	Total.
Reported cases,	2,444	3,033	2,919	4,936	13,332
Deaths,	575	891	926	1,376	3,768
Fatality (per cent.),	23.5	29.2	31.7	27.9	28.3

Diphtheria.

[Antitoxin Period.]

	1912.	1913.	Total 1895-1913.
Reported cases,	5,433	6,741	140,352
Deaths,	473	628	15,182
Fatality (per cent.),	8.7	9.3	10.8

Scarlet Fever.

	1912.	1913.	Total 1891-1913.
Reported cases,	5,633	8,062	132,156
Deaths,	118	293	6,064
Fatality (per cent.),	2.1	3.6	4.6

Typhoid Fever.

Reported cases,	2,088	2,398	59,593
Deaths,	269	280	9,716
Fatality (per cent.),	12.9	11.7	16.3

Measles.

Reported cases,	22,423	29,192	262,578
Deaths,	286	315	3,471
Fatality (per cent.),	1.3	1.1	1.3

In the foregoing tables the statistics relating to diphtheria have been arranged in two periods, which may properly be called the pre-antitoxin and the antitoxin periods, since antitoxin came into general use in the State about the beginning of the year 1895. For the latter period the figures for 1912 and 1913 are given, and the total for the nineteen years 1895 to 1913, inclusive. The mean fatality in the former period (1891–1894) was 28.3 per cent. (ratio of deaths to cases), and in the latter period (1895–1913) it was 10.8 per cent., or less than half as large.

III.

Official Returns of Notified Diseases Dangerous to the Public Health for the Year ended Dec. 31, 1913.

The figures presented in the following summary are those of the official returns of diseases "dangerous to the public health," made to the State Board of Health during the year ended Dec. 31, 1913, under the provisions of chapter 75 of the Revised Laws. In this act no disease is specified as being "dangerous to the public health" except smallpox. Hence the State Board deemed it necessary to indicate the diseases which should be included in the meaning of the term "dangerous to the public health." They are the following: actinomycosis, anterior poliomyelitis, Asiatic cholera, cerebro-spinal meningitis, diphtheria, glanders, leprosy, malignant pustule, measles, ophthalmia neonatorum, scarlet fever, smallpox, tetanus, trachoma, trichinosis, tuberculosis, typhoid fever, typhus fever, varicella, whooping cough, yellow fever.

The whole number of cases of infective diseases reported to the Board in the year ended Dec. 31, 1913, under the provisions of this act, was 65,308, which was divided chiefly as follows: —

Reported cases of smallpox,	157
Reported cases of scarlet fever,	8,062
Reported cases of diphtheria,	6,741
Reported cases of typhoid fever,	2,398
Reported cases of measles,	29,192
Reported cases of cerebro-spinal meningitis,	180
Reported cases of anterior poliomyelitis,	361
Total,	47,091

The summary for the twenty years and four months, 1893–1913, is as follows: —

	Reported Cases of —							
	Smallpox.	Scarlet Fever.	Diphtheria.	Typhoid Fever.	Measles.	Cerebro-spinal Meningitis.	Anterior Polio-myelitis.	Totals.
1893 (four months only), .	35	2,914	1,109	1,525	1,503	–	–	7,086
1894, ...	181	6,731	4,178	2,372	2,133	–	–	15,595
1895, ...	1	6,194	7,806	2,438	4,868	–	–	21,307
1896, ...	5	3,801	8,515	2,637	6,362	–	–	21,320
1897, ...	18	5,495	7,613	2,104	12,695	–	–	27,925
1898, ...	10	3,667	3,980	2,196	4,478	–	–	14,331
1899, ...	105	5,349	7,134	2,776	12,355	–	–	27,719
1900, ...	104	6,396	12,641	2,967	10,507	–	–	32,615
1901, ...	773	4,356	9,793	2,689	9,398	–	–	27,009
1902, ...	2,314	4,613	7,036	2,721	17,249	–	–	33,933
1903, ...	422	5,877	6,888	2,955	9,430	–	–	25,572
1904, ...	100	4,100	6,772	2,605	12,511	–	–	26,088
1905 (11 months), . .	44	3,594	5,059	2,794	6,107	455	–	18,053
1906 (Dec. 1, 1905–Nov. 30, 1906).	35	5,162	7,967	3,093	17,048	291	–	33,596
1907, ...	164	7,860	9,098	2,350	5,688	428	–	25,588
1908, ...	16	7,833	8,939	3,639	21,745	205	–	42,377
1909 (Dec. 1, 1908–Dec. 31, 1909).	21	8,036	8,795	2,945	15,857	143	–	35,797
1910, ...	156	7,882	7,390	3,452	18,794	153	654	38,481
1911, ...	11	6,173	6,998	2,238	16,094	150	232	31,896
1912, ...	220	5,633	5,433	2,088	22,423	202	169	36,168
1913, ...	157	8,062	6,741	2,398	29,192	180	361	47,091
Total, ...	4,892	119,728	149,885	54,982	256,437	2,207	1,416	589,547

By months these diseases were reported as follows: —

Cases of Infective Diseases reported to the State Board of Health by Months for the Year ended Dec. 31, 1913.

Months.	Smallpox.	Scarlet Fever.	Diphtheria.	Typhoid Fever.	Measles.	Cerebrospinal Meningitis.	Anterior Poliomyelitis.
January, . . .	9	961	605	156	3,239	14	4
February, . . .	6	943	562	137	4,407	15	3
March, . . .	24	1,023	592	83	6,206	25	4
April, ...	21	812	566	112	5,583	18	2
May, ...	11	721	588	93	4,455	18	6
June, ...	53	520	488	101	2,915	13	1
July, ...	5	248	406	178	882	6	10
August, . . .	7	196	323	374	251	14	60
September, . . .	5	268	445	459	141	14	125
October, . . .	7	503	642	365	333	11	89
November, . . .	6	747	707	224	344	14	38
December, . . .	3	1,120	817	116	436	18	19
Totals, . . .	157	8,062	6,741	2,398	29,192	180	361

The following table is introduced for the purpose of facilitating the comparison of the seasonal prevalence of the diseases named in the table, in different years. By means of the method employed, the errors due to the difference in the length of the months are eliminated. The figures should be read as follows: for example, the mean daily number of reported cases of diphtheria throughout the year, Jan. 1, 1913, to Dec. 31, 1913, was 18.5; of scarlet fever, 22.1; of typhoid fever, 6.6; and of measles, 80.0. During the month of January the mean daily number of reported cases of these diseases was: for diphtheria, 19.5; scarlet fever, 31.0; typhoid fever, 5.0; and for measles, 104.5 (see columns marked A). Assuming a standard of 10 as a daily mean throughout the year for each disease, the ratios for January were as follows: diphtheria, 10.5; scarlet fever, 14.0; typhoid fever, 7.6; and measles, 13.1 (see columns marked B). So that for each 10 cases of diphtheria reported as a daily mean throughout the year ended Dec. 31, 1912, there were 10.5 in January, 10.8 in February, 10.3 in March, etc.

From this table it appears that the maximum prevalence of diphtheria was in December and the minimum in August. January, February, March, April, May, October and November were also above the mean in intensity of prevalence.

The prevalence of scarlet fever was above the mean in January, February, March, April, May, November and December, and below it in the remaining months. The maximum occurred in December and the minimum in August.

Typhoid fever was below the mean in the intensity of its prevalence in the months of January, February, March, April, May, June, July and December, the maximum occurring in September.

The prevalence of measles was above the mean in the first six months of the year and below it in the remaining months, the maximum occurring in March and the minimum in September.

Cerebro-spinal meningitis was above the mean in the months of March, April, May and December, the maximum occurring in March and the minimum in July.

Anterior poliomyelitis was above the mean in the months of August, September, October and November, the maximum occurring in September and the minimum in June.

Certain Infective Diseases. — Seasonal Intensity of Prevalence.

Months.	Diphtheria.			Scarlet Fever.			Typhoid Fever.			Measles.			Cerebro-spinal Meningitis.			Anterior Poliomyelitis.		
	1913.		1912.	1913.		1912.	1913.		1912.	1913.		1912.	1913.		1912.	1913.		1912.
	A	B	B	A	B	B	A	B	B	A	B	B	A	B	B	A	B	B
	Mean Daily Number of Cases reported in each Month.	Decimal Ratio.	Decimal Ratio.	Mean Daily Number of Cases reported in Each Month.	Decimal Ratio.	Decimal Ratio.	Mean Daily Number of Cases reported in Each Month.	Decimal Ratio.	Decimal Ratio.	Mean Daily Number of Cases reported in Each Month.	Decimal Ratio.	Decimal Ratio.	Mean Daily Number of Cases reported in Each Month.	Decimal Ratio.	Decimal Ratio.	Mean Daily Number of Cases reported in Each Month.	Decimal Ratio.	Decimal Ratio.
January,	19.5	10.5	11.8	31.0	14.0	13.7	5.0	7.6	4.9	104.5	13.1	9.6	.5	10.0	7.1	.13	1.3	5.0
February,	20.1	10.8	12.2	33.7	15.2	12.7	4.1	6.2	4.7	157.4	19.7	13.3	.5	10.0	7.5	.11	1.1	2.2
March,	19.1	10.3	9.1	33.0	14.9	12.3	2.7	4.1	4.4	200.2	25.0	15.3	.8	16.0	15.8	.13	1.3	5.7
April,	18.9	10.2	7.8	27.1	12.3	10.9	3.7	5.6	5.4	186.1	23.3	18.5	.6	12.0	21.3	.07	0.7	3.7
May,	19.0	10.3	8.6	23.3	10.5	8.8	3.0	4.5	7.2	143.7	18.0	19.8	.6	12.0	14.0	.19	1.9	10.4
June,	16.3	8.8	7.8	17.3	7.8	5.5	3.4	5.2	9.6	97.2	12.2	14.9	.4	8.0	9.1	.03	0.3	8.7
July,	13.1	7.1	6.5	8.0	3.6	3.6	5.7	8.6	10.0	28.5	3.6	5.6	.2	4.0	9.5	.32	3.2	23.9
August,	10.4	5.6	6.6	6.3	2.8	3.6	12.1	18.3	17.7	8.1	1.0	1.7	.5	10.0	6.5	1.94	19.4	19.6
September,	14.8	8.0	8.3	8.9	4.0	4.9	15.3	23.2	20.4	4.7	0.6	1.0	.5	10.0	7.3	4.17	41.7	18.0
October,	20.7	11.2	12.0	16.2	7.3	9.4	11.8	17.9	18.2	10.7	1.3	3.0	.4	8.0	7.6	2.87	28.7	14.8
November,	23.6	12.8	16.3	24.9	11.3	12.5	7.5	11.4	9.6	11.5	1.4	6.3	.5	10.0	7.3	1.27	12.7	7.2
December,	26.4	14.3	13.5	36.1	16.3	22.0	3.7	5.6	7.7	14.1	1.8	11.1	.6	12.0	7.6	.61	6.1	0.7
Mean,	18.5	10.0	10.0	22.1	10.0	10.0	6.6	10.0	10.0	80.0	10.0	10.0	.5	10.0	10.0	1.0	10.0	10.0

Cases of Infective Diseases reported to the State Board of Health from 314 Cities and Towns for the Year ended Dec. 31, 1913.

	Diphtheria.	Measles.	Scarlet Fever.	Typhoid Fever.	Tuberculosis.	Cerebro-spinal Meningitis.	Smallpox.	Whooping Cough.	Varicella.	Anterior Poliomyelitis.
Abington,	–	13	27	–	1	–	–	–	3	–
Acton,	2	45	22	–	–	–	–	2	–	–
Acushnet,	1	61	3	–	–	–	5	3	3	–
Adams,	6	4	109	21	13	–	–	1	1	1
Agawam,	1	5	10	3	–	–	–	–	–	–
Alford,	–	–	1	–	–	–	–	–	1	–
Amesbury,	–	206	20	9	11	–	–	2	3	5
Amherst,	–	31	62	3	6	1	–	10	–	–
Andover,	11	146	6	5	5	–	–	–	4	1
Arlington,	12	225	34	6	26	1	–	3	2	2
Ashburnham,	–	–	4	–	–	–	–	–	–	–
Ashby,	–	1	3	–	1	–	–	5	–	–
Ashfield,	–	–	4	–	–	–	–	–	–	–
Ashland,	1	3	14	2	–	–	–	–	1	–
Athol,	2	321	8	7	7	–	–	4	1	1
Attleborough,	9	1	26	–	1	–	–	–	–	2
Auburn,	6	5	9	–	–	–	–	–	3	–
Avon,	17	1	10	6	2	–	–	–	13	–
Ayer,	1	4	16	1	1	2	–	–	–	1
Barnstable,	26	201	18	2	2	–	–	1	8	–
Barre,	8	8	4	1	–	–	–	–	–	–
Becket,	5	6	3	2	–	–	–	–	–	–
Bedford,	–	3	4	–	–	–	–	–	–	2
Belchertown,	–	–	–	1	–	–	–	–	–	–
Bellingham,	2	5	2	–	–	–	–	–	–	–
Belmont,	5	5	4	1	7	–	–	2	–	–
Berkley,	–	2	1	–	–	–	–	–	–	1
Berlin,	–	89	-	–	–	–	–	–	–	1
Beverly,	19	69	28	15	17	–	–	92	41	12
Billerica,	15	14	7	–	–	–	–	–	1	–
Blackstone,	7	7	–	2	4	–	–	–	–	–
Blandford,	–	–	–	1	–	–	6	–	–	–
Bolton,	–	–	–	1	–	–	–	–	–	–

Cases of Infective Diseases, etc. — Continued.

	Diphtheria.	Measles.	Scarlet Fever.	Typhoid Fever.	Tuberculosis.	Cerebro-spinal Meningitis.	Smallpox.	Whooping Cough.	Varicella.	Anterior Poliomyelitis.
Boston,	2,195	5,622	1,903	522	3,170	51	1	1,377	1,153	41
Bourne,	-	30	-	-	3	-	-	-	-	-
Boxborough,	-	1	4	-	-	-	-	-	7	-
Boxford,	-	-	1	-	-	-	-	-	-	-
Boylston,	-	77	-	1	-	-	-	-	-	-
Braintree,	6	157	14	2	10	-	-	4	1	-
Brewster,	-	-	4	-	-	-	-	-	-	-
Bridgewater,	2	100	18	-	26	-	-	2	51	1
Brimfield,	-	4	-	-	-	-	-	-	-	-
Brockton,	179	174	96	39	161	2	-	78	382	21
Brookfield,	2	4	9	-	-	1	-	6	4	-
Brookline,	83	256	89	11	48	1	-	3	57	4
Buckland,	-	-	-	1	-	-	-	-	-	-
Cambridge,	219	1,093	135	105	326	5	-	194	219	6
Canton,	-	108	30	1	10	-	-	12	29	-
Carlisle,	1	-	1	1	-	-	-	-	-	-
Carver,	1	4	3	-	-	-	-	-	-	-
Charlemont,	1	1	-	-	2	-	-	-	2	-
Chatham,	1	70	-	-	-	-	-	-	-	-
Chelmsford,	10	49	10	2	-	-	-	-	-	-
Chelsea,	90	296	86	49	102	3	-	60	120	1
Cheshire,	1	-	-	-	2	-	-	-	-	-
Chester,	1	11	-	-	-	-	-	-	-	-
Chesterfield,	-	-	-	-	-	-	-	-	2	-
Chicopee,	39	94	97	42	43	-	6	12	29	1
Clarksburg,	5	-	-	1	1	-	-	-	-	-
Clinton,	16	385	3	11	28	1	-	8	6	-
Cohasset,	17	37	27	4	4	-	-	9	-	-
Colrain,	-	12	-	-	2	-	-	-	-	-
Concord,	7	20	10	1	10	1	-	1	4	2
Cummington,	1	1	-	-	-	-	-	-	-	-
Dalton,	1	19	1	-	2	-	-	-	1	-
Dana,	-	-	-	-	-	-	1	-	-	-
Danvers,	13	16	11	6	15	1	-	59	9	3

Cases of Infective Diseases, etc. — Continued.

	Diphtheria.	Measles.	Scarlet Fever.	Typhoid Fever.	Tuberculosis.	Cerebro-spinal Meningitis.	Smallpox.	Whooping Cough.	Varicella.	Anterior Poliomyelitis.
Dartmouth,	4	20	6	1	2	2	–	–	–	–
Dedham,	10	101	27	14	18	2	–	5	27	–
Deerfield,	12	8	6	1	–	–	–	–	–	–
Dennis,	1	10	16	–	2	–	–	–	1	–
Dighton,	2	–	3	–	4	1	–	–	–	–
Douglas,	1	25	3	–	1	–	–	–	–	–
Dracut,	7	3	4	2	–	–	–	–	–	–
Dudley,	5	6	11	–	3	–	6	–	4	–
Dunstable,	–	–	2	–	–	–	–	–	–	–
Duxbury,	–	16	3	1	–	–	–	–	3	–
East Bridgewater,	–	14	17	–	52	–	–	1	–	1
East Longmeadow,	1	2	7	–	1	1	–	–	–	–
Eastham,	1	–	–	1	–	–	–	–	–	–
Easthampton,	14	–	38	1	5	–	–	–	–	–
Easton,	28	7	16	3	6	–	–	5	23	1
Edgartown,	13	–	–	1	–	–	–	–	2	–
Egremont,	–	6	–	–	–	–	–	–	1	–
Enfield,	–	5	–	–	–	–	–	–	–	–
Erving,	3	70	3	–	–	–	–	–	12	–
Essex,	–	51	4	–	1	–	–	–	–	–
Everett,	35	258	157	23	63	1	–	88	50	3
Fairhaven,	15	11	12	1	2	–	6	1	7	1
Fall River,	202	825	540	151	270	5	–	43	58	4
Falmouth,	7	97	20	1	5	–	–	–	10	–
Fitchburg,	60	1,483	44	7	57	–	4	39	26	3
Florida,	–	–	–	1	1	–	–	–	–	–
Foxborough,	8	79	–	1	2	–	–	5	12	–
Framingham,	6	234	51	2	16	–	–	15	12	7
Franklin,	6	66	17	–	–	–	–	1	–	2
Freetown,	5	20	13	12	1	–	–	–	–	–
Gardner,	13	557	80	23	14	3	–	2	6	1
Georgetown,	–	2	6	–	1	–	–	–	–	–
Gill,	3	1	2	–	1	–	–	–	–	–
Gloucester,	23	10	29	7	15	–	–	17	11	–

Cases of Infective Diseases, etc. — Continued.

	Diphtheria.	Measles.	Scarlet Fever.	Typhoid Fever.	Tuberculosis.	Cerebro-spinal Meningitis.	Smallpox.	Whooping Cough.	Varicella.	Anterior Poliomyelitis.
Goshen,	1	1	–	–	–	–	–	–	–	–
Grafton,	1	–	–	–	2	–	–	–	–	–
Granby,	–	3	1	–	–	–	–	–	–	–
Granville,	–	1	–	–	–	–	–	–	–	–
Great Barrington,	–	45	7	5	8	–	–	–	4	1
Greenfield,	46	115	26	11	12	–	–	5	9	–
Greenwich,	–	1	–	–	–	–	–	–	–	–
Groton,	3	–	1	–	–	–	–	–	–	–
Groveland,	3	54	6	1	1	–	–	–	1	–
Hadley,	11	2	4	–	3	–	–	–	–	–
Halifax,	–	–	1	2	–	–	–	–	–	–
Hamilton,	6	–	–	–	1	–	–	–	–	1
Hampden,	–	2	–	1	–	–	–	–	–	–
Hancock,	–	1	–	–	–	–	–	–	–	–
Hanover,	–	4	2	1	1	–	–	–	2	–
Hanson,	5	1	3	1	–	–	–	–	2	–
Hardwick,	–	4	2	2	1	–	–	–	–	4
Harvard,	10	74	–	2	–	–	–	–	–	–
Harwich,	5	6	–	–	2	–	–	–	–	–
Hatfield,	6	1	6	1	2	–	–	–	7	1
Haverhill,	82	1,014	88	46	123	14	–	68	50	21
Hawley,	–	–	1	–	–	–	–	–	–	–
Hingham,	3	–	9	2	1	–	–	–	–	–
Hinsdale,	–	10	–	–	–	–	–	–	–	–
Holbrook,	1	3	5	–	4	–	–	–	1	–
Holden,	1	30	1	3	1	–	–	–	–	–
Holliston,	–	3	5	–	1	–	–	–	–	–
Holyoke,	103	373	236	22	91	–	5	6	5	–
Hopedale,	3	–	11	–	–	–	–	–	–	–
Hopkinton,	–	8	1	5	2	–	–	6	–	–
Hubbardston,	–	–	–	2	–	–	–	–	–	–
Hudson,	1	190	5	3	4	–	–	–	–	2
Hull,	3	48	16	7	3	–	–	–	–	–
Huntington,	1	–	3	–	–	–	12	–	–	–

Cases of Infective Diseases, etc. — Continued.

	Diphtheria.	Measles.	Scarlet Fever.	Typhoid Fever.	Tuberculosis.	Cerebro-spinal Meningitis.	Smallpox.	Whooping Cough.	Varicella.	Anterior Poliomyelitis.
Ipswich,	3	15	7	8	10	–	–	–	1	–
Kingston,	–	–	5	–	1	–	–	–	–	–
Lakeville,	4	–	2	–	–	–	–	–	–	–
Lancaster,	1	157	3	–	5	–	–	4	9	–
Lanesborough,	–	3	1	–	2	–	–	–	–	–
Lawrence,	95	994	79	46	201	2	–	30	36	21
Lee,	–	–	6	1	1	–	–	–	3	–
Leicester,	2	–	1	–	1	–	–	–	–	1
Lenox,	–	–	13	2	1	–	–	–	–	–
Leominster,	115	161	50	3	25	–	5	6	33	3
Leverett,	–	6	5	2	–	–	–	1	–	–
Lexington,	5	8	12	10	5	–	–	35	33	–
Leyden,	–	1	–	–	–	–	–	–	–	–
Lincoln,	–	12	–	–	–	–	–	–	–	–
Littleton,	–	–	2	–	–	–	–	–	–	–
Longmeadow,	2	1	2	21	2	–	–	–	1	–
Lowell,	270	617	194	65	130	12	40	3	37	4
Ludlow,	8	–	6	8	5	–	3	–	1	5
Lunenburg,	9	90	2	–	2	–	–	–	4	–
Lynn,	152	1,210	175	65	199	2	4	76	98	3
Malden,	144	1,075	105	17	87	5	–	20	9	6
Manchester,	1	1	9	3	2	–	–	9	–	–
Mansfield,	2	3	7	2	2	–	2	2	1	–
Marblehead,	3	7	15	6	8	–	–	11	4	–
Marion,	4	–	1	–	–	–	–	–	–	–
Marlborough,	8	296	10	9	14	1	–	–	15	–
Marshfield,	–	38	–	2	1	–	–	4	1	–
Mattapoisett,	1	4	–	–	–	–	–	–	8	1
Maynard,	3	15	–	2	5	–	–	–	–	–
Medfield,	2	2	–	–	18	–	–	8	–	–
Medford,	29	257	104	9	22	–	–	33	61	3
Medway,	5	16	5	–	1	–	–	–	1	–
Melrose,	17	62	71	6	23	–	–	29	29	4
Merrimac,	–	5	–	1	–	–	–	–	–	–

Cases of Infective Diseases, etc. — Continued.

	Diphtheria.	Measles.	Scarlet Fever.	Typhoid Fever.	Tuberculosis.	Cerebro-spinal Meningitis.	Smallpox.	Whooping Cough.	Varicella.	Anterior Poliomyelitis.
Methuen,	6	220	15	4	5	1	–	–	–	3
Middleborough,	5	3	4	–	–	–	–	–	–	–
Middleton,	–	–	–	–	1	–	–	–	–	–
Milford,	6	3	14	3	11	1	–	2	1	1
Millbury,	8	1	9	–	1	1	–	37	–	–
Millis,	2	6	–	–	–	–	–	–	–	–
Milton,	6	29	19	7	13	–	–	5	21	–
Monson,	27	8	14	2	3	–	–	–	1	–
Montague,	41	8	14	3	5	–	–	–	2	–
Montgomery,	1	–	–	–	–	–	–	–	–	–
Nahant,	1	–	1	–	–	–	–	1	1	1
Nantucket,	2	–	1	1	2	–	–	–	–	–
Natick,	2	2	28	1	3	–	–	–	–	–
Needham,	12	5	1	1	8	–	–	–	–	1
New Bedford,	152	1,213	326	87	283	16	29	72	103	16
New Marlborough,	–	1	7	2	–	–	–	–	1	–
New Salem,	1	1	–	–	–	–	–	–	1	–
Newbury,	–	–	1	–	–	–	–	–	–	–
Newburyport,	15	184	3	25	36	1	–	4	18	3
Newton,	37	297	72	20	46	1	–	8	69	3
Norfolk,	5	21	–	2	–	–	–	2	–	–
North Adams,	27	18	27	23	17	1	–	1	5	–
North Andover,	4	59	10	3	8	–	–	4	2	–
North Attleborough,	6	95	22	9	11	–	1	3	29	–
North Brookfield,	6	5	–	1	–	–	–	3	–	–
North Reading,	–	1	–	1	2	–	–	–	–	–
Northampton,	8	21	127	4	52	–	3	6	74	1
Northborough,	–	24	10	–	–	–	–	–	–	–
Northbridge,	11	145	6	10	6	2	–	–	–	1
Northfield,	1	2	1	2	2	–	–	–	2	–
Norton,	2	9	2	2	3	–	–	–	–	–
Norwell,	–	2	9	–	1	–	–	3	2	–
Norwood,	4	36	13	2	8	–	–	41	5	–
Orange,	–	5	–	14	2	–	–	–	–	–

Cases of Infective Diseases, etc. — Continued.

	Diphtheria.	Measles.	Scarlet Fever.	Typhoid Fever.	Tuberculosis.	Cerebro-spinal Meningitis.	Smallpox.	Whooping Cough.	Varicella.	Anterior Poliomyelitis.
Orleans,	–	1	–	–	3	–	–	–	–	–
Otis,	–	–	2	–	–	–	–	–	–	–
Oxford,	1	29	3	–	1	–	–	–	7	–
Palmer,	5	4	5	42	–	–	–	–	–	1
Paxton,	1	–	–	–	–	–	–	–	–	–
Peabody,	34	30	33	6	23	2	–	26	15	1
Pembroke,	–	7	–	–	–	–	–	–	–	–
Pepperell,	–	6	–	–	1	–	–	–	1	–
Peru,	–	4	–	–	–	–	–	–	–	–
Petersham,	2	2	–	–	–	–	–	–	–	–
Phillipston,	–	4	–	1	–	–	–	6	–	–
Pittsfield,	83	291	116	50	73	2	–	37	70	2
Plainville,	–	8	3	–	2	–	–	–	1	–
Plymouth,	9	7	29	5	10	–	–	–	–	2
Plympton,	–	4	–	–	–	–	–	–	–	–
Princeton,	1	5	–	6	–	–	–	–	–	–
Provincetown,	12	48	–	2	7	–	–	–	–	–
Quincy,	77	388	53	29	45	2	–	89	48	14
Randolph,	14	8	2	2	1	–	–	–	2	–
Reading,	8	209	15	1	3	1	–	–	1	4
Rehoboth,	1	–	3	–	2	–	–	–	–	–
Revere,	48	4	37	15	54	–	–	–	1	2
Richmond,	–	–	5	–	1	–	–	–	–	–
Rochester,	5	–	–	–	1	–	–	–	–	–
Rockland,	1	1	14	3	4	1	–	3	–	–
Rockport,	–	1	21	4	11	–	–	1	2	–
Rowley,	–	1	2	4	–	–	–	–	–	–
Royalston,	–	–	1	1	1	–	–	–	–	–
Russell,	–	6	3	6	–	–	–	–	–	–
Salem,	54	152	61	21	90	3	–	142	90	2
Salisbury,	6	4	1	1	1	–	3	–	–	–
Sandwich,	–	122	1	–	2	–	–	–	4	–
Saugus,	8	29	20	41	4	1	–	21	17	–
Savoy,	1	–	–	–	–	–	–	–	–	–

Cases of Infective Diseases, etc. — Continued.

	Diphtheria.	Measles.	Scarlet Fever.	Typhoid Fever.	Tuberculosis.	Cerebro-spinal Meningitis.	Smallpox.	Whooping Cough.	Varicella.	Anterior Poliomyelitis.
Scituate,	1	7	2	2	1	–	–	–	4	–
Sharon,	1	6	4	–	6	1	–	–	–	–
Sheffield,	–	1	1	–	1	–	–	–	–	–
Shelburne,	–	2	10	–	1	–	–	–	–	–
Sherborn,	–	2	3	–	6	–	–	–	–	–
Shirley,	–	6	3	4	2	–	–	–	–	–
Shrewsbury,	2	1	–	–	1	–	–	–	–	–
Somerset,	11	18	10	–	2	–	–	–	–	1
Somerville,	161	537	210	66	189	1	–	21	40	5
South Hadley,	3	51	9	1	2	–	1	–	1	–
Southborough,	–	–	–	–	–	–	–	–	–	2
Southbridge,	14	100	4	6	5	1	–	–	–	2
Southwick,	2	–	–	–	–	–	–	–	–	–
Spencer,	–	5	1	9	1	–	–	–	–	–
Springfield,	192	602	184	83	108	4	–	37	84	12
Sterling,	1	11	–	5	1	–	–	–	–	–
Stockbridge,	1	5	3	–	–	–	–	–	–	–
Stoneham,	3	31	4	–	4	–	–	–	1	–
Stoughton,	2	13	1	9	–	1	–	–	1	–
Stow,	4	8	–	1	–	–	–	–	–	1
Sturbridge,	1	5	–	1	–	–	–	–	1	–
Sunderland,	–	16	18	–	–	–	–	–	–	–
Sutton,	2	38	–	1	1	–	–	8	2	–
Swampscott,	7	151	21	5	2	–	–	3	–	1
Swansea,	1	5	9	1	3	–	–	2	–	1
Taunton,	50	52	121	6	63	1	3	–	2	1
Templeton,	1	158	12	2	1	1	–	1	–	–
Tewksbury,	3	11	8	1	–	–	–	–	–	–
Tisbury,	29	1	–	2	4	–	–	–	–	–
Topsfield,	–	2	4	–	–	–	–	2	–	1
Townsend,	6	76	3	–	–	–	–	3	–	–
Truro,	2	2	–	–	–	–	–	–	–	–
Tyngsborough,	1	–	1	–	1	–	–	1	1	–
Tyringham,	–	–	–	–	–	–	–	–	–	1

Cases of Infective Diseases, etc. — Continued.

	Diphtheria.	Measles.	Scarlet Fever.	Typhoid Fever.	Tuberculosis.	Cerebro-spinal Meningitis.	Smallpox.	Whooping Cough.	Varicella.	Anterior Poliomyelitis.
Upton,	3	6	5	–	2	–	–	–	1	–
Uxbridge,	33	50	2	1	–	–	–	–	–	–
Wakefield,	6	88	6	7	2	–	–	–	8	8
Walpole,	5	48	3	1	8	–	–	14	22	–
Waltham,	116	167	53	17	37	1	–	76	20	21
Ware,	19	4	7	1	5	–	–	–	–	1
Wareham,	5	200	7	–	12	–	–	–	–	–
Warren,	3	–	–	1	–	–	–	–	–	–
Washington,	–	1	–	–	1	–	–	–	–	1
Watertown,	13	49	41	6	21	–	–	1	4	–
Wayland,	2	4	–	4	1	1	–	–	–	–
Webster,	13	3	41	–	13	–	11	2	10	1
Wellesley,	11	14	9	2	6	–	–	14	5	–
Wellfleet,	–	28	–	–	–	–	–	–	–	–
Wendell,	–	10	–	–	–	–	–	–	–	–
Wenham,	3	–	–	–	–	–	–	–	–	–
West Boylston,	–	15	5	–	–	–	–	–	–	–
West Bridgewater,	–	14	5	–	–	–	–	–	–	3
West Newbury,	1	–	1	–	–	–	–	–	–	–
West Springfield,	6	–	21	–	1	–	–	–	–	1
West Stockbridge,	1	3	2	–	–	1	–	–	–	–
Westborough,	4	95	1	1	7	–	–	–	1	–
Westfield,	21	166	43	22	17	–	–	1	15	3
Westford,	3	14	9	–	–	–	–	–	–	–
Westminster,	3	11	6	1	1	–	–	–	–	–
Weston,	1	6	8	–	1	–	–	2	7	–
Westport,	2	21	3	2	1	–	–	–	–	–
Westwood,	–	13	2	–	–	–	–	–	1	–
Weymouth,	3	1	16	–	2	–	–	–	–	–
Whately,	–	–	–	–	1	–	–	–	–	–
Whitman,	7	8	17	3	4	–	–	–	3	–
Wilbraham,	9	–	4	–	–	–	–	–	–	2
Williamsburg,	–	–	–	2	1	–	–	–	–	–
Williamstown,	11	33	14	1	2	–	–	–	–	–

Cases of Infective Diseases, etc. — Concluded.

	Diphtheria.	Measles.	Scarlet Fever.	Typhoid Fever.	Tuberculosis.	Cerebro-spinal Meningitis.	Smallpox.	Whooping Cough.	Varicella.	Anterior Poliomyelitis.
Wilmington,	–	55	2	–	2	–	–	–	–	–
Winchendon,	1	176	2	4	8	–	–	4	15	1
Winchester,	28	43	4	1	18	–	–	44	45	–
Winthrop,	8	115	28	14	12	1	–	17	5	1
Woburn,	9	166	18	4	14	3	–	1	–	–
Worcester,	405	650	356	82	300	6	–	23	35	19
Wrentham,	4	12	8	–	–	–	–	3	–	–
Yarmouth,	–	22	1	–	2	–	–	–	–	–
Totals,	6,741	29,192	8,062	2,398	7,424	180	157	3,325	3,822	361

Actinomycosis occurred in the following places: —

Boston,	2
Worcester,	1
	3

Anthrax occurred in the following places: —

Boston,	3
Chelsea,	1
Haverhill,	4
	[1] 8

Erysipelas occurred in the following places: —

Brockton,	11
Canton,	3
Framingham,	1
Wellesley,	1
	16

Glanders occurred in the following places: —

Acton,	1
Belmont,	1
Boston,	1
	3

[1] One Boston case and the Chelsea and Haverhill cases were those of malignant pustule.

Keratitis occurred in the following place: —

Dartmouth,	1

Leprosy occurred in the following place: —

Boston,	2

Lupus occurred in the following place: —

Westfield,	1

Malaria occurred in the following places: —

Boston,	1
Dedham,	1
	2

Meningitis other than cerebro-spinal occurred in the following places: —

Beverly,	1
Boston,	79
Braintree,	1
Everett,	1
Fall River,	1
Fitchburg,	1
Gardner,	2
Greenfield,	1
Hatfield,	1
Haverhill,	8
Lawrence,	1
Methuen,	1
New Bedford,	6
Newton,	2
North Adams,	2
Northampton,	1
Peabody,	2
Pittsfield,	3
Revere,	2
Rockport,	1
Somerville,	3
Springfield,	4
Waltham,	1
Ware,	1
Worcester,	4
	130

Mumps occurred in the following places: —

Amherst,	1
Barre,	1
Becket,	1
Boston,	275
Braintree,	1
Brockton,	27
Brookline,	4
Canton,	1
Cohasset,	1
Dedham,	1
Dennis,	2
Easton,	9
Everett,	13
Lancaster,	4
Lexington,	4
Lowell,	1
Lynn,	83
Medford,	3
Natick,	1
New Marlborough,	2
Newton,	3
Peabody,	3
Scituate,	4
Sharon,	1
Somerville,	19
Walpole,	1
Wellesley,	5
Winthrop,	5
	476

Ophthalmia neonatorum occurred in the following places: —

Acushnet,	1
Agawam,	1
Amesbury,	1
Amherst,	1
Andover,	2
Athol,	2
Attleborough,	1
Barnstable,	2
Belmont,	2
Beverly,	1
Boston,	1,395
Bourne,	1
Brockton,	40

Brookline,	5
Cambridge,	35
Carver,	2
Chelsea,	12
Chesterfield,	4
Chicopee,	5
Clinton,	2
Concord,	1
Cummington,	1
Dalton,	2
Danvers,	2
Dartmouth,	1
Dedham,	1
Douglas,	1
Dudley,	1
East Bridgewater,	2
Easton,	2
Everett,	18
Fairhaven,	1
Fall River,	118
Falmouth,	2
Fitchburg,	6
Freetown,	1
Gardner,	6
Gloucester,	4
Granby,	1
Great Barrington,	4
Greenfield,	1
Groveland,	1
Hanover,	1
Hanson,	1
Hardwick,	1
Harvard,	1
Harwich,	1
Hatfield,	1
Haverhill,	27
Hawley,	1
Holden,	1
Holyoke,	19
Lancaster,	2
Lanesborough,	1
Lawrence,	27
Lee,	2
Lenox,	1
Leominster,	2
Lowell,	27

Ludlow,	3
Lynn,	35
Malden,	48
Mansfield,	1
Marblehead,	1
Marlborough,	3
Medford,	9
Melrose,	8
Methuen,	2
Milford,	1
New Bedford,	60
Newburyport,	14
Newton,	10
Norfolk,	1
North Adams,	4
North Andover,	3
North Attleborough,	4
Northampton,	2
Northbridge,	1
Northfield,	1
Norton,	1
Peabody,	7
Pelham,	1
Pepperell,	2
Pittsfield,	15
Plymouth,	4
Quincy,	13
Revere,	7
Rockport,	1
Rowley,	2
Salem,	12
Saugus,	1
Sharon,	2
Somerset,	1
Somerville,	31
South Hadley,	1
Southbridge,	2
Southwick,	1
Springfield,	82
Stoneham,	1
Stoughton,	1
Sutton,	2
Swampscott,	4
Taunton,	4
Topsfield,	2
Walpole,	1

Waltham,	25
Wareham,	1
Watertown,	3
Wayland,	1
Wellesley,	1
West Springfield,	3
Westfield,	3
Westport,	2
Weymouth,	3
Whitman,	1
Wilbraham,	3
Wilmington,	1
Winchester,	2
Winthrop,	1
Woburn,	2
Worcester,	32
	2,304

Pellagra occurred in the following places: —

Haverhill,	1
Whitman,	1
	2

Rabies occurred in the following place: —

North Andover,	1

Tetanus occurred in the following places: —

Beverly,	1
Boston,	4
Cambridge,	2
Everett,	2
Fall River,	1
Gloucester,	1
Great Barrington,	1
Greenfield,	1
New Bedford,	2
Peabody,	1
Pittsfield,	1
Stow,	1
Westfield,	1
Weston,	1
Worcester,	3
	23

Tonsillitis occurred in the following places: —

Abington,	1
Arlington,	25
Braintree,	5
Brockton,	84
Easton,	2
Foxborough,	2
Milton,	9
Randolph,	4
Sherborn,	2
Somerville,	1
Walpole,	6
West Bridgewater,	2
	143

Trachoma occurred in the following places: —

Boston,	98
Cambridge,	2
Chelsea,	1
Fall River,	1
Gloucester,	1
Greenfield,	1
Haverhill,	1
Lowell,	1
Newton,	1
Revere,	2
Springfield,	1
Worcester,	2
	112

Trichinosis occurred in the following places: —

Brookline,	1
Fall River,	1
Fitchburg,	1
Lowell,	2
	5

Tuberculosis other than phthisis occurred in the following places: —

Adams,	2
Beverly,	1
Boston,	222
Brockton,	2
Brookline,	2

Chelsea,	2
Chicopee,	1
Clinton,	1
Danvers,	1
Dartmouth,	2
Dedham,	1
East Bridgewater,	1
Easthampton,	2
Easton,	1
Everett,	5
Fall River,	11
Fitchburg,	12
Framingham,	1
Haverhill,	12
Holyoke,	1
Hudson,	1
Lawrence,	5
Lexington,	1
Lowell,	1
Lynn,	2
Malden,	1
Mattapoisett,	1
Maynard,	1
Medford,	1
Melrose,	2
New Bedford,	53
Newburyport,	2
Newton,	1
North Adams,	4
Northampton,	1
Peabody,	1
Pittsfield,	3
Salem,	10
Somerville,	8
Southbridge,	1
Springfield,	7
Waltham,	2
Ware,	1
Wellesley,	1
Worcester,	14
	412

Typhus occurred in the following places: —

Boston,	1
Taunton,	1
	2

List of Cities and Towns from which no Reports were received.

1. Cities.

None.

2. Towns having a Population of More than 5,000.

None.

3. Towns having a Population of More than 1,000 but Less than 5,000 in Each.

Charlton,	Raynham,	Sudbury,
Conway,	Rutland,	West Brookfield. — 8
Oak Bluffs,	Seekonk,	

4. Towns having Less than 1,000 Inhabitants.

Bernardston,	Middlefield,	Sandisfield,
Burlington,	Monroe,	Shutesbury,
Chilmark,	Monterey,	Southampton,
Dover,	Mount Washington,	Tolland,
Gay Head,	New Ashford,	Wales,
Gosnold,	New Braintree,	Warwick,
Heath,	Oakham,	West Tisbury,
Holland,	Plainfield,	Westhampton,
Lynnfield,	Prescott,	Windsor,
Mashpee,	Rowe,	Worthington. — 31.
Mendon,		

A supply of postal cards for the purpose of reporting infective diseases to the State Board of Health, as required by statute, will be forwarded to any local board of health on application to the secretary of the State Board, Room 145, State House, Boston.

NOTE. — Previous to the going to print of the annual report of 1913, the State Board of Health had been reorganized under the name of the State Department of Health. Communications should be addressed to the Commissioner of Health, Room 145, State House, Boston.

IV.

OFFICIAL RETURNS OF DEATHS IN CITIES AND LARGE TOWNS (REVISED LAWS, CHAPTER 75, SECTION 12).

1913.

In the following summary, the statistics of deaths required by chapter 75, section 12, of the Revised Laws, are presented. These statistics are returned to the Board from each city and town which has, "according to the latest census, more than five thousand inhabitants."

The cities and towns which have contributed these returns for the year 1913 comprise the same list as for the year 1912. This list embraces all of the 33 cities and the towns having more than 5,000 inhabitants in each.

The list for the year 1913 includes 110 cities and towns. The total estimated population of this group of cities and towns in 1913 was 3,221,256, or about 89 per cent. of the total estimated population of the State. Hingham and Williamstown have again made returns, although their populations fell below 5,000 in 1910. In addition, the following towns, now near the 5,000 mark, have voluntarily made returns, although not required by law so to do: Lexington, Ludlow, Monson and Walpole.

The whole number of registered deaths in these cities and towns in 1913 was 46,954, and the death-rate, as calculated from the foregoing estimated population, was 14.58 per 1,000 of the living population, that of the previous year having been 14.67 per 1,000, and that of 1911, 15.25 per 1,000.

The death-rate for the year 1913 was lower than that of 1912, and considerably lower than the mean annual death-rate of the State for the fifty years ended Dec. 31, 1900, which was 19.22 per 1,000.

Sexes. — The number of deaths of males was 24,510, or 52.23 per cent. of the whole number of deaths whose sex was known; and the deaths of females were 22,421, or 47.77 per cent. There were 23 in which the sex was not stated in the returns.

Ages. — The deaths by four groups of ages were as follows: —

Ages.	Deaths, 1913.	Percentages of All Deaths.	
		1913.	1912.
Under 1 year,	9,062	19.32	20.64
1 to 20 years,	5,879	12.53	11.72
20 to 50 years,	10,981	23.41	22.91
50 and over,	20,987	44.74	44.73

Infant Mortality. — The deaths of infants under one year old were 9,062, or 19.32 per cent. of the total mortality, as compared with 20.64 per cent. in 1912. In the year 1900 the rate was 23; that of the five years 1909–13, respectively, constituted 21.63, 22.05, 20.54, 20.64 and 19.32 per cent. of the total mortality.

The deaths of children under five years old were 12,515, or 26.7 per cent. of the total mortality, as compared with 27.4 per cent. for the same age in 1912.

All of the percentages in the foregoing table were estimated upon the number of deaths of those whose ages were stated in the returns. The total number of deaths in which the age was not specified was 45; in 1912 it was 41.

Still-births. — The number of still-births was 3,250, and when compared with the total mortality (still-births included), this was 6.5 per cent. of the total deaths and still-births combined, practically the same percentage being maintained as for 1912.

Months and Quarters. — The number of deaths in each quarter of the year is shown in the following table: —

	Deaths, 1913.	Percentages.	
		1913.	1912.
First quarter,	13,102	27.91	27.85
Second quarter,	11,654	24.82	23.55
Third quarter,	11,336	24.15	24.20
Fourth quarter,	10,853	23.12	24.40
Total,	46,945	100.00	100.00

These percentages differ but little from the mean of several years. As in 1908, 1909, 1910, 1911 and 1912, the highest mortality was in the first quarter.

During the forty-year period (1856–95) the mortality was generally above the mean in the third quarters of the years and below it in the other three quarters.

The intensity of the seasonal death-rate is more accurately shown in the following table, the method employed being explained on page By in Section III. of these summaries, relating to disease notification. 622 this method the errors which are due to differences in the length of the months are eliminated.

Months.	Deaths in Each Month.	Mean Daily Deaths per Month, 1913.	Centesimal Ratio.	
			1913.	1912.
January,	4,423	142.7	111.0	109.0
February,	4,186	149.5	116.3	114.5
March,	4,493	144.9	112.7	112.7
April,	4,036	134.5	104.6	104.0
May,	4,091	132.0	102.6	94.3
June,	3,527	117.5	91.4	85.9
July,	3,655	117.9	91.7	95.3
August,	3,869	124.8	97.0	97.0
September,	3,812	127.1	98.8	96.6
October,	3,521	113.6	88.3	93.8
November,	3,326	110.9	86.2	91.5
December,	4,006	129.2	100.5	105.9
	–	128.6	100.0	100.0

The figures in the foregoing table indicate a departure in excess of the mean death-rate in January, February, March, April, May and December, while that of the remaining months was below the mean.

The mean maximum departure from the death-rate for each month for the period of twenty years 1856–75 was 32.9 per cent. in August, and the twenty-year period 1876–95 it was 20 per cent. in August, while that of August, 1913, was below the mean, and those of February and March, the two months in which the death-rates were the highest, were respectively, 16.3 and 12.7 per cent.

In the two years having the highest death-rates in Massachusetts in the past half-century or more (1849 and 1872) the maximum departures from the yearly means were, respectively, 83.4 per cent. in August, 1849, and 40 per cent. in August, 1872. That of January, 1890, the month in which the epidemic of influenza was at its maximum, was 43.4 per cent. above the mean.

The figures for 1913, when compared with those of earlier years in the past half-century, show a much greater uniformity in the seasonal mortality, since serious epidemics have not prevailed in the State either in the past year or in any of the years of the past decade.

Death-rates of Cities and Large Towns. — In Table II., last column, the death-rates of cities and towns having over 5,000 inhabitants are given. These death-rates are obtained by comparing the deaths in each city and town with the estimated population. They vary from a minimum of 8.7 in Watertown to 20.7 per 1,000 in Amherst, the latter being the only town that had a death-rate above 19 in 1913.

The following cities and towns had death-rates above 19 per 1,000 in 1912: Grafton, 21.0; Montague, 19.8; Fairhaven, 19.7; Hingham, 19.1.

The following cities and towns had death-rates less than 12 per 1,000 in 1913: Northampton, 11.9; Melrose, 11.9; Gardner, 11.8; Maynard, 11.7; Everett, 11.7; Milton, 11.6; Lynn, 11.6; Marblehead, 11.6; Newton, 11.6; Easthampton, 11.4; Brookline, 11.3; Attleborough, 11.2; Hudson, 11.2; Medford, 11.2; Southbridge, 11.2; Winchester, 11.1; Malden, 10.8; Brockton, 10.8; West Springfield, 10.7; Concord, 10.3; Wellesley, 10.2; Norwood, 10.1; North Attleborough, 10.0; Winthrop, 10.0; Walpole, 9.9; Westborough, 9.5; Revere, 9.4; Watertown, 8.7. Of these, Attleborough, Brockton, Brookline, Concord, Everett, Hudson, Lynn, Malden, Maynard, Melrose, Milton, North Attleborough, Norwood, Revere, Southbridge, Walpole, Watertown, Wellesley and Winchester had death-rates below 12 per 1,000 in 1912.

Death-rates of Certain Cities having a Population of More than 25,000. Mean Death-rates of the Seven Census Years 1870, 1875, 1880, 1885, 1890, 1895, 1900, and for 1905, 1910, 1911, 1912 and 1913.

Cities.	Mean Death-rates, 1870, 1875, 1880, 1885, 1890, 1895 and 1900.	Death-rate, 1905.	Death-rate, 1910.	Death-rate, 1911.	Death-rate, 1912.	Death-rate, 1913.
Boston,	23.3	18.5	17.3	17.1	16.2	16.1[1]
Worcester,	19.5	17.4	17.0	15.7	16.1	16.1[1]
Fall River,	22.8	20.2	18.5	17.5	15.8	16.7
Lowell,	21.8	20.0	19.8	17.7	17.0	15.4
Cambridge,	19.0	15.5	15.4	16.0	14.1	13.4
New Bedford,	20.7	17.2	18.8	17.0	15.4	14.8
Lynn,	17.4	16.2	13.1	12.5	11.7	11.6
Springfield,	19.0	15.2	16.7	15.3	15.1	14.7
Lawrence,	21.7	19.6	17.7	16.0	15.4	14.5
Somerville,	17.1	14.0	13.5	13.1	12.2	12.0
Holyoke,	22.2	16.3	17.8	15.2	14.7	16.0
Brockton,	15.3	12.7	12.4	10.9	11.5	10.8
Malden,	16.4	13.3	13.1	12.1	11.2	10.8
Haverhill,	17.2	15.5	17.0	13.9	14.6	13.7
Salem,	21.4	19.5	15.9	16.7	14.5	14.6
Newton,	14.3	13.1	12.2	11.4	12.5	11.6
Fitchburg,	16.4	13.1	13.4	12.8	12.2	13.4
Taunton,	19.7	21.8	23.4	20.5	21.0	19.3[1]
Everett,	15.4	13.9	11.0	11.0	11.0	11.7
Quincy,	17.1	13.1	11.7	11.1	11.1	13.3
Chelsea,	19.7	18.4	18.6	19.3	16.0	18.2[1]
Pittsfield,	17.5	16.6	17.7	16.6	16.4	18.0
Waltham,	15.0	13.7	14.0	13.8	12.4	13.0
Chicopee,	20.8	17.7	15.4	14.7	15.1	13.0
Gloucester,	20.6	14.8	16.0	14.3	15.0	13.8[2]

[1] These figures for Boston, Chelsea, Worcester and Taunton include all deaths. By exclusion of deaths of nonresidents in Boston and deaths in public and private institutions in the other 3 cities, the death-rates would be reduced to 13.4 in Chelsea, 14.0 in Boston, 14.5 in Taunton and 14.7 in Worcester.

[2] Gloucester has been allowed to stand in this list, although it dropped below the 25,000 mark during the five years 1905–1910.

Causes of Death. — In Table III. the mortality of the cities and towns embraced in this summary is presented in absolute figures, classified according to the principal causes of death. The same figures are again presented in relative terms in Table IV., for the whole group of cities and towns combined. Two sets of figures are given in Table IV., in one of which the mortality from each principal cause of death is compared with the estimated population of the group for 1913, as well as for each of the last five years, and in the other with the total mortality of the group of cities and towns.

By this it appears that the general death-rate from all causes, as shown in the lower line at the left of the table, 145.76 per 10,000 living, or, as usually stated, 14.58 per 1,000, was lower than that of 1912, and lower than in the years 1911, 1910 and 1909, when it was 15.25, 16.04 and 15.92, respectively. The population comprised in these returns constitutes about 89 per cent. of that of the whole State.

The decline in the general death-rate during the year 1913 is chiefly due to a decrease in the relative number of deaths from infective diseases.

The death-rate from each of the following causes was less than that of 1912: consumption, smallpox, erysipelas and puerperal fever.

The following table, first published in the report of 1899, presents the combined death-rate from eight of the principal infective diseases. The diseases referred to are consumption, measles, scarlet fever, diphtheria, whooping cough, typhoid fever, puerperal fever and diarrhœa and enteritis under two years.

The combined death-rate per 10,000 of the population from these eight causes for the nineteen years (1895–1913) in the cities and towns included in this report (about nine-tenths of the total population of the State) was as follows: —

Combined Death-rate from Eight Principal Infective Diseases.

Year.	Combined Death-rate per 10,000.	Year.	Combined Death-rate per 10,000.
1895,	46.4	1905,	28.0
1896,	46.8	1906,	27.9
1897,	39.7	1907,	27.8
1898,	36.3	1908,	28.5
1899,	35.2	1909,	27.1
1900,	40.7	1910,	26.1
1901,	33.5	1911,	22.5
1902,	30.9	1912,	19.9
1903,	30.7	1913,	22.3
1904,	27.0		

The death-rate from consumption was lower in 1913 than in any year of record, being 10.37, as against 10.72 in 1912, 11.11 in 1911, 12.60 in 1910, and 13.38 in 1909.

The seasonal table which appeared in the earlier reports, presenting the deaths by months for each city and town and for the whole State, is omitted in the present report, since the details presented in this table are not of essential value. Its chief value consisted in the column of total figures for the State, which is retained essentially in the table on page 644.

The table of percentages of total mortality shown in Table IV. acts in a measure as a check or control in case of erroneous estimates of population.

The changes in the death-rate from consumption, typhoid fever and puerperal fever (see child-birth in report of 1896, page 804) were quite fully treated in the report of 1896. To these may be added the later comments on the changes in the death-rate from diphtheria, which appear in the figures of the past nineteen years.

The following preventable causes of death, consumption, measles, scarlet fever, diphtheria, whooping cough, typhoid fever, puerperal fever and diarrhœa and enteritis under 2, together constituted 27.2 per cent. of the total mortality in 1894, but had fallen off to 24.2, 24.2, 21.9, 21.1, 20.4, 22.3, 19.9, 19, 19, 17.5, 16.7, 16.8, 15.9, 17.4, 17.0, 16.3, 14.7, 13.6 and 15.3 in the nineteen succeeding years; while the principal acute lung diseases, diseases of the heart, brain, kidneys, cancer, suicide and accident had increased from 35.7 per cent. of the total mortality to 36.9, 36.9, 38.5, 39.2, 40.2, 38.6, 40.1, 42.7, 43, 45.7, 46.6, 45.6, 46.3, 46.7, 47.5, 50.3, 49.4, 52.5 and 53.7 in the same years.

These all combined constituted the greater part of the total mortality in each of the twenty years 1894–1913, and of the diseases specified in the table entitled the "Balance of Mortality," in the annual report of 1896, page 812.

TABLE I.

Population of Cities and Large Towns, estimated for 1913.

Reporting Cities and Towns.	Population, 1913.	Reporting Cities and Towns.	Population, 1913.
Abington,	5,680	Beverly,	21,066
Adams,	13,361	Blackstone,	5,648
Amesbury,	10,527	Boston,	736,332
Amherst,	5,112	Braintree,	8,777
Andover,	7,703	Bridgewater,	8,249
Arlington,	12,211	Brockton,	63,137
Athol,	9,340	Brookline,	30,785
Attleborough,	18,773	Cambridge,	109,549
Belmont,	6,250	Chelmsford,	5,463

TABLE I. — *Continued.*

Reporting Cities and Towns.	Population, 1913.	Reporting Cities and Towns.	Population, 1913.
Chelsea,	37,500	Methuen,	13,520
Chicopee,	29,152	Middleborough,	9,009
Clinton,	13,075	Milford,	13,660
Concord,	7,021	Milton,	8,446
Danvers,	9,614	Monson,	5,007
Dedham,	10,190	Montague,	6,866
Easthampton,	9,553	Natick,	10,019
Easton,	5,277	Needham,	5,470
Everett,	36,417	New Bedford,	113,116
Fairhaven,	5,647	Newburyport,	15,116
Fall River,	128,232	Newton,	41,708
Fitchburg,	41,038	North Adams,	22,019
Framingham,	13,868	Northampton,	19,431
Franklin,	5,878	North Andover,	6,078
Gardner,	16,592	North Attleborough,	10,573
Gloucester,	24,398	Northbridge,	9,650
Grafton,	6,098	Norwood,	8,785
Great Barrington,	5,926	Orange,	5,282
Greenfield,	11,273	Palmer,	9,123
Haverhill,	48,377	Peabody,	17,541
Hingham,	5,052	Pittsfield,	37,333
Holyoke,	62,980	Plymouth,	12,799
Hudson,	7,058	Quincy,	35,731
Ipswich,	6,119	Reading,	5,899
Lawrence,	88,000	Revere,	22,667
Leominster,	19,901	Rockland,	7,312
Lexington,	5,152	Salem,	47,799
Lowell,	113,785	Saugus,	9,124
Ludlow,	5,587	Somerville,	82,447
Lynn,	97,635	Southbridge,	13,656
Malden,	48,725	South Hadley,	4,894
Mansfield,	5,747	Spencer,	6,740
Marblehead,	7,416	Springfield,	99,662
Marlborough,	14,891	Stoneham,	7,546
Maynard,	6,738	Stoughton,	6,529
Medford,	25,515	Swampscott,	6,843
Melrose,	16,634	Taunton,	36,400

TABLE I. — *Concluded.*

Reporting Cities and Towns.	Population, 1913.	Reporting Cities and Towns.	Population, 1913.
Wakefield,	12,145	Weymouth,	13,751
Walpole,	5,426	Whitman,	7,754
Waltham,	28,809	Williamstown,	3,708
Ware,	8,882	Winchendon,	5,678
Watertown,	13,955	Winchester,	9,948
Webster,	12,508	Winthrop,	12,612
Wellesley,	5,413	Woburn,	15,879
Westborough,	5,488	Worcester,	157,869
Westfield,	17,708	Total,	3,221,256
West Springfield,	9,899		

TABLE II.

Total Deaths, Deaths by Sexes, Age Periods and Still-births in Cities and Towns having over 5,000 Inhabitants in Each with General Death-rates estimated for 1913.

	Total Deaths.	Males.	Females.	Sex Unknown.	Still-births.	Under 1 Day.	1 to 2 Days.	2 to 3 Days.	3 Days to 1 Week.	1 to 2 Weeks.	2 to 3 Weeks.	3 Weeks to 1 Month.	1 to 2 Months.	2 to 3 Months.	3 to 6 Months.	6 to 9 Months.	9 to 12 Months.	1 Year.	2 Years.	3 Years.	4 Years.	5 to 9 Years.
Abington,	73	42	31	–	3	–	–	1	–	1	–	–	–	1	1	3	2	3	–	–	–	2
Adams,	179	80	99	–	11	11	5	–	5	2	2	2	6	7	7	11	2	12	5	3	–	3
Amesbury,	173	92	81	–	5	4	1	1	1	–	1	–	5	1	3	3	1	4	3	–	3	4
Amherst,	106	60	46	–	3	2	1	1	–	1	4	–	–	1	3	2	1	2	2	1	1	1
Andover,	121	61	60	–	8	2	2	–	1	–	–	1	–	3	1	2	2	2	–	–	1	1
Arlington,	160	73	87	–	12	6	2	1	–	4	1	1	1	2	6	4	1	7	3	1	–	4
Athol,	125	65	59	1	11	–	–	1	1	2	2	2	5	2	3	4	2	–	4	–	1	2
Attleborough,	210	97	113	–	18	8	1	1	3	1	–	1	6	4	6	8	2	5	5	2	1	4
Belmont,	87	40	47	–	4	–	–	–	3	–	–	–	1	–	1	–	–	1	1	1	1	–
Beverly,	293	150	143	–	17	5	2	2	8	5	3	2	1	3	6	3	4	8	5	–	2	4
Blackstone,	92	43	49	–	3	–	–	–	–	1	–	–	2	–	2	2	–	–	2	2	2	3
Boston,[1]	11,837	6,327	5,510	–	735	299	76	70	153	111	84	88	185	134	383	290	238	422	191	116	85	233
Braintree,	118	61	57	–	10	–	–	1	1	2	1	–	1	1	2	4	2	5	1	1	–	–
Bridgewater,[2]	105	60	45	–	6	2	–	–	7	–	–	–	–	2	10	1	1	–	2	–	–	1
Brockton,	681	351	330	–	57	42	5	7	15	6	9	8	10	10	19	14	9	15	6	5	8	21

[1] Nonresidents, 1,541 included.

[2] State Farm, 112 additional.

TABLE II. — *Continued.*

	Total Deaths.	Males.	Females.	Sex Unknown.	Still-births.	Under 1 Day.	1 to 2 Days.	2 to 3 Days.	3 Days to 1 Week.	1 to 2 Weeks.	2 to 3 Weeks.	3 Weeks to 1 Month.	1 to 2 Months.	2 to 3 Months.	3 to 6 Months.	6 to 9 Months.	9 to 12 Months.	1 Year.	2 Years.	3 Years.	4 Years.	5 to 9 Years.
Brookline,	348	171	177	–	12	5	1	1	3	2	–	1	1	3	1	4	7	1	1	–	2	1
Cambridge,	1,470	737	733	–	99	43	7	9	22	15	9	10	14	18	54	39	25	67	18	13	7	30
Chelmsford,	71	32	39	–	5	1	–	–	–	4	–	1	1	–	2	–	–	2	–	–	–	3
Chelsea,[1]	682	432	250	–	52	11	8	9	8	5	5	2	11	8	23	17	12	20	7	6	5	13
Chicopee,	378	201	177	–	31	10	6	6	5	6	6	4	15	10	26	22	12	31	11	3	3	10
Clinton,	157	77	80	–	15	5	4	1	1	5	–	–	3	2	1	4	4	8	4	1	2	4
Concord,	72	40	32	–	13	1	2	1	1	–	–	2	–	–	2	–	–	–	1	–	–	1
Danvers,[2]	133	64	69	–	2	1	–	–	–	–	–	–	2	1	4	1	2	1	2	1	4	3
Dedham,	144	87	57	–	8	2	4	–	–	–	–	–	3	1	3	2	2	5	2	–	5	3
Easthampton,	109	56	53	–	18	6	–	–	2	1	2	–	5	3	6	6	3	9	3	–	–	1
Easton,	70	44	26	–	2	2	1	–	–	–	–	–	–	1	2	1	–	1	–	–	–	3
Everett,	426	219	207	–	31	19	6	4	4	3	5	3	8	6	12	8	7	15	9	1	–	9
Fairhaven,	82	41	41	–	7	–	–	–	3	–	–	–	–	–	–	2	6	2	3	–	2	1
Fall River,	2,137	1,103	1,034	–	177	61	52	42	57	73	79	65	52	54	62	50	45	208	62	32	21	52
Fitchburg,	548	273	275	–	43	20	3	3	9	7	3	6	9	11	22	19	18	30	13	2	3	15
Framingham,	213	112	101	–	20	2	2	–	4	–	4	–	2	–	5	3	3	10	3	1	1	3
Franklin,	85	49	36	–	12	4	1	–	–	1	1	–	1	2	–	–	3	2	1	2	1	2
Gardner,	196	106	90	–	20	6	–	–	4	–	1	1	4	4	10	4	8	11	2	4	–	6
Gloucester,	336	196	140	–	16	1	3	2	1	5	3	1	6	4	5	11	3	9	2	5	–	4

Grafton,	105	51	54	-	5	4	-	-	-	-	-	1	1	2	4	-	1	5	-	-	-	1
Great Barrington,	99	55	44	-	7	3	-	-	4	-	2	1	1	1	2	2	2	4	2	-	3	3
Greenfield,	163	80	71	12	9	7	1	1	2	6	-	1	4	1	2	2	2	3	4	3	1	2
Haverhill,	663	342	321	-	71	3	10	4	6	4	6	5	11	9	13	19	14	33	10	4	7	11
Hingham,	78	37	41	-	5	-	1	-	-	-	1	-	2	-	2	1	3	-	-	-	-	-
Holyoke,	1,009	586	423	-	73	27	10	1	12	14	20	17	61	40	54	40	22	46	29	18	9	31
Hudson,	79	44	35	-	9	1	-	-	1	-	2	-	-	1	4	3	1	-	1	-	1	1
Ipswich,	110	57	53	-	6	4	1	-	1	-	1	4	-	1	10	3	3	4	2	-	-	3
Lawrence,	1,277	653	624	-	151	26	7	7	14	17	16	36	32	44	62	47	35	84	43	14	10	24
Leominster,	285	152	133	-	16	5	-	2	1	2	1	-	10	4	4	4	7	12	5	5	6	9
Lexington,	86	43	43	-	5	4	-	1	-	-	-	-	3	2	1	1	1	3	1	-	-	1
Lowell,	1,749	907	842	-	137	62	19	10	15	16	11	13	36	42	85	68	45	102	42	18	10	41
Ludlow,	99	54	45	-	8	-	1	1	1	1	3	2	2	1	8	6	5	7	2	3	2	2
Lynn,	1,132	579	553	-	103	8	15	10	18	9	5	8	13	11	23	15	19	37	16	12	10	23
Malden,	527	260	267	-	28	10	5	4	6	1	1	1	8	5	12	17	4	14	2	8	8	17
Mansfield,	82	43	39	-	6	2	-	-	1	-	-	-	1	1	2	-	1	5	-	-	-	-
Marblehead,	86	40	46	-	3	1	-	-	1	-	1	1	1	-	3	-	-	1	1	-	-	-
Marlborough,	212	104	108	-	10	5	1	-	3	1	2	1	2	1	1	4	1	4	-	-	-	7
Maynard,	79	37	42	-	9	1	-	-	1	-	2	-	2	1	6	2	3	5	1	-	4	-
Medford,	286	140	146	-	9	9	2	1	2	2	-	1	1	4	4	9	6	3	-	1	3	4
Melrose,	198	94	104	-	88	3	-	-	3	1	-	2	-	-	4	3	3	3	1	-	2	3
Methuen,	209	96	113	-	13	5	1	-	3	5	1	1	4	1	5	6	3	11	6	1	3	4
Middleborough,	120	67	53	-	-	2	-	-	-	-	-	1	1	2	3	1	-	4	-	-	2	3
Milford,	220	119	97	4	16	-	4	2	3	2	3	3	-	4	4	7	3	7	1	-	-	4

[1] Soldiers' Home and marine and naval hospitals, 178 included.

[2] Insane asylum, 201 additional.

TABLE II. — *Continued.*

	Total Deaths.	Males.	Females.	Sex Unknown.	Still-births.	Under 1 Day.	1 to 2 Days.	2 to 3 Days.	3 Days to 1 Week.	1 to 2 Weeks.	2 to 3 Weeks.	3 Weeks to 1 Month.	1 to 2 Months.	2 to 3 Months.	3 to 6 Months.	6 to 9 Months.	9 to 12 Months.	1 Year.	2 Years.	3 Years.	4 Years.	5 to 9 Years.
Milton,	98	43	55	–	4	3	1	–	2	2	–	–	–	1	–	1	–	2	–	1	–	–
Monson,[1]	69	36	33	–	5	–	2	1	–	1	2	–	2	–	1	–	–	4	2	1	–	–
Montague,	126	74	52	–	6	3	2	–	1	1	1	2	1	3	–	2	2	3	2	3	–	4
Natick,	176	81	95	–	5	2	3	–	3	5	1	3	3	–	3	–	–	6	2	–	–	–
Needham,	74	33	41	–	8	1	–	1	–	1	–	–	1	–	2	2	–	3	1	–	–	2
New Bedford,	1,673	837	836	–	129	55	14	11	23	16	24	6	46	41	130	91	59	125	51	26	16	37
Newburyport,	258	102	156	–	13	11	2	–	1	–	–	–	2	4	–	9	1	5	2	2	1	5
Newton,	483	226	257	–	24	18	3	1	6	9	3	4	4	3	6	8	8	6	6	4	2	10
North Adams,	340	194	146	–	19	6	2	1	5	4	2	1	5	1	7	6	1	13	7	3	1	7
Northampton,[2]	373	199	174	–	11	10	–	1	3	1	–	–	5	4	14	5	2	6	2	2	3	4
North Andover,	73	42	31	–	8	–	1	–	1	–	–	–	–	1	3	–	1	–	1	–	1	1
North Attleborough,	106	62	44	–	2	1	1	–	1	–	1	–	1	1	2	2	–	1	5	2	–	1
Northbridge,	123	63	60	–	11	3	2	2	1	1	–	1	3	3	5	5	4	5	1	–	1	4
Norwood,	89	37	52	–	12	2	–	1	2	1	–	1	3	2	1	3	1	6	1	–	–	2
Orange,	97	60	37	–	1	3	–	–	–	–	–	–	3	1	2	2	–	1	1	–	1	1
Palmer,	153	83	70	–	3	6	6	1	1	2	1	2	1	4	10	5	5	5	7	3	2	6
Peabody,	253	150	103	–	10	3	3	2	7	2	2	–	2	2	10	3	6	7	5	4	3	6
Pittsfield,	671	353	318	–	51	17	5	5	10	1	7	1	6	13	25	9	10	18	13	3	6	17
Plymouth,	213	117	96	–	5	3	1	3	2	3	2	1	5	3	8	2	–	4	1	2	–	3

Quincy,	475	246	229	–	30	15	6	4	4	9	3	–	8	5	15	15	11	19	8	4	5	11
Reading,	77	32	45	–	7	2	–	–	–	–	–	–	–	1	1	1	–	–	–	–	1	1
Revere,	212	104	108	–	23	5	–	–	–	2	2	1	3	2	7	11	6	5	3	2	1	1
Rockland,	104	53	51	–	3	1	–	–	1	–	2	–	–	1	3	1	3	–	1	–	–	1
Salem,	699	346	353	–	63	7	27	8	14	4	5	2	13	12	30	23	25	33	13	12	3	19
Saugus,	110	54	56	–	5	3	1	–	4	3	–	–	–	–	2	4	1	5	–	3	–	3
Somerville,	993	487	506	–	51	33	11	7	10	9	9	7	9	14	24	9	26	25	13	8	5	10
Southbridge,	153	78	74	1	7	12	2	–	3	2	2	1	2	2	6	8	2	7	1	2	1	2
South Hadley,	74	36	38	–	5	3	–	–	–	–	–	1	1	2	4	4	1	1	2	–	1	1
Spencer,	85	51	34	–	5	2	–	–	3	–	1	1	2	2	2	–	–	1	3	–	–	1
Springfield,	1,464	778	686	–	100	58	10	11	24	16	14	15	19	24	51	26	27	39	20	12	14	29
Stoneham,	139	75	64	–	8	–	1	–	1	–	–	1	2	–	3	1	–	2	1	–	–	5
Stoughton,	91	51	40	–	7	1	–	1	–	–	–	1	1	1	4	5	–	1	3	2	1	1
Swampscott,	94	59	35	–	10	4	3	1	1	1	1	1	3	1	3	1	–	1	–	–	–	1
Taunton,[3]	701	379	322	–	25	15	7	4	7	4	5	1	15	15	31	22	10	33	5	4	2	12
Wakefield,	172	73	99	–	12	–	2	1	1	–	1	–	2	2	5	4	2	7	–	–	–	3
Walpole,	54	24	30	–	10	1	–	–	1	1	–	1	1	1	2	–	–	1	–	–	–	3
Waltham,	375	186	189	–	17	10	–	4	4	2	2	1	4	2	6	5	1	10	4	2	4	14
Ware,	136	69	67	–	11	2	2	1	1	1	–	1	4	4	11	4	1	6	3	2	1	5
Watertown,	122	52	70	–	5	3	2	–	2	2	1	–	2	2	3	–	1	4	5	–	1	2
Webster,	175	96	79	–	9	12	3	–	–	3	1	1	4	4	11	7	2	2	5	2	1	6
Wellesley,	55	27	27	1	2	–	–	–	–	–	–	–	2	–	–	–	1	1	–	–	–	–
Westborough,[4]	172	84	88	–	2	–	–	1	–	1	–	1	1	–	1	2	1	–	–	–	1	1
Westfield,	269	133	136	–	14	4	2	1	6	–	5	10	6	3	11	11	5	9	6	4	1	5

[1] Epileptic hospital, 62 additional. [2] Nonresidents, 140 included. [3] Insane asylum, 172 included. [4] Insane hospital, 120 included.

TABLE II. — *Continued.*

	Total Deaths.	Males.	Females.	Sex Unknown.	Still-births.	Under 1 Day.	1 to 2 Days.	2 to 3 Days.	3 Days to 1 Week.	1 to 2 Weeks.	2 to 3 Weeks.	3 Weeks to 1 Month.	1 to 2 Months.	2 to 3 Months.	3 to 6 Months.	6 to 9 Months.	9 to 12 Months.	1 Year.	2 Years.	3 Years.	4 Years.	5 to 9 Years.
West Springfield,	106	57	49	–	8	3	3	1	–	1	1	–	1	4	5	4	3	3	2	1	1	2
Weymouth,	195	104	91	–	18	2	1	1	1	2	1	–	3	–	7	2	2	4	1	–	–	–
Whitman,	94	52	41	1	4	4	1	–	1	–	2	2	–	1	–	–	–	1	1	–	–	1
Williamstown,	60	32	28	–	5	1	1	–	–	–	–	–	1	2	–	1	1	1	1	2	1	–
Winchendon,	91	44	47	–	7	3	–	1	2	–	3	1	4	–	–	3	1	1	2	1	–	–
Winchester,	110	50	60	–	5	4	–	2	1	–	2	–	–	1	3	4	2	–	–	1	2	2
Winthrop,	126	57	69	–	11	1	–	–	1	–	1	1	–	–	–	1	2	–	2	1	1	2
Woburn,	213	110	100	3	3	5	3	1	1	3	5	–	1	4	3	4	2	4	2	–	–	4
Worcester,[1]	2,540	1,357	1,183	–	158	80	12	12	24	25	17	10	40	42	94	56	58	101	40	27	26	66
	46,954	21,510	22,421	23	3,250	1,216	421	300	607	485	435	383	803	718	1,588	1,198	908	1,862	800	438	353	965

[1] Insane hospitals, 223 included.

TABLE II. — *Continued.*

	10 to 14 Years.	15 to 19 Years.	20 to 24 Years.	25 to 29 Years.	30 to 34 Years.	35 to 39 Years.	40 to 44 Years.	45 to 49 Years.	50 to 54 Years.	55 to 59 Years.	60 to 64 Years.	65 to 69 Years.	70 to 74 Years.	75 to 79 Years.	80 to 84 Years.	85 to 89 Years.	90 to 94 Years.	95 to 99 Years.	100+	Unknown.	Rate per 1,000.
Abington,	1	-	1	1	4	3	1	1	3	5	4	8	6	7	5	7	2	-	-	-	12.85
Adams,	-	4	12	-	11	-	8	-	11	-	16	-	25	-	9	-	-	-	-	-	13.40
Amesbury,	-	4	6	3	5	4	4	8	12	7	20	13	19	10	13	4	4	2	-	-	16.43
Amherst,	1	2	5	3	1	1	1	2	2	8	9	15	8	7	8	5	5	-	-	-	20.74
Andover,	1	4	3	3	2	3	8	4	6	12	9	9	11	14	5	4	2	2	-	1	15.71
Arlington,	3	4	7	3	9	6	8	3	8	12	6	16	7	10	10	2	1	1	-	-	13.10
Athol,	3	1	3	4	4	5	2	9	6	10	5	10	10	11	7	3	1	-	-	-	13.38
Attleborough,	1	1	7	6	8	9	9	8	14	13	17	15	11	16	8	7	1	1	-	-	11.19
Belmont,	-	3	4	3	3	2	6	3	8	6	9	3	10	12	5	1	-	-	-	-	13.92
Beverly,	4	5	12	7	10	13	10	20	16	24	28	14	24	21	12	8	2	-	-	-	13.91
Blackstone,	2	4	3	5	3	8	3	6	5	7	3	5	11	3	3	3	2	-	-	-	16.28
Boston,[1]	158	200	368	482	466	642	677	752	728	804	810	789	667	515	352	183	68	17	1	-	13.98[2]
Braintree,	-	2	3	2	5	2	4	10	2	6	16	12	14	7	5	4	2	-	-	-	13.44
Bridgewater,[3]	-	5	3	3	-	5	5	7	4	7	1	6	4	6	2	2	2	-	-	17	12.73[2]
Brockton,	15	10	28	21	26	22	17	33	37	39	44	45	45	41	22	19	8	-	-	-	10.79
Brookline,	2	3	7	6	6	12	11	15	28	24	35	40	47	41	20	13	4	-	-	-	11.30

[1] Nonresidents, 1,541 included.

[2] In obtaining this death-rate, deaths occurring in public institutions were not included, many being nonresidents.

[3] State Farm, 112 additional.

TABLE II. — *Continued.*

	10 to 14 Years.	15 to 19 Years.	20 to 24 Years.	25 to 29 Years.	30 to 34 Years.	35 to 39 Years.	40 to 44 Years.	45 to 49 Years.	50 to 54 Years.	55 to 59 Years.	60 to 64 Years.	65 to 69 Years.	70 to 74 Years.	75 to 79 Years.	80 to 84 Years.	85 to 89 Years.	90 to 94 Years.	95 to 99 Years.	100+	Unknown.	Rate per 1,000.
Cambridge,	16	42	41	59	61	63	75	99	75	88	78	99	94	80	58	25	14	3	–	–	13.42
Chelmsford,	3	–	1	4	3	2	3	1	3	2	5	8	7	4	8	3	–	–	–	–	13.00
Chelsea,[1]	6	8	20	19	19	33	28	29	29	41	31	66	69	60	33	14	6	–	–	1	13.44[2]
Chicopee,	6	6	12	12	9	10	17	12	10	15	17	18	19	17	6	3	3	–	–	–	12.96
Clinton,	–	6	3	6	2	7	5	12	7	6	10	14	13	12	1	3	1	–	–	–	12.00
Concord,	2	2	6	–	–	5	2	4	2	2	6	5	8	4	5	6	–	–	–	2	10.26
Danvers,[3]	3	1	3	1	2	8	2	7	11	13	9	11	9	14	6	8	2	–	–	1	13.84[2]
Dedham,	1	1	2	5	3	6	9	4	3	16	9	12	10	14	10	6	1	–	–	–	14.13
Easthampton,	–	4	3	2	1	6	3	4	1	6	3	4	11	9	3	1	–	–	–	1	11.41
Easton,	1	–	2	2	2	3	1	2	4	3	6	12	9	5	4	1	1	1	–	–	13 26
Everett,	3	15	7	7	7	12	21	28	18	21	35	42	30	32	16	9	3	1	–	–	11 70
Fairhaven,	–	1	1	2	–	1	5	4	5	7	6	6	7	7	7	3	–	1	–	–	14.51
Fall River,	21	36	100	23	29	77	76	98	102	86	99	116	79	68	36	14	10	–	–	–	16.67
Fitchburg,	10	9	25	11	23	15	15	19	20	29	35	34	34	35	19	9	9	2	1	1	13.35
Framingham,	3	9	5	10	9	3	6	9	13	14	9	18	24	17	14	6	1	–	–	–	15.36
Franklin,	–	2	1	4	1	1	5	4	4	3	5	9	8	6	9	1	1	–	–	–	14 46
Gardner,	2	2	5	3	9	8	5	13	11	13	13	10	15	7	5	8	–	2	–	–	11.81
Gloucester,	4	3	9	4	9	19	16	23	17	12	35	22	31	20	33	9	2	2	–	1	13.77
Grafton,	–	2	1	4	2	7	6	6	4	7	8	13	4	7	7	8	–	–	–	–	17 21

Great Barrington,	2	1	1	4	2	4	–	3	3	7	7	8	7	6	10	2	2	–	–	–	16.69
Greenfield,	2	3	5	7	–	7	3	6	6	7	7	19	15	10	15	2	2	2	–	3	14.46
Haverhill,	7	21	21	22	20	24	34	23	37	41	50	39	50	53	29	17	2	3	–	1	13 70
Hingham,	2	–	–	1	–	1	6	6	4	7	5	5	13	8	6	3	–	1	–	–	15.45
Holyoke,	18	20	32	35	32	43	42	39	39	39	53	52	53	27	23	9	2	–	–	–	16.02
Hudson,	1	3	1	1	–	2	4	3	2	5	4	10	5	8	7	5	2	–	–	–	11.19
Ipswich,	2	2	3	1	2	3	5	4	3	5	7	2	6	10	8	6	4	–	–	–	17.97
Lawrence,	16	34	37	37	45	55	54	61	71	59	72	70	64	41	25	13	5	–	–	–	14.51
Leominster,	6	8	7	8	7	10	13	11	9	9	20	28	24	17	14	11	4	1	–	1	14.32
Lexington,	1	–	3	4	–	2	4	5	1	4	6	10	6	5	12	4	1	–	–	–	16 70
Lowell,	19	35	36	50	52	78	83	83	81	102	106	106	113	75	43	32	13	6	1	–	15.37
Ludlow,	4	1	4	6	1	–	4	3	4	4	5	1	6	1	3	4	–	1	–	–	17.71
Lynn,	11	22	43	33	46	65	40	56	50	74	95	94	89	60	58	27	13	2	1	1	11.59
Malden,	7	13	21	14	14	14	22	19	32	47	31	39	42	42	27	13	7	–	–	–	10.81
Mansfield,	–	2	1	2	2	2	1	7	2	10	4	9	5	11	4	6	1	–	–	–	14 26
Marblehead,	–	1	2	–	1	–	4	–	4	4	4	14	8	14	9	7	4	–	–	–	11.59
Marlborough,	4	6	5	12	7	10	9	9	10	13	11	22	25	17	6	8	4	1	–	–	14.24
Maynard,	–	1	5	2	3	8	1	3	2	5	6	2	8	3	2	–	–	–	–	–	11.72
Medford,	3	6	9	8	7	7	12	15	19	16	26	26	29	18	21	9	2	–	1	–	11.21
Melrose,	3	2	2	6	9	6	11	7	15	12	17	16	19	15	16	8	5	–	1	–	11.91
Methuen,	5	6	4	6	3	9	6	8	9	12	11	15	17	20	9	5	3	–	1	–	15 46
Middleborough,	1	3	–	8	1	2	3	3	5	7	8	10	16	16	10	5	3	–	–	–	13.32
Milford,	4	1	5	12	7	13	9	17	11	14	15	16	18	12	10	6	2	1	–	–	16.11

[1] Soldiers' Home and marine and naval hospitals, 178 included.
[2] In obtaining this death-rate, deaths occurring in public institutions were not included, many being nonresidents.
[3] Insane asylum, 201 additional.

TABLE II. — *Continued.*

	10 to 14 Years.	15 to 19 Years.	20 to 24 Years.	25 to 29 Years.	30 to 34 Years.	35 to 39 Years.	40 to 44 Years.	45 to 49 Years.	50 to 54 Years.	55 to 59 Years.	60 to 64 Years.	65 to 69 Years.	70 to 74 Years.	75 to 79 Years.	80 to 84 Years.	85 to 89 Years.	90 to 94 Years.	95 to 99 Years.	100+	Unknown.	Rate per 1,000.
Milton,	–	2	2	7	3	4	6	5	6	6	9	10	9	5	3	3	3	2	–	–	11.60
Monson,[1]	2	–	1	1	2	1	2	4	5	5	2	3	5	6	8	5	1	–	–	–	13.77[2]
Montague,	–	4	5	2	4	6	4	6	9	6	7	13	12	7	5	4	–	1	–	1	18.34
Natick,	3	4	3	3	10	6	2	4	15	17	14	11	17	16	13	4	2	1	–	–	17.56
Needham,	1	–	2	2	1	2	3	5	6	3	10	5	8	4	3	4	1	–	–	–	13.53
New Bedford,	17	35	43	50	50	56	60	56	70	69	75	92	72	71	46	24	13	2	–	1	14.79
Newburyport,	1	4	8	4	7	11	14	12	16	14	15	22	26	28	20	3	5	2	1	–	17.06
Newton,	7	9	15	13	13	18	22	13	25	31	23	49	46	33	32	21	10	2	–	–	11.58
North Adams,	9	12	12	10	14	10	22	20	23	18	18	36	30	21	5	4	1	3	–	–	15.44
Northampton,[3]	3	4	14	12	14	13	20	23	18	21	25	23	37	41	25	12	5	1	–	–	11.99[2]
North Andover,	–	1	4	2	6	3	3	3	4	8	7	2	7	8	5	–	–	–	–	–	12.01
North Attleborough,	2	–	7	2	3	4	8	5	6	7	8	7	4	10	8	4	1	1	–	–	10.03
Northbridge,	3	4	7	3	7	3	6	5	3	6	3	9	11	4	4	2	1	1	–	–	12.75
Norwood,	–	4	2	2	1	4	–	2	4	6	6	8	7	7	7	–	1	–	–	2	10.13
Orange,	1	4	3	2	2	1	–	5	8	7	7	8	5	15	7	4	3	–	–	–	18.37
Palmer,	5	4	2	5	2	4	3	2	8	5	6	6	11	9	8	4	1	–	1	–	16.78
Peabody,	2	5	11	10	9	16	9	10	21	12	23	15	16	12	12	1	2	–	–	–	14.42
Pittsfield,	6	14	31	23	32	35	34	39	37	28	51	49	35	34	35	15	7	–	–	–	17.97
Plymouth,	–	5	3	11	6	12	9	10	7	9	15	16	19	22	16	4	5	–	1	–	16.64

Quincy,	3	12	11	6	24	23	17	18	39	38	30	22	30	29	20	6	1	1	–	3	13.29
Reading,	1	1	1	1	1	3	1	6	5	6	7	6	7	6	11	6	–	1	–	–	13.05
Revere,	6	3	8	7	10	4	14	10	13	12	20	17	11	18	5	2	1	–	–	–	9 35
Rockland,	1	1	4	2	1	2	3	7	4	9	13	8	16	9	8	1	1	–	–	–	14.23
Salem,	7	12	26	13	21	29	29	22	35	23	44	54	49	36	26	13	8	1	–	1	14.62
Saugus,	2	4	1	3	2	4	4	2	6	4	10	11	9	8	7	3	1	–	–	–	12.06
Somerville,	9	15	27	22	31	41	38	33	49	64	75	86	79	95	58	25	13	4	–	–	12.04
Southbridge,	1	1	2	4	4	3	11	6	3	9	11	10	10	10	5	2	5	–	–	1	11 20
South Hadley,	1	3	2	2	2	1	1	4	4	4	1	5	5	4	5	6	1	–	1	1	15.13
Spencer,	–	1	5	3	2	–	–	3	3	4	8	13	6	6	6	5	2	–	–	–	12.61
Springfield,	17	33	47	46	54	68	75	66	77	73	98	90	104	92	56	42	10	5	1	1	14.69
Stoneham,	1	1	7	5	6	6	5	7	10	3	17	13	16	14	4	7	–	–	–	–	18.41
Stoughton,	–	1	2	3	5	6	3	4	3	8	5	6	7	4	5	5	2	–	–	–	13 94
Swampscott,	2	2	3	2	5	3	1	8	5	3	7	7	8	7	3	4	1	–	–	1	13.74
Taunton,[4]	7	7	16	21	23	24	31	35	39	39	33	58	58	60	36	15	4	3	–	–	14 53[2]
Wakefield,	3	2	8	4	8	6	12	10	6	10	10	11	13	14	13	8	3	1	–	–	14.16
Walpole,	1	–	1	2	1	3	–	2	–	3	8	5	4	5	4	1	1	–	1	–	9.94
Waltham,	9	12	13	14	10	13	16	12	16	28	22	21	34	31	33	10	5	–	–	1	13.02
Ware,	2	4	5	1	3	3	3	6	1	8	7	7	12	6	8	9	–	2	–	–	15.32
Watertown,	–	1	1	7	1	2	5	5	15	8	8	9	7	10	7	6	–	–	–	–	8.74
Webster,	3	3	10	4	6	4	4	5	9	8	11	12	12	11	3	5	1	–	–	–	13.91
Wellesley,	1	1	2	–	3	1	4	2	2	2	3	5	6	6	6	3	2	1	–	1	10.17

[1] Epileptic hospital, 62 additional.
[2] In obtaining this death-rate, deaths occurring in public institutions were not included, many being nonresidents.
[3] Nonresidents, 140 included.
[4] Insane asylum, 172 included.

TABLE II. — *Concluded.*

	10 to 14 Years.	15 to 19 Years.	20 to 24 Years.	25 to 29 Years.	30 to 34 Years.	35 to 39 Years.	40 to 44 Years.	45 to 49 Years.	50 to 54 Years.	55 to 59 Years.	60 to 64 Years.	65 to 69 Years.	70 to 74 Years.	75 to 79 Years.	80 to 84 Years.	85 to 89 Years.	90 to 94 Years.	95 to 99 Years.	100+	Unknown.	Rate per 1,000.
Westborough,[1]	–	–	2	7	5	8	13	10	14	13	20	20	7	29	4	6	4	–	–	–	9.47[3]
Westfield, ...	3	1	8	9	8	7	13	14	6	7	12	24	12	22	19	8	7	–	–	–	15.19
West Springfield, . . .	1	2	4	3	1	3	5	2	3	6	3	9	12	5	6	2	4	–	–	–	10.71
Weymouth, ...	3	4	5	4	6	4	8	3	6	12	18	22	20	24	16	8	3	1	1	–	14.18
Whitman, ...	2	1	2	4	4	2	4	2	5	2	8	12	6	13	7	5	1	–	–	–	12.13
Williamstown, ...	1	1	1	1	1	4	1	4	3	3	6	2	6	7	4	–	2	1	–	–	16.17
Winchendon, ...	1	1	1	1	3	4	4	2	7	7	4	7	11	6	4	3	2	1	–	–	16.02
Winchester, ...	1	1	1	2	1	5	6	3	5	6	14	8	12	11	3	4	3	–	–	–	11.06
Winthrop, ...	1	2	1	4	2	3	5	8	6	11	15	19	10	9	13	1	3	–	–	–	9.99
Woburn, ...	3	5	8	5	4	11	7	11	18	9	12	24	9	19	9	14	3	–	–	–	13.41
Worcester,[2]	29	42	67	90	83	123	133	143	155	149	175	151	147	150	105	46	17	3	2	–	14.68[3]
	574	887	1,443	1,475	1,542	2,020	2,147	2,354	2,511	2,740	3,080	3,290	3,170	2,757	1,914	1,003	412	94	16	45	14.58

[1] Insane hospital, 120 included.
[2] Insane hospitals, 223 included.
[3] In obtaining this death-rate, deaths occurring in public institutions were not included, many being nonresidents.

TABLE III.

Deaths from Specified Causes in Cities and Towns having more than 5,000 Inhabitants in Each, 1913.

	Anterior Poliomyelitis.	Actinomycosis.	Asiatic Cholera.	Cerebro-spinal Meningitis.	Diphtheria.	Glanders.	Leprosy.	Malignant Pustule.	Measles.	Ophthalmia Neonatorum.	Scarlet Fever.	Smallpox.	Tetanus.	Trachoma.	Trichinosis.	Tuberculosis, Pulmonary.	Tubercular Meningitis.	Tuberculosis (other forms).	Typhoid Fever.	Typhus Fever.	Varicella.	Whooping Cough.	Yellow Fever.	Cancer.	Malarial Fever.	Influenza.
Abington,	–	–	–	1	–	–	–	–	1	–	2	–	–	–	–	2	2	–	–	–	–	–	–	5	–	1
Adams,	–	–	–	–	–	–	–	–	–	–	12	–	–	–	–	13	–	2	2	–	–	–	–	4	–	–
Amesbury,	–	–	–	–	–	–	–	–	–	2	–	–	–	–	–	15	–	–	1	–	–	–	–	15	–	2
Amherst,	–	–	–	3	–	–	–	–	–	–	9	–	–	–	–	6	–	–	–	–	–	1	–	7	–	–
Andover,	–	–	–	–	1	–	–	–	2	–	–	–	–	–	–	10	–	–	1	–	–	–	–	9	–	1
Arlington,	–	–	–	2	–	–	–	–	1	–	–	–	–	–	–	16	4	1	–	–	–	–	–	9	–	–
Athol,	–	–	–	–	–	–	–	–	1	–	–	–	–	–	–	5	–	1	2	–	–	–	–	10	–	–
Attleborough,	–	–	–	2	1	–	–	–	1	–	3	–	–	–	–	18	–	1	–	–	–	1	–	7	–	–
Belmont,	–	–	–	–	1	–	–	–	–	–	–	–	–	–	–	5	–	1	–	–	–	–	–	10	–	1
Beverly,	–	–	–	–	2	–	–	–	–	–	–	–	1	–	–	10	3	5	3	–	–	1	–	31	–	1
Blackstone,	–	–	–	3	2	–	–	–	–	–	–	–	–	–	–	8	–	–	–	–	–	1	–	4	–	–
Boston,	7	1	–	37	156	1	–	1	77	–	77	–	7	–	–	1,064	124	72	60	–	1	97	–	841	–	27
Braintree,	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	3	–	–	–	–	–	–	–	8	–	2
Bridgewater,	–	–	–	–	–	–	–	–	–	–	2	–	–	–	–	11	–	1	–	–	–	1	–	6	–	–
Brockton,	4	–	–	2	16	–	–	–	2	–	1	–	–	–	–	45	5	6	1	–	–	3	–	52	–	5
Brookline,	–	–	–	–	1	–	–	–	–	–	–	–	–	–	–	13	1	2	–	–	–	–	–	46	–	1

TABLE III. — *Continued.*

	Anterior Poliomyelitis.	Actinomycosis.	Asiatic Cholera.	Cerebro-spinal Meningitis.	Diphtheria.	Glanders.	Leprosy.	Malignant Pustule.	Measles.	Ophthalmia Neonatorum.	Scarlet Fever.	Smallpox.	Tetanus.	Trachoma.	Trichinosis.	Tuberculosis, Pulmonary.	Tubercular Meningitis.	Tuberculosis (other forms).	Typhoid Fever.	Typhus Fever.	Varicella.	Whooping Cough.	Yellow Fever.	Cancer.	Malarial Fever.	Influenza.
Cambridge,	2	-	-	3	14	-	-	-	12	-	-	-	1	-	-	195	10	8	10	-	-	11	-	87	-	15
Chelmsford,	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5	-	-	1	-	-	-	-	-	-	2
Chelsea,	-	-	-	3	3	-	-	-	1	-	-	-	-	-	-	34	-	3	5	-	-	3	-	45	-	-
Chicopee,	-	-	-	1	7	-	-	-	1	-	6	-	-	-	-	26	4	8	3	-	-	-	-	12	-	-
Clinton,	-	-	-	-	2	-	-	-	4	-	-	-	1	-	-	12	3	2	1	-	-	-	-	9	-	-
Concord,	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Danvers,	-	-	-	3	1	-	-	-	-	-	-	-	-	-	-	11	-	14	-	-	-	5	-	18	-	-
Dedham,	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-	10	2	2	1	-	-	2	-	16	-	-
Easthampton,	-	-	-	-	1	-	-	-	1	-	1	-	-	-	-	2	1	5	-	-	-	-	-	3	-	-
Easton,	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5	-	-	-	-	-	-	-	4	-	1
Everett,	-	-	-	1	-	-	-	-	1	-	5	-	2	-	-	34	2	2	1	-	-	9	-	30	-	1
Fairhaven,	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	3	2	-	-	-	-	-	-	6	-	-
Fall River,	3	-	-	2	31	-	-	-	34	2	20	-	-	-	-	159	-	-	12	-	-	10	-	82	-	1
Fitchburg,	-	-	-	1	7	-	-	-	19	-	1	-	-	-	-	-	-	-	-	-	-	-	-	36	-	3
Framingham,	3	-	-	2	1	-	-	-	-	-	-	-	-	-	-	18	4	1	-	-	-	-	-	9	-	1
Franklin,	-	-	-	-	-	-	-	-	-	-	2	-	1	-	-	3	-	-	-	-	-	-	-	5	-	-
Gardner,	-	-	-	-	3	-	-	-	3	-	3	-	-	-	-	7	1	2	-	-	-	-	-	12	-	2
Gloucester,	-	1	-	2	2	-	-	-	-	-	-	-	1	-	-	25	1	7	2	-	-	-	-	15	-	1

Grafton,	-	-	-	-	1	-	-	-	1	-	-	-	-	-	-	8	-	1	1	-	-	-	-	2	-	-
Great Barrington,	-	-	-	-	-	-	-	-	1	-	-	-	1	-	-	4	1	1	1	-	-	-	-	5	-	-
Greenfield,	-	-	-	-	3	-	-	-	1	-	2	-	1	-	-	4	1	2	1	-	-	5	-	9	-	-
Haverhill,	3	-	-	8	7	-	-	-	9	1	-	-	-	-	-	51	8	2	2	-	-	8	-	39	-	5
Hingham,	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	1	1	-	-	-	-	-	-	4	-	-
Holyoke,	-	-	-	-	26	-	-	-	7	-	25	-	-	-	-	73	12	7	4	-	-	6	-	36	-	3
Hudson,	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	4	-	1	-	-	-	-	-	3	-	1
Ipswich,	-	-	-	-	-	-	-	-	3	-	-	-	-	-	-	5	1	3	1	-	-	1	-	8	-	-
Lawrence,	4	-	-	4	9	-	-	-	19	-	3	-	-	-	-	108	15	11	11	-	-	7	-	63	-	2
Leominster,	-	-	-	2	13	-	-	-	1	-	-	-	-	-	-	14	1	3	1	-	-	-	-	12	-	-
Lexington,	-	-	-	-	-	-	-	-	-	-	2	-	-	-	-	3	-	-	1	-	-	-	-	4	-	-
Lowell,	3	-	-	10	34	-	-	-	7	-	3	-	-	-	-	93	18	12	11	-	-	4	-	78	1	2
Ludlow,	-	-	-	-	2	-	-	-	2	-	-	-	-	-	-	5	1	-	1	-	-	1	-	5	-	-
Lynn,	-	-	-	3	15	-	-	-	1	-	5	-	3	-	-	87	3	13	12	-	-	8	-	72	-	4
Malden,	-	-	-	6	16	-	-	-	6	-	2	-	-	-	-	32	-	7	2	-	-	2	-	50	-	2
Mansfield,	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	6	-	1	1	-	-	-	-	8	-	1
Marblehead,	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	-	-	-	-	-	2	-	11	-	-
Marlborough,	-	-	-	1	1	-	-	-	-	-	-	-	-	-	-	25	3	-	2	-	-	-	-	17	-	-
Maynard,	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	8	-	3	1	-	-	-	-	2	-	1
Medford,	1	-	-	-	1	-	-	-	1	-	1	-	-	-	-	15	-	4	1	-	-	1	-	30	-	1
Melrose,	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	7	2	-	2	-	-	1	-	21	-	2
Methuen,	-	-	-	-	-	-	-	-	1	-	2	-	-	-	-	10	3	3	-	-	-	1	-	4	-	-
Middleborough,	-	-	-	1	1	-	-	-	-	-	1	-	1	-	-	6	-	1	-	-	-	-	-	12	-	2
Milford,	-	-	-	3	1	-	-	-	-	-	-	-	-	-	-	14	2	-	2	-	-	-	-	16	-	1
Milton,	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4	-	2	-	-	-	-	-	7	-	-

TABLE III. — *Continued.*

	Anterior Poliomyelitis.	Actinomycosis.	Asiatic Cholera.	Cerebro-spinal Meningitis.	Diphtheria.	Glanders.	Leprosy.	Malignant Pustule.	Measles.	Ophthalmia Neonatorum.	Scarlet Fever.	Smallpox.	Tetanus.	Trachoma.	Trichinosis.	Tuberculosis, Pulmonary.	Tubercular Meningitis.	Tuberculosis (other forms).	Typhoid Fever.	Typhus Fever.	Varicella.	Whooping Cough.	Yellow Fever.	Cancer.	Malarial Fever.	Influenza.
Monson,	–	–	–	1	–	–	–	–	–	–	–	–	–	–	–	3	–	–	1	–	–	–	–	7	–	–
Montague,	–	–	–	–	1	–	–	–	–	–	–	–	–	–	–	5	1	1	–	–	–	–	–	11	–	–
Natick,	–	–	–	1	–	–	–	–	–	–	–	–	–	–	–	4	–	1	1	–	–	1	–	9	–	3
Needham,	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	5	–	2	–	–	–	–	–	9	–	–
New Bedford,	–	–	–	–	35	–	–	–	5	–	1	–	1	–	–	112	24	2	10	–	–	4	–	88	–	–
Newburyport,	1	–	–	1	3	–	–	–	–	–	–	–	–	–	–	19	2	2	3	–	–	–	–	22	–	–
Newton,	–	–	–	–	1	–	–	–	–	–	3	–	–	–	–	19	5	3	2	–	–	–	–	38	–	1
North Adams,	–	–	–	2	7	–	–	–	–	–	–	–	–	–	–	18	3	4	7	–	–	–	–	22	–	–
Northampton,	1	–	–	–	1	–	–	–	–	–	–	–	–	–	–	28	2	3	–	–	–	–	–	16	–	1
North Andover,	–	–	–	–	–	–	–	–	–	–	1	–	–	–	–	10	1	2	–	–	–	–	–	10	–	–
North Attleborough,	–	–	–	–	2	–	–	1	–	–	–	–	–	–	–	11	–	–	3	–	–	4	–	10	–	–
Northbridge,	–	–	–	5	1	–	–	–	2	–	–	–	1	–	–	8	2	2	–	–	–	–	–	8	–	1
Norwood,	–	–	–	–	–	–	–	–	1	–	1	–	–	–	–	6	1	–	–	–	–	1	–	3	1	1
Orange,	–	–	–	1	–	–	–	–	–	–	–	–	–	–	–	2	–	2	1	–	–	–	–	5	–	–
Palmer,	–	–	–	1	2	–	–	–	1	–	1	–	–	–	–	9	3	2	2	–	–	–	–	–	–	1
Peabody,	–	–	–	1	4	–	–	–	–	–	2	–	–	–	–	17	6	–	3	–	–	2	–	16	–	2
Pittsfield,	–	–	–	15	6	–	–	–	–	–	13	–	–	–	–	39	13	–	6	–	–	–	–	36	–	–
Plymouth,	–	–	–	–	1	–	–	–	–	–	1	–	–	–	–	7	–	1	3	–	–	–	–	14	–	1

Quincy,	2	–	–	2	8	–	–	–	2	–	–	–	–	–	–	35	6	5	3	–	–	5	–	32	–	1
Reading,	–	–	–	1	–	–	–	–	–	–	–	–	–	–	–	5	–	–	–	–	–	–	–	11	–	–
Revere,	4	–	–	–	1	–	–	–	–	–	–	–	–	–	–	22	5	1	1	–	–	1	–	17	–	1
Rockland,	–	–	–	1	–	–	–	–	–	–	5	–	–	–	–	7	1	–	–	–	–	–	–	10	–	–
Salem,	2	–	–	3	7	–	–	–	1	–	2	–	–	–	–	42	4	5	7	6	–	–	–	35	–	1
Saugus,	–	–	–	–	–	–	–	–	–	–	2	–	1	–	–	4	2	3	5	–	–	–	–	7	–	5
Somerville,	1	1	–	–	13	–	–	–	5	–	4	–	1	–	–	69	15	3	6	–	–	1	–	62	–	–
Southbridge,	1	–	–	1	1	–	–	–	–	–	1	–	–	–	–	8	–	1	–	–	–	–	–	7	–	–
South Hadley,	–	–	–	–	1	–	–	–	1	–	1	–	–	–	–	1	–	1	–	–	–	–	–	3	–	1
Spencer,	–	–	–	2	–	–	–	–	–	–	–	–	–	–	–	9	2	–	–	–	–	–	–	8	–	–
Springfield,	1	–	–	–	16	–	–	–	9	–	3	–	1	–	–	73	15	11	20	–	1	6	–	109	1	17
Stoneham,	–	–	–	1	–	–	–	–	–	–	1	–	–	–	–	4	–	3	–	–	–	1	–	17	–	–
Stoughton,	–	–	–	2	1	–	–	–	4	–	–	–	–	–	–	7	–	1	–	–	–	–	–	7	–	–
Swampscott,	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	3	–	2	1	–	–	–	–	1	–	–
Taunton,	2	–	–	1	4	–	–	–	2	–	11	–	1	–	–	50	6	3	3	1	–	1	–	30	–	6
Wakefield,	–	–	–	7	–	–	–	–	–	–	–	–	–	–	–	3	–	11	–	–	–	–	–	22	–	–
Walpole,	–	–	–	1	–	–	–	–	–	–	–	–	–	–	–	1	–	–	–	–	–	–	–	4	–	–
Waltham,	–	–	–	–	7	–	–	–	–	–	1	–	1	–	–	30	3	2	–	–	–	–	–	22	–	1
Ware,	–	–	–	–	3	–	–	–	–	–	–	–	–	–	–	12	2	1	–	–	–	3	–	9	–	1
Watertown,	–	–	–	2	1	–	–	–	–	–	–	–	–	–	–	12	1	3	–	–	–	–	–	6	–	1
Webster,	–	–	–	3	5	–	–	1	–	–	2	–	–	–	–	10	1	2	–	–	–	2	–	12	1	1
Wellesley,	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	3	1	–	–	–	–	–	–	1	–	–
Westborough,	–	–	–	–	1	–	–	–	–	–	–	–	–	–	–	15	–	3	–	–	–	–	–	11	–	1
Westfield,	1	–	–	–	2	–	–	–	2	–	1	–	–	–	–	11	–	1	–	–	–	–	–	15	–	–
West Springfield,	1	–	–	–	–	–	–	–	–	–	–	–	–	–	4	5	1	–	–	–	–	–	–	8	–	–

TABLE III. — *Continued.*

	Anterior Poliomyelitis.	Actinomycosis.	Asiatic Cholera.	Cerebro-spinal Meningitis.	Diphtheria.	Glanders.	Leprosy.	Malignant Pustule.	Measles.	Ophthalmia Neonatorum.	Scarlet Fever.	Smallpox.	Tetanus.	Trachoma.	Trichinosis.	Tuberculosis, Pulmonary.	Tubercular Meningitis.	Tuberculosis (other forms).	Typhoid Fever.	Typhus Fever.	Varicella.	Whooping Cough.	Yellow Fever.	Cancer.	Malarial Fever.	Influenza.
Weymouth, ...	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	17	1	2	-	-	-	-	-	19	-	-
Whitman, ...	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	2	2	1	-	-	-	-	5	-	-
Williamstown, . . .	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	4	-	-	-	-	-	-	-	-	-	-
Winchendon, . . .	-	-	-	1	-	-	-	-	2	-	-	-	-	-	-	2	1	1	1	-	-	-	-	8	-	-
Winchester, . . .	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	11	1	-	-	-	-	2	-	10	-	-
Winthrop, ...	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	2	-	1	1	-	-	-	-	14	-	-
Woburn, ...	-	-	-	2	-	-	-	-	1	-	1	-	-	-	-	9	-	-	1	-	-	-	-	9	-	-
Worcester, ...	-	-	-	19	33	-	-	-	17	-	11	-	3	-	-	148	26	32	9	-	-	9	-	171	-	10
	51	3	-	187	553	1	-	3	277	5	261	-	31	-	4	3,342	400	350	265	7	2	235	-	2,997	4	153

TABLE III. — *Continued.*

	Erysipelas.	Diabetes.	Alcoholism.	Diseases of the Nervous System.	Organic Diseases of the Heart.	Pneumonia.	Broncho Pneumonia.	Bronchitis.	Diarrhœa and Enteritis under 2 Years.	Diarrhœa and Enteritis 2 Years and over.	Dysentery.	Cholera Nostras.	Acute Nephritis and Bright's Disease.	Puerperal Fever.	Homicide.	Suicide.	Electric Cars.	Motor Vehicles.	Steam Railroads.	Teams.	Elevators.	Illuminating Gas Poisoning.	All Other External Causes.	Unknown or Ill-defined.	All Other Causes.
Abington,	–	1	–	2	6	1	–	2	4	1	–	–	5	–	–	1	–	–	1	–	–	–	2	–	33
Adams,	–	–	–	20	17	11	–	3	5	–	1	–	7	–	–	2	–	–	–	–	–	–	2	–	78
Amesbury,	2	–	–	17	29	15	–	2	7	–	–	8	34	–	–	3	–	–	–	–	–	–	7	–	14
Amherst,	2	4	–	–	24	6	6	2	1	–	1	–	12	–	–	–	–	–	–	–	–	–	6	–	16
Andover,	–	4	–	–	25	5	5	5	2	–	–	–	6	–	–	1	–	–	1	–	–	–	–	–	43
Arlington,	1	3	–	–	29	11	3	3	8	–	–	–	2	–	1	2	–	1	1	–	–	–	3	–	59
Athol,	1	2	1	2	19	11	9	1	6	–	1	–	8	–	–	2	–	–	1	–	–	–	4	2	35
Attleborough,	1	7	2	5	23	14	4	3	8	1	1	5	16	2	1	2	2	1	–	1	–	–	4	12	60
Belmont,	–	2	–	17	8	5	–	2	1	–	–	–	4	–	–	2	1	–	–	–	–	–	1	–	26
Beverly,	–	1	1	–	53	18	9	7	5	–	–	–	9	–	1	3	–	–	4	2	–	–	13	–	110
Blackstone,	–	–	–	9	16	10	5	–	1	1	1	–	17	3	–	1	–	–	–	–	–	–	3	–	7
Boston,	44	138	159	882	1,629	924	528	121	525	78	7	–	767	50	36	103	33	42	69	37	25	24	503	25	2,431
Braintree,	–	1	–	–	14	7	6	3	1	–	–	–	6	–	1	3	–	1	3	–	–	–	7	–	52
Bridgewater,	–	–	1	–	6	3	3	–	1	1	–	–	5	–	–	–	–	1	2	–	–	–	6	–	55
Brockton,	1	9	3	68	110	32	12	15	24	5	2	–	35	3	1	8	5	–	–	–	–	–	24	17	165
Brookline,	1	7	–	51	73	27	10	2	2	6	–	–	18	–	–	2	1	–	1	1	–	–	6	–	76
Cambridge,	3	17	4	124	149	118	78	24	86	9	4	1	81	5	4	15	5	5	9	1	2	3	56	1	298

TABLE III. — *Continued.*

	Erysipelas.	Diabetes.	Alcoholism.	Diseases of the Nervous System.	Organic Diseases of the Heart.	Pneumonia.	Broncho Pneumonia.	Bronchitis.	Diarrhœa and Enteritis under 2 Years.	Diarrhœa and Enteritis 2 Years and over.	Dysentery.	Cholera Nostras.	Acute Nephritis and Bright's Disease.	Puerperal Fever.	Homicide.	Suicide.	Electric Cars.	Motor Vehicles.	Steam Railroads.	Teams.	Elevators.	Illuminating Gas Poisoning.	All Other External Causes.	Unknown or Ill-defined.	All Other Causes.
Chelmsford,	–	–	–	–	1	4	1	–	1	–	–	–	–	–	–	3	–	2	–	–	–	1	4	–	46
Chelsea,	2	5	5	62	131	40	34	9	26	3	3	–	65	5	3	3	2	4	4	2	–	4	27	11	135
Chicopee,	1	3	–	48	21	9	20	11	34	4	1	–	7	–	1	3	1	1	1	–	–	–	7	–	137
Clinton,	1	2	–	29	10	9	8	2	–	2	–	–	3	–	–	1	–	1	4	–	–	–	1	4	46
Concord,	–	–	–	17	11	6	–	–	–	–	–	–	8	–	–	1	1	–	–	–	–	–	1	–	26
Danvers,	1	–	1	12	25	15	–	2	–	–	4	–	9	–	–	–	–	–	–	–	–	–	1	–	11
Dedham,	–	4	–	16	23	8	6	3	2	3	1	–	6	–	1	1	1	5	–	–	–	–	3	–	26
Easthampton,	–	1	1	–	13	6	3	3	5	–	–	–	10	–	1	–	–	1	2	–	–	–	4	–	45
Easton,	–	1	–	–	10	3	7	–	2	1	–	–	2	–	–	1	–	–	–	–	–	–	3	–	30
Everett,	–	4	–	34	64	26	15	11	5	2	–	–	26	–	–	3	1	6	3	–	–	–	14	20	104
Fairhaven,	–	–	–	–	15	7	–	1	2	4	2	–	6	–	–	2	–	–	–	–	–	–	6	–	25
Fall River,	2	16	9	190	227	154	205	77	55	–	2	–	120	–	–	11	–	2	–	–	–	8	67	19	617
Fitchburg,	3	8	1	56	56	40	32	8	20	–	–	–	17	–	4	2	–	2	5	1	–	–	9	7	210
Framingham,	–	2	–	18	37	24	18	–	7	3	–	–	20	–	–	1	–	–	3	–	–	1	3	3	34
Franklin,	–	2	–	15	14	6	1	4	2	2	–	–	3	–	–	–	1	–	1	–	–	1	3	–	19
Gardner,	1	–	2	18	17	12	9	5	10	2	–	–	–	–	–	–	1	–	4	–	–	–	9	–	73
Gloucester,	–	–	2	42	66	27	13	6	10	1	1	–	34	–	–	1	2	1	–	2	–	1	43	–	27
Grafton,	3	1	–	–	7	3	3	1	1	–	–	–	1	–	1	1	1	–	2	–	–	–	1	–	65

Great Barrington,	-	1	-	-	19	5	4	1	2	2	-	6	9	-	-	1	-	1	5	-	-	-	1	-	28
Greenfield,	-	2	1	6	16	9	2	6	5	4	1	-	9	-	-	2	-	-	4	-	-	-	6	6	55
Haverhill,	-	6	9	55	73	67	23	6	23	2	-	-	46	6	2	7	5	1	3	-	1	5	23	17	138
Hingham,	-	-	-	-	11	8	-	2	-	-	1	-	4	-	-	-	1	-	-	-	-	-	5	1	38
Holyoke,	2	8	-	82	99	71	67	9	118	5	-	-	65	3	-	5	-	-	-	-	3	54	-	1	217
Hudson,	-	2	-	14	15	6	-	4	2	-	-	1	8	-	-	1	-	-	2	1	-	-	13	-	-
Ipswich,	-	2	1	6	14	8	4	-	5	-	-	-	3	-	2	1	-	-	2	-	-	-	5	2	26
Lawrence,	2	8	10	36	117	64	66	23	10	2	5	-	45	-	1	5	1	2	8	-	1	2	31	17	565
Leominster,	-	3	1	2	36	17	13	2	9	4	1	-	20	1	-	3	-	2	-	1	1	1	8	-	106
Lexington,	-	4	1	8	12	5	7	-	2	-	-	-	2	-	-	1	-	2	-	-	-	-	4	20	7
Lowell,	-	12	5	163	332	108	75	37	174	27	4	-	117	3	-	14	4	5	5	4	-	4	44	10	326
Ludlow,	-	-	-	10	13	3	13	-	17	3	-	-	6	1	1	1	1	-	3	-	-	-	-	1	6
Lynn,	1	20	11	48	107	135	-	21	6	5	1	18	71	5	5	9	-	7	5	-	-	6	29	5	391
Malden,	2	3	1	57	78	28	19	2	19	2	-	-	39	2	-	7	2	1	1	1	1	-	7	-	130
Mansfield,	-	1	-	-	17	-	6	-	3	2	-	-	5	-	-	-	-	-	2	-	-	-	3	-	25
Marblehead,	-	-	-	-	17	4	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	46
Marlborough,	-	2	-	8	33	12	3	1	2	3	-	2	6	-	-	2	-	2	-	-	-	-	2	-	85
Maynard,	-	-	-	-	8	4	7	-	8	-	-	-	5	1	-	1	-	-	-	-	-	-	1	-	28
Medford,	-	5	-	-	20	18	12	5	-	-	-	-	34	-	-	4	-	-	4	-	-	-	2	-	126
Melrose,	-	3	2	33	32	20	5	3	3	-	-	-	8	1	-	2	-	1	1	1	-	-	2	-	43
Methuen,	1	-	1	1	18	12	14	5	-	-	-	-	11	-	-	4	-	-	-	-	-	-	11	4	103
Middleborough,	-	3	-	16	28	5	-	2	3	1	1	-	6	-	-	-	-	-	-	-	-	-	9	-	15
Milford,	2	2	-	4	22	23	-	3	-	1	10	4	21	-	-	2	-	-	-	-	-	-	9	-	78
Milton,	1	2	1	-	20	12	1	3	-	-	-	-	8	-	-	-	-	-	-	-	-	-	1	-	36
Monson,	-	1	-	-	13	2	2	3	3	-	-	-	4	1	-	1	-	-	-	1	-	-	2	-	15

TABLE III. — *Continued.*

	Erysipelas.	Diabetes.	Alcoholism.	Diseases of the Nervous System.	Organic Diseases of the Heart.	Pneumonia.	Broncho Pneumonia.	Bronchitis.	Diarrhœa and Enteritis under 2 Years.	Diarrhœa and Enteritis 2 Years and over.	Dysentery.	Cholera Nostras.	Acute Nephritis and Bright's Disease.	Puerperal Fever.	Homicide.	Suicide.	Electric Cars.	Motor Vehicles.	Steam Railroads.	Teams.	Elevators.	Illuminating Gas Poisoning.	All Other External Causes.	Unknown or Ill-defined.	All Other Causes.
Montague,	-	1	-	3	20	7	5	3	5	1	-	-	8	1	-	5	1	-	4	-	-	-	8	9	25
Natick,	-	1	2	2	42	6	5	-	7	5	-	-	12	-	-	1	-	-	1	-	1	1	8	22	38
Needham,	-	-	-	8	13	9	-	2	-	-	-	-	2	-	-	2	-	-	-	-	-	-	6	-	16
New Bedford,	6	2	8	138	138	105	156	38	243	1	1	-	54	-	1	16	-	7	-	-	-	5	4	27	441
Newburyport,	1	2	-	26	10	22	12	3	6	2	1	-	18	-	-	2	1	1	2	-	-	-	9	-	87
Newton,	1	5	2	56	52	38	14	7	9	3	1	-	24	4	-	7	-	1	2	2	-	-	-	2	181
North Adams,	4	1	2	31	43	19	10	10	12	1	1	-	12	1	-	1	1	1	4	1	-	1	8	1	112
Northampton,	2	1	-	62	37	23	4	5	12	1	3	-	25	-	-	6	-	-	5	-	-	-	13	6	114
North Andover,	-	1	-	3	8	6	-	1	-	-	2	-	7	-	-	-	-	-	-	-	-	-	7	-	14
North Attleborough,	1	-	-	10	17	9	-	3	2	2	-	-	8	-	-	-	-	1	1	-	-	-	4	-	17
Northbridge,	-	3	-	2	12	1	14	1	8	1	1	-	9	2	-	-	-	-	4	-	1	-	4	-	30
Norwood,	-	2	-	10	23	4	5	3	3	1	-	-	2	-	-	2	-	-	1	-	-	-	1	-	17
Orange,	-	3	-	10	21	7	-	1	-	-	-	-	4	-	-	3	-	-	-	-	-	-	4	1	32
Palmer,	1	1	-	4	19	5	10	1	1	1	-	-	8	-	-	1	1	-	3	-	-	-	7	-	68
Peabody,	-	-	-	15	57	11	12	7	11	-	-	-	-	-	12	-	-	-	-	-	-	-	14	-	61
Pittsfield,	-	9	-	56	101	80	12	6	7	9	3	7	54	2	-	3	1	2	16	2	-	3	28	-	142
Plymouth,	2	3	-	32	34	11	6	-	9	-	-	-	17	-	-	3	-	-	-	-	-	-	7	-	57
Quincy,	2	8	5	55	73	39	20	10	18	4	-	-	25	-	-	8	-	3	5	1	-	-	24	2	72

Reading,	-	2	-	9	22	8	-	2	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	16
Revere,	1	3	-	21	36	14	9	3	11	1	-	-	11	-	-	2	-	1	-	-	-	1	6	9	30
Rockland,	-	-	1	2	22	5	2	-	4	2	-	-	13	-	-	1	-	-	-	-	-	-	3	-	24
Salem,	1	8	1	54	116	48	28	16	60	8	10	-	31	-	-	4	-	1	9	-	-	-	22	1	166
Saugus,	1	1	-	9	18	6	3	2	6	4	1	-	12	2	-	1	-	-	-	-	-	-	2	8	5
Somerville,	1	7	-	97	178	96	31	13	37	13	2	-	51	-	-	4	1	2	6	1	1	1	21	-	249
Southbridge,	1	4	-	7	18	27	1	1	12	-	1	-	16	1	-	-	-	-	-	-	-	1	4	15	24
South Hadley,	-	-	-	-	9	5	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	7	3	38
Spencer,	-	1	-	9	12	5	5	2	5	-	1	-	1	-	-	-	-	2	1	-	-	-	-	12	8
Springfield,	4	21	20	122	134	93	64	15	81	7	1	1	160	7	6	16	8	3	9	-	2	6	1	5	395
Stoneham,	-	6	1	11	36	7	4	3	-	-	1	-	6	1	-	1	-	2	-	-	-	-	5	28	-
Stoughton,	-	-	-	4	13	5	3	1	4	-	-	-	5	-	-	1	-	2	-	-	-	-	4	-	27
Swampscott,	-	-	-	-	7	8	3	-	-	-	1	-	-	-	1	-	-	-	2	-	-	2	5	-	58
Taunton,	5	9	1	86	75	51	39	6	46	9	4	11	24	-	1	1	-	-	-	-	-	-	20	-	191
Wakefield,	1	1	-	-	15	12	11	1	-	-	1	-	8	-	-	-	-	2	2	-	-	1	3	-	71
Walpole,	-	-	-	-	5	2	3	2	1	-	-	-	-	-	-	-	-	-	-	-	-	-	5	-	30
Waltham,	2	4	2	49	51	38	7	3	9	2	-	-	21	4	-	3	1	-	3	-	-	-	7	16	86
Ware,	-	1	-	6	17	10	2	4	6	8	3	-	9	-	-	-	1	-	1	-	-	-	7	4	26
Watertown,	-	5	-	-	5	4	3	3	2	-	-	-	8	1	-	1	3	-	-	-	-	-	-	-	59
Webster,	-	5	1	12	19	15	3	3	13	1	5	-	8	3	-	2	-	-	-	-	-	-	6	30	9
Wellesley,	-	-	-	10	18	4	2	1	-	1	-	-	2	-	-	1	-	-	-	-	-	-	5	2	3
Westborough,	-	1	-	39	38	20	5	3	-	6	1	-	12	-	-	1	-	-	-	-	-	-	2	2	11
Westfield,	-	-	-	23	25	31	8	4	15	1	-	-	22	1	-	3	1	2	5	1	-	-	10	-	84
West Springfield,	-	7	-	-	21	19	4	-	8	-	-	-	8	-	-	-	1	1	-	-	-	-	6	-	12
Weymouth,	-	1	1	33	39	16	4	4	6	3	-	-	12	2	-	-	-	-	1	-	-	-	2	7	15

TABLE III. — *Concluded.*

	Erysipelas.	Diabetes.	Alcoholism.	Diseases of the Nervous System.	Organic Diseases of the Heart.	Pneumonia.	Broncho Pneumonia.	Bronchitis.	Diarrhœa and Enteritis under 2 Years.	Diarrhœa and Enteritis 2 Years and over.	Dysentery.	Cholera Nostras.	Acute Nephritis and Bright's Disease.	Puerperal Fever.	Homicide.	Suicide.	Electric Cars.	Motor Vehicles.	Steam Railroads.	Teams.	Elevators.	Illuminating Gas Poisoning.	All Other External Causes.	Unknown or Ill-defined.	All Other Causes.
Whitman,	–	2	1	7	22	8	3	3	–	2	–	–	6	1	1	1	2	–	–	–	–	–	3	–	10
Williamstown,	–	1	1	2	6	2	3	1	–	–	–	–	4	–	–	1	–	–	–	–	–	–	2	–	32
Winchendon,	–	1	–	–	11	8	3	–	–	–	–	–	4	–	–	1	–	1	–	–	–	–	3	–	43
Winchester,	–	2	1	13	17	5	6	1	4	–	–	–	6	–	–	–	–	2	–	1	–	–	6	–	21
Winthrop,	–	3	1	–	24	13	5	–	–	–	–	–	8	–	–	1	–	1	–	–	–	1	7	–	43
Woburn,	–	–	2	2	18	12	4	3	1	3	–	–	16	–	–	1	–	1	2	–	–	1	10	–	114
Worcester,	10	35	13	286	271	173	98	34	156	37	–	–	131	8	6	26	–	–	–	–	–	–	118	2	648
	128	509	302	3,739	6,286	3,435	2,047	720	2,123	332	101	64	2,826	133	96	390	95	139	255	65	39	139	1,529	419	11,939

Abscess of lung: —	
Whitman,	1
Acute indigestion: —	
Whitman,	1
Addison's disease: —	
Attleborough,	1
Anæmia, pernicious: —	
Leominster,	2
Middleborough,	3
Montague,	1
	6
Aneurism of the aorta: —	
Leominster,	1
Foramen ovale: —	
Whitman,	2
Heat prostration: —	
Haverhill,	2
Taunton,	1
Hemorrhage of stomach: —	
Ipswich,	1
Hodgkins' disease: —	
Athol,	1
Hook worm: —	
Leominster,	1
Hydrocephalus: —	
Monson,	1
Hypernephroma: —	
Plymouth,	1
Ostiosarcoma: —	
Plymouth,	1
Otitis media: —	
Monson,	1
Pellagra: —	
Boston,	4
Northampton,	2
Rockland,	1
Weymouth,	1
Whitman,	1
	9
Paralysis of bowels: —	
Weymouth,	1

Aneurism of the heart: —	
Leominster,	1
Aneurism, basilar: —	
Monson,	1
Congenital atelectasis: —	
Ludlow,	1
Convulsions, epilepsy: —	
Weymouth,	1
Eclampsia, infantile: —	
Weymouth,	1
Elephantiasis: —	
Lexington,	1
Embolism, puerperal: —	
Westborough,	1
Embolus, pulmonary: —	
Leominster,	1
Middleborough,	2
Weymouth,	1
	4
Exfoliative dermatitis: —	
Weymouth,	2
Fibroid of uterus: —	
Weymouth,	1
Inanition: —	
Whitman,	1
Inflammation of the bile duct: —	
Ipswich,	2
Intestinal obstruction: —	
Ipswich,	1
Whitman,	1
Marasmus from accident: —	
Monson,	1
Melæna: —	
Monson,	1
Meningitis, acute strepto: —	
Watertown,	1
Meningitis, septic: —	
Watertown,	1
Myocarditis: —	
Ipswich,	1
Monson,	1
Myxœdema: —	
Plymouth,	1
Œdema of lungs: —	
Whitman,	1
Omphalorrhagia hemorrhagic diathesis: —	
Weymouth,	1
Postpartum hemorrhage: —	
Ludlow,	1
Prolonged labor: —	
Ludlow,	1
Prostatitis, chronic: —	
Middleborough,	1
Pyæmia: —	
Ipswich,	1
Rupture of stomach: —	
Leominster,	1
Senile gangrene: —	
Monson,	1
Spine, sarcoma of: —	
Monson,	1
Spina bifida: —	
Natick,	2
Spinal pressure: —	
Monson,	1
Strangulated hernia: —	
Whitman,	1
Thrush: —	
Plymouth,	1
Tumor of brain: —	
Ipswich,	1

Table IV.

Deaths from Specified Causes, 1913, in Cities and Towns required to report to the State Board of Health, Death-rates per 10,000, 1909–13, Deaths per 1,000 from All Causes, 1909–13.[1]

Causes of Death.	Deaths, 1913.	Mortality per 10,000 of the Population.					Deaths per 1,000 from All Causes.				
		1913.	1912.	1911.	1910.	1909.	1913.	1912.	1911.	1910.	1909.
Anterior poliomyelitis,	51	0.16	0.11	0.12	-	-	1.09	0.72	0.77	-	-
Actinomycosis,	3	0.009	-	-	-	-	0.064	-	-	-	-
Asiatic cholera,	-	-	-	0.0033	-	-	-	-	0.021	-	-
Cerebro-spinal meningitis,	187	0.58	0.68	0.66	0.71	0.82	3.98	4.62	4.32	4.45	5.12
Diphtheria,	553	1.72	1.34	1.66	2.10	2.37	11.78	9.13	10.89	13.46	14.89
Glanders,	1	0.003	-	-	-	-	0.021	-	-	-	-
Leprosy,	-	-	-	-	-	-	-	-	-	-	-
Malignant pustule,	3	0.009	-	-	-	-	0.064	-	-	-	-
Measles,	277	0.86	0.92	0.64	0.86	0.66	5.90	6.27	4.22	5.33	4.14
Ophthalmia neonatorum,	5	0.016	-	-	-	-	0.11	-	-	-	-
Scarlet fever,	261	0.81	0.37	0.55	0.82	0.88	5.56	2.50	3.58	5.14	5.55
Smallpox,	-	-	0.003	0.01	-	0.0036	-	0.021	0.064	-	0.022
Tetanus,	31	0.10	-	-	-	-	0.66	-	-	-	-
Trachoma,	-	-	-	-	-	-	-	-	-	-	-
Trichinosis,	4	0.012	-	-	-	-	0.09	-	-	-	-
Tuberculosis, pulmonary,	3,342	10.37	10.72	11.11	12.60	13.38	71.18	73.03	72.89	78.52	84.07
Tubercular meningitis,	400	1.24	2.12	2.49	-	-	8.52	14.45	16.34	-	-
Tuberculosis (other forms),	350	1.09					7.45				

Typhoid fever,	265	0.82	0.77	0.85	1.26	1.35	5.64	5.25	5.92	7.84	8.49
Typhus fever,	7	0.022	–	–	–	–	0.15	–	–	–	–
Varicella,	2	0.006	–	–	–	–	0.43	–	–	–	–
Whooping cough,	235	0.73	0.71	1.12	0.76	0.92	5.00	4.86	7.31	4.74	5.76
Yellow fever,	–	–	–	–	–	–	–	–	–	–	–
Cancer,	2,997	9.30	9.01	8.63	8.53	8.33	63.83	61.42	56.57	53.17	52.33
Malarial fever,	4	0.012	0.006	0.03	0.02	0.05	0.09	0.043	0.21	0.15	0.32
Influenza,	153	0.47	0.37	0.54	0.81	0.80	3.26	2.54	3.56	5.08	5.03
Erysipelas,	128	0.40	0.46	0.53	0.59	0.55	2.73	3.10	3.45	3.66	3.48
Diabetes,	509	1.58	–	–	–	–	10.84	–	–	–	–
Alcoholism, acute or chronic,	302	0.94	–	–	–	–	6.43	–	–	–	–
Diseases of the nervous system and of the organs of special sense.	3,739	11.61	11.76	11.82	13.68	13.50	79.63	80.13	77.50	85.28	84.79
Organic diseases of the heart,	6,286	19.51	19.32	18.54	19.07	17.33	133.88	131.63	121.60	118.85	108.88
Pneumonia,	3,435	10.66	16.74	16.44	19.32	16.82	73.16	114.06	107.80	120.42	105.67
Broncho pneumonia,	2,047	6.35					43.60				
Bronchitis,	720	2.24	2.73	2.70	3.50	3.46	15.33	18.59	17.72	21.80	21.74
Diarrhœa and enteritis, under 2 years,	2,123	6.59	4.68	6.09	7.26	7.16	45.21	31.92	39.93	45.27	45.14
Diarrhœa and enteritis, 2 years and over,	332	1.03	4.80	3.24	–	–	7.07	32.76	21.25	–	–
Dysentery,	101	0.31	0.31	0.40	0.58	0.60	2.15	2.08	2.02	3.59	3.78
Cholera nostras,	64	0.20	–	–	–	–	1.36	–	–	–	–
Acute nephritis and Bright's disease,	2,826	8.77	9.57	9.19	9.31	8.96	60.19	62.50	60.28	58.04	56.27
Diabetes,	509	1.58					10.81				
Puerperal fever,	133	0.41	0.42	0.47	0.36	0.37	2.83	2.88	3.06	2.24	2.34

[1] The list of deaths from specified causes has been considerably increased for the year 1913; consequently, comparisons with previous years can be made only in part.

TABLE IV. — *Concluded.*

Causes of Death.	Deaths, 1913.	Mortality per 10,000 of the Population.					Deaths per 1,000 from All Causes.				
		1913.	1912.	1911.	1910.	1909.	1913.	1912.	1911.	1910.	1909.
Homicide,	96	0.30	–	–	–	–	2.04	–	–	–	–
Suicide,	390	1.21	1.27	1.23	1.20	1.25	8.31	8.68	8.11	7.46	7.85
Electric cars,	95	0.29					2.02				
Motor vehicles,	139	0.43					2.96				
Steam railroads,	255	0.79					5.43				
Teams,	65	0.20	6.67	6.80	6.15	6.03	1.38	45.43	44.58	38.35	37.86
Elevators,	39	0.12					0.83				
Illuminating gas poisoning,	139	0.43					2.96				
All other external causes,	1,529	4.75					32.56				
From unknown or ill-defined causes,	419	1.30	1.72	2.23	2.48	1.51	8.92	11.74	14.63	15.49	9.47
All causes,	46,954	145.76	146.74	152.47	161.43	159.17	–	–	–	–	–

SEVENTH ANNUAL REPORT

OF THE

WORK OF THE STATE INSPECTORS OF HEALTH.

BY THE ASSISTANT TO THE SECRETARY OF THE BOARD.

Seventh Annual Report of the Work of the State Inspectors of Health.

By the Assistant to the Secretary of the Board.

Following is a record of the proceedings and observations of the State Inspectors of Health for the year 1913, in accordance with the provisions of chapter 537 of the Acts of 1907.

The Legislature of 1912 enacted a law creating a State Board of Labor and Industries, and all duties of the State Inspectors of Health relative to the enforcement of laws in factories, workshops and mercantile establishments were transferred to that Board on June 1, 1913. These transferred duties are as follows: —

To inspect and license tenement-house workrooms where work is done on wearing apparel (chapter 537, Acts of 1907).

To enforce the provisions relative to the proper water-closets and seats for women in mercantile establishments (chapter 537, Acts of 1907).

To enforce all laws in factories and workshops relative to conditions affecting the health of persons employed in them (chapter 537, Acts of 1907), including the requirements as to cleanliness; the provision for mechanical ventilating apparatus; the protection of employees against dust caused by occupational processes; and the provision for adequate washing facilities and water closets in foundries.

To investigate lighting conditions in factories and workshops and eye injuries to the operatives (chapter 603, Acts of 1911).

To enforce the laws relative to the purity and use of water for humidifying purposes, and the regulation of humidity and temperature of the atmosphere in textile factories (chapter 543, Acts of 1910).

To prohibit the use of suction shuttles in factories (chapter 281, Acts of 1911).

To make rules relating to the employment of women in core rooms (chapter 653, Acts of 1912).

To inform themselves concerning the health of all minors employed in factories (chapter 537, Acts of 1907).

To exclude minors from occupations injurious to health (chapter 404, Acts of 1910).

Of the duties imposed on the State Inspectors of Health by the original act of 1907, and by subsequent legislation, the following remain in force: —

To gather information concerning all influences that are or may be dangerous to the public health (chapter 537, Acts of 1907).

To gather all information possible concerning the prevalence of tuberculosis and other diseases dangerous to the public health (chapter 537, Acts of 1907).

To disseminate knowledge as to the best methods of preventing the spread of such diseases and to take such steps as shall be deemed advisable for their eradication (chapter 537, Acts of 1907).

To aid the State Board of Health in the enforcement of laws relative to the maintenance of isolation hospitals, tuberculosis hospitals and tuberculosis dispensaries (chapter 613, Acts of 1911, as amended by chapter 151, Acts of 1912).

To assist the State Board of Health in the enforcement of laws relative to furnishing drinking water on passenger trains (chapter 581, Acts of 1912).

To make such examinations of school buildings as in the opinion of the State Board of Health the protection of the health of the pupils may require.

To inspect police station houses, lockups, houses of detention, jails, houses of correction, prisons and reformatories (chapter 405, Acts of 1910, as amended by chapter 282, Acts of 1911).

To perform such duties as the State Board of Health may impose upon them from time to time (chapter 537, Acts of 1907).

During the year the State Inspectors of Health have co-operated with and assisted local boards of health in the various problems of community health work, and in the eradication of communicable diseases. Conferences have been held by the State Inspectors of Health with the local boards of health. These conferences were often asked for by the local health officials who wished the guidance of the inspectors in dealing with local health matters.

Much educational work has been done by the State Inspectors of Health. Among some of the activities along these lines have been the reading of papers before medical societies, and civic and philanthropic organizations of all kinds, upon certain phases of communal health work; instruction and guidance of many local boards of health in the State as to methods of handling communicable diseases; distribution of literature to local authorities, and, whenever necessary, to citizens of the Commonwealth, upon the control and prevention of typhoid fever, tuberculosis, ophthalmia neonatorum, infantile mortality, etc.

DISEASES DANGEROUS TO THE PUBLIC HEALTH.

Tuberculosis.

The attention of a special committee of the State Inspectors of Health was directed toward an investigation of the tuberculosis situation in the State. This committee has gone extensively into the subject. The existing agencies dealing with tuberculosis in the various communities in the State have been carefully investigated, and hearings were given in different parts of the State upon the tuberculosis problem as it at present exists in Massachusetts. A vast amount of material has been gathered expressing the opinion of officials of State boards and commissions, superintendents of State hospitals and sanatoria, officers of municipal governments, local health officials, superintendents of schools, school physicians and nurses, superintendents of private hospitals and sanatoria, officials of anti-tuberculosis associations, officers of charity organizations, social service workers, officers of district nursing associations and district nurses, physicians, business men, clergymen, lawyers, representatives of labor unions, manufacturers, employees and others interested in the work. The report of this committee, with all the material obtained, was turned over to the State Board of Health, who, acting as a Joint Board with the Board of Trustees of Hospitals for Consumptives, had this matter under consideration in accordance with the requirements of chapter 112 of the Resolves of 1912.

In March an intensive study was begun of cases of tuberculosis discharged from the State sanatoria. By arrangement between the State Board of Health and the Trustees of Hospitals for Consumptives, notices of admissions and discharges from the sanatoria are sent to the office of the State Board of Health, thence to the State Inspectors of Health. The latter are thus enabled to follow up all cases discharged from sanatoria, visit them at their homes, and see that proper precautions are taken to safeguard the public health against the possible spread of the infection. Whenever necessary, recommendations are made to local boards of health as to necessary precautions to be taken, and in many instances letters are sent to the superintendents of the sanatoria from which the patients are discharged, informing them of the conditions of the patients.

Typhoid Fever.

In a preliminary report to the Massachusetts State Board of Health of a special committee composed of Harry Linenthal, M.D., Charles E. Simpson, M.D., Wm. W. Walcott, M.D., and Lyman Asa Jones, M.D., it was stated in part: —

It is conservatively estimated that there are 8 cases of typhoid fever for each death from this disease, though the proportion may be greater or less in individual outbreaks. Assuming this proportion as correct, *there are in Massachusetts each year over 70 cases of typhoid fever per 100,000 of population, equivalent to nearly 2,500 cases annually over and above the present rate in the European cities.* These cases are surely possible of prevention.

In view of the fact that typhoid fever is a preventable disease, and that its occurrence in the State as a whole is so pronounced, causing many unnecessary deaths, it is astonishing to find how many difficulties at present exist, when it comes to the matter of prevention.

I. Difficulties having to do with General Conditions.

A. Public Indifference.

Perhaps the greatest obstacle of all is the indifference, not only of the general public, but even of health authorities and physicians. Typhoid fever has been present so commonly year after year that it has come to be considered as a regular, almost a natural, feature of the life of the community. Through vaccination smallpox has been so far prevented that few people, including physicians, have ever seen a case. If a case is discovered, the disease occasions consternation, and the community submits to rigid regulations to prevent its spread. But the same community manifests comparatively little fear or uneasiness because of typhoid fever in its midst, even though, in individual years, the typhoid cases number a hundred for every case of smallpox.

B. Efficiency of Local Health Boards.

While many local boards of health are carrying on active campaigns with excellent results, other local authorities, more numerous, are handicapped, partly because they do not appreciate the importance of public health work, and partly because they do not know how to proceed, even though they may have every desire to do so. To a considerable extent this is the outgrowth of the system under which they are appointed.

In cities, under their charters, the members of the board of health are usually appointed by the mayor. In consequence it happens not infrequently that the membership of the board changes entirely when there is a change in the local administration, the new mayor appointing to the health board his personal friends or supporters. The new appointees may be entirely unfamiliar with health work; indeed, they may not even be interested in it.

Such course of action does not tend to secure an even and progressive administration of health laws.

In towns the law provides that one member of the board of health shall be elected annually to serve for a period of three years; in towns with a population of 5,000 or over it provides that one member shall be a physician. Were this latter practice universal much better health work would result.

Even under such circumstances difficulties arise. For example, two years ago Ipswich (population, 5,777) had an outbreak of typhoid fever, confined to the mill section, the thickly populated portion of the town. Following this outbreak the mill authorities established and carried out a rigid sanitary code, with the result that they have had no case of typhoid fever in that section of the town since.

The agent of the mill corporation, furthermore, and the medical member of the board of health became much interested in the sewage disposal of the town, and, with the idea of making typhoid outbreaks less likely in the future, advised the town to establish a sewer system for the thickly settled portion. The scattered farming portion of the population were thereby greatly incensed, however, and at the following election chose a layman in the physician's place, leaving no physician on the board.

The situation thus brought about being contrary to the law, the matter was referred to the courts, whereupon the physician was declared elected, since he had received the highest number of votes cast for a physician, and under the law a physician had to be chosen. Such an experience in health administration, however, is calculated to discourage even a strong official.

In towns where no health board is elected the law provides that the selectmen shall serve as a board of health. As a rule, the selectmen are elected annually for a period of one year, so that there is frequently a complete change of officials from one year to another. The selectmen, moreover, are more or less engrossed in the general affairs of the town, and oftentimes, desiring re-election, are slow to push health measures, even in the presence of an emergency, because such measures may involve inconvenience to voters whom they prefer not to antagonize. Even if they are interested and do try to accomplish something, they may be retired from office at the next election, and it then becomes necessary to begin all over again. Such possibility of change interferes seriously with any permanent health administration or policy, especially with any plan looking to joint action by adjoining or neighboring towns and municipalities.

C. Insufficient Funds.

Another obstacle to the carrying on properly of health work is the lack of sufficient funds. This lack grows out of the popular and official ignorance as to the value of health work already mentioned.

The idea has prevailed that the board of health existed merely to supply the means for the paying of political or other debts; that its work (which is too often the case) amounted to nothing; that there was little or nothing of importance for it to do, and that, in consequence, there was no real need for funds. Appropriations and salaries are always small; indeed, in many localities there is no appropriation whatever for health work. Bills incurred for health purposes are paid from the contingent or general funds after the selectmen or other officials have passed upon the necessity for the expenditure. Under the circumstances the wonder is not that so little has been accomplished, but that so much good work has been done.

To secure better results there must be greater permanency in health departments. Interested and competent officials are needed, and when secured their tenure of office should continue during their efficiency. They should be paid adequately. The public should be taught that ample funds are necessary for the carrying on of health work, and that, although much less spectacular, there is much more virtue in *preventing illness* than in merely overseeing an epidemic after it has occurred.

D. Summer Colonies.

Within the last few years interest in country life and out-of-door recreation, especially during the warm season, has led to the establishment of numerous pleasure parks, summer colonies, and other places where out-of-door living may be enjoyed. Within the State many such places have sprung up rapidly, and often dwellings are thickly crowded. The majority of these localities are without water supply other than the well, or means of sewage disposal other than the common privy.

In the absence of all sanitary regulation or supervision, the dangers from typhoid fever are great, there being many opportunities for the spread of the disease when once the infection is introduced. This criticism applies, also, to the many construction camps maintained in connection with steam and electric railway and power development during the past few years.

There is urgent need for State-wide sanitary regulation of such summer colonies and construction camps.

II. Difficulties having to do with the Agencies through which the Infection is spread.

The original source of typhoid infection is the infected individual himself, and the typhoid germs in his excretions. The manner in which the infection is conveyed to others varies greatly. In the great majority of instances typhoid infection gains entrance into the individual through the alimentary canal, the specific organisms being carried by polluted water, food or other means to the mouth. This pollution becomes possible only because, in some way, typhoidal excretions have not been thoroughly disinfected. A further consideration of the agencies through which the infection reaches the individual will disclose additional factors involved in any campaign for the prevention of typhoid fever.

A. Infection of the Water Supply.

A water supply may become infected in various ways. Sewage emptying into a lake or pond to be used as a public water supply may spread infection among the takers of the water, even though the case of typhoid fever be located at an isolated country house on the bank of some small feeder or tributary, the privy being placed possibly over the brook or so located that its contents are washed into the stream with the rain or melting snow. A well or a clear flowing spring may receive the leachings from a stable yard or privy located in close proximity.

A few examples may be cited: —

1. Infection of a public water supply from overhanging privies is very strikingly shown by the experience of Lowell and Lawrence in 1890–91. In Lowell there occurred probably over 1,000 cases of typhoid fever, while a little later there was an extensive outbreak in Lawrence, which is located nine miles farther down the Merrimac River, both cities obtaining their public water supply directly from the river.

In Lowell the infection was traced to several cases of typhoid fever in North Chelmsford, where the privies concerned overhung Stony Brook, a tributary of the Merrimac River, at a point above the location where the city of Lowell obtained its public supply. In Lawrence the public water supply was further polluted by the sewage of the city of Lowell.

2. The accidental infection of a public water supply is illustrated by the outbreak in 1904 at Millinocket, Me., at the headwaters of the Penobscot River. Valves were installed through which river water could be pumped to supplement the public supply in case of fire. Following such pumping, when the valves failed to act, some 200 cases of typhoid fever occurred, and later still some 600 cases of the disease occurred in Bangor and vicinity, places where the Penobscot River furnished the source of public water supply.

3. Typhoid discharges from a single patient thrown on the frozen ground and washed into the public supply with the spring thaws gave rise in 1885 to 1,100 cases of the disease at Plymouth, Pa., in a total population of but 8,000.

B. Infection of the Milk Supply.

Milk itself as it comes from the cow is free from typhoid infection. But because of its extensive use as food, because of its unusual qualities as a culture medium, and the many hands through which it passes to reach the consumer, it is one of the chief agents through which typhoid fever is spread. It may become infected through washing the cans and utensils in polluted water. If containers are left in households where the disease exists, they may bring back infection when returned to the dairy. Milk and its containers when exposed may be infected by flies which have been in contact with a typhoid patient or his excretions.

At this point attention is directed to the possible contamination of milk through the interchange of milk bottles at homes where typhoid fever is present. It is more or less customary to forbid the leaving of bottled milk at such times. When sickness exists in a household the source of milk supply is often changed, and in the absence of some placard, which is seldom used for typhoid fever, there is no certainty that the new milkman is warned as to the nature of the illness. Furthermore, the exchange of milk bottles is usually resumed with the return of convalescence, at which time a small proportion of the patients are still discharging typhoid bacilli.

A further source of danger in this connection lies in the fact that, among certain classes in the community, bottled milk or cream is purchased from grocery stores, to which the bottles are returned when empty. The grocer has no means of knowing whether illness exists in the family, and may not even know the purchaser's name.

Though definite proof is not available, it is highly probable that typhoid infection is sometimes carried in this manner, especially if bottles from infected homes are returned to small dealers who have no means of sterilizing them before they are refilled.

To avoid the possibility of spreading typhoid infection in this way, there is need of some definite system for placarding cases. Provision should be made, moreover, for requiring stools and urine to be free from typhoid bacilli before the removal of the placard, in the same manner that negative throat cultures are required prior to the release of diphtheria patients. This necessity would apply especially to those who handle food. Local health authorities should also try in every way to prevent the use of milk and cream bottles in homes where diseases such as diphtheria, scarlet fever and typhoid fever are present.

One or two illustrations of typhoid infection caused by milk may be mentioned. The importance of undetected typhoid carrier cases is also emphasized: —

1. Two cases of typhoid fever occurred in Lowell in 1910 on the route of a certain milkman early in September. The dairy was immediately investigated, and from the 13 employees Widal tests were taken, of which 12 were negative. The thirteenth test was atypical. Since nothing was found here to explain satisfactorily the cases, further investigations were made at other dairies from which the milkman secured milk, and at one place the dairyman, ill with typhoid fever, had just been removed to the hospital. The milk had been infected by this man in the handling, and this was the source of the infection in the cases reported. Later positive Widals were obtained from the thirteenth man at the milkman's dairy, and this same man was shown to be harboring typhoid bacilli for a period of seven weeks, though he himself had never had the disease, nor was he ill during the period in question. But for this investigation the carrier would not have been discovered.

Though this investigation was undertaken promptly, and the sale of milk from this source was forbidden when but 6 cases had been reported, there were 94 additional cases reported during the remainder of the month, 53 of which were attributed directly to this source.

2. Milk handled by a table maid who was coming down with the disease infected 60 people who spent Labor Day at a country hotel in Worcester County in 1909.

C. *Infection of Other Food Supplies.*

1. Lettuce, celery and other vegetables used without cooking, and taken from gardens where sewage or night soil is used for fertilizer, have spread typhoid infection.

In 1889, celery from a garden fertilized with sediment from a sewage filter bed was supposed to have infected 63 persons in one of the Massachusetts State insane hospitals. The discharges from one, perhaps two typhoid cases, unrecognized, had gone to the filter bed without disinfection. Subsequently, when the filter bed was cleaned, a portion of the sludge was used on the celery beds.

2. Bakers' products, handled by employees who are carriers, or who are coming down with the disease, have carried infection to those who used the products in question.

In 1909, in North Adams, through the use of bakers' products, 6 persons contracted typhoid fever. The infection was traced to two unreported typhoid cases in an adjoining town. Both, a baker and a driver, were employees of the bakery and both continued at work for some time after the onset of their illness.

3. Shell fish, oysters, clams, etc., taken from or stored in sewage-polluted waters near sewer outlets, have caused typhoid infection.

Oysters eaten raw at banquets resulted in the illness of 127 persons of whom 21 developed unmistakable typhoid, at Winchester and Southampton, Eng., in 1902. The oysters at both banquets came from the same dealer, and were obtained from an oyster bed so located that the oysters were contaminated by sewage from the main sewer outlet serving a community where typhoid fever had been present for some time.

D. *Infection through Flies.*

Infection may be carried by flies in contact with typhoid patients and their discharges. This is especially the case in localities where unscreened privies and vaults are in use, or where there are no such conveniences.

E. *Infection through Contact.*

Contact infection is also a very important factor in the spread of the disease. By contact infection is meant actual personal contact or touch with the patient, as in caring for and nursing such cases, or contact through handling utensils or articles used by him, or infection through food or objects in the household which have been in contact with the patient, such as bed linen, towels, dishes, milk bottles, etc.

To be considered as contact infection, infection through the handling of infected objects as just suggested should be more or less immediate in point of time. A mother caring for the patient may later, through failure to observe proper precautions, prepare with infected hands food for other members of the family, and thus spread infection to herself or them. Physicians and nurses are often infected through contact.

By far the largest percentage of contact infection occurs during the incubation period, when the presence of the disease is least suspected and when the fewest precautions are observed, and during the first three weeks of the sickness.

F. Infection through Carriers.

Of recent years another source of infection has been recognized, one which readily explains many cases hitherto impossible to account for satisfactorily. It has been found that certain persons, called carriers, harbor typhoid bacilli and discharge them through the urine and feces. The elimination of bacilli is not constant, but intervals of varying length occur when the stools and urine are free from the germs. Repeated examinations are, therefore, often necessary to demonstrate that a carrier is no longer a source of danger.

For convenience carriers have been divided into two classes: the transitory, when the bacilli are found for a period of less than three months, and the chronic, when they are found for a longer period. The class of transitory carriers includes (*a*) persons during the incubation stage of the disease, (*b*) those clinically recovered, but who still eliminate bacilli in their excretions, and (*c*) healthy persons in contact with the infection. Chronic carriers include persons who have had the disease and healthy persons who have never had it.

Of 431 carrier cases discovered in southwestern Germany, where carrier cases have been especially studied, 211 were transitory and 220 were chronic carriers. Of the transitory, 43.6 per cent., and of the chronic, 80 per cent., had had typhoid fever. Three months was considered the limit for distinguishing between transitory and chronic carriers.

Several painstaking and careful investigations by different observers have shown that over 11 per cent. of the cases investigated were eliminating bacilli for a period exceeding six weeks after the cessation of the fever.

Conservative judgment, based upon data available at the present time, indicates that 4 or 5 per cent. of the cases become carriers. It is not known how long a person may continue to be a carrier. Instances are recorded where the period is known to have extended over ten, twenty, thirty, even forty or more years.

This means that in Massachusetts alone there are from 120 to 150 carriers added to the population from year to year. The important significance of these facts is plain when we realize that typhoid bacillus carriers are liable at any time to be employed on dairy farms, in public places such as hotels or restaurants, or in homes as cooks and waitresses, or in other positions where their work involves the handling of food products.

In connection with the preparation of this report, several experiences with carrier infection have been encountered: —

1. One experience, occurring in Lowell, well illustrates the desirability of the early report of cases and the importance of early co-operation with the laboratory, since the source of infection was found and preventive measures were taken before the report of the cases had been received through the ordinary channels.

The State Health Inspector, happening to be in the Lowell laboratory on August 8, learned of three positive Widal tests taken on August 5, 7 and 8, from patients in North Chelmsford. By arrangement the three positive cases and two other doubtful cases in North Chelmsford were visited on August 9. All five obtained milk from the same dairy. A visit showed the dairy to be rather dirty. Widal tests taken from all who were said to be connected with the dairy were negative. Being dissatisfied, the inspector made a second visit to the dairy on the morning of the 10th of August, and another employee was found who had recently come to the dairy. This man gave a positive Widal on August 11, though he himself was not ill, had never had typhoid fever, and could recall no illness since childhood. He probably was a carrier, as suitable preventive measures were taken, and no further cases resulted. All this preventive work, as stated above, had been accomplished before the usual reports had been received.

2. The second instance concerned a select apartment hotel in Brookline, where several employees of the food department became ill with typhoid fever. Investigation disclosed the fact that the general pantry man, who handled pastry and other food, was a carrier. This employee strenuously denied that he had ever had typhoid fever, nor was he in any way ill at the time.

3. In North Adams, 1909, a chronic carrier was discovered, a woman who had had typhoid fever in an adjoining State fifteen years earlier. During a period of seven years, while milk was being sold from her dairy, she had unconsciously been responsible for 60 cases, through the occasional straining of the milk or the washing of the cans. The cases represented approximately one-fifth of all the typhoid fever in the community during the years in question, though less than one-hundredth part of the milk used in the city came from this dairy.

III. Other Difficulties.

A. Lack of Care as to Milk Bottles.

But 35 towns (no cities) placard for typhoid fever. The bearing of this fact upon the spread of infection through the exchange of milk bottles and the danger from the exchange of bottles at the grocer's has already been noted.

The use of milk bottles for other purposes than that for which they are intended is prohibited by law. It is no uncommon sight to see specimens of urine brought into a doctor's office in a milk bottle, and authentic instances have been reported of tuberculosis sputum being delivered for examination in a milk bottle. These bottles are thrown into the ash can and eventually find their way to the public dump.

One firm in this State makes a business of collecting stray bottles and returning them to their owners. During the past year nearly 2,500,000 bottles were handled by this exchange. Of this number 500,000 were picked up at various dumps. Many of these bottles were in an unspeakably filthy condition. After washing with warm water and soda these bottles are distributed to the various owners. Of the 325 milk dealers using this exchange, only a few of the larger ones have sterilizing plants. In consequence these filthy bottles, recovered from public dumps, after one or two more or less careful washings, are refilled with milk and distributed to the public.

The use of such bottles should be prohibited unless thoroughly cleaned and sterilized.

B. Lack of Investigation of Cases.

Another difficulty in suppressing typhoid fever is that outside of some cities and a few of the larger towns there is little or no investigation of cases, no attempt to discover the source of infection and no record regarding previous cases beyond the list of cases reported, which might be used for studying the situation.

C. Lack of Isolation of Cases.

Responsible for very many secondary infections is the lack of proper isolation of typhoid cases and the entire absence of any supervision of isolation. This is plainly evident from the many instances in which second, third and fourth cases occur in a household. The majority of these cases could be avoided by proper isolation where such is possible, or by the removal of the patient to the hospital if proper isolation at home is impossible.

D. Lack of Prompt Reporting of Cases.

The late reporting of cases by householders (more frequently their entire failure to report) and physicians is another difficulty. It is not uncommon to find upon investigation that intervals of one, two or more weeks have intervened between the physician's first visit and his report of the case. During this interval, when the patient is especially liable to spread infection, no precautions, as a rule, have been taken.

If a physician waits to be sure of the diagnosis, every precaution should be taken during the period of waiting that would be called for were the diagnosis fully established. The fact that a suspicious case is under observation should be reported promptly.

E. Lack of Instruction as to Disinfection.

The frequent failure on the part of the local health authorities and the physicians to give specific instructions as to the disinfection of utensils, linen and excretions is often responsible for the further spread of the infection.

F. Lack of Effort to follow up Carriers.

Still another difficulty lies in the fact that there is at present practically no effort made to follow up convalescent patients and carriers, and especially those whose work involves the handling of food products, to determine when they may safely resume their regular duties.

Much work has already been done by the State Board of Health looking to the prevention of typhoid fever, especially along lines connected with securing and preserving the purity of public water supplies, and it is probable that much of the steady reduction of the typhoid mortality rate in the State during the past thirty years has been due to this work.

Under the present law all physicians and householders are required to report cases of typhoid (or other diseases dangerous to the public health) to the local board of health. The local board in turn is required to report such cases to the State Board of Health within the ensuing twenty-four hours. For this purpose double post cards are supplied, one-half addressed to the State Board of Health, and the other, sent as a matter of courtesy, addressed to the health inspector of the district.

At the State House the cases are tabulated under each city or town as the reports are received, by days and months. Whenever the records show fresh cases in a community previously free from the disease, it is the custom to investigate in detail in order to determine the source of the infection.

At the present time the laboratory of the State Board of Health makes Widal tests and examinations of the stools, urine and blood for the typhoid organism for any physician free of charge. A pamphlet giving information about the management of typhoid cases is sent to every household where the disease is known to be present.

The preparation of material for antityphoid inoculation has been undertaken, and this material is now ready for distribution free, in the same manner as diphtheria antitoxin and smallpox vaccine.

Although every effort should be made to eradicate all sources of typhoid infection, this happy result is not immediately attainable, and the committee desires to call attention to the remarkable results following the use of antityphoid inoculation. During the past eleven months, since such inoculation has been carried out in the United States navy, there has not been a single case of typhoid fever among the 64,000 troops so protected. When 12,000 inoculated soldiers were mobilized along the Mexican border last year, not one case occurred, though camp conditions were very similar to those at the time of the Cuban war, when typhoid fever was exceedingly prevalent.

Similar success has followed the use of antityphoid inoculation in other armies, while in civil life evidence is accumulating to show the value of its use in protecting those exposed to infection.

For these reasons the committee urges the use of antityphoid inoculation. Its use by hospitals for the protection of nurses and all other employees is especially urged; and likewise the material may well be used to inoculate the remaining members of a household when the presence of the disease is first recognized or suspected.

What has been said concerning the difficulties encountered in the prevention of typhoid fever makes plainly evident the many factors entering into the problem. It shows unmistakably that the problem is far-reaching; that it is not confined to any one city or town; that no local board of health alone can solve the problem, though its own health conditions be perfect, because conditions beyond its borders may undo all that it has accomplished.

In short, the work can only be done by some central organization like the State Board of Health, through its inspectors of health, co-operating with the local health authorities, and bringing up to a proper standard the health work in those communities as yet not sufficiently active or organized.

In regard to legislation, the committee is strongly of the opinion that it should cover the whole State. Otherwise health administration will vary much in different localities, and the careless community will still be a source of real danger to its neighbors.

A campaign against typhoid will of necessity be developed along a number of different lines, and must be continued over a considerable period of time if adequate results are to be obtained.

Knowledge of the distribution of the disease will be required. This has already been obtained through a study of the morbidity and mortality rates in the various cities and towns over a term of years. The committee has arranged to receive daily reports of cases as they occur throughout the State. An effort will be made, furthermore, to secure a detailed account of every case reported or discovered, using for the purpose the following blank: —

STATE BOARD OF HEALTH OF MASSACHUSETTS.

[SEAL.]

INQUIRY BLANK.

TYPHOID FEVER IN ....
(Name of city or town.)

TYPHOID FEVER CASE NO. ....

IN ...., SINCE ....
(Name of city or town.) (Year.)

Date when case was reported to local board of health, ...
Date of physician's first visit, ...
Date of first symptoms, ...
Dates of Widal tests, ...; Results, ...
Name of attending physician, ...
Residence, ...
Name of patient, ...
Age, ..., Sex, ..., Nationality, ...
Residence, ...
....
(If patient has moved during a period of two months ending with the date of sickness, please state
....
former and present residences and date or dates of removal.)
Number of members of household where patient resides, ...
Number of occupants who have had typhoid, ..., When, ...
Previous cases in same house or in the same part of a double house or tenement block, ... (Give
....
names of any persons ill with or dead from typhoid who were at any previous time residents of the
....
premises.)
Newcomers, including servants in house, within 3 months prior, ...
Newcomers, including servants in house, had typhoid, ...
Dates of association with (*a*) typhoid patient, (*b*) suspected cases, ... (Consider neighbors, in-
....
cluding servants, visitors other than neighbors, fellow workmen, playmates, school children.)
Place of business, ...
(State all places of business occupied during two months ending with date of illness.)
Occupation, ...
(If changed during two months ending with date of illness, state changes, with dates of such changes.)

School or other public or private institution attended, ...

....
(During period of two months ending with date of illness.)

Trips out of town, ...
(Information should cover, with dates, all places visited during a period of at least two months

....
ending with date of illness.)

Conditions possibly giving rise to contact infection:

Condition of premises, ...
(Including location of and disposal of human excrement and sewage, garbage and water closets.)

General personal hygiene, ...
(Including conditions favoring contact infection such as unclean personal habits, failure to wash

....
hands after contact with secretions and excretions — putting fingers to mouth and nose, etc.)

....

Flies, ... Screens, ...

Treatment of stools and urine of patient, ...
(Were the stools disinfected? What methods were used? Urine?)

Sources of milk supply, in town, ...
(Give names of all dealers of whom milk has been obtained by

....
patient during the period of two months ending with date of illness.)

....
(Give names of stores and other places supplying milk to patient.)

Out of town, ...

Sources of water supply:

At home, ...
(State whether the public supply is used or water from private or semi-private wells, springs, etc.)

At school, ...

Out of town, ...

Ice supply:

Dealer or dealers, ...

Source or sources, ...

Remarks:[1]

From tabulations of the detailed information above suggested it will be possible to discover in what places typhoid fever is unusually prevalent, and opportunity will be given for special investigation in such places, especially as regards the water and sewerage systems, the character of the milk supplies and any other special factors. Much of this information is already recorded in different places. An effort will be made to collate the same and to arrange it so that it will be readily accessible for study.

Much of the work against typhoid must be educational. It is necessary to convince the people, local boards of health and physicians, even, that typhoid fever is a preventable disease; that to prevent it their active co-operation is needed; that suspicious cases should be reported early, and should not wait upon positive Widal tests, because it is this uncertain period, before a positive diagnosis can be established, that is the most dangerous of all from a general standpoint; for these cases not properly controlled may afford the starting point of an extensive outbreak.

The committee is of the opinion that the physician who does not report a case of continued fever as a probable typhoid as soon as he has eliminated other

[1] Remarks should embody all additional information which can be obtained relative to special or unusual conditions affecting this case.

common causes, and who does not in such a case take appropriate precautions, must shoulder very serious responsibility to the community for any subsequent results in the community.

The use of Widal tests and blood cultures as an aid in making or confirming a diagnosis should be encouraged.

All stools and urine from typhoid patients and carriers should be thoroughly disinfected, whether the patient is in the hospital or in the home, and whether the discharges enter the sewer or whether they are otherwise cared for.

Local boards of health might very properly provide disinfecting outfits which should be loaned to householders for use when typhoid is present, since few householders have the necessary equipment, and if the providing of such equipment is left to the householder, the disinfection is often indifferently carried out.

All convalescents from typhoid, whether in the hospital or in the home, should be detained until two negative examinations of the stools and urine have been obtained at an interval of one week.

Carriers, whether transitory or chronic, should be restrained, by force if need be, from handling all food products. This should apply especially to those employed in dairies, in kitchens or dining rooms.

Circulars of instruction should be furnished to convalescents and carriers containing information as to precautions necessary to prevent the further spread of the infection.

It is the purpose of the committee to render available the information collected by means of maps, card indices, etc.; that there shall be frequent meetings to discuss and tabulate the information obtained; that aggressive work be inaugurated in those places where typhoid fever has been prevalent, without waiting for the usual outbreak; and in case there is any suggestion of an outbreak in a given locality, that some one or more members of the committee will visit that place at once to confer with the local authorities as to what measures may be taken to avert the threatened outbreak.

Such work as has been suggested, persistently followed, cannot fail to produce favorable results.

Typhoid Fever occurring in Various Communities during the Year.

Thirteen cases of typhoid fever reported to the board of health of Adams between the 29th of September and the 31st of October were investigated. With the exception of one, they all occurred among the employees of one of the manufacturing establishments. One case, employed in the same establishment, together with two secondary cases in the same family, have been reported in North Adams. These cases were in all probability due to contact from the common drinking cup infected by some typhoid patient who continued at work for a time. Recommendations were made to the management of the establishment that bubbling fountains be installed to replace the common drinking cups.

Five cases of typhoid fever reported to the board of health of Amesbury during the second week of September were investigated. All the cases were on one milk supply. The investigation showed that the first patient to be taken ill with the disease was the wife of the milkman who supplied the other cases with their milk. The premises of the milkman were thoroughly disinfected, all cans and other milk utensils were sterilized, and the wife of the milkman was removed to a hospital in Newburyport. No further cases on this supply occurred.

Four cases of typhoid fever were investigated in Athol in September. Two of these cases were found to have been imported from Springfield, and one was a contact case in a family where an undiagnosed case had occurred during the previous month.

Three cases of typhoid fever were investigated on a milk farm in Boxborough. It was learned that a farmer had taken sick first, and that the other two cases were secondary. This farmer sold his milk in Watertown, and two weeks previous to his illness a can of milk which he had sent to Watertown was returned to him. The farmer drank most of this milk himself. Several other cases occurred in Watertown on the same milk supply. It seemed probable that a can of milk was infected in Watertown before its being returned to Boxborough.

A case of typhoid fever on a farm in Carlisle was investigated on October 23. Milk was being sent from this farm to Lowell. The patient was sent to a hospital, the place thoroughly cleaned up, and negative blood tests obtained from remaining members of the family. Arrangements were made with the dealer to pasteurize the milk. The Lowell board of health, being informed of all the facts, allowed the distribution of the milk to continue. There were no further cases.

Two cases of typhoid fever were investigated on a milk farm in Chelmsford during the month of July. An excellent quarantine of the cases was established, and after all others on the farm had shown negative Widals, the city where this milk was being sold consented to allow the sales to continue. There were no further cases.

Three cases of typhoid fever occurring in Clinton in April were investigated. All the cases were transferred to the local hospital for treatment. Unsanitary conditions existed upon the premises common to two of the cases which were favorable to contact infection. Again in August, four cases were investigated in Clinton, two occurring in each one of two families. From the point of time at which they became ill, two were evidently contacts. All were cared for in the local hospital.

Three cases of typhoid were investigated in October in Fitchburg, the only ones occurring in the city during the year. One was imported from Ashburnham, one from Boston, and the other had been employed at Lake Whalom, where there were plenty of opportunities for contact infection. The premises of the one from Ashburnham were in a filthy condition and favorable to contact infection. Recommendations were made to the local board of health that the patients be removed to a hospital. Two of the three cases were given hospital treatment.

Six cases of typhoid fever occurring among Polish people in Gardner were investigated in January. Two of these appeared to be contact infected from the first case in the household, the latter being a recent immigrant and probably infected en route. Five of the six cases were removed to the local hospital.

Thirteen cases of reported typhoid were investigated in Gardner. The cases occurred between July 28 and September 17. Only two of the cases showed a positive Widal. The course of illness in the other cases was rather atypical. The febrile state did not exceed two weeks in any one case, and was not typical in character. The Widals as well as the bile tests of the feces and urine were all negative. The infection was probably one of the paratyphoid group. Five of the cases occurred among hospital employees and were, in all probability, contact cases. The cases were reported at intervals of a few days, covering in all a period of seven weeks, not more than two being reported upon the same day. Investigation did not point to milk as a source of the infection.

A case of typhoid was investigated in Hardwick in September. The patient had visited in Palmer, where the disease was prevalent, prior to her illness, and she was probably infected there. Recommendations were made to the local board of health to remedy certain conditions on the premises which were favorable to contact infection.

Two cases of typhoid fever on a milk farm in Harvard were investigated in June. The cases were properly isolated, and after stopping the sale of the milk from that farm for a reasonable length of time the town where the milk was being sold allowed it to be sold again. No secondary cases occurred.

Two cases of typhoid fever were investigated in Holden. Inasmuch as the home conditions of both cases were favorable to contact infection, the patients were removed to the hospital for treatment.

A case of typhoid fever was investigated in Hudson. The case was transferred for treatment to the Marlborough Hospital.

Nine cases of typhoid fever occurring in Lexington between the 5th of November and the 4th of January were investigated. It was found that they could all be traced to one milk supply. An investigation of the milk farm was made, and it was found that the man who handled the milk had a positive Widal with no history of ever having had typhoid fever. One bile culture of his urine and stools was negative. The man refused to have other examinations made.

It was reported that there were several cases of typhoid fever in Cambridge about February 1, who were taking milk from a certain man in Lexington. On investigation it was found that there was a carrier on the place, shown by the second examination of the discharges.

Ten cases of typhoid fever occurring during the month of September were investigated in Orange. The sanitary conditions surrounding all the cases were decidedly objectionable. There were open privies, uncleanly homes and deposits of swarms of flies. Milk and water could be definitely ruled out as possible sources of this infection.

For several years typhoid fever cases have appeared quite regularly at Pittsfield Junction. Long-continued investigation finally resulted in the discovery last spring that polluted water from the east branch of the Housatonic River, pumped for railway use, also entered the domestic service of the private supply used at the junction. Following this discovery the city of Pittsfield extended its mains to the streets heretofore dependent upon the private supply. Since May 1 there have been no cases of typhoid fever at the junction, and none elsewhere referable to this source. Formerly cases had also appeared in other parts of the city, and even in other towns, which apparently had their source at the junction. Nine cases of typhoid fever occurred in July on a small milk route supplying about 40 persons in Pittsfield. An investigation instituted immediately upon the report of the first one or two cases disclosed that a man had been employed at this dairy, milking and handling milk, for about three weeks before the cases appeared. The agent of the local board of health was unable to secure specimens of the stools and urine of this man for examination. This man had typhoid fever three or four years ago. He was stopped from handling the milk, and there were no further cases.

Six cases of typhoid fever were investigated in Princeton and West Sterling in January. These cases obtained their milk from a common source, H. of Princeton, who supplied only a few of the residents, and shipped the greater part of his supply, together with milk he collected from several other farms in the neighborhood, to Chelsea, where an outbreak of typhoid fever had occurred simultaneously, and which was traced to his route. Mr. H. had typhoid in 1906. In 1907 other members of the family, including his mother, became ill with the disease. Since that time 1 to 3 cases of typhoid have occurred in Princeton and West Sterling each year, all of which took milk of H. Late in December of 1912 Mr. H.'s mother became ill and died from pneumonia on Jan. 6, 1913. It was shortly after her death that the outbreak of typhoid occurred, both in Chelsea and Princeton. She had the care of the milk utensils up to the time of her last illness. Widal and bile tests of feces of members of the family proved negative. The evidence pointed strongly to a probable carrier in the family as a source of infection. In September, 1913, two more cases of typhoid were reported in Princeton in a man and his wife who had taken milk from Mr. H. Widal and bile tests were again made with negative results.

A case of typhoid fever was investigated in Royalston, and it was found that the disease was contracted in Connecticut.

Several cases of typhoid fever were visited in the town of Saugus on July 17. From an investigation of the patients it was found that with but one exception all lived in a small Italian settlement, and with but one exception all obtained their milk from one supply. The latter was an Italian dealer, who kept four cows in a small barn back of his house. He did the milking and bottling of the milk and delivered it to the few customers he had in this vicinity, producing about 60 quarts daily, distributed among 20 families. The conditions of the cows and barn were satisfactory, but it was found on investigation that the hay, grain and meal which were used for feeding the cows were kept in the corner of a basement kitchen where the family lived most of the time, and where the meals were cooked, and which was also used as sleeping apartments, as indicated by two cot beds. The bottles and milking utensils were washed in this same kitchen by the dealer's wife and her sister, and at the time of the visit the clean bottles were on the kitchen table ready to be filled with the afternoon's milking. It appeared from the history of a niece of the dealer, living with them, that she may have had a mild case of typhoid fever some two and one-half months previous, with the possibility of direct infection by her through those who handled the milk supply or milking utensils. On account of the conditions found, the Saugus board of health were immediately informed to revoke this dealer's license until he had provided facilities for carrying on his milk business outside of the dwelling in which he lived. Instructions were given that all milk bottles and milking utensils be boiled, and that bottles be not taken away from houses where the disease existed.

About the middle of October, Shirley asked help in investigating the probable source of several cases of typhoid that had occurred in the center of the town. All had been taking water from the same well, and it was possible that pollution of this well may have come from a house where there had been about 300 people during the summer. Subsequent analysis of the water in the well showed pollution.

Thirteen cases of typhoid fever were investigated in Spencer, in the French section, during the latter part of the year 1912 and the first part of 1913. The common factor in the situation was that they all were employed in one shoe factory, and had therefore, at least while at work, a common water supply. The drinking water at this factory was from Shaw Pond, the regular town supply. The first case of typhoid in this epidemic was reported on Oct. 25, 1912. This case was brought from Natick to her home in Spencer. The father of this case died from typhoid fever Sept. 23, 1912. He was living in Natick and working in Newton as a carpenter. During the course of his illness he was moved to his home in Spencer. The other cases followed during the period November 16 to January 3. The cases mentioned above, the father and daughter, lived in a house situated upon the bank of Cider Mill Pond, within ten yards of the water, and the sewage from this house entered directly into the pond. While it was stated that lime was used on the excreta, there is considerable doubt that they received proper attention before being emptied into the flush closet and thence to the pond. The entrance of this sewage is about 250 yards above the factory in question. On the factory premises is a reservoir receiving this water via a drain or pipe or seepage. This water is pumped from reservoir into the factory and used for the boiler, closets and sinks. The operatives wash their hands and faces in it, and it is not at all improbable that they may have used it for drinking. The arrangement of the water pipes used for conducting Shaw Pond water, Cider Mill Pond supply, and that from the tubular well is somewhat involved and not particularly clear. For example, when there was a break in the main of the tubular well, or in case of accident to the pump, Cider Mill Pond water might be used in various pipes. With three sources of water supply more or less interchangeable, according to present layout of pipes, the State Inspector of Health of the Midland district, who was sent to investigate these cases, thought it would be worth while to determine the exact course of the pipes controlling these supplies, and thereby learn the possible distribution of these supplies during the outbreak. Analysis of water from the tubular well showed it to be polluted. The water from Cider Mill Pond had obviously been polluted with typhoid excreta. An analysis of the Shaw Pond water (the town supply) showed few bacteria and absence of pollution. In view of these facts it seemed best to the State Inspector of Health to urge the local board to order that water from the tubular well and from the Cider Mill Pond supply be discontinued, and Shaw Pond water used in all pipes and mains in the factory for all purposes.

A number of cases of typhoid fever which were reported to the Springfield board of health, occurring among engineers and firemen of the New Haven & Hartford Railroad, were investigated. The conditions which prevailed at the railroad yards showed that there was ample opportunity for the use of polluted water from the Connecticut River.

A case of typhoid fever was investigated in Sterling in January, the case ending fatally. Upon suggestion of the State Inspector of Health, other members of the family were given inoculations of typhoid prophylactic. No contact cases occurred. The well water which this family used was analyzed by the State Board of Health, and found to be badly polluted. Unsanitary conditions upon the premises were removed.

An unusual number of cases of typhoid fever occurred in Stoughton late in December and early in January. An investigation of the situation made, in connection with the local board of health and the engineering department of the State Board of Health, developed the fact that in all likelihood the source of infection was in the town water supply. It was not a continuous infection, but one of those sudden epidemics in which all of the cases appeared to have received their infection at about the same time. At the suggestion of the State Board of Health the town authorities were urged to secure a pure public water supply.

A case of typhoid was investigated in Templeton. The family had their own milk and individual water supply. Sanitary conditions upon the premises, except the surface drainage of sink water, were satisfactory. The father of the patient and owner of the premises promised to construct a cesspool for sink drainage immediately.

Twelve cases of typhoid fever were investigated in Westfield in October. These cases were scattered in different parts of the town. It was found that two cases occurred in the family of a milkman, and furthermore two cases developed on his route. Investigation of this milkman's dairy showed inadequate facilities for sterilizing his cans and milking utensils. The attention of the local board was called to the matter and they took prompt action toward improving the conditions. There was apparently no common source of infection.

A case of typhoid fever was investigated in Winchendon, occurring in a Polish family of nine members. The patient had been out of town logging, and had drunk water from a number of different sources. Suggestions were offered the board of health relative to measures for the prevention of the spread of the disease, and upon advice of the State Inspector of Health inoculations of typhoid prophylactic were given to the other members of the family, but not sufficiently early to prevent two contact cases. All recovered. Another case of typhoid, which terminated fatally, was investigated in Winchendon. The patient was brought from Baldwinsville, where he contracted the disease.

Milk-borne Typhoid Outbreak in Chelsea during the Latter Part of December, 1912.

During the early part of January, 1913, a number of cases of typhoid fever were reported to the Chelsea board of health. An investigation of the cases showed that there was in all probability a common source of the infection, since all the cases occurred on the milk route of one local milk dealer X. In all, 30 cases were reported to the local board. The dates on which the cases were reported were as follows: —

January 8,	1	January 17,	3
January 9,	1	January 18,	1
January 10,	2	January 22,	2
January 11,	1	January 24,	1
January 13,	10	January 29,	2
January 15,	2	February 3,	1
January 16,	3		

An investigation of the cases showed that 14 had their first symptoms between Dec. 25, 1912, and Jan. 1, 1913; 9 of these came down with the disease on Dec. 25, 1912. The incidence of the cases according to the first symptoms is shown in the accompanying chart (see page 705).

All the cases were practically confined to one part of the city known as Prattville. All the cases took milk from dealer X, with the exception of one case which took sick within ten days after arriving in Chelsea from Russia, and does not therefore belong to this outbreak. The diagnosis of one case reported as typhoid was later changed to "jaundice." This case gave two negative Widals. The total number of cases belonging to this outbreak was therefore 28.

From the incidence of the cases it is highly probable that they resulted from a single infection. The later cases may be the result of delayed incubation periods, and some of them may have been contact cases, although no definite history of contact could be traced in any of them.

Of the 28 cases 14 were males and 14 females.

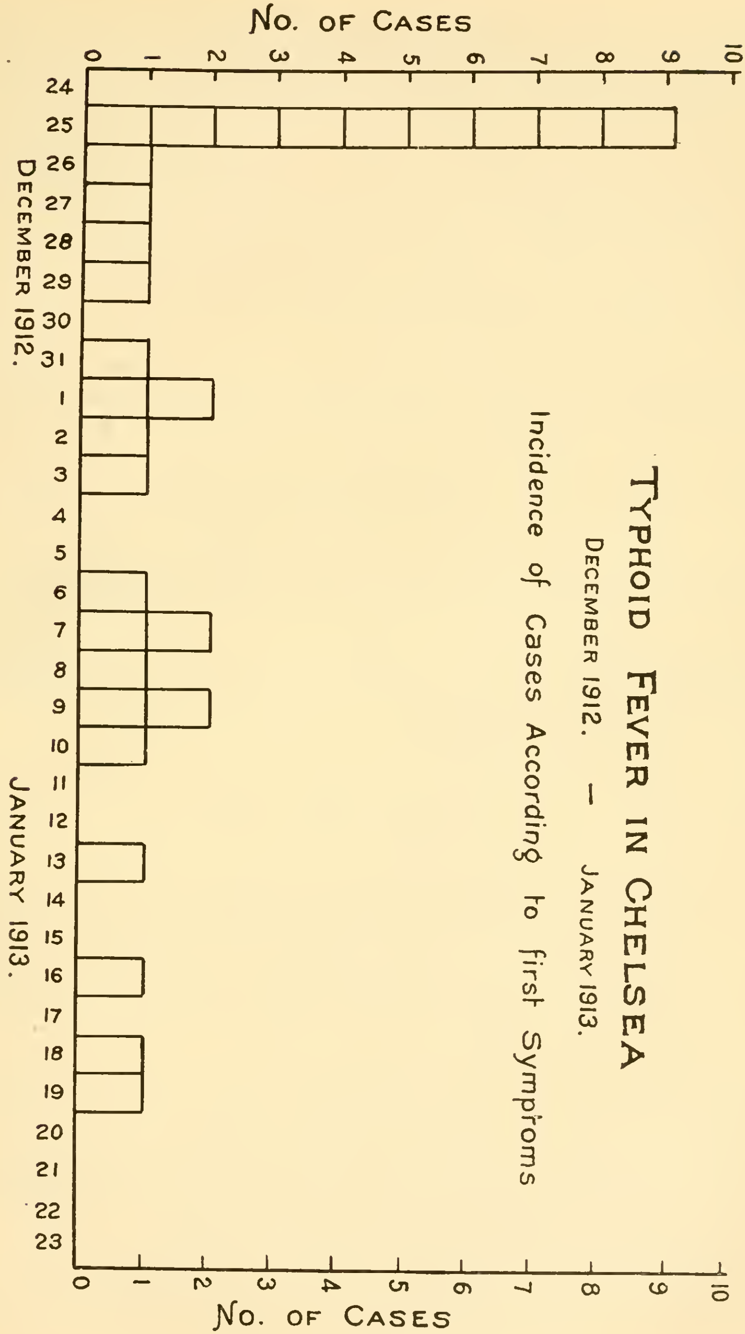
The age distribution of the cases was as follows: —

	Number.		Number.
1– 5 years,	5	26–30 years,	3
6–10 years,	6	36–40 years,	3
11–15 years,	3	51–55 years,	1
16–20 years,	3	56–60 years,	1
21–25 years,	2	61–65 years,	1

The Milk Supply. — X receives about 52 cans of milk daily from 9 farms located in Sterling and Princeton. About 27 of the cans are used for bottling purposes for family trade; the rest are delivered in cans, 15 of which go to the Marine Hospital in Chelsea, and the rest to various groceries in Chelsea and Everett. The morning milk is used for the bottle trade and the evening milk for the can trade. All the morning milk is put into one large mixer, from which it is bottled and capped by hand. The evening milk for the can trade is mixed separately. There are thus two mixings daily. All the cases of typhoid occurred on the bottle supply; not a case occurred on the can supply. It is therefore probable that an infected can of milk was delivered with the morning milk and mixed with the entire supply for the bottle trade. The can supply, since it is mixed separately, thus escaped infection.

At the stable in Chelsea the milk is handled by three persons, — X's brother, his nephew and a hired man. X is said to have handled the milk and utensils on very rare occasions only. No history of typhoid could be obtained from any of the men. Widal tests taken from the three of them were negative, and so were bile cultures of the urine. X himself, however, had left on a trip to California on January 6, two days before the first case was reported to the board of health. It was stated that he was not feeling well, and a week before his departure he felt sick, complained of a headache and had fever for one day. That X might have had a mild, unrecognized typhoid for several weeks previous to his departure, and thus infected his supply, is within the range of probabilities. As he is away now, no definite information on this point can be obtained.

There is, however, stronger evidence that the infection came from one of the farms in Princeton. Mr. H., who has a farm in Princeton, pro-


Typhoid Fever in Chelsea
December 1912. — January 1913.
Incidence of Cases According to first Symptoms
No. of Cases
0 1 2 3 4 5 6 7 8 9 10
December 1912.
24 25 26 27 28 29 30 31
January 1913.
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23
0 1 2 3 4 5 6 7 8 9 10
No. of Cases

duces from 6 to 8 cans daily. He sends his entire supply to X, with the exception of a small quantity which he sells to some families in Princeton and Sterling. H. also acts as a collector of X's milk from the other milk farms. Five cases of typhoid fever in Sterling and Princeton came down with the disease the first week in January. They all took milk from H. The appearance of these cases about the same time with the Chelsea outbreak on a milk supply which goes to X, points very strongly to H.'s milk as the source of the infection of the Chelsea cases as well as of those in Princeton and Sterling. Moreover, a case of typhoid reported in Princeton last September, and a case in Sterling last October, both took milk from H.

An investigation at the H. farm revealed the fact that in 1906 H. had typhoid fever. A year later his mother, wife and one child had the disease. In the same year two other cases of typhoid occurred in the neighborhood. In 1909 there were two cases there, in 1910 one case and in 1911 three cases. One of these cases took sick immediately after returning from a trip, and the disease was probably contracted elsewhere. All the other cases but one used H.'s milk. It is thus seen that since 1906, of the 18 cases of typhoid that occurred, 16 used H.'s milk. In view of the fact that H. distributes but a very small quantity of milk in the neighborhood, the occurrence of so many cases on his supply points very strongly to the probability that one of the members of H.'s household, who was engaged in handling the milk, was a chronic carrier who infected the milk from time to time.

It was learned that the only two persons in the H. family who handled the milk or utensils were H. and his mother, both of whom, as was stated above, had had typhoid fever.

A Widal and bile examination of urine and stools from H. and from his daughter, who occasionally went into the milk room, were all negative. Unfortunately, H.'s mother, who had practically complete charge of the milking utensils and milk room, died of pneumonia after an illness of four days, several days before the first cases were reported to the Chelsea board of health. It is, of course, quite possible that she was the disseminator of the infection.

The history of this farm is extremely interesting, and the question presents itself as to how many other farms there are in the State with similar previous histories of typhoid, and with chronic carriers of the disease, periodically excreting typhoid bacilli and giving rise to sporadic cases the source of whose infection cannot be traced.

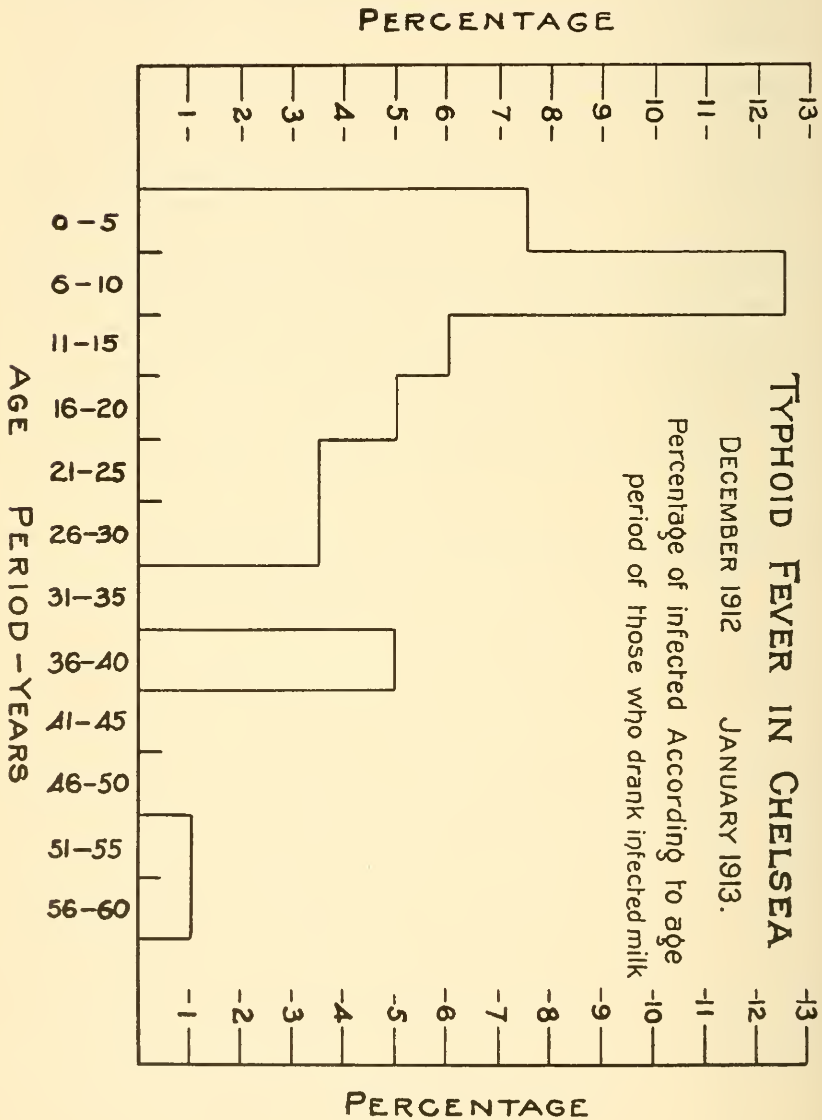
As soon as the outbreak became apparent the Chelsea board of health took active measures to check the spread of the disease. The entire milk supply of X was pasteurized, and a few days later the H. supply was entirely cut off. The board also addressed a letter to the physicians caring for typhoid fever cases, urging them to use the typhoid prophylactic among the members of the families who are exposed to contact with patients. All the nurses at the Frost Hospital were immunized, and many persons in contact with those ill in private families were likewise immunized.

With the energetic assistance of the Chelsea board of health, an effort was made to determine the number of persons that drank the milk at the time the infection probably occurred. It was found that the total number of persons in the families who used the milk in question about that time was 759. Of this number only 270 were milk drinkers; the others used the milk only in tea or coffee or on cereals. Twenty-two persons of the entire number had had typhoid fever previously; 6 of these had had the disease within ten years. The total number of those infected constitutes approximately 3.5 per cent. of the number that used the milk in any form, while it constitutes 10 per cent. of those that were in the habit of drinking milk.

If we compare by age periods the number of those who became infected with the number of those who used the milk, we get the following results: —

Ages.	Number who used Milk.	Number of Infected.	Per Cent. of Infected.
1- 5,	68	5	7.3
6-10,	51	6	11.7
11-15,	49	3	6.0
16-20,	60	3	5.0
21-25,	60	2	3.3
26-30,	62	3	3.2
31-35,	58	-	-
36-40,	61	3	4.9
41-45,	72	-	-
46-50,	58	-	-
51-55,	40	1	2.5
56-60,	39	1	2.5
61-65,	22	1	4.5
66 and over,	59	-	-

The following chart indicates the per cent. infected according to age periods: —



An Outbreak of Typhoid Fever in Cambridge, Somerville and Arlington.

During January and February, 61 persons living in Cambridge, Somerville and Arlington were stricken with typhoid fever. Of this number, 41, or 67 per cent., were taken ill between January 20 and February 2, inclusive, a period of two weeks. Forty-four of these persons lived in Cambridge, 13 in Somerville and 4 in Arlington.

	Week ending — January. 18.	25.	February. 1.	8.	15.	Total Number of Cases.	Population, 1910.	Cases per 1,000 Population.
Cambridge,	7	15	15	4	3	44	104,839	.42
Somerville,	2	–	7	1	3	13	77,236	.17
Arlington,	1	3	–	–	–	4	11,187	.36
Totals,	10	18	22	5	6	61	–	–
Per cent. of cases in each week,	16.4	29.5	36	8.2	9.9	–	–	–

The Outbreak in Cambridge. — Forty-four residents of Cambridge were stricken with typhoid fever between January 11 and February 15. Of these cases 31, or 75 per cent., occurred between January 19 and February 2. Nearly all of the families in which typhoid fever occurred lived in North Cambridge or on the streets adjoining Harvard and Central squares. In 1 household 3 cases occurred, and in 5 other households 2 cases occurred, and in 1 family a secondary case developed from direct infection, leaving 29 households in which but one case of the disease occurred.

	Cases.	Totals.
In 1 household,	3	3
In 5 households,	2	10
In 1 household,	1[1]	2
In 29 households,	1	29
Total,	–	44

[1] Second.

All of these patients obtained their water from the public supply, but in view of the fact that few or no cases occurred in other parts of the city using the same supply, this source of infection can be eliminated.

With but four exceptions, all of the 44 cases in this city obtained milk from the same dealer, and it therefore appears that the outbreak of typhoid fever in Cambridge was chiefly among the customers of one milk dealer who produced his own milk, milkman H. Of the four exceptions, 1 took milk from still another dealer, but this patient had also eaten raw oysters frequently before her attack; 1 obtained milk from B.; and the other 2, 1 of which was of secondary infection, took milk from C.

The Outbreak in Somerville. — Thirteen residents of Somerville were stricken with typhoid fever between January 12 and February 14. Of these 13 cases, 7, or 54 per cent., occurred between January 26 and February 1, inclusive. Nearly all of the families in which typhoid fever occurred lived along the southern border of the city adjacent to the Cambridge line. In 1 household 3 cases appeared, and in another one, 2 cases, there being a possibility of a secondary infection of 1 patient in the first group, leaving 8 households in which but 1 case of the disease occurred.

	Cases.	Totals.
In 1 household,	3	3
In 1 household,	2	2
In 8 households,	1	8
Total,	–	13

These patients obtained their drinking water from the public water supply, which is from the metropolitan system, and as the disease was not prevalent in other parts of the city, this source of infection can be eliminated.

Of the 13 cases reported in this city, with but one exception all had milk from one dealer, milkman H., above referred to as supplying milk to the stricken persons in Cambridge. It therefore appears that the outbreak in Somerville and that in Cambridge arose from a common source of infection. In the exception referred to, the patient took milk from W.

The Outbreak in Arlington. — Four residents of Arlington were stricken with typhoid fever between January 16 and January 25. Nearly all of the families in which the disease occurred lived on or near Massachusetts Avenue, all being in different households.

The water supply was obtained from the metropolitan system and can be eliminated as a cause of the spread of infection.

Of these 4 patients, 3 obtained milk from the same milkman, H., and it therefore appears that the outbreak was due to the same cause as those that occurred in Cambridge and Somerville. The exception was a traveling man who was away from home most of the time, and it appears that he probably contracted the disease while absent from the town.

Summary. — It therefore appears that the outbreak in the three communities was practically simultaneous and that it essentially constituted only one epidemic. This epidemic reached its height during the period between January 19 and February 2, when 41 of the 61 cases were reported and the majority of the cases in all three places occurred. The epidemic reached its climax during the last week in January, and the two days when the greatest number of patients went to bed were on January 25, when 6 patients were stricken, and February 1, when 7 were stricken.

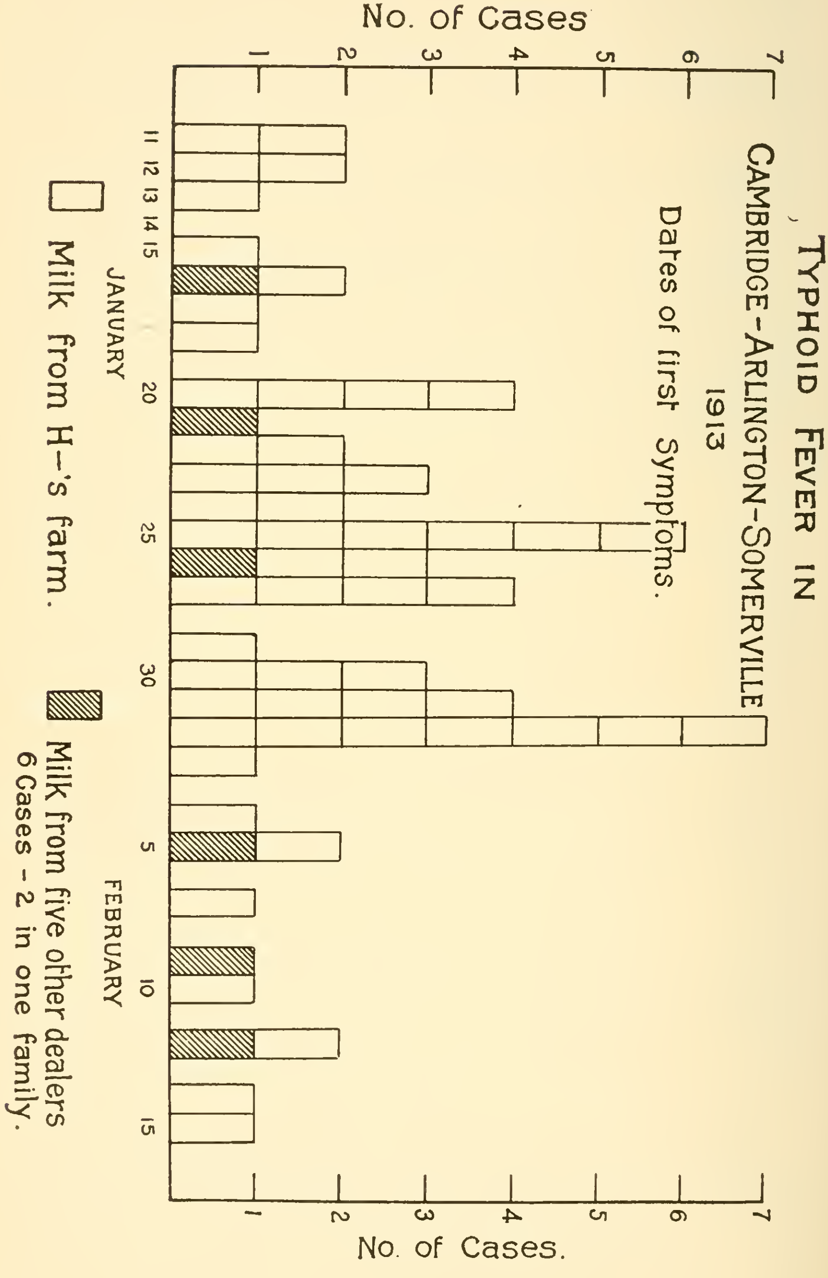
Locality.	1-5 Years.	6-10 Years.	11-15 Years.	16-20 Years.	21-30 Years.	31-40 Years.	41-50 Years.	51-60 Years.	Over 60 Years.	Totals.
Cambridge,	7	3	8	10	8	4	1	1	2	44
Somerville,	4	3	–	2	2	–	1	1	–	13
Arlington,	1	–	–	–	1	1	1	–	–	4
Totals,	12	6	8	12	11	5	3	2	2	61

Milk Supply of Patients Ill with the Disease.

	Cambridge.	Somerville.	Arlington.
Milkman H,	40	12	3
Milkman B,	1	–	–
Milkman C,	2	–	–
Milkman D,	1	–	–
Milkman W,	–	1	–
Milkman T,	–	–	1
Totals,	44	13	4

Of milk dealers C., D., W. and T., 3 of them are large contractors and have had no other cases of typhoid fever upon their routes. Milk dealer B., although having only a small business, has had no other reported cases occurring on his route.

The milk supply from dealer H., therefore, was found to be the prob-



TYPHOID FEVER IN
CAMBRIDGE-ARLINGTON-SOMERVILLE
1913
Dates of first Symptoms.
No. of Cases
1 2 3 4 5 6 7
11 12 13 14 15
20
25
30
JANUARY
5
10
15
FEBRUARY
Milk from H—'s farm.
Milk from five other dealers
6 Cases - 2 in one family.
No. of Cases.

able source of infection. This dealer produced most of the milk on his own farm in Lexington, and kept between 50 and 60 cows, producing about 50 $8\frac{1}{2}$-quart cans of milk daily, 40 of which were delivered in Cambridge, 10 in Somerville and only about 1 can in Arlington. As an additional supply when necessary, he bought occasionally from Mr. D. of Lexington. While Mr. D. sold milk to other dealers, no cases of typhoid fever were found on their milk routes.

Milk dealer H. has a large business, supplying between 350 and 400 customers, aggregating about 1,500 people using his milk. A visit was made to his farm on February 5. It was found to be well conducted; the milk room was in a building adjacent to the barn and opening through a door from it. After the milking had been done by four employees, the milk was taken to the milk room, cooled, and subsequently mixed and bottled, the latter process being done by the sister of H. The washing of the bottles was done by the drivers of the two teams, but the washing of the pails and cans was usually done by H. himself. There were no provisions for the steam sterilization of the utensils used, and a mechanical wash in warm, soapy water with a cold water rinse was all that was done for cleanliness. The bottles of milk were then put in cases until taken by the drivers the next morning and placed in the teams. There was no regular order of bottling, and the driver who got to the milk room first in the morning was first to load his team with the milk in the nearest cases. One team distributed milk entirely in Cambridge, along the route of the residences of the patients ill with the disease, and the team which delivered in Somerville also had a considerable number of customers along the border line in Cambridge. The fact that cases occurred upon both routes meant that the entire supply was infected. Bottles were collected by the drivers at the houses of the customers and brought back by them each day to the farm.

The water on the premises was obtained from a driven well, located between the barn and the house, and from its location it did not appear to be seriously polluted by surface drainage.

Five days previous to this visit, blood specimens were taken from the four who did the milking, from Mr. H. and from his sister, who did the bottling, and on this day, February 5, a positive Widal reaction was obtained from one of the milkers. Two subsequent examinations were made of this man's excretions from the bowels and kidneys, one of which was found to contain typhoid bacilli, so that it may be presumed that he was the source of the infection.

Conclusions. — A study of the sudden outbreak of 61 cases of typhoid fever in Arlington, Cambridge and Somerville which occurred at a time of the year when few or no cases existed in these communities shows that the disease was probably contracted from infected milk supplied by milk dealer H. of Lexington. A clinical examination of the persons handling the milk or milking utensils failed to show any evidence of any sickness, but a blood test of one of the milkers showed a positive reaction of typhoid fever, and a subsequent examination of his excreta showed typhoid bacilli present. Following the exclusion of this man from handling the milk, and the pasteurization of the milk supply on February 5, the epidemic ceased. The only other persons stricken with the disease were those in families with the afflicted. These patients, stricken apparently from direct contact with the sick, were taken ill later than February 15.

Precautions to prevent the Spread of the Infection. — Although at least 7 of the many cases of typhoid fever occurring in Cambridge between January 14 and February 1 were known to have been reported promptly to the local board of health, it was not until February 5 that milk producer and dealer H. was informed by the said board that all milk delivered by him should be pasteurized.

On February 4 and 5, 4 cases of typhoid fever were reported to the Somerville board of health, and upon investigation it was found that all of these patients obtained milk from dealer H. A visit was immediately made to his farm by the milk inspector and the medical inspector of the board. As a result of the examination of the existing conditions, dealer H. was instructed (1) to boil all cans, pails, bottles and other utensils used in the production of the milk; (2) to pasteurize all milk before delivery the following morning; (3) to remove the man who responded positively to the Widal reaction from any connection with milk whatever.

From an observation of the lack of care exercised in cleaning the milking utensils and bottles as mentioned above and the inefficiency of the process, it was found necessary to install a steam boiler in order to carry out the provisions of the first two recommendations. Accordingly, that day a boiler was obtained and the milking utensils and bottles thoroughly treated with live steam and the milk pasteurized by the following method: the milk in $8\frac{1}{2}$-quart cans was placed in a wooden sink, 2 by 6 feet, containing water, and steam forced into it until it reached a temperature of 145 degrees Fahrenheit. During this process, which lasted twenty minutes, the milk was constantly stirred, after which it was rapidly cooled, mixed and bottled, ready for delivery the following morning.

The efficiency of these recommendations in controlling the spread of the disease was shown by the rapid diminution in the number of cases reported, the last one going to bed ill on February 15, ten days after these measures were instituted and corresponding to the incubation period of the disease.

Deaths resulting from the Outbreak.

Locality.	Date.	Total Number of Cases.	Deaths.
Cambridge,	January 11–February 15,	44	8
Somerville,	January 12–February 14,	13	1
Arlington,	January 16–January 25,	4	–
Total,		61	9

Report upon a Milk-borne Outbreak of Typhoid Fever in Quincy during the Month of April, 1913.

During the month of April a small outbreak of typhoid fever occurred in Quincy, which, owing to prompt action, was prevented from assuming larger proportions. The details of the outbreak are as follows: —

The following are the dates when cases were reported to the local board of health: —

April 10,	5 cases.
April 11,	4 cases.
April 14,	3 cases.
April 16,	1 case.
April 17,	1 case.
April 20,	1 case.

The occurrence of the cases according to first symptoms, as nearly as could be ascertained, was as follows: —

March 29,	1 case.
March 31,	2 cases.
April 1,	3 cases.
April 2,	1 case.
April 4,	3 cases.
April 5,	2 cases.
April 6,	2 cases.
April 8,	1 case.

As soon as the first five cases were reported to the Quincy board of health, on April 10, the State Board of Health was notified by telephone, and on the same day the inspector visited Quincy and with Dr.

Jones of the Quincy board of health made an investigation of the situation. All the 5 cases were on one milk supply.

An investigation of the milk barn of the supply in question did not reveal any source of contagion. No history of typhoid was obtained from any of the men handling the milk, and Widals taken from all of them later proved to be negative. It was suspected that the infection came from one of the farms in Connecticut where the milk was produced. The dealer in question bought daily 90 cans of milk from one of the large milk contractors in Boston. This milk came direct to him from the farms.

The local board of health was advised to stop at once that supply or to see that it was properly pasteurized. All the physicians in Quincy were telephoned to, and they were asked to report immediately to the board of health any suspicious cases that they might have under observation. The milk contractor in Boston was notified of the situation, and an investigation on the farms in Connecticut was promptly started.

The assumption that this was a milk-borne outbreak was later confirmed by the fact that all the subsequent cases occurred on the same milk supply. On the day following the report of the first cases all the milk supplied to the local dealer by the milk firm in Boston was pasteurized. A physician in Danielson, Conn., reported that on one of the farms which contributed to the supply in question a child was ill, and was suspected of having typhoid. The diagnosis was later definitely established by a positive Widal test. The milk from this farm was promptly excluded.

There is little doubt but that this case of typhoid, who had been ill for several weeks before a diagnosis was made, was the source of the infection. From the incidence of the cases it would appear that it was a single infection, only one can probably being infected. The receptacle in which the milk was mixed in Quincy was a small one, which fact accounts for the comparatively small number of cases of typhoid that occurred, for only a portion of the entire milk was mixed with that of the infected can.

This outbreak indicates the value of prompt action and co-operation between the State and local health authorities and milk dealers.

An Outbreak of Typhoid Fever in Palmer.

Thirty-nine cases of typhoid were reported in Palmer and 1 in Monson between July 30 and August 28, making 40 cases in all. The following table shows the dates on which the cases were reported: —

July 30,	5 cases.
July 31,	2 cases.
August 2,	4 cases.
August 4,	5 cases.
August 6,	7 cases.
August 7,	5 cases.
August 8,	1 case.
August 11,	3 cases.
August 12,	2 cases.
August 15,	1 case.
August 16,	1 case.
August 22,	1 case.
August 26,	1 case.
August 27,	1 case.
August 28,	1 case.
Total,	40 cases.

The incidence of the cases according to the first symptoms was between the 21st of July and the 9th of August.

Of the 40 cases, 25 were males and 15 females. The age distribution was as follows: —

1 to 5 years,	4 cases.
6 to 10 years,	8 cases.
11 to 15 years,	–
16 to 20 years,	7 cases.
21 to 30 years,	12 cases.
31 to 40 years,	7 cases.
41 to 50 years,	2 cases.
Total,	40 cases.

The Milk Supply. — An investigation of the cases revealed the fact that all of them had either the entire supply or part of it from milkman H. Mr. H. has a farm in Monson where he produces from 125 to 150 quarts of milk daily. The milking is done by Mr. H. himself, assisted by a young boy, and during the past two months he had two helpers who no longer work for him. Nothing on the H. farm or the other farm where he occasionally bought milk revealed any possible source of infection. Further investigation, however, showed that a young man who helped H. on his farm between July 7 and 20 was ill with typhoid fever. When this young man was seen on August 12 he was in a semi-delirious condition, and it was impossible to obtain from him a definite history of the onset of the disease. From his condition, however, it would appear that he was in about the third or fourth week of the disease. It is further highly probable that he had infected the milk on the H. farm previous to his leaving. Recommendations were made to the local board of health in regard to the control of the sale of milk from the H. farm during the outbreak, and also as to the care of some of the typhoid fever cases.

Scarlet Fever.

One hundred and twelve cases of scarlet fever occurred in Adams between January and August, 1913. All but 12 of these cases occurred among Polish families. On account of the overcrowded conditions among these families, and the fact that physicians are not called to see mild cases, the control of the outbreak was exceedingly difficult.

On Jan. 16, 1913, at the request of the secretary of the State Board of Health, a State Inspector of Health was sent to Amherst to look into an outbreak of cases of scarlet fever occurring at the Massachusetts Agricultural College. Twenty-five cases of the disease occurred at the college. A conference was immediately held with the president of the college and board of health, and on the next day the students were addressed in the chapel by the State Inspector of Health, reviewing the situation, the number of cases, the facilities for caring for them, and assuring them that on account of not knowing at that time the exact source of infection it would be best for them to remain at college and not go to their homes, thereby preventing further foci of infection. Two fraternity houses were taken, — one as a hospital and the other as an observation building. The sudden outbreak of this disease pointed at once to some common infection, probably of the milk supply. A careful investigation of all the farms which furnished milk to this supply revealed three possible sources where the milk might have been infected.

A small outbreak of scarlet fever at the Middlesex Training School at North Chelmsford was investigated. The disease was very mild in character. Suggestions were made to the local board of health as to proper measures to prevent the spread of the disease.

An outbreak of 60 cases of scarlet fever occurred in Gardner between February and August. A carcful investigation of the milk supply failed to reveal any source of infection. The disease, in all probability, spread through contact, inasmuch as many cases were extremely mild and were not seen by a physician at the time of the illness. Cases were found among school children who were desquamating without having been treated previously by a physician. Daily medical inspection of the school children was instituted, and many visits were made by the school nurse to the homes. All cases that could not be properly isolated at home were moved to the local isolation hospital. The outbreak was confined to the west section of the town.

Several cases of scarlet fever reported in Lexington during June were investigated. One suspicious case was found in a man who was delivering milk in Somerville. He was stopped from this work. No further cases occurred.

An extensive outbreak of scarlet fever started in Lowell at the beginning of the year, and cases continued to be reported for several months. While, in the beginning, suspicion was directed to one milk supply as the source of infection, nothing definite could be found. The outbreak was, in all probability, due to contact with mild, unrecognized cases of the disease.

At the request of the Ludlow board of health an investigation was made of a case of scarlet fever reported to them on the 1st of April. The patient proved to be a young woman who had recently come back from the State Hospital at Monson. She was found to be desquamating freely. A visit made to the State Hospital at Monson by the State Inspector of Health revealed a number of mild cases of the disease among the inmates. Some 15 cases subsequently developed among the inmates, all of them very mild in form. Active steps were immediately taken to prevent the spread of the disease. Isolation camps were provided for those ill with the disease, and daily inspection made of the inmates of the institution, all suspicious cases being properly isolated. No further cases developed.

Assistance was given to a physician in Quincy in the diagnosis of several cases of scarlet fever.

Two cases of scarlet fever occurring on milk farms, as well as several cases of sore throat in Shirley, were investigated. There were adequate facilities for the strict isolation of the patients. After a thorough sterilization of all the milk utensils, the dealers were permitted to sell their milk.

Fifteen cases of scarlet fever were investigated in South Hadley Falls in November, 1912. Advice was given to the local board of health as to the best means of preventing further spread of the disease.

Investigations of cases of scarlet fever were also made in Agawam, Athol, Barre, Hadley, Hingham, Northampton, Randolph, Rockport, Russell, Sunderland, Templeton, Westfield and West Boylston. Advice was given to the local board of health as to the proper steps to prevent the spread of the disease.

Diphtheria.

Several cases of diphtheria occurred in Cummington during the months of November and December which were traced to a carrier. He was promptly isolated until two negative cultures were obtained. No further cases appeared.

Cases of diphtheria were also investigated in Fitchburg, Greenfield, Hadley, Leominster, Longmeadow, Lunenburg, Montague and Wenham. In every instance advice and assistance were given to the local board of health to carry out the proper measures so as to prevent the spread of the disease.

Smallpox.

Five cases of smallpox were investigated in Acushnet. All of them could be traced to a case in Providence.

An epidemic of smallpox occurred in Blandford and Huntington in May and June. The source of infection is unknown. The earliest cases developed in a woolen mill, and subsequently spread through several families, and these in turn passed the infection along through means of schools, shops and public gatherings. It was ascertained that the vaccination laws had not been rigidly enforced for years in these towns, and it was recommended that wholesale vaccination be commenced at once. This was done. The cases were isolated and the epidemic soon ran its course. Adjacent towns were advised to vaccinate their inhabitants also.

A case of smallpox in Chicopee was investigated on April 8. The patient had arrived from Canada a few days before. He had never been vaccinated. Six members of his family were vaccinated for the first time several days after exposure. His wife had been vaccinated several years before. All the members of the family, with the exception of the wife, came down with the disease, and the local board of health instituted a rigid quarantine, and no further cases developed.

A case of smallpox was investigated in Dana in April. It was found that the patient had worked in a sporting goods factory in Springfield until he was taken ill, when he came home. Advice was given to the local board of health as to proper measures to prevent the spread of the disease. All the school children were vaccinated. The only other case that occurred was in the father of the patient, who came down with a modified form of the disease ten days after vaccination.

Six cases of smallpox were investigated in Dudley. None of these had been vaccinated. Proper measures were taken to prevent the spread of the disease, and a general free vaccination was carried out in the town.

One case of smallpox occurred in Edgartown, the source of the infection of which could not be traced.

Seven cases of smallpox investigated in Fairhaven were traceable to a patient in Providence who was also responsible for the Acushnet cases previously mentioned.

A case of modified smallpox was discovered in Fitchburg in April. The patient worked in a large shirt factory in Leominster until taken ill. At the same time suspicious cases came under the observation of the physician of the board of health of Leominster, the diagnosis of smallpox being confirmed by the State Inspector of Health. Investigation revealed the fact that a considerable number of people, principally French, in Leominster had had a similar eruption. Strict quarantine regulations were immediately established in both places. The Leominster cases with one exception were transferred, together with several direct contacts, to the isolation hospital for such cases. Vaccination of all known direct and indirect contacts was enforced, including the employees of two large shirt factories in Leominster.

Three cases of smallpox were investigated in Holyoke. The local board of health acted promptly, and strict quarantine of the cases was instituted. There was a general free vaccination. No further cases developed.

An outbreak of smallpox occurred in Lowell. The first case was taken sick January 13, although he worked until the 15th. The man came from Canada where he had been from the 1st to the 10th. Possibly he contracted it there or on the train, but the time seems rather short, unless it was the first day or two out from home. In June two more cases were reported in children attending private schools. The local board of health determined on a crusade to see whether there were not more concealed cases. The State Inspector of Health advised looking up all absentees from the suspected schools. This, as well as investigating all rumors, resulted in the uncovering of 39 cases, as well as finding indications from history and scars that many more had been through the course of the trouble and recovered. This investigation revealed the fact that the teachers and physicians in most of the private schools had paid no attention to having the children vaccinated, with the result that a very small percentage of them had ever had it done. The board took active measures to have this better attended to in the future.

Three cases of smallpox occurred in one family living in Ludlow. One of these cases was so mild that the patient worked for a few days in a factory in Springfield while she was coming down with the disease. The State Inspector of Health notified the Springfield authorities, and they vaccinated the employees of this factory who were exposed by this girl. The Ludlow board of health instituted a thorough vaccination of the school children, and placed a rigid quarantine on the house where the smallpox patients lived. No further cases developed.

Five cases of smallpox were seen in Lynn by the State Inspector of Health. These cases were moved to the Swampscott smallpox hospital.

Twenty-six cases of smallpox in New Bedford were traceable to a man from Providence, responsible also for the Acushnet and Fairhaven cases previously mentioned.

Three cases of smallpox in one family in North Attleborough were investigated by the State Inspector of Health of the district including that town, and suggestions were given as to quarantine, vaccination and disinfection. The original case in the family contracted the disease in Canada.

A diagnosis of smallpox was made for the board of health and a private physician of Salisbury in January.

Two cases of smallpox were investigated in South Hadley Falls. One, a baby, proved fatal, the child being ill only a short time. The other case, a man, was found to be improperly isolated, on account of crowded conditions in his home. The local board of health erected a building for his use, and located same on the outskirts of the town. A thorough vaccination of the school children was instituted. No further cases developed.

Five cases of smallpox in Webster were investigated in October.

Miscellaneous Diseases.

An extensive outbreak of septic sore throat occurred in Canton during the last of April and the first part of May. An investigation of the situation was made early in the outbreak by a State Inspector of Health. Suspicion was directed to a certain milk supply as the source of the infection, inasmuch as nearly all the cases reported occurred on that supply. The local board of health were advised to prohibit the sale of that milk, and on May 9 that milk supply was stopped. The clinical aspect of the outbreak was a severe streptococcus infection of the throat with glandular enlargement, marked prostration, and complications of peritonsillar or cervical abscesses, peritonitis, œdema of the glottis, œdema of the lungs, pneumonia and severe gastrointestinal disturbances. Thirteen deaths were directly traceable to complications resulting from the infection.

Immediately on the stopping of the sale of the milk the number of cases diminished, the last case being reported on May 12. The source of the infection in the milk was traceable to a man who handled bottles and delivered the milk from this dairy. Late in March and some time between the first and middle of April, this man had two attacks of tonsillitis. Shortly after his recovery three members of the milkman's family, including the milkman himself, were ill with tonsillitis, during which time he continued to handle the milk, and there was thus ample opportunity for infecting the supply. A pasteurizing outfit was subsequently installed in this dairy, and the pasteurization was carried on for a number of days under the direct supervision of the State Board of Health. The dairy was thoroughly cleaned, and after the conditions were arranged, so that there was no longer any danger of spreading any infection from this supply, the milkman was permitted to sell his milk again.

Sixty-five cases of septic sore throat occurred in the middle of June among the young women of Wheaton College in Norton. The cases varied in their severity; some were very mild and others were extremely severe. Among the more serious complications of the throat infection were tonsil abscesses, acute arthritis, peritonitis and endocarditis. No one in the town of Norton outside of the college developed the disease. Pasteurization of the milk supply was instituted and the outbreak soon subsided.

Measles has been extremely prevalent during the last year. This is due to epidemics, the nonclosure of public schools, promiscuous and unrestrained contact. Many people continue to think that measles is a disease to be little feared, that it is a disease of childhood, therefore to be expected. The inspector of the Southern Bay and Cape District reports 2,369 cases more than for a corresponding period a year ago.

The schools in Fitchburg were so badly involved that it became necessary for the board of health to temporarily suspend its ruling relative to the exclusion from school of well children in a family where measles was present. Clinton closed its schools for a longer period than usual during the Christmas holidays because of the extensive outbreak, as did Boylston. Assistance was given and suggestions offered to boards of health during the outbreaks. Of the smaller towns in this district, viz., the North Central, Boylston reported the largest number of cases, possibly because the board of selectmen, acting as board of health, was urged by the inspector to inform householders of their duty to report such cases to the board. A copy of the statute was printed and sent to each householder.

In the Northern Connecticut Valley District the disease was epidemic in Greenfield from November until June, with a total of 173 cases. From Greenfield it spread along the lines of travel, appearing during December in Montague, Erving, Wendell and Northampton; in January it appeared in Amherst, Colrain, Deerfield and Northfield; in March, in Orange, Leverett and Shelburne; in May, in Hatfield, Cummington and Goshen; in June, in Sunderland; and in September, in Gill, — 379 cases in 17 towns.

In the Berkshire District measles was present in 2 cities and 18 towns, the number of cases (452) being more than double those of last year (197). These cases were largely grouped in Pittsfield, Great Barrington, Williamstown and North Adams.

Scattering cases were seen by inspectors in other districts and such advice given as to isolation as was necessary.

State Inspectors of Health were frequently called upon by local boards of health, as well as by private physicians, to assist them in the diagnosis of smallpox. Twenty cases suspected of being smallpox, diagnosed as chickenpox by Dr. Frank L. Morse, the State Inspector of Health of the North Metropolitan District, were seen in the towns or cities of Amesbury, Boxborough, Dedham, Everett, Gloucester, Holyoke, Huntington, Ludlow, Lynn, Northfield, Pittsfield, Reading and Springfield. Similar cases were also seen in Amesbury, North Adams and Northampton.

A case of trachoma was investigated in Greenfield.

A case of trichinosis was investigated in Dedham.

Two cases of tetanus were diagnosed and investigated, — 1 in Everett and 1 in Taunton.

An outbreak of gastro-enteric disturbance was investigated in Duxbury in the month of August. Thirty cases of the disease appeared in 12 families living in that section of the town known as "Powder Point." All the cases were on one milk supply, and it was apparently a milk-borne outbreak. The definite source of the trouble, however, could not be determined.

An extensive outbreak of gastro-enteritis affecting some thousands of persons in the town of Peabody was investigated in October. A thorough investigation of the situation was made by the State Inspector of Health of the district, together with the engineering department of the State Board of Health. The source of the infection was found in the water supply.

A case of human glanders was investigated in West Acton. The diagnosis of the disease was made by an examination of the patient's blood.

The State Inspectors of Health have assisted in the investigation of cases of infantile paralysis and have submitted special reports during the year on the cases investigated by them.

Ophthalmia Neonatorum.

Ophthalmia neonatorum, or inflammation of the eyes of the new-born, includes all the inflammatory conditions of the conjunctiva that occur shortly after birth, usually before the end of the first month. . . . Ophthalmia neonatorum is not always gonorrheal, but may be produced by other virulent micro-organisms or by irritating substances. (Definition of Milton J. Rosenau, M.D., in his book "Preventive Medicine and Hygiene.")

Cases of ophthalmia neonatorum reported throughout the State, with the exception of Boston, were investigated by the State Inspectors of Health. Preliminary as well as final detailed reports were submitted to the office of the State Board of Health. Whenever it appeared that the infant's eyes were in a serious condition, or were not receiving proper care, or whenever it appeared that the conditions at home were such that the other members of the family were not protected against infection, the family was urged to send the child to the hospital, and recommendations to that effect were made to the local board of health. These recommendations were invariably carried out.

Cases of ophthalmia neonatorum discharged from the Massachusetts Eye and Ear Infirmary, or from the lying-in hospitals, or others, of which notice was submitted to the office of the State Board of Health, were visited to determine the end results in each case.

Efforts were made by the State Inspectors of Health to make sure that the infant was receiving proper medical and nursing care. Physicians were made to account for failure to report cases of the disease. Ignorance of the law requiring such cases to be reported, ignorance of proper methods of treatment, and carelessness on the part of local boards of health, physicians, nurses, midwives and parents, were observed during the year; and yet, on the whole, there was noted an improved condition on the part of many boards of health and physicians as to the recognition of the seriousness of this disease and its ultimate results if neglected or improperly treated. There was also observed a tendency upon the part of some physicians, as a routine method of treating the disease when it appeared, to use the silver nitrate prophylactic provided by the State Board of Health as a preventive of this disease. In a few cases this treatment was followed by an increased activity of the inflammation. Certain physicians appeared not to consider a case as having a discharge until the eyes were literally overflowing with thick pus. The prophylactic furnished by the State Board of Health is being used more frequently. The public is fast becoming educated to the desirability of its use, and is inclined to criticise the physician for failure to use it if the eyes later become inflamed. Literature and circular letters have been sent to local boards of health within the State, in which the dangers of the disease have been pointed out and the necessity urged for the prompt reporting of all cases. The law relative to the reporting of all births has been brought to the attention of local boards to some extent.

In many cases physicians discharge their cases on the third day after delivery. Soreness of the eyes coming on after this time is usually not brought to the attention of the physician promptly, because, for one reason, it means extra calls and extra expense for the family. This is shown in the following case: —

Baby N., born November 24. Physician made his last visit on the third day. Eyes of baby became inflamed on the sixth day. Condition was allowed to run for six days longer, when the physician was notified. He delayed several hours, although the condition was serious, before reporting to the local board of health. The State Inspector of Health saw the child on the seventh day after inflammation was first noticed by family. Immediate removal to a hospital was recommended, and acted upon by the board of health at once. It was too late, however, ulceration of the cornea had developed, and the child lost the sight of one eye.

During the month of April the State Inspector of Health of the North Metropolitan District, at the request of the State Board of Health, investigated 694 cases of eye infection admitted to the Massachusetts Eye and Ear Infirmary during 1910, 1911 and 1912. Of this number, 335 were found to be ill with ophthalmia neonatorum.

The State Inspector of Health of the Massachusetts Bay District has recorded the following observations in connection with this disease: —

In dealing with ophthalmia neonatorum there are in the present law a number of inefficiencies which should be corrected. The law at present requires that hospitals where cases of ophthalmia are treated report to the State Board of Health when these cases are discharged, and the condition of the discharge, whether "cured" or "uncured." No such reports are required of them to the local board of health. It thus may happen that several days may elapse before the discharge of an "uncured" case is brought to the attention of the local board of health, and valuable time may be lost. During this interval serious damage may be done. A case in point was of a baby discharged from a lying-in hospital as "cured." Several days later the baby's eyes became sore again, and a physician who was called in to see the case ordered its removal to the Eye and Ear infirmary.

Another serious difficulty in our handling the problem is one which is usually overlooked. The great majority of the children are breast fed, and in sending them to the hospital they are put on the bottle, — a serious procedure under any conditions. It works fairly well when the child is in the hospital, where the preparation of the milk is in skilled hands. When, however, the child is returned the feeding is left to the mother, who is often careless, ignorant and unable to pay for the proper milk. This frequently results in nutritional disturbances, particularly during the summer months. Mothers are for that reason extremely reluctant to send their breast-fed infants away.

We succeed in avoiding possible danger to the eyesight at the expense of the child's general health. Why should not the nursing mothers be taken into the hospital with the children and kept there till the child is ready for discharge? To be sure, it would somewhat increase the cost of caring for the cases, but would not the results justify such an additional expense? As the matter stands now, in order to prevent what is in a great majority of the cases only a remote possibility of injury to the eye, we submit the children to all the dangers of bottle feeding in the hands of untrained and ignorant mothers.

Some further difficulties in the situation might be mentioned. Some physicians still make a distinction between conjunctivitis and ophthalmia neonatorum, assuming that the latter is necessarily of gonorrheal origin. Reports are therefore delayed, pending a bacteriological diagnosis or until the case becomes severe. Such delays are often disastrous, inasmuch as it is impossible in the early stages of the disease to distinguish those cases which are of little consequence from those which will within a short time be so severe as to make it impossible to save the child's eyesight.

Even more serious than the above condition is the custom, not uncommon with physicians practicing among the poorer classes of the community, to discharge obstetrical cases several days after delivery. The child is thus often left to the mercy of ignorant or careless persons, who fail to take notice of any inflammation of the child's eyes, and who do not call a physician until the case is so far advanced that blindness cannot be prevented. It would seem that the local board of health should take some measures to prevent such occurrences. To do so the co-operation of the physicians must be enlisted.

While it is not possible to require physicians to follow up their cases for two weeks, — the period within which ophthalmia most frequently develops, — it would seem to be reasonable to require physicians to report to the local board of health any case which they discharge within two weeks after delivery. The local board of health could then, through their physician or nurse, have the case under observation until the danger period was passed. But even where no such physician or nurse is available, a letter written from the board of health office to the parents, calling attention to the necessity of watching the baby's eyes, might result in earlier consultation of the physician when the baby's eyes show signs of inflammation or discharge.

The following data were obtained in the 896 cases which were investigated by the State Inspectors of Health: —

	Cases.
Outfit used at time of birth in	587
Substitute prophylactic used in	126
Prophylactic not used in	95
Not ascertained or unrecorded in	88
Infection of the eyes occurred in the first week in	607
Infection of the eyes occurred in the second week in	184
Infection of the eyes occurred after the second week in	30
Not recorded in	75
Condition of the child's eyes reported to physician: —	
First day of infection,	484
Second day of infection,	197
Third day of infection,	86
After the third day,	50
Not recorded,	79
Condition of the eyes when first seen by State Inspector of Health: —	
Slight or serious discharge in	225
Seropurulent discharge in	7
Mucopurulent discharge in	86
Purulent discharge in	240
No discharge in	227
Not recorded in	111
Cornea clear in	881
Cornea infiltrated in	10
Cornea ulcerated in	5
Eyes of family properly safeguarded in	692
Eyes of family not safeguarded in	46
Not recorded,	158
Home treatment was found adequate in	599
Home treatment was found inadequate in	97
Cases transferred,	124
Not recorded,	76
Nurse employed in home care of cases,	194
Ophthalmologist consulted in	129
Institutional cases,	229

NUISANCES.

In determining the existence of a local nuisance, the health and comfort of the community are factors for consideration. In the matter of preventing or abating nuisances, the local boards of health have absolute authority. The function of the State Inspectors of Health is to investigate such nuisances, if necessary, for the purpose of bringing them to the attention of the local authorities and of recommending measures for the removal of objectionable conditions. Although boards of health and other health authorities customarily consider as nuisances those conditions which are sources of filth and causes of sickness or productive of objectionable odors, the Supreme Court of Massachusetts has ruled that "in order to amount to a nuisance it is not necessary that the corruption of the atmosphere should be such as to be dangerous to health; it is sufficient that the effluvia are offensive to the senses, and render habitations uncomfortable."

The nuisances most commonly brought to the attention of the local boards of health include such conditions as overflowing or otherwise objectionable cesspools, privy vaults and sink drains, filthy privies, dumps, dirty yards, pigpens, poultry yards, stables and dead animals. These are the nuisances most frequently called to the attention of boards of health of the smaller cities and towns, and may be dealt with under the general laws concerning nuisances. The less frequent complaints relate to low, wet and spongy lands, dwellings unfit for habitation, offensive trades and smoke. Nuisances arising from defective plumbing in houses may also be included in this group. The boards of health of small towns are seldom called upon to investigate nuisances in this group, the abatement of which is regulated by certain specific laws.

During the year 110 complaints relative to local nuisances were brought to the attention of the State Inspectors of Health, involving 13 cities and 57 towns. The character of the nuisances consisted of offensive odors, accumulation of manure and other refuse, overflowing cesspools, proximity of dumps to dwelling houses, noises, the use of the common drinking cup and common towel, stagnant waters and improper drainage conditions. All these complaints were investigated by the State Inspectors of Health, and when necessary, recommendations were made to local boards of health as to what steps should be taken to abate the nuisances. In 52 instances efforts were promptly made to abate the nuisances: 41 are still pending or in progress of abatement; and 17 were found to be groundless.

Especially in the Southern Bay and Cape District it has been observed that there is a growing tendency on the part of local authorities to bring about abatements within their respective jurisdictions, and an unwillingness to allow such complaints to reach the advisory authorities.

An article entitled, "The Abatement of Nuisances," by Elliott Washburn, M.D., State Inspector of Health of the South Midland District, read at a conference of the Association of Boards of Health of the Southern Bay and Cape District, and printed in the January, 1913, monthly bulletin of the State Board of Health, may be of interest to those engaged in community health work.

SANITATION OF SCHOOLHOUSES.

Photographs of different schoolhouses throughout the State were obtained for an exhibit at the Fourth International Congress on School Hygiene, Buffalo, N. Y., Aug. 27, 1913, at which congress a representative from the State Board of Health read a paper entitled, "The Correlation of the Work of School Physicians and Local and State Health Officials."

In the investigation of diseases dangerous to the public health the State Inspectors of Health have visited the schools in various sections of the State.

In the Southern Bay and Cape District the inspector, in company with members of board of health, school committee, or school physician, visited the schools in Barnstable, Dennis, Somerset and Lakeville, and the school children were examined for evidences of diseases dangerous to the public health.

In the North Central District the South Berlin school building was inspected and found to be satisfactory. Several school children in attendance, who had been reported as having a contagious disease, were looked over and found to be suffering with impetigo contagiosa and ringworm. The school committee and school physician were notified and the condition corrected. The graded school building at Sterling was inspected and found to be in a satisfactory condition. West Boylston school building and the Fitchburg High School building were inspected and found satisfactory. New toilet rooms were constructed at the Day Street School building, Fitchburg, as a result of inspection and suggestions made by the State Inspector of Health. New school buildings were inspected at South Barre and Hardwick.

In the South Central District a number of school buildings have been visited by the State Inspector of Health of this district. It was noted that recommendations made in past years, relative to lighting and sanitary conditions, are being followed out by the school committee. The sanitaries attached to the school buildings in the towns surrounding Worcester were noted to be in better shape than in former years. They are cleaned oftener, and kept in better repair.

Owing to a complaint made to the inspector in the Southern Connecticut Valley District an inspection was made of the School Street School, South Hadley Falls. As a result of this inspection it was found that many of the rooms were overcrowded, that the basement classrooms were not fit to use on account of dampness, and the water-closets were found to be faulty. A letter was written to the proper authorities calling their attention to the matter.

While observing the inspection of the children during scarlet-fever epidemics in Amherst, Hadley and Northampton, the inspector of the Northern Connecticut Valley District found no grave errors of sanitation in the school buildings. During the winter and spring statistics were obtained from all the school superintendents in the district except one, covering the question of the vaccination of the school children as provided for by the statutes. At the opening of the schools this year in several of the towns a more stringent regulation in regard to the admission of unvaccinated children was enforced, and the statistics for this year will be compared with those of last year.

Inquiries regarding the details of school inspection were made in two cities and in two towns by the State Inspector of Health of the Berkshire District. These inquiries were made through interviews with school inspectors, physicians and the local authorities.

DRINKING WATER.

During the year the conditions obtaining on passenger trains as to the furnishing of pure drinking water and individual drinking cups have been investigated. Reports have been made covering these conditions in several trains.

MATTERS RELATING TO WATER SUPPLY AND SEWERAGE.

Much of the work that has been done under this heading has been in conjunction with the engineering department or in the investigation of diseases, and further information may be obtained in another section of the annual report.

Agawam. — On July 29 conditions at Riverside Park, Agawam, were investigated upon request of the president of the amusement company, who owned the grove where a large number of people come during the summer. It was found that, owing to the pollution by a distillery and a woolen mill of a small stream which flows through the grove, considerable odor arose, making it very objectionable to the public. The matter was referred to the engineering department, and one of the engineers investigated the conditions and reported the matter to the Board. A letter was sent to the Agawam authorities requesting them to take action against these manufacturing plants, also advice as to the best means of preventing the pollution of this brook.

Amesbury. — Water samples were taken from a private well in Amesbury. This well is used by a milk dealer for domestic purposes. An analysis of the water was made by the engineering department of the Board.

Amherst. — Land near the Amherst watershed was examined because of probable pollution of a stream from which water was being pumped for an emergency supply. The pollution was evident and the pumping from that source was discontinued.

At intervals during the winter the condition of the brook supplying an ice pond in Amherst, and the public use of that pond for skating, were investigated and reported on.

Ashburnham. — Drainage conditions have been improved during the year in Ashburnham by the construction of cesspools upon the premises of householders. Heretofore sink drainage had been disposed of into open ditches running through the village.

Becket. — A visit to the Y. M. C. A. camp, Camp Becket, in the town of Becket, at the opening of the season, showed various improvements. A new water supply has been introduced, an artesian well, some distance from the camp; bubbling drinking fountains have been installed for camp use; dry closets have been arranged, with daily emptying of the cans, and the whole so protected as to keep flies out; and new cottages have been built so that all employees are now housed on the camp grounds. There were no cases of typhoid fever in the camp this year.

Berlin. — Upon complaint of probable pollution of a well in Berlin, from water spilled from open pails used for watering horses, an examination of the well was made. It was found exposed to surface drainage, and suggestions were offered to the board of health for the removal of the conditions.

Bridgewater. — The matter of the introduction of a sewerage system in the town of Bridgewater was taken up with the local board of health of that town.

Dalton. — In Dalton the town authorities were urged to have the town accept provisions of law with reference to requiring houses to be connected with sewers, but through some oversight the subject was not included in the warrant.

Deerfield. — In September a part of the watershed of the Deerfield water supply was inspected because of the proximity of a case of typhoid fever. It was found that there was little danger of pollution from that source.

Dighton. — Sample of water for testing was taken from a well in Dighton.

Easthampton. — In May the condition of the shore of Nashuannuck Pond in Easthampton was inspected and the matter taken up with the local board of health.

Fitchburg. — Water from an open spring located in the east yard of the Boston & Maine Railroad in Fitchburg, and used by a large number of railroad men, was caused to be analyzed by the State Board of Health, and found to be a dangerous water for drinking.

Construction of temporary privies on the new fair grounds at Fitchburg was investigated with reference to possible pollution of a stream, the water of which is used for a public ice supply. No objectionable conditions were found. Privies were properly constructed at a safe distance from the stream.

Drainage conditions from a stable in Fitchburg, with reference to possible pollution of the stream mentioned above, were investigated, and it appeared that there was little or no danger of pollution therefrom.

Freetown. — Sample of water for testing was taken from a well in a grove at Assonet in Freetown.

Gardner. — The water from an open spring in a vacant lot by the side of the highroad in Gardner, used for drinking purposes by a considerable number of people in the neighborhood, was caused to be analyzed by the State Board of Health. The water was declared dangerous for drinking.

The construction of a new stable to be located on the watershed of the Gardner water supply, with reference to drainage into a stream emptying into the supply, was investigated. It was found that all the rules and regulations of the local water commissioners were to be complied with, and that there was little or no danger of pollution of the stream.

Great Barrington. — The subject of a sewer survey was urged upon the authorities in Great Barrington, but no action was taken.

Greenfield. — In August the sources of spring water brought for sale into Greenfield were ascertained.

Hamilton. — An investigation was made of the drinking water supply of the resort in Hamilton known as Asbury Park. Analyses of the waters from the various wells were made by the engineering department of the Board. Conditions are such in Asbury Park, as well as in other parts of the town, that a public water supply should be installed.

Haverhill. — An investigation was made of a private water supply in the Rosemont District, a well used in common by several families. An analysis of this water showed a supply unfit for drinking purposes. The owners of the well were advised to seek another supply.

Holyoke. — In February and March the cutting of ice on Ashley Ponds, near Holyoke, was investigated. It was ascertained that reasonable care was being used on the ponds to prevent pollution of the ice and water. However, the men employed on the main pond were polluting the West Springfield watershed, and after consultation with the engineer the matter was taken up with the proper authorities in West Springfield.

Visits were made to Holyoke to observe the conditions under which ice was being cut on the city reservoirs.

Huntington. — The watershed in the town of Huntington, where public works were under construction, was inspected, and steps taken to protect the public water supply from pollution.

Lee. — An article was inserted in the town warrant in Lee authorizing the selectmen to secure a sewer survey, but the article was rejected, though the subject had been repeatedly urged upon the board of health and various citizens. Many acknowledge that such a step is needed and urgent, but apparently the town shrinks from beginning a task which it fears will eventually require large expenditures.

Middleton. — An investigation was made of the conditions surrounding the drinking water supply at the summer resort known as Haswell Park. Analyses of the waters from the wells at this resort were made by the engineering department.

Monson. — The location of a spring in Monson was ascertained for the Board, the water from which spring was to be examined.

North Adams. — During the past summer the public water supply was extremely low. At the present time plans are being worked out for increasing the storage capacity of the city and increasing the city's supply. Various samples of water have been taken and sent to the laboratory of the Board for analysis.

Northampton. — In August the sources of spring water brought for sale into Northampton were ascertained.

Northbridge. — In the town of Northbridge several cases of typhoid fever were found, patients having used the water from a well which was highly polluted, use of which has been discontinued, and since that time no other cases have developed from this source.

Palmer. — While investigating typhoid fever in Palmer during July and August, an inspection of the water supply of the town was made. Many objectionable conditions were found to exist, and the matter was brought to the attention of the local board of health.

Plymouth. — A sample of water for testing was taken from a well in Plymouth.

Russell. — The watershed in the town of Russell, where public works were under construction, was inspected, and steps were taken to protect the public water supply from pollution.

Shelburne Falls. — In April the question of an extension of the town sewer, to relieve a probable concentration of sewage at its present outlet, was discussed, the ground inspected and a report made. The proposed extension was approved by the State Board of Health.

Southwick. — At the request of the Congamond Park Association the inspector investigated conditions at the Lake House, Southwick Ponds. Sewage has been entering the pond from this point, and a year ago the matter was investigated by the inspector and an assistant engineer. The Southwick board of health were requested to take action toward preventing this objectionable nuisance, but for some reason the condition has not been remedied. Another letter was sent to the Southwick board of health calling their attention to the matter, with a request that they take action to prevent further pollution of this pond by the sewage from the Lake House.

Springfield. — In August an examination of the grounds around the House of the Good Shepherd, Springfield, was made upon request of the Sister Superior. It was found that a cesspool was the cause of a nuisance, and the institution was requested to abate same by the Springfield board of health. The matter was referred to the engineering department for a solution, and one of the assistant engineers made a thorough study of the situation, and upon his report the Board gave the institution certain advice as to the best way of taking care of the sewage.

Sterling. — Water from an individual well in Sterling, used by a family in which typhoid fever had occurred, was caused to be analyzed by the State Board of Health, and was found to be polluted and unfit for drinking.

West Springfield. — The location of a spring in West Springfield was ascertained for the Board, the water from which spring was to be examined.

Wilbraham (North). — Upon the request of a manufacturing company the inspector investigated a condition which consisted of surface water coming from a highway on to their land. The State was building a highway through the town, and placed a culvert so as to empty water from the road on land that the company were filling in for building purposes. The matter was referred to the engineering department, and they decided that the State Board of Health had no authority in the matter, so it was referred to the local board of health, who could ask for advice from the State Board should they deem it necessary.

Williamsburg. — In September a well in Williamsburg, the water of which had developed a suspicious taste and odor, was investigated. It seemed probable that the unpleasant qualities were the result of low water rather than of pollution.

Westford. — In July a doctor asked for a lead analysis of the well water of one of his patients, as the man usually became sick after using the water for a time. The examination showed no lead, but a badly polluted water.

The source and possibility of the pollution of the water supplied to locomotive engines was ascertained and reported on.

SANITATION OF FACTORIES AND WORKSHOPS AND MERCANTILE ESTABLISHMENTS.

The work to June 1, 1913, when the transfer was made to the State Board of Labor and Industries, consisted in special investigations and in investigating complaints relative to conditions in industrial and mercantile establishments, and reinspecting establishments that had previously been visited and where orders requiring changes in compliance with the law had been issued.

Many foundries in the State were inspected, and following the provisions of an act of 1912, the State Board of Health voted to adopt the following rules, for regulating the employment of women in core rooms: —

Rule 1. — Core rooms where women are employed should be so separated from the foundry that the women workers should not be exposed to the fumes and gases from the foundry.

Rule 2. — Core rooms where women are employed should have a separate entrance so that women going and coming from work should not have to pass through the foundry.

Rule 3. — The ovens located in the core rooms should be so constructed, and mechanical devices used when necessary, as to carry off all the fumes generated in the process of baking the cores.

Rule 4. — No woman should be permitted to carry cores from benches to ovens.

Rule 5. — Forty pounds should be the maximum weight that a woman should be permitted to lift.

Rule 6. — The State Inspector of Health of the health district wherein the foundry is located shall be empowered to change the maximum limit which a woman shall be allowed to lift if on personal examination of that woman working in a core room it shall seem to him safe and proper to do so.

It does not seem necessary to prescribe any limit for the size and the weight which the women shall work on, as such work does not seem injurious to a woman's health.

Visits to several foundries disclosed improved sanitary conditions. One foundry, however, visited November 16, had not complied with an order given by the State Inspector of Health in connection with that part of chapter 514 of the Acts of 1909 which related to hoods and blowers over emery wheels, and on Feb. 6 and 7, 1913, action was brought against the foundry in the Malden District Court, the case being continued until February 19 and 21, at which time the defendant was found guilty and a fine imposed. A further visit to the foundry on May 9 showed that the law had been complied with.

Several laundries inspected during the year showed improvement. It was observed that proprietors are learning that they cannot get the best results from their employees in an overheated atmosphere.

The lighting conditions in a variety of establishments were reported upon. In all establishments visited artificial light was by electricity, the carbon lamp being most commonly used, although many establishments are changing to the high-power tungsten lamps. Except in a few instances in certain sections of rooms where light was obstructed, either from without by other buildings or within from machinery, and in one old building, low studded with small windows, lighting was found to be good.

One inspector spent considerable time in investigating the humidity requirements in spinning worsted yarns; more particularly, whether the same schedule could be used as in the cotton mills, and as to whether the enforcement of the Massachusetts standard would work a hardship. Factories were examined in Lawrence, Newton and Holyoke. The result of the investigation showed to the inspector: —

First. — That many places left it to the spinners to determine what degree of moisture and heat was used, rather than accurately standardizing it and seeing that those points were constantly maintained.

Second. — That the majority of the rooms were well within the Massachusetts standard.

Third. — That the spinning of all wool required more moisture than part or all cotton.

Fourth. — That the finer yarns required more than the coarse.

Fifth. — That better grades of wool were required for the finer yarns, and that all required numbers of yarn could be spun within the Massachusetts standard if good enough quality of stock were used, properly conditioned, but that a higher degree of heat and moisture would probably enable the use of a less carefully conditioned or poorer grade of stock in producing a given number of worsted yarn.

Sixth. — That the spinners seemed to be a particularly healthy looking set of people, and that their average attendance at work was above that of the average of the other departments as computed for a period of two months.

Seventh. — That in one mill, where women were found to be running mule frames, it was learned that they were liable to faint if the temperature exceeded 85° F., regardless of whether humidity was excessive or not.

A special investigation of tobacco-sorting shops was made in the Northern Connecticut Valley District, and a report on the same submitted to the State Board of Health.

Statistics, Oct. 31, 1912, to June 1, 1913.

Number of inspections made of factories, workshops and mercantile establishments,		556
Number of minors seen and questioned,		1,800
Number of physical examinations made because of: —		
Tubercular family history,	11	
Previous personal history,	5	
Pale skin or personal appearance,	15	
		31
Classification of conditions of ill health, physical unfitness or abnormalities: —		
Bronchitis,	1	
Anæmia,	3	
Rapid heart,	2	
Enlarged tonsils,	2	
Number of minors judged to be in ill health,		8

Lead Poisoning.

A case of lead poisoning, treated at the Massachusetts General Hospital, in an employee in a glass works company, was investigated in detail. Further investigation showed that two other cases of lead poisoning had occurred in the same establishment. These cases occurred in men who mixed the various ingredients of the glass containing red lead. Advice was given the establishment to provide respirators for the men engaged in that process.

HYGIENE OF TENEMENT WORKROOMS.

During the fall, which is the busy season in the clothing trades, most of the time was occupied in inspecting for new licenses. In January, however, there was a lull, due not only to the usual slack in the work on women's wear, but more especially to the strike in the men's tailoring shops.

This strike lasted nearly three months. Very few new licenses were applied for during this time among the workers on men's wear, as very few women were working at their homes. Many of the women who remained at home had no outside work to do, thus allowing them more time to attend to their household duties. As a result the improved condition of many of the homes and the better care of the children were quite striking.

The condition of the workers during the strike was interesting, as it gave a side light on what might result if home work on wearing apparel was entirely prohibited. So far as could be observed, the strike did not materially increase discomfort among the majority of the home workers. If a three months' cessation of the work resulted in no very serious hardships upon the majority of the workers, a total cessation would probably not produce very much harm. There are, it is true, many mothers with large families of children who could not leave home to work in a shop, but whose small earnings at home help to support the family. But this is gained only at the expense of much time and strength on the mother's part, and, of necessity, some neglect of the home and the children.

Several new firms have started to require licenses this year, but these have been firms making fine wear for children and women, — work that must, of necessity, be done by women of some skill and intelligence. The homes where this work was done were in the less congested districts, and were well kept and sanitary.

Very few children were found at work in the homes. In only two instances were children under fourteen years observed pulling basting threads during the noon hour. Many children were found, however, who did a great deal of the housework and who took care of the small children while the mother worked.

The inspection and licensing of tenement house workrooms passed from the authority of the State Board of Health on June 1, 1913.

Inasmuch, however, as the Board of Labor and Industries had not then been appointed, supervision was maintained over the premises where licenses were held, to see that no work was done on premises from which communicable diseases had been reported.

The foregoing applies to the Massachusetts Bay District, in which district since 1907 an intensive educational work has been carried on in connection with a large number of tenement workrooms. The efforts directed to maintain higher sanitary standards have been gratifying, and as stated in a previous report, while the primary object of inspection of tenement workrooms is to guard the public health from the spread of contagious diseases by means of infected wearing apparel, it accomplishes a great deal more by the maintenance of high sanitary standards in these congested tenement homes. The friendly visits to these homes, and close personal contact with the workers, have been a great educational force in the development of higher standards of hygienic living. This fact becomes evident by comparing the conditions in the licensed flats with those that prevail in other flats of the same building, where no licenses are held. The difference in the sanitary conditions in these two classes of homes is often striking.

In other sections of the State the work which the women do consists mainly of crocheting on women's undervests. It is done in comfortable homes where the sanitary conditions are beyond reproach, and for astonishingly low wages, — apparently "for a pastime or for a little additional pin money." The only danger to the public health from this class of workrooms consists in the occurrence of communicable diseases in these homes, and the exposure of the garments made or finished in them to infectious and contagious matter.

Numerical Data recorded for All Districts.

Number of licenses granted,	1,181
Number of licenses refused, revoked or dropped,[1]	813
Number not in or not found,	2,503
Number of reinspections,	1,202

[1] Because of poor conditions, sickness in the house, contagious disease in family, removal or did not care for them.

SANITATION OF POLICE STATION HOUSES, LOCK-UPS, HOUSES OF DETENTION, JAILS, HOUSES OF CORRECTION, PRISONS AND REFORMATORIES.[1]

In accordance with chapter 405 of the Acts of 1910, as amended by chapter 282 of the Acts of 1911, the State Inspectors of Health made the fourth annual examination of police station houses, lock-ups and houses of detention, and the third annual examination (excluding Suffolk County) of jails, houses of correction, prisons and reformatories.

Following the provisions of this law the State Board of Health have prescribed the following general rules: —

Concerning Police Station Houses, Lock-ups and Houses of Detention.

1. *As to Furnishing and Use of Drinking Cups.* — The provision of the common drinking cup is unlawful in accordance with the provisions of chapter 428 of the Acts of 1910. A drinking cup after use by one person should be washed clean before being used by another.

2. *As to Dishes used for Food.* — All dishes and utensils used for food should be thoroughly cleaned and washed in boiling water after use.

3. *As to Bedding.* — Every woman prisoner should be furnished with a mattress. The mattress should have a smooth surface and be covered with rubber or other waterproof material. This should be encased in a slip of washable material or covered with a sheet. These slips or sheets should be changed for each occupant and washed. Both mattresses and coverings should be removed from the cells during the day and thoroughly aired.

4. *As to Ventilation.* — All cells should be adequately ventilated. (Cells ventilated by means of openings into ventilating flues must have some means, mechanical or other, for creating a circulation of air.)

Concerning Jails, Houses of Correction, Prisons and Reformatories.

1. *As to Furnishing and Use of Drinking Cups.* — The provision of the common drinking cup is unlawful in accordance with the provisions of chapter 428 of the Acts of 1910.

2. *As to Dishes used for Food.* — All dishes and utensils used for food should be thoroughly cleaned and washed in boiling water after use.

3. *As to Bedding.* — Every prisoner should have one mattress, in which a sufficient amount of hair, excelsior or some other material is stuffed to make it comfortable, a pair of sheets and a sufficient number of blankets to keep him warm. Whenever the mattress becomes soiled it should be renovated or replaced. Mattress and coverings should be thoroughly aired during the day. Clean sheets should be used for each occupant. Blankets should be washed frequently.

4. *As to Ventilation.* — All cells should be adequately ventilated. (Cells ven-

[1] Period between Jan. 1, 1913, and Dec. 31, 1913, inclusive.

tilated by means of openings into ventilating flues must have some means, mechanical or other, for creating a circulation of air.)

5. *As to Towels.* — The provision of the common towel is unlawful in accordance with chapter 59 of the Acts of 1912, as set forth in rules and regulations made by the State Board of Health, viz.: "It shall be unlawful to provide a common towel: (*a*) In a lavatory used in connection with any public institution. . . . (*b*) The term 'common towel' as used in these regulations shall be considered to mean a roller towel or a towel available for use by more than one person without being washed after such use."

Police Station Houses, Lock-ups and Houses of Detention.

In 151 towns in the State prisoners are conveyed elsewhere immediately upon arrest. In the 169 remaining towns, and in the 33 cities in the State, temporary or permanent provision is made for the detention of prisoners.

It was the purpose of the Board to follow up recommendations, suggestions or rules given as the result of previous inspection, in order that the public buildings coming under this law be maintained in a sanitary condition.

In accordance with the statute requirement the State Board of Health approved plans for new buildings from time to time during the year.

The officials responsible for the enforcement of the rules made by the State Board of Health were informed of adverse conditions existing soon after inspection by the State Inspectors of Health, in order that necessary steps might be taken locally to bring a given lock-up or other building up to a proper sanitary standard.

So far as station houses, lock-ups and houses of detention were concerned, letters were sent to the proper authorities in the following cities and towns: —

As to Furnishing and Use of Drinking Cups.

Andover.
Avon.
Blackstone.
Bridgewater.
CHICOPEE.
Dedham.
Enfield.
EVERETT.
Georgetown.
Greenfield.
Hardwick.
Holbrook.
HOLYOKE.
Hudson.
Huntington.
Ipswich.
Kingston.
LAWRENCE.
Ludlow.
LYNN.
Methuen.
Milton.
Monson
North Attleborough.
North Reading.
Pembroke.
Randolph.
Sharon.
Southborough.
South Hadley.
SPRINGFIELD (Indian Orchard).
Sudbury.
Uxbridge.
Ware.
Wareham.
West Brookfield.
Winthrop.

As to Dishes used for Food.

Avon.
Blackstone.
Sharon.
Southborough.
Sudbury.
Wareham.
West Brookfield.

As to Bedding.

Amesbury.
Avon.
Becket.
Billerica.
Blackstone.
Braintree.
Bridgewater.
Canton.
CHICOPEE.
Concord.
Conway.
Dana.
Danvers.
Dedham.
Enfield.
Franklin.
Georgetown.
Greenfield.
Hardwick.
Hinsdale.
HOLYOKE.
Hopedale.
Hopkinton.
Hudson.
Huntington.
Ipswich.
Kingston.
LAWRENCE.
Ludlow.
LYNN.
Methuen.
Monson.
Montague.
Nahant.
North Attleborough.
Norwood.
Pembroke.
Reading.
Scituate.
Sharon.
Southborough.
South Hadley.
Sudbury.
TAUNTON.
Templeton.
Tisbury.
Uxbridge.
WALTHAM.
Ware.
Wareham.
Warren.
Wellesley.
West Boylston.
West Brookfield.
Westfield.
Wrentham.

As to Ventilation.

Andover.
Avon.
Barre.
Becket.
Belmont.
Blackstone.
Bridgewater.
BROCKTON.
CAMBRIDGE.
Canton.
CHICOPEE.
Concord.
Dana.
Danvers.
Dedham.
Enfield.
FALL RIVER.
Franklin.
Georgetown.
GLOUCESTER.
Greenfield.
Groton.
Hardwick.
Holbrook.
Hopedale.
Huntington.
Ipswich.
Kingston.
LAWRENCE.
Ludlow.
MELROSE.
Methuen.
Middleborough.
Monson.
Montague.
Nahant.
NEW BEDFORD.
NORTH ADAMS.
North Attleborough.
Oak Bluffs.
Randolph.
Reading.
Rockland.
Sandwich.
Scituate.
Sharon.
SOMERVILLE.
Southborough.
Sterling.
Sudbury.
TAUNTON.
Tisbury.
Uxbridge.
Walpole.

WALTHAM.	West Brookfield.	WORCESTER.
Wareham.	Winthrop.	Wrentham.
Warren.		

Also, attention was called in these letters to lighting, disposal of sewage and cleanliness, as follows: —

Lighting.

Amesbury.	GLOUCESTER.	Rockland.
Andover.	Groton.	Sharon.
Avon.	Holbrook.	SOMERVILLE.
Barre.	Hopedale.	Southborough.
Becket.	Kingston.	Sterling.
Belmont.	Middleborough.	Sudbury.
Blackstone.	Monson.	TAUNTON.
BROCKTON.	Montague.	Tisbury.
CAMBRIDGE.	Nahant.	Uxbridge.
Canton.	NEW BEDFORD.	Walpole.
CHICOPEE.	NORTH ADAMS.	WALTHAM.
Concord.	North Attleborough.	West Brookfield.
Enfield.	Oak Bluffs.	Wrentham.
FALL RIVER.	Randolph.	WORCESTER.
Franklin.		

Disposal of Sewage.

Avon.	Monson.	Sudbury.
Blackstone.	Rockland.	TAUNTON.
Bridgewater.	Sharon.	Uxbridge.
CHICOPEE.	South Hadley.	Warren.
Enfield.	Southborough.	WORCESTER.
Kingston.		

Cleanliness.

Amesbury.	Hinsdale.	Pembroke.
Avon.	Holbrook.	Randolph.
Belmont.	HOLYOKE.	Reading.
Blackstone.	Ipswich.	Rockland.
Braintree.	Kingston.	Scituate.
Bridgewater.	MELROSE.	Sharon.
BROCKTON.	Middleborough.	Southborough.
CHICOPEE.	Monson.	Sudbury.
Enfield.	Nahant.	Uxbridge.
FALL RIVER.	NEW BEDFORD.	Wareham.
Georgetown.	North Attleborough.	West Brookfield.
GLOUCESTER.	Oak Bluffs.	Wrentham.
Hardwick.		

Replies have been received to many of these letters, some stating that letters had been forwarded to the police department for immediate attention, others stating that contemplated changes were being considered, while others were held, pending action of local government.

Some extensive changes noted by the inspectors during the year are as follows: —

Boston. — In all the station houses in the city of Boston hot water was provided in each cell room, so that the tin dippers used as drinking cups can be thoroughly cleaned after being used. And in the station houses where women prisoners are detained excelsior mattresses with rubber coverings and slips were provided.

Station 7 in East Boston has been provided with a new building.

The old city hall building in Charlestown Square is being reconstructed and remodeled, and is to be occupied by Station 15.

A $100,000 appropriation has been made for a new building for Station 6 in South Boston. The land has been selected and plans have been drawn. Work will be started in the near future.

An appropriation has been made for a new station house in Dorchester.

Some plans are under consideration to remodel a building in City Hall Avenue, to be occupied by Station 2.

Gardner. — New police station in use.

Pittsfield. — Plans have been adopted for enlarging the station, adding another story, improving the offices and affording better cell room and ventilation, all of which is highly desirable.

Southbridge. — Many changes have been made in this station since last year following suggestions; new toilets have been installed; the stairway widened; thoroughly cleaned; and above all, the building has been sold and will soon be vacated; plans for and a lot purchased for a new station. . . .

The inspectors' comments in regard to the following stations or lock-ups are worth noting: —

Adams. — Best police station in the district.

Beverly. — A clean, neat, well-kept station.

Easthampton. — The best lock-up in this district, and kept in excellent condition.

Haverhill. — Particularly well-kept station.

Malden. — A very fine and well-kept station.

Manchester. — A well-kept station.

Marblehead. — This station has just been remodeled. It is an excellent station, well appointed.

Marlborough. — New model station.

Medford. — A very fine and well-kept station.

Newburyport. — A new building, — clean, neat and well kept throughout.

Orange. — Good lock-up.
Sherborn. — Well-kept, old-fashioned lock-up.
Salem. — A new station just occupied.
Taunton (Central Station). — Excellent station.

Jails, Houses of Correction, Prisons and Reformatories.

The examinations of jails, houses of correction, prisons and reformatories showed that, as a rule, they were in a condition worthy of commendation.

In one report was the following statement in regard to conditions in a county jail and house of correction: Sanitation in general excellent, except "off the jail kitchen there is a water-closet, with no outside windows, unventilated except by a seat vent. This closet is used by the kitchen force, and should be abolished unless proper ventilation and separation from the kitchen can be established."

In another report was the following statement in regard to conditions in a jail and house of correction: "A clean, neat and well-kept jail," but there was a criticism of arrangement of cells in the new building. "Cells were so dark that they should not be used."

In the report of a prison was the following statement: "Plumbing and ventilating arrangements renovated during past year and inside of rooms or cells painted."

In another jail and house of correction report it was stated that there was a "marked improvement in all departments compared with last year."

The Nantucket jail continues to be inadequate.

The Plymouth jail and house of correction was reported as being "a present-day model for like institutions."

SLAUGHTERHOUSE INSPECTION AND INSPECTORS OF SLAUGHTERING.

Several slaughterhouses in the State have been inspected. Uncleanly conditions were noted in those located in four towns, and the boards of health were notified and urged to have the conditions remedied.

The nominations for the office of inspector of slaughtering from the cities and towns in the State have been referred for investigation to the State Inspectors of Health, who submitted reports upon the qualifications of the candidates before such nominations were approved by the State Board of Health.

THE STATE INSPECTORS OF HEALTH.

The Southern Bay and Cape District.

Adam S. MacKnight, M.D. (Jefferson Medical College, Philadelphia, 1888).

Hospital work,	1888–1890
Colliery surgeon, Middle Coal Field, Lehigh Region, Pennsylvania,	1891–1895
Deputy Medical Inspector to the Pennsylvania Board of Health,	1892–1895
Secretary, board of health, Freeland, Pa.,	1892–1895
Health Officer, Little Compton, R. I.,	1896–1899
Medical examiner, 1st district, Rhode Island,	1897–1900
Health officer, Tiverton, R. I.,	1899–1900
Physician in charge of the tuberculosis department of the City Hospital, Fall River,	1903–1907
Examining physician for the Massachusetts State Sanatorium at Rutland,	1903–1910
Appointed State Inspector of Health,	1907

President of the Association of the State Inspectors of Health of Massachusetts.

355 North Main Street, Fall River, Mass.

The South Midland District.

Elliott Washburn,[1] M.D. (Harvard Medical School, 1892).

House surgeon of Boston City Hospital,	1891–1892
Chairman of the Taunton board of health,	1896–1908
Appointed State Inspector of Health,	1907

50 Broadway, Taunton, Mass.

The Midland District.

William W. Walcott, S.B. (Massachusetts Institute of Technology, 1901), M.D. (Harvard Medical School, 1905).

House officer, Massachusetts General Hospital,	1905–1906
Appointed State Inspector of Health,	1907

32 West Central Street, Natick, Mass.

The Massachusetts Bay District.

Harry Linenthal, A.B. (Harvard College, 1900), M.D. (Harvard Medical School, 1904).

Volunteer assistant in neurological clinic, Massachusetts General Hospital,	1904–1907
Inspector of schools for the city of Boston,	1906–1908
Member of medical staff of Mt. Sinai Hospital Society since	1905

[1] Resigned Oct. 1, 1913.

Assistant in pulmonary diseases, Tufts College Medical School, since 1910
Appointed State Inspector of Health, ... 1907
Assistant physician to out-patients, Massachusetts General Hospital, ... 1913
442 Warren Street, Roxbury, Mass.

The North Metropolitan District.

Frank L. Morse, M.D. (Harvard Medical School, 1894).
Surgical house officer, Boston City Hospital, ... 1894–1896
Assistant resident physician, South Department, Boston City Hospital, ... 1896–1897
Medical and sanitary inspector to the Massachusetts State Board of Health, ... 1898–1905
Medical inspector to the Somerville board of health since . . 1903
Superintendent of the Somerville Hospital for Contagious Diseases since 1906
Appointed State Inspector of Health, ... 1909
78 Highland Avenue, Somerville, Mass.

The Northeastern District.

Wm. Hall Coon, M.D. (Bellevue Hospital Medical College, New York, 1897).
Assistant physician, Northampton Insane Hospital, . . . 1897–1898
Appointed State Inspector of Health, ... 1907
Visiting physician to the Haverhill City Hospital, ... 1911
92 Main Street, Haverhill, Mass.

The North Midland District.

Charles E. Simpson, M.D. (Harvard Medical School, 1883).
Superintendent of the hospital of the Lowell Hospital Association, Lowell, ... 1886–1911
Appointed State Inspector of Health, ... 1907
100 Holyrood Avenue, Lowell, Mass.

The North Central District.

Lewis Fish, M.D. (Baltimore Medical College, 1898).
Appointed State Inspector of Health, ... 1907
86 Day Street, Fitchburg, Mass.

The South Central District.

Melvin G. Overlock, M.D. (Baltimore Medical College, 1896).
Appointed State Inspector of Health, ... 1907
91 Chandler Street, Worcester, Mass.

The Southern Connecticut Valley District.

James V. W. Boyd, M.D. (College of Physicians and Surgeons, New York, 1894).

Interne, Randall's Island Hospital, ... 1895
Appointed State Inspector of Health, ... 1909

24 Oxford Street, Springfield, Mass.

The Northern Connecticut Valley District.

John S. Hitchcock, A.B., M.A. (Amherst College, 1889, 1905), M.D. (University of Maryland, School of Medicine, 1893).

Appointed State Inspector of Health, ... 1910

160 Main Street, Northampton, Mass.

The Berkshire District.

Lyman A. Jones, A.B., A.M. (Lawrence University, 1886, 1889), M.D. (Harvard Medical School, 1891).

House officer, Worcester City Hospital, ... 1890–1891
Assistant in Worcester Insane Hospital, ... 1892–1895
Studied in Germany, ... 1895–1896
Physician to North Adams board of health, ... 1903–1904
Appointed State Inspector of Health, ... 1907
Secretary of the Association of the State Inspectors of Health of Massachusetts.

141 Church Street, North Adams, Mass.

LIST OF CITIES AND TOWNS INCLUDED IN EACH HEALTH DISTRICT.

The Southern Bay and Cape District.

Includes the cities of Fall River and New Bedford and the neighboring towns, and the towns on the Cape.

Acushnet.	Freetown.	Provincetown.
Barnstable.	Gay Head.	Rochester.
Bourne.	Gosnold.	Sandwich.
Brewster.	Harwich.	Somerset.
Chatham.	Lakeville.	Swansea.
Chilmark.	Marion.	Tisbury.
Dartmouth.	Mashpee.	Truro.
Dennis.	Mattapoisett.	Wareham.
Eastham.	Nantucket.	Wellfleet.
Edgartown.	New Bedford.	West Tisbury.
Fairhaven.	Oak Bluffs.	Westport.
Fall River.	Orleans.	Yarmouth.
Falmouth.		

Dr. Adam S. MacKnight, Fall River, *State Inspector of Health.*

The South Midland District.

Includes the cities of Taunton and Brockton and the intervening and surrounding towns.

Attleborough.	Hanson.	Plymouth.
Abington.	Hingham.	Plympton.
Avon.	Holbrook.	Randolph.
Berkley.	Hull.	Raynham.
Braintree.	Kingston.	Rehoboth.
Bridgewater.	Mansfield.	Rockland.
BROCKTON.	Marshfield.	Scituate.
Carver.	Middleborough.	Seekonk.
Cohasset.	Norton.	Stoughton.
Dighton.	North Attleborough.	TAUNTON.
Duxbury.	Norwell.	West Bridgewater.
East Bridgewater.	Norwood.	Westwood.
Easton.	Pembroke.	Weymouth.
Halifax.	Plainville.	Whitman.
Hanover.		

Dr. Elliott Washburn,[1] Taunton, *State Inspector of Health.*

The Midland District.

Includes the cities of Cambridge, Marlborough, Newton and Waltham and the towns between Sudbury and the Rhode Island State line, and between Worcester and Brookline.

Arlington.	Hopkinton.	Sherborn.
Ashland.	MARLBOROUGH.	Shrewsbury.
Bellingham.	Medfield.	Southborough.
Belmont.	Medway.	Sudbury.
Blackstone.	Mendon.	Upton.
CAMBRIDGE.[2]	Milford.	Walpole.
Canton.	Millis.	WALTHAM.
Dover.	Natick.	Watertown.
Foxborough.	Needham.	Wayland.
Framingham.	NEWTON.	Wellesley.
Franklin.	Norfolk.	Westborough.
Grafton.	Northborough.	Weston.
Holliston.	Sharon.	Wrentham.
Hopedale.		

Dr. William W. Walcott, Natick, *State Inspector of Health.*

[1] Resigned Oct. 1, 1913.

[2] Wards 8 to 11, inclusive.

The Massachusetts Bay District.

Includes the cities of Boston and Chelsea, and the towns along Massachusetts Bay from Revere to the city of Quincy, inclusive.

Boston.	Dedham.	Revere.
Brookline.	Milton.	Winthrop.
Chelsea.	Quincy.	

Dr. Harry Linenthal, Roxbury, *State Inspector of Health.*

The North Metropolitan District.

Includes the cities of Cambridge, Everett, Lynn, Malden, Medford, Melrose and Somerville, and neighboring towns.

Cambridge.[1]	Medford.	Somerville.
Everett.	Melrose.	Stoneham.
Lynn.	Saugus.	Wakefield.
Malden.		

Dr. Frank L. Morse, Somerville, *State Inspector of Health.*

The Northeastern District.

Includes the cities of Beverly, Gloucester, Haverhill, Newburyport and Salem, and the towns in the northeastern part of the State.

Amesbury.	Ipswich.	Peabody.
Beverly.	Lynnfield.	Reading.
Boxford.	Manchester.	Rockport.
Danvers.	Marblehead.	Rowley.
Essex.	Merrimac.	Salem.
Georgetown.	Middleton.	Salisbury.
Gloucester.	Nahant.	Swampscott.
Groveland.	Newbury.	Topsfield.
Hamilton.	Newburyport.	Wenham.
Haverhill.	North Reading.	West Newbury.

Dr. William Hall Coon, Haverhill, *State Inspector of Health.*

The North Midland District.

Includes the cities of Lawrence, Lowell and Woburn, and the towns from the New Hampshire State line to the town of Sudbury.

Acton.	Billerica.	Chelmsford.
Andover.	Boxborough.	Concord.
Ayer.	Burlington.	Dracut.
Bedford.	Carlisle.	Dunstable.

[1] Wards 1 to 7, inclusive.

Groton.	Maynard.	Townsend.
Harvard.	Methuen.	Tyngsborough.
LAWRENCE.	North Andover.	Westford.
Lexington.	Pepperell.	Wilmington.
Lincoln.	Shirley.	Winchester.
Littleton.	Stow.	WOBURN.
LOWELL.	Tewksbury.	

Dr. CHARLES E. SIMPSON, Lowell, *State Inspector of Health.*

THE NORTH CENTRAL DISTRICT.

Includes the city of Fitchburg, and the towns from the New Hampshire State line to Worcester.

Ashburnham.	Hardwick.	Petersham.
Ashby.	Holden.	Phillipston.
Athol.	Hubbardston.	Princeton.
Barre.	Hudson.	Royalston.
Berlin.	Lancaster.	Rutland.
Bolton.	Leominster.	Sterling.
Boylston.	Lunenburg.	Templeton.
Clinton.	New Braintree.	West Boylston.
Dana.	Oakham.	Westminster.
FITCHBURG.	Paxton.	Winchendon.
Gardner.		

Dr. LEWIS FISH, Fitchburg, *State Inspector of Health.*

THE SOUTH CENTRAL DISTRICT.

Includes the city of Worcester, and the towns to the Rhode Island and Connecticut State lines on the south.

Auburn.	Millbury.	Sutton.
Brimfield.	Northbridge.	Uxbridge.
Brookfield.	North Brookfield.	Wales.
Charlton.	Oxford.	Warren.
Douglas.	Southbridge.	Webster.
Dudley.	Spencer.	West Brookfield.
Holland.	Sturbridge.	WORCESTER.
Leicester.		

Dr. MELVIN G. OVERLOCK, Worcester, *State Inspector of Health.*

The Southern Connecticut Valley District.

Includes the cities of Holyoke, Chicopee and Springfield, and the southern Connecticut valley towns to the Connecticut State line.

Agawam.	HOLYOKE.	South Hadley.
Blandford.	Huntington.	Southwick.
CHICOPEE.	Longmeadow.	SPRINGFIELD.
East Longmeadow.	Ludlow.	Tolland.
Enfield.	Monson.	Ware.
Granby.	Montgomery.	West Springfield.
Granville.	Palmer.	Westfield.
Greenwich.	Russell.	Wilbraham.
Hampden.		

Dr. JAMES V. W. BOYD, Springfield, *State Inspector of Health.*

The Northern Connecticut Valley District.

Includes the city of Northampton, and the Connecticut valley towns to the New Hampshire and Vermont State lines.

Amherst.	Gill.	Pelham.
Ashfield.	Goshen.	Plainfield.
Belchertown.	Greenfield.	Prescott.
Bernardston.	Hadley.	Shelburne.
Buckland.	Hatfield.	Shutesbury.
Chesterfield.	Leverett.	Southampton.
Colrain.	Leyden.	Sunderland.
Conway.	Montague.	Warwick.
Cummington.	New Salem.	Wendell.
Deerfield.	NORTHAMPTON.	Westhampton.
Easthampton.	Northfield.	Whately.
Erving.	Orange.	Williamsburg.

Dr. JOHN S. HITCHCOCK, Northampton, *State Inspector of Health.*

The Berkshire District.

Includes the cities of North Adams and Pittsfield, and the towns between Huntington and the New York State line, and the towns between the Vermont and Connecticut State lines.

Adams.	Clarksburg.	Hawley.
Alford.	Dalton.	Heath.
Becket.	Egremont.	Hinsdale.
Charlemont.	Florida.	Lanesborough.
Cheshire.	Great Barrington.	Lee.
Chester.	Hancock.	Lenox.

Middlefield.	Peru.	Stockbridge.
Monroe.	PITTSFIELD.	Tyringham.
Monterey.	Richmond.	Washington.
Mount Washington.	Rowe.	West Stockbridge.
New Ashford.	Sandisfield.	Williamstown.
New Marlborough.	Savoy.	Windsor.
NORTH ADAMS.	Sheffield.	Worthington.
Otis.		

Dr. LYMAN A. JONES, North Adams, *State Inspector of Health.*

CITIES AND TOWNS ALPHABETICALLY ARRANGED.

CITY OR TOWN.	Health District Name.	County.
Abington,	The South Midland District,	Plymouth.
Acton,	The North Midland District,	Middlesex.
Acushnet,	The Southern Bay and Cape District,	Bristol.
Adams,	The Berkshire District,	Berkshire.
Agawam,	The Southern Connecticut Valley District,	Hampden.
Alford,	The Berkshire District,	Berkshire.
Amesbury,	The Northeastern District,	Essex.
Amherst,	The Northern Connecticut Valley District,	Hampshire.
Andover,	The North Midland District,	Essex.
Arlington,	The Midland District,	Middlesex.
Ashburnham,	The North Central District,	Worcester.
Ashby,	The North Central District,	Middlesex.
Ashfield,	The Northern Connecticut Valley District,	Franklin.
Ashland,	The Midland District,	Middlesex.
Athol,	The North Central District,	Worcester.
Attleborough,	The South Midland District,	Bristol.
Auburn,	The South Central District,	Worcester.
Avon,	The South Midland District,	Norfolk.
Ayer,	The North Midland District,	Middlesex.
Barnstable,	The Southern Bay and Cape District,	Barnstable.
Barre,	The North Central District,	Worcester.
Becket,	The Berkshire District,	Berkshire.
Bedford,	The North Midland District,	Middlesex.
Belchertown,	The Northern Connecticut Valley District,	Hampshire.
Bellingham,	The Midland District,	Norfolk.
Belmont,	The Midland District,	Middlesex.
Berkley,	The South Midland District,	Bristol.
Berlin,	The North Central District,	Worcester.
Bernardston,	The Northern Connecticut Valley District,	Franklin.
BEVERLY,	The Northeastern District,	Essex.
Billerica,	The North Midland District,	Middlesex.
Blackstone,	The Midland District,	Worcester.
Blandford,	The Southern Connecticut Valley District,	Hampden.
Bolton,	The North Central District,	Worcester.
BOSTON,	The Massachusetts Bay District,	Suffolk.
Bourne,	The Southern Bay and Cape District,	Barnstable.
Boxborough,	The North Midland District,	Middlesex.
Boxford,	The Northeastern District,	Essex.
Boylston,	The North Central District,	Worcester.
Braintree,	The South Midland District,	Norfolk.
Brewster,	The Southern Bay and Cape District,	Barnstable.
Bridgewater,	The South Midland District,	Plymouth.
Brimfield,	The South Central District,	Hampden.
BROCKTON,	The South Midland District,	Plymouth.
Brookfield,	The South Central District,	Worcester.
Brookline,	The Massachusetts Bay District,	Norfolk.
Buckland,	The Northern Connecticut Valley District,	Franklin.
Burlington,	The North Midland District,	Middlesex.
CAMBRIDGE,	The Midland District (Wards 8-11),	Middlesex.
CAMBRIDGE,	The North Metropolitan District (Wards 1-7),	Middlesex.
Canton,	The Midland District,	Norfolk.
Carlisle,	The North Midland District,	Middlesex.
Carver,	The South Midland District,	Plymouth.
Charlemont,	The Berkshire District,	Franklin.
Charlton,	The South Central District,	Worcester.

CITIES AND TOWNS ALPHABETICALLY ARRANGED — *Continued.*

City or Town.	Health District Name.	County.
Chatham,	The Southern Bay and Cape District,	Barnstable.
Chelmsford,	The North Midland District,	Middlesex.
CHELSEA,	The Massachusetts Bay District,	Suffolk.
Cheshire,	The Berkshire District,	Berkshire.
Chester,	The Berkshire District,	Hampden.
Chesterfield,	The Northern Connecticut Valley District,	Hampshire.
CHICOPEE,	The Southern Connecticut Valley District,	Hampden.
Chilmark,	The Southern Bay and Cape District,	Dukes.
Clarksburg,	The Berkshire District,	Berkshire.
Clinton,	The North Central District,	Worcester.
Cohasset,	The South Midland District,	Norfolk.
Colrain,	The Northern Connecticut Valley District,	Franklin.
Concord,	The North Midland District,	Middlesex.
Conway,	The Northern Connecticut Valley District,	Franklin.
Cummington,	The Northern Connecticut Valley District,	Hampshire.
Dalton,	The Berkshire District,	Berkshire.
Dana,	The North Central District,	Worcester.
Danvers,	The Northeastern District,	Essex.
Dartmouth,	The Southern Bay and Cape District,	Bristol.
Dedham,	The Massachusetts Bay District,	Norfolk.
Deerfield,	The Northern Connecticut Valley District,	Franklin.
Dennis,	The Southern Bay and Cape District,	Barnstable.
Dighton,	The South Midland District,	Bristol.
Douglas,	The South Central District,	Worcester.
Dover,	The Midland District,	Norfolk.
Dracut,	The North Midland District,	Middlesex.
Dudley,	The South Central District,	Worcester.
Dunstable,	The North Midland District,	Middlesex.
Duxbury,	The South Midland District,	Plymouth.
East Bridgewater,	The South Midland District,	Plymouth.
East Longmeadow,	The Southern Connecticut Valley District,	Hampden.
Eastham,	The Southern Bay and Cape District,	Barnstable.
Easthampton,	The Northern Connecticut Valley District,	Hampshire.
Easton,	The South Midland District,	Bristol.
Edgartown,	The Southern Bay and Cape District,	Dukes.
Egremont,	The Berkshire District,	Berkshire.
Enfield,	The Southern Connecticut Valley District,	Hampshire.
Erving,	The Northern Connecticut Valley District,	Franklin.
Essex,	The Northeastern District,	Essex.
EVERETT,	The North Metropolitan District,	Middlesex.
Fairhaven,	The Southern Bay and Cape District,	Bristol.
FALL RIVER,	The Southern Bay and Cape District,	Bristol.
Falmouth,	The Southern Bay and Cape District,	Barnstable.
FITCHBURG,	The North Central District,	Worcester.
Florida,	The Berkshire District,	Berkshire.
Foxborough,	The Midland District,	Norfolk.
Framingham,	The Midland District,	Middlesex.
Franklin,	The Midland District,	Norfolk.
Freetown,	The Southern Bay and Cape District,	Bristol.
Gardner,	The North Central District,	Worcester.
Gay Head,	The Southern Bay and Cape District,	Dukes.
Georgetown,	The Northeastern District,	Essex.
Gill,	The Northern Connecticut Valley District,	Franklin.
GLOUCESTER,	The Northeastern District,	Essex.
Goshen,	The Northern Connecticut Valley District,	Hampshire.
Gosnold,	The Southern Bay and Cape District,	Dukes.
Grafton,	The Midland District,	Worcester.
Granby,	The Southern Connecticut Valley District,	Hampshire.
Granville,	The Southern Connecticut Valley District,	Hampden.
Great Barrington,	The Berkshire District,	Berkshire.
Greenfield,	The Northern Connecticut Valley District,	Franklin.
Greenwich,	The Southern Connecticut Valley District,	Hampshire.
Groton,	The North Midland District,	Middlesex.
Groveland,	The Northeastern District,	Essex.
Hadley,	The Northern Connecticut Valley District,	Hampshire.
Halifax,	The South Midland District,	Plymouth.
Hamilton,	The Northeastern District,	Essex.
Hampden,	The Southern Connecticut Valley District,	Hampden.
Hancock,	The Berkshire District,	Berkshire.

CITIES AND TOWNS ALPHABETICALLY ARRANGED — *Continued.*

City or Town.	Health District Name.	County.
Hanover,	The South Midland District,	Plymouth.
Hanson,	The South Midland District,	Plymouth.
Hardwick,	The North Central District,	Worcester.
Harvard,	The North Midland District,	Worcester.
Harwich,	The Southern Bay and Cape District,	Barnstable.
Hatfield,	The Northern Connecticut Valley District,	Hampshire.
HAVERHILL,	The Northeastern District,	Essex.
Hawley,	The Berkshire District,	Franklin.
Heath,	The Berkshire District,	Franklin.
Hingham,	The South Midland District,	Plymouth.
Hinsdale,	The Berkshire District,	Berkshire.
Holbrook,	The South Midland District,	Norfolk.
Holden,	The North Central District,	Worcester.
Holland,	The South Central District,	Hampden.
Holliston,	The Midland District,	Middlesex.
HOLYOKE,	The Southern Connecticut Valley District,	Hampden.
Hopedale,	The Midland District,	Worcester.
Hopkinton,	The Midland District,	Middlesex.
Hubbardston,	The North Central District,	Worcester.
Hudson,	The North Central District,	Middlesex.
Hull,	The South Midland District,	Plymouth.
Huntington,	The Southern Connecticut Valley District,	Hampshire.
Ipswich,	The Northeastern District,	Essex.
Kingston,	The South Midland District,	Plymouth.
Lakeville,	The Southern Bay and Cape District,	Plymouth.
Lancaster,	The North Central District,	Worcester.
Lanesborough,	The Berkshire District,	Berkshire.
LAWRENCE,	The North Midland District,	Essex.
Lee,	The Berkshire District,	Berkshire.
Leicester,	The South Central District,	Worcester.
Lenox,	The Berkshire District,	Berkshire.
Leominster,	The North Central District,	Worcester.
Leverett,	The Northern Connecticut Valley District,	Franklin.
Lexington,	The North Midland District,	Middlesex.
Leyden,	The Northern Connecticut Valley District,	Franklin.
Lincoln,	The North Midland District,	Middlesex.
Littleton,	The North Midland District,	Middlesex.
Longmeadow,	The Southern Connecticut Valley District,	Hampden.
LOWELL,	The North Midland District,	Middlesex.
Ludlow,	The Southern Connecticut Valley District,	Hampden.
Lunenburg,	The North Central District,	Worcester.
LYNN,	The North Metropolitan District,	Essex.
Lynnfield,	The Northeastern District,	Essex.
MALDEN,	The North Metropolitan District,	Middlesex.
Manchester,	The Northeastern District,	Essex.
Mansfield,	The South Midland District,	Bristol.
Marblehead,	The Northeastern District,	Essex.
Marion,	The Southern Bay and Cape District,	Plymouth.
MARLBOROUGH,	The Midland District,	Middlesex.
Marshfield,	The South Midland District,	Plymouth.
Mashpee,	The Southern Bay and Cape District,	Barnstable.
Mattapoisett,	The Southern Bay and Cape District,	Plymouth.
Maynard,	The North Midland District,	Middlesex.
Medfield,	The Midland District,	Norfolk.
MEDFORD,	The North Metropolitan District,	Middlesex.
Medway,	The Midland District,	Norfolk.
MELROSE,	The North Metropolitan District,	Middlesex.
Mendon,	The Midland District,	Worcester.
Merrimac,	The Northeastern District,	Essex.
Methuen,	The North Midland District,	Essex.
Middleborough,	The South Midland District,	Plymouth.
Middlefield,	The Berkshire District,	Hampshire.
Middleton,	The Northeastern District,	Essex.
Milford,	The Midland District,	Worcester.
Millbury,	The South Central District,	Worcester.
Millis,	The Midland District,	Norfolk.
Milton,	The Massachusetts Bay District,	Norfolk.
Monroe,	The Berkshire District,	Franklin.
Monson,	The Southern Connecticut Valley District,	Hampden.
Montague,	The Northern Connecticut Valley District,	Franklin.

Cities and Towns alphabetically arranged — *Continued.*

City or Town.	Health District Name.	County.
Monterey,	The Berkshire District,	Berkshire.
Montgomery,	The Southern Connecticut Valley District,	Hampden.
Mount Washington,	The Berkshire District,	Berkshire.
Nahant,	The Northeastern District,	Essex.
Nantucket,	The Southern Bay and Cape District,	Nantucket.
Natick,	The Midland District,	Middlesex.
Needham,	The Midland District,	Norfolk.
New Ashford,	The Berkshire District,	Berkshire.
NEW BEDFORD,	The Southern Bay and Cape District,	Bristol.
New Braintree,	The North Central District,	Worcester.
New Marlborough,	The Berkshire District,	Berkshire.
New Salem,	The Northern Connecticut Valley District,	Franklin.
Newbury,	The Northeastern District,	Essex.
NEWBURYPORT,	The Northeastern District,	Essex.
NEWTON,	The Midland District,	Middlesex.
Norfolk,	The Midland District,	Norfolk.
NORTH ADAMS,	The Berkshire District,	Berkshire.
North Andover,	The North Midland District,	Essex.
North Attleborough,	The South Midland District,	Bristol.
North Brookfield,	The South Central District,	Worcester.
North Reading,	The Northeastern District,	Middlesex.
NORTHAMPTON,	The Northern Connecticut Valley District,	Hampshire.
Northborough,	The Midland District,	Worcester.
Northbridge,	The South Central District,	Worcester.
Northfield,	The Northern Connecticut Valley District,	Franklin.
Norton,	The South Midland District,	Bristol.
Norwell,	The South Midland District,	Plymouth.
Norwood,	The South Midland District,	Norfolk.
Oak Bluffs,	The Southern Bay and Cape District,	Dukes.
Oakham,	The North Central District,	Worcester.
Orange,	The Northern Connecticut Valley District,	Franklin.
Orleans,	The Southern Bay and Cape District,	Barnstable.
Otis,	The Berkshire District,	Berkshire.
Oxford,	The South Central District,	Worcester.
Palmer,	The Southern Connecticut Valley District,	Hampden.
Paxton,	The North Central District,	Worcester.
Peabody,	The Northeastern District,	Essex.
Pelham,	The Northern Connecticut Valley District,	Hampshire.
Pembroke,	The South Midland District,	Plymouth.
Pepperell,	The North Midland District,	Middlesex.
Peru,	The Berkshire District,	Berkshire.
Petersham,	The North Central District,	Worcester.
Phillipston,	The North Central District,	Worcester.
PITTSFIELD,	The Berkshire District,	Berkshire.
Plainfield,	The Northern Connecticut Valley District,	Hampshire.
Plainville,	The South Midland District,	Norfolk.
Plymouth,	The South Midland District,	Plymouth.
Plympton,	The South Midland District,	Plymouth.
Prescott,	The Northern Connecticut Valley District,	Hampshire.
Princeton,	The North Central District,	Worcester.
Provincetown,	The Southern Bay and Cape District,	Barnstable.
QUINCY,	The Massachusetts Bay District,	Norfolk.
Randolph,	The South Midland District,	Norfolk.
Raynham,	The South Midland District,	Bristol.
Reading,	The Northeastern District,	Middlesex.
Rehoboth,	The South Midland District,	Bristol.
Revere,	The Massachusetts Bay District,	Suffolk.
Richmond,	The Berkshire District,	Berkshire.
Rochester,	The Southern Bay and Cape District,	Plymouth.
Rockland,	The South Midland District,	Plymouth.
Rockport,	The Northeastern District,	Essex.
Rowe,	The Berkshire District,	Franklin.
Rowley,	The Northeastern District,	Essex.
Royalston,	The North Central District,	Worcester.
Russell,	The Southern Connecticut Valley District,	Hampden.
Rutland,	The North Central District,	Worcester.

CITIES AND TOWNS ALPHABETICALLY ARRANGED — *Continued.*

City or Town.	Health District Name.	County.
SALEM,	The Northeastern District,	Essex.
Salisbury,	The Northeastern District,	Essex.
Sandisfield,	The Berkshire District,	Berkshire.
Sandwich,	The Southern Bay and Cape District,	Barnstable.
Saugus,	The North Metropolitan District,	Essex.
Savoy,	The Berkshire District,	Berkshire.
Scituate,	The South Midland District,	Plymouth.
Seekonk,	The South Midland District,	Bristol.
Sharon,	The Midland District,	Norfolk.
Sheffield,	The Berkshire District,	Berkshire.
Shelburne,	The Northern Connecticut Valley District,	Franklin.
Sherborn,	The Midland District,	Middlesex.
Shirley,	The North Midland District,	Middlesex.
Shrewsbury,	The Midland District,	Worcester.
Shutesbury,	The Northern Connecticut Valley District,	Franklin.
Somerset,	The Southern Bay and Cape District,	Bristol.
SOMERVILLE,	The North Metropolitan District,	Middlesex.
South Hadley,	The Southern Connecticut Valley District,	Hampshire.
Southampton,	The Northern Connecticut Valley District,	Hampshire.
Southborough,	The Midland District,	Worcester.
Southbridge,	The South Central District,	Worcester.
Southwick,	The Southern Connecticut Valley District,	Hampden.
Spencer,	The South Central District,	Worcester.
SPRINGFIELD,	The Southern Connecticut Valley District,	Hampden.
Sterling,	The North Central District,	Worcester.
Stockbridge,	The Berkshire District,	Berkshire.
Stoneham,	The North Metropolitan District,	Middlesex.
Stoughton,	The South Midland District,	Norfolk.
Stow,	The North Midland District,	Middlesex.
Sturbridge,	The South Central District,	Worcester.
Sudbury,	The Midland District,	Middlesex.
Sunderland,	The Northern Connecticut Valley District,	Franklin.
Sutton,	The South Central District,	Worcester.
Swampscott,	The Northeastern District,	Essex.
Swansea,	The Southern Bay and Cape District,	Bristol.
TAUNTON,	The South Midland District,	Bristol.
Templeton,	The North Central District,	Worcester.
Tewksbury,	The North Midland District,	Middlesex.
Tisbury,	The Southern Bay and Cape District,	Dukes.
Tolland,	The Southern Connecticut Valley District,	Hampden.
Topsfield,	The Northeastern District,	Essex.
Townsend,	The North Midland District,	Middlesex.
Truro,	The Southern Bay and Cape District,	Barnstable.
Tyngsborough,	The North Midland District,	Middlesex.
Tyringham,	The Berkshire District,	Berkshire.
Upton,	The Midland District,	Worcester.
Uxbridge,	The South Central District,	Worcester.
Wakefield,	The North Metropolitan District,	Middlesex.
Wales,	The South Central District,	Hampden.
Walpole,	The Midland District,	Norfolk.
WALTHAM,	The Midland District,	Middlesex.
Ware,	The Southern Connecticut Valley District,	Hampshire.
Wareham,	The Southern Bay and Cape District,	Plymouth.
Warren,	The South Central District,	Worcester.
Warwick,	The Northern Connecticut Valley District,	Franklin.
Washington,	The Berkshire District,	Berkshire
Watertown,	The Midland District,	Middlesex.
Wayland,	The Midland District,	Middlesex.
Webster,	The South Central District,	Worcester.
Wellesley,	The Midland District,	Norfolk.
Wellfleet,	The Southern Bay and Cape District,	Barnstable.
Wendell,	The Northern Connecticut Valley District,	Franklin.
Wenham,	The Northeastern District,	Essex.
West Boylston,	The North Central District,	Worcester.
West Bridgewater,	The South Midland District,	Plymouth.
West Brookfield,	The South Central District,	Worcester.
West Newbury,	The Northeastern District,	Essex.
West Springfield,	The Southern Connecticut Valley District,	Hampden.
West Stockbridge,	The Berkshire District,	Berkshire.
West Tisbury,	The Southern Bay and Cape District,	Dukes.
Westborough,	The Midland District,	Worcester.

Cities and Towns alphabetically arranged — *Concluded.*

City or Town.	Health District Name.	County.
Westfield, ...	The Southern Connecticut Valley District, . . .	Hampden.
Westford, ...	The North Midland District, ...	Middlesex.
Westhampton, . . .	The Northern Connecticut Valley District, . . .	Hampshire.
Westminster, . . .	The North Central District, ...	Worcester.
Weston, ...	The Midland District, ...	Middlesex.
Westport, ...	The Southern Bay and Cape District, ...	Bristol.
Westwood, ...	The South Midland District, ...	Norfolk.
Weymouth, ...	The South Midland District, ...	Norfolk.
Whately, ...	The Northern Connecticut Valley District, . . .	Franklin.
Whitman, ...	The South Midland District, ...	Plymouth.
Wilbraham, ...	The Southern Connecticut Valley District, . . .	Hampden.
Williamsburg, . . .	The Northern Connecticut Valley District, . . .	Hampshire.
Williamstown, . . .	The Berkshire District, ...	Berkshire.
Wilmington, ...	The North Midland District, ...	Middlesex.
Winchendon, . . .	The North Central District, ...	Worcester.
Winchester, ...	The North Midland District, ...	Middlesex.
Windsor, ...	The Berkshire District, ...	Berkshire.
Winthrop, ...	The Massachusetts Bay District, ...	Suffolk.
Woburn, ...	The North Midland District, ...	Middlesex.
Worcester, ...	The South Central District, ...	Worcester.
Worthington, . . .	The Berkshire District, ...	Hampshire.
Wrentham, ...	The Midland District, ...	Norfolk.
Yarmouth, ...	The Southern Bay and Cape District, ...	Barnstable.

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